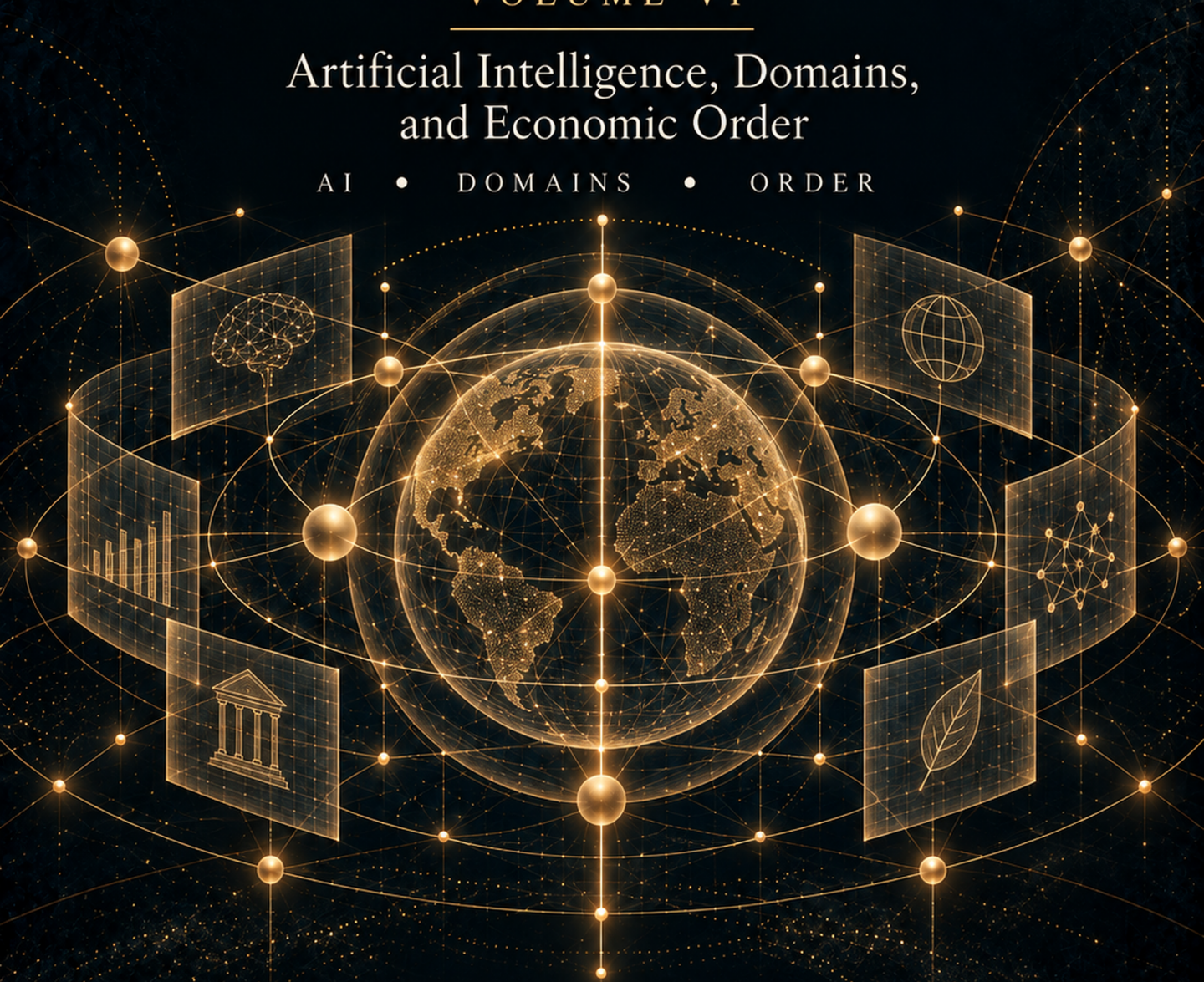


GENERATIVE RELATIONAL ECONOMICS

VOLUME VI

Artificial Intelligence, Domains,
and Economic Order

AI • DOMAINS • ORDER



WANHONG HUANG

GENERATIVE RELATIONAL ECONOMICS

Seven-Volume Treatise

Volume VI

**Artificial Intelligence, Domains, and
Economic Order**

Chapters 18–21

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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 18

Artificial Intelligence and Radical Capability Asymmetry

Artificial Capability and Chapter Scope

Chapter 18 develops the artificial-intelligence dimension of Generative Relational Economics by examining economic life under persistent and potentially radical capability asymmetry. Chapter 17 established the epistemic interface: artificial-intelligence systems can expand machine-mediated generation, symbolic production, retrieval, synthesis, and decision support while relocating scarcity toward verification, provenance, attention, orientation, infrastructure, and accountable judgment. It also established that capability differences become economically consequential through relations of access, control, dependence, institutional incorporation, and conversion. The present chapter broadens that analysis beyond the epistemic economy. Its object is the organization of productive capacity, labor, ownership, surplus, participation, power, subjecthood, and governance when artificial systems can perform economically consequential operations at scales, speeds, costs, or levels of coordination that differ materially from those available to human participants.

The chapter uses the term *radical capability asymmetry* in a relational and scoped sense. Radicality does not mean that artificial systems dominate every task, that human capabilities can be summarized by one scalar, or that technological development follows a predetermined trajectory. It refers to configurations in which capability differences become sufficiently multidimensional, persistent, infrastructurally supported, weakly substitutable, cumulatively reinforced, or institutionally embedded that they alter the feasible action spaces, bargaining positions, productive roles, or future generative possibilities of differently situated participants. Such asymmetry can exist between humans and artificial systems, between organizations with unequal access to artificial capability, among states or regions with different infrastructures, and among institutions whose capacities to verify, deploy, govern, or refuse artificial systems differ substantially.

This formulation preserves a distinction stabilized in Chapters 16 and 17. Capability asymmetry is descriptive before it is a theory of power or justice. A system can exceed a human participant on a specified task while remaining dependent on

human institutions for energy, ownership, authorization, deployment, maintenance, data, legal standing, or objective selection. An organization can control a highly capable model while depending on external compute or distribution infrastructure. A worker can gain productive capability through access to an artificial assistant while becoming more dependent on the organization that controls that access. Power arises only where capability differences enter identifiable mechanisms that condition another position's feasible action, access, standing, dependence, or future possibilities. Normative evaluation requires a further analysis of justification, distribution, participation, contestability, alternatives, and historical consequences.

The chapter therefore resists treating artificial intelligence as a single autonomous actor with one economic effect. The relevant unit is a relational configuration containing models, compute, data, energy, software, networks, interfaces, institutions, organizations, human participants, legal permissions, verification practices, and historically inherited infrastructures. Artificial capability becomes economically effective through these relations. A frontier model that cannot be accessed, integrated, verified, or legally deployed can have limited productive relevance for a given organization. A less capable system embedded deeply in a workflow can have greater economic consequence because it changes the timing, cost, allocation, or coordination of recurrent operations. GRE consequently follows the conditions through which artificial capability enters production and reorganizes future possibilities. Benchmark performance provides one input into that wider economic analysis.

The chapter's first analytical block concerns productive capacity and capability asymmetry. Section 18.1 develops artificial productive capacity through cognitive automation, machine-mediated knowledge generation, symbolic production, simulation, decision support, productive abundance, functional economic agency, capability concentration, and AI-generated epistemic events. Section 18.2 then develops radical capability asymmetry across knowledge, computation, speed, memory, coordination, persistence, and the limits of equalization. Section 18.3 connects those asymmetries to the power framework of Chapter 16 by examining dependency, infrastructure control, model control, access control, epistemic authority, decision mediation, conversion mechanisms, and institutional mediation.

A second analytical block examines labor, subjecthood, ownership, and surplus. Section 18.4 considers labor after artificial intelligence without presuming either universal displacement or automatic complementarity. It distinguishes task automation, comparative productivity, employment scarcity, wage-based distribution, care and relational labor, human contribution beyond productivity, participation beyond employment, and changing forms of work. Section 18.5 then develops subjecthood and existential participation because income and productive necessity do not exhaust the social meaning of work. Contribution, being needed, learning, care, curiosity, aesthetic orientation, and subjective continuity can remain economically and institutionally consequential even where direct human productive necessity declines.

Sections 18.6–18.8 address control and distribution. Ownership of productive intelligence is decomposed across models, compute, data, platforms, infrastructure, access rights, public and commons arrangements, and distributed forms of control. AI-generated surplus is analyzed through productivity gains, concentration, returns to model and infrastructure ownership, generative allocation, social investment, and recirculation. Redistribution is then evaluated together with its limits. Income security can reduce material deprivation while leaving capability, access, participation,

institutional standing, relational continuity, or meaningful contribution weakly addressed. The chapter therefore treats distribution of money as one component of a wider generative allocation problem.

A third analytical block studies human–AI relational economies and their epistemic and representational consequences. Section 18.9 examines complementarity, dependency, delegation, trust, verification, relational substitution, co-generation, human–AI collectives, and co-evolution of relational fields. Section 18.10 returns to epistemic dependence at a wider economic scale by analyzing verification gaps, interpretive dependence, opacity, infrastructure dependence, contestability, audit, and preservation of human epistemic agency. Section 18.11 examines synthetic text, images, evidence, authenticity, provenance, trust, institutional verification, and performative synthetic representation. Section 18.12 then treats research orientation as an allocation problem under abundant machine generation: problem generation can become cheap while judgment concerning worth, beauty, historical significance, relational sensitivity, and generative promise remains consequential.

The final analytical block concerns governance, participation, heterogeneous subjects, and long-horizon order. Section 18.13 develops governance under radical asymmetry through dependency reduction, access and infrastructure governance, contestability, auditability, reversibility, and protection of human action space. Section 18.14 examines generative participation in knowledge, decision, institutions, care, community, and culture, while distinguishing available generative capacity from realized normative influence, tracing recursive reweighting and possible normative closure, and asking whether asymmetric relations return future generative capacity to participating positions. Section 18.15 keeps the ontology and value structure open by distinguishing human subjects, artificial agents, collective subjects, non-human subjects, incommensurable values, coexistence, and institutional mediation. Section 18.16 then studies long-horizon trajectories of capability, dependency, institutions, labor, participation, and knowledge while preserving open futures. Section 18.17 closes the chapter by stating requirements for translating the AI architecture into substantive domains while reserving the domain inquiries themselves for Chapter 19.

Several conceptual disciplines govern the chapter. First, productive performance does not settle subjecthood, moral standing, or responsibility. Artificial systems can occupy economically consequential operational roles while questions of personhood, consciousness, moral patienthood, or ultimate ontology remain open. Second, capability is multidimensional. Speed, memory, computation, symbolic generation, physical embodiment, situated knowledge, judgment, accountability, social recognition, and institutional authority can vary independently. Third, abundance in one capability can create scarcity elsewhere. Cheap generation can increase the value of verification, trustworthy infrastructure, human attention, provenance, or rights of access. Fourth, dependence is not automatically a defect. Complex economies rely on specialization and interdependence. The relevant question is whether dependence remains contestable, substitutable, revisable, and compatible with meaningful participation and future generative capacity. Fifth, generative capacity and realized normative influence are analytically distinct. A participant, institution, practice, or artificial system can possess substantial capacity to generate candidate interpretations or classifications while acquiring little formative influence, whereas comparatively limited capacity can become consequential through access, visibility, recognition, default

placement, institutional uptake, or infrastructural persistence. The chapter therefore evaluates both first-order contributions and second-order changes to the conditions through which later contributions become legible and consequential.

The chapter also preserves temporal and historical analysis. Artificial capability can diffuse rapidly in one layer while remaining concentrated in another. Organizations can redesign workflows around systems that later become difficult to replace. Skills can be amplified, displaced, transformed, or lost through repeated assistance. Ownership structures can convert transient technical advantage into durable institutional position. Synthetic representations can alter the fields they describe. The economic significance of artificial intelligence therefore lies partly in the trajectories through which capability differences are stabilized, translated into institutions, reproduced across generations, or revised after failure.

The chapter's overall objective is to develop a GRE architecture for economies in which artificial productive capacity becomes deeply embedded while capability equality remains neither a realistic baseline nor an adequate normative objective. The central questions concern how artificial capability is constituted, where it is concentrated, how it interacts with human capability, which relations convert capability into power, how gains and dependencies are distributed, how participation and subjecthood are sustained, and which governance arrangements preserve contestability and open future possibilities. The analysis remains conditional and revisable. It does not assume a single technological trajectory, a final ontology of artificial agency, or a universal institutional response to capability asymmetry.

18.1 Artificial Productive Capacity

This section establishes the productive-capacity foundation for Chapter 18. Its role is to specify what counts as economically consequential artificial capability before the chapter analyzes radical asymmetry, power, labor, ownership, surplus, or governance. The objective is to characterize artificial intelligence through a relationally embedded set of productive capacities while preserving distinctions among technical performance, economic incorporation, agency, and subjecthood. Artificial productive capacity is analyzed as a set of computational capacities that can automate cognitive operations, generate or transform epistemic material, produce symbols, simulate possible configurations, support decisions, expand output, initiate delegated economic transformations, and become concentrated through control of complementary infrastructures. The discussion proceeds through nine dimensions: cognitive automation, machine knowledge generation, symbolic production, simulation capacity, decision support, productive abundance, artificial economic agency, capability concentration, and AI-generated epistemic events. The method is relational and mechanism-sensitive. Current empirical evidence is used to establish that selected forms of AI assistance already change task performance and organizational productivity, while the broader conceptual architecture remains explicitly conditional on domain, workflow, verification, and institutional context.

The starting point is a distinction between a model's technical performance and its productive capacity in an economic configuration. A computational system can exhibit high performance on a benchmark while remaining economically peripheral if the system cannot be integrated into a workflow, accessed at acceptable cost, sup-

plied with relevant data, trusted for the intended consequence, or connected to institutions authorized to act on its outputs. Conversely, a system with modest frontier performance can become economically consequential when it is embedded in a high-frequency workflow and repeatedly changes the cost, timing, quality, scale, or coordination of productive operations. Productive capacity therefore belongs to a coupled arrangement of artificial systems, human participants, organizations, infrastructures, rules, interfaces, and complementary resources.

Experimental and workplace evidence already demonstrates this relational character in bounded settings. Noy and Zhang find that access to ChatGPT reduced completion time and increased evaluated quality in a set of professional writing tasks, while Brynjolfsson, Li, and Raymond report productivity gains after the introduction of a generative-AI assistant in customer support, with heterogeneous effects across workers and evidence consistent with diffusion of organizational know-how (Noy and Zhang 2023; Brynjolfsson et al. 2025). These studies do not establish a universal productivity effect or a general replacement trajectory. They establish that artificial systems can enter productive relations and alter the performance of human-organizational configurations.

Definition 18.1 (Artificial productive capacity). *Artificial productive capacity* is the practically available capacity of an artificial computational system, together with the human, organizational, infrastructural, informational, and institutional complements required for its use, to contribute to economically consequential production, transformation, coordination, simulation, decision, or generation within a specified relational configuration.

Definition 18.1 makes practical availability part of the object. Capability that exists only under unavailable compute, inaccessible data, incompatible interfaces, unaffordable licensing, or institutionally prohibited use has a different economic status from capability that can be repeatedly mobilized. The definition also permits the artificial component to be highly capable while leaving productive responsibility, legal authority, or final judgment elsewhere in the configuration.

Proposition 18.2 (Relational embedding condition). *The economic significance of an artificial capability depends on the relations that connect technical performance to usable inputs, complementary resources, organizational workflows, verification, authorization, and consequential uptake. A change in any of these relations can increase or reduce productive capacity without requiring a corresponding change in the underlying model's benchmark performance.*

Proposition 18.2 prevents capability analysis from collapsing into model comparison. It also prepares the chapter's later power analysis. Control over a complementary resource can matter because the resource conditions whether an otherwise available capability can become productive. The proposition does not imply that every complement is equally important. The binding relation varies by task, organization, regulatory environment, and historical stage of deployment.

Table 18.1 summarizes the dimensions developed in this section.

18.1.1 Cognitive Automation

Cognitive automation concerns the transfer of selected operations involving language, classification, search, calculation, prediction, planning, coding, pattern recognition, document processing, or related symbolic work into computational systems. The rel-

Table 18.1: Dimensions of artificial productive capacity

Dimension	Productive role	Principal GRE distinction
Cognitive automation	Execution of selected cognitive operations within a wider workflow	Task automation differs from automation of an occupation, organization, or complete decision process
Machine knowledge generation	Production, retrieval, transformation, or organization of candidate epistemic material used in production	Generated material differs from warranted knowledge and from accountable incorporation
Symbolic production	Scalable generation of text, code, images, classifications, plans, and other representations	Symbolic abundance differs from truth, interpretation, and socially recognized value
Simulation capacity	Construction or acceleration of counterfactual, model-based, or synthetic exploration	Simulated possibility differs from realized feasibility and empirical validation
Decision support	Generation of predictions, rankings, recommendations, summaries, or candidate actions	Informational influence differs from delegated authority and final responsibility
Productive abundance	Expansion of feasible output relative to selected scarce inputs	Abundance in one layer can relocate bottlenecks toward verification, infrastructure, demand, access, or governance
Artificial economic agency	Delegated initiation or sequencing of economically consequential operations	Functional economic agency differs from personhood, moral agency, and ultimate ontological status
Capability concentration	Unequal control of the stack required to produce and deploy artificial capability	Technical concentration differs from power until conversion mechanisms are established
AI-generated epistemic events	Machine-mediated outputs that alter warranted representations or later economic action	Artifact generation differs from an epistemic event whose uptake changes the relational field

evant economic unit is usually smaller than an occupation and larger than a single isolated model output. A workflow can contain several operations with different verification requirements, dependencies, temporal positions, and consequences. Artificial systems may automate some operations, accelerate others, leave some primarily human, and create new coordination or checking work around the automated components.

This decomposition matters because the economic effect of automation depends on where the artificial operation enters the productive sequence. Automating an initial draft can reduce production time while increasing the relative importance of review. Automating classification can alter downstream routing or eligibility. Automating code generation can accelerate prototyping while creating additional testing and

maintenance requirements. Automating search can broaden the set of candidate inputs while shifting scarce effort toward evaluation and synthesis. The same technical capability can therefore have different productivity effects depending on the surrounding workflow.

The task-level evidence cited above illustrates this point. In the professional writing experiment studied by Noy and Zhang, generative-AI access changed completion time and evaluated quality for specified tasks (Noy and Zhang 2023). In customer support, Brynjolfsson, Li, and Raymond study an assistant embedded inside an organizational environment in which workers retained roles in interaction and resolution (Brynjolfsson et al. 2025). The economic object in both cases is a human–AI production configuration whose performance depends on institutional incorporation; an isolated model output captures only part of that configuration.

Definition 18.3 (Cognitive-automation profile). A *cognitive-automation profile* records the operations within a productive workflow that are delegated to an artificial system, the operations retained by human or institutional participants, the interfaces connecting them, the verification and exception-handling requirements, and the consequences of failure or delay at each retained stage.

The profile is preferable to a binary label of automated or non-automated work because partial automation can reorganize the whole sequence. A highly automated process can still depend on a small human bottleneck whose judgment becomes more valuable as upstream generation expands. A process with limited direct automation can experience substantial change if an artificial system reorganizes search, scheduling, or coordination. The relevant question is how the distribution of operations changes across the workflow.

Cognitive automation can also alter learning. Chapter 17 distinguished assisted performance from changes in later independent capability. Repeated delegation can free human attention for higher-level judgment, or it can reduce opportunities to practice a capability that previously developed through routine work. Both trajectories are possible. Section 18.4 will treat these labor consequences directly. The present subsection records only that automation changes the environment in which human capabilities are exercised and reproduced.

18.1.2 Machine Knowledge Generation

Machine-mediated epistemic generation was defined in Chapter 17 as the production, transformation, retrieval, organization, or proposal of candidate epistemic material that enters a wider process of inquiry, learning, interpretation, verification, design, or decision. The productive question developed here concerns what happens when that material becomes an input to economic production. Generated explanations can support technical work; retrieved precedents can accelerate legal or administrative analysis; synthesized documents can reduce search costs; generated code can become part of software production; and candidate hypotheses can redirect research or product development.

The economic value of such generation often appears before the generated material attains the standing of independently warranted knowledge. A candidate solution can reduce search cost even when later rejected. A summary can accelerate navigation through a document collection while remaining subject to verification. A generated code fragment can serve as a prototype before testing. A machine-produced

explanation can help a worker formulate a question for a specialist. Productive value can therefore arise through search-space reduction, translation, recombination, or accelerated iteration.

The epistemic boundary remains important because productive systems can act on errors. Bender and colleagues caution against identifying fluent language generation with understanding (Bender et al. 2021). GRE uses that caution economically: symbolic fluency can be productive while the warrant of the resulting claim remains uncertain. The appropriate productive architecture therefore depends on consequence. Low-cost ideation can tolerate broad candidate generation, whereas high-stakes engineering, medical, legal, financial, or public decisions can require stronger verification and authorization before generated material becomes action-guiding.

Machine generation can also change the distribution of expertise. When a system externalizes patterns previously available mainly to experienced workers, less-experienced participants may perform some tasks more effectively. The customer-support evidence reported by Brynjolfsson, Li, and Raymond is consistent with such a knowledge-diffusion channel in their studied setting (Brynjolfsson et al. 2025). The economic consequence is relational: expertise can become partly available through access to an artificial system, while control over the system, its data, or its deployment conditions becomes a complementary determinant of who can mobilize that expertise.

The productive importance of machine knowledge generation therefore lies in the transformation of search, recombination, translation, and access to task-relevant patterns. The subsection does not assign the artificial system an ontological status as knower. It identifies the productive pathway through which machine-generated epistemic material changes what human and organizational configurations can do.

18.1.3 Symbolic Production

Artificial systems can generate large volumes of text, code, images, audio, classifications, summaries, plans, diagrams, and other symbolic artifacts at low marginal cost relative to many human production processes. Chapter 17 analyzed this condition as symbolic abundance within the epistemic economy. The present subsection treats symbolic generation as productive capacity because symbolic artifacts can enter contracts, software, advertising, education, design, research, administration, customer interaction, entertainment, internal coordination, and institutional documentation.

The relevant output is broader than natural language. Code can instantiate executable instructions. Images can function as design proposals or marketing assets. Structured classifications can route work. Generated forms can become administrative records. Plans can sequence later operations. Synthetic examples can support testing or training. The productive effect therefore depends on what the symbol does inside a wider system through its role within the wider system, with representational form supplying only part of the explanation.

Definition 18.4 (Symbolic productive capacity). *Symbolic productive capacity* is the practically available capacity of an artificial system to generate, transform, or organize symbolic artifacts that can enter economically consequential workflows as communicative, executable, classificatory, design, coordination, or representational inputs.

Definition 18.4 deliberately separates productive usability from epistemic warrant.

A generated advertisement can be economically usable without representing knowledge. A generated code fragment can be executable yet insecure. A classification can reorganize access while being normatively or empirically defective. Symbolic artifacts can therefore possess productive efficacy before questions of truth, justice, or reliability have been settled.

Symbolic productive capacity also changes the cost structure of variation. When candidate drafts, designs, explanations, or code paths become cheap to generate, a production process can explore more alternatives before selection. The marginal value of generation can decline while the value of selection, evaluation, integration, provenance, or distinctive contextual knowledge rises. This is one route through which artificial productivity produces bottleneck relocation rather than simple elimination of scarcity.

The abundance of synthetic representation can also alter markets for symbolic labor. Some tasks become easier to perform; others shift toward specification, curation, verification, customization, relationship management, or responsibility-bearing judgment. Section 18.4 analyzes these labor consequences. The present subsection establishes the productive mechanism: artificial systems can expand the feasible volume and variety of symbolic output, thereby changing the scarcity profile of the complementary operations through which that output acquires economic value.

18.1.4 Simulation Capacity

Simulation capacity concerns the use of computational systems to explore possible configurations, trajectories, interactions, or responses before committing resources to realized action. Simulation can be numerical, agent-based, language-mediated, graphical, synthetic, or hybrid. Artificial intelligence can contribute by accelerating surrogate models, generating scenario variants, constructing synthetic environments, controlling simulated agents, translating natural-language conditions into model inputs, or helping users interpret large spaces of possible outcomes.

Simulation is already an established methodological resource in economics and social science. Agent-based work such as Epstein and Axtell's constructive simulations demonstrates how heterogeneous interacting agents can be used to study the emergence of aggregate patterns (Epstein and Axtell 1996). Contemporary artificial systems expand the range of operations that can be embedded within or around simulations, yet the epistemic status of the resulting trajectories remains model-dependent. A simulated continuation is a represented possibility under declared assumptions; it does not become an observed future merely because it can be generated at scale.

Definition 18.5 (Simulation productive capacity). *Simulation productive capacity* is the practically available capacity to construct, execute, vary, or interpret model-based representations of possible states, interactions, or trajectories in ways that can inform economically consequential search, design, testing, planning, or coordination.

The productive value of simulation can arise through reduced experimentation cost. A firm can test design variants before physical production. A logistics system can explore schedules. A policy team can compare stylized scenarios before selecting an intervention. A research group can identify regions of a parameter space that merit empirical investigation. Such uses can preserve resources and broaden exploration, especially where direct experimentation is expensive or slow.

Simulation can also create false precision if generated scenarios are treated as di-

rect forecasts without adequate model validation. Productive simulation therefore depends on a translation between represented possibilities and the practical decision. Assumptions, omitted variables, model error, distribution shift, and changing institutional responses can all limit transfer. The capacity to simulate many scenarios does not remove the need to decide which assumptions, outcomes, and uncertainties matter.

GRE treats simulation as a generative intermediary. It changes the space of considered possibilities and can therefore alter later allocation even when no simulated trajectory is realized. This role becomes especially important in governance under radical asymmetry, where artificial systems may make some futures more cognitively available to decision makers than others. The power implications of such selective visibility are deferred to Sections 18.3 and 18.13.

18.1.5 Decision Support

Artificial productive capacity also enters economic action through decision support. Systems can rank alternatives, predict outcomes, summarize evidence, flag anomalies, recommend actions, allocate attention, propose schedules, generate candidate strategies, or translate complex information into an interface used by a human or institutional decision process. The economically consequential operation can occur even when the artificial system lacks formal authority to decide.

Definition 18.6 (Artificial decision-support capacity). *Artificial decision-support capacity* is the practically available capacity of an artificial system to alter the information, ordering, salience, comparison, or candidate-action structure presented to a human or institutional decision process.

The definition focuses on the decision environment and the ordering of alternatives presented before final choice. A recommendation system can make one option visible and another obscure. A risk score can reorder cases. A planning assistant can reduce the cost of considering additional alternatives. A forecast can alter expectations. A summary can determine which evidence enters deliberation under time pressure. These effects can be economically significant even when the formal decision right remains human.

Decision support introduces a responsibility distinction. Prediction, recommendation, authorization, and execution are different operations. A model can estimate risk without possessing the authority to allocate credit. It can propose an intervention without bearing institutional responsibility for the intervention. It can produce a recommendation that an organization adopts automatically, in which case the surrounding institution has effectively delegated a greater share of the decision pathway. The degree of delegation should therefore be traced through the workflow through the workflow, because the label “decision support does not specify the actual degree of delegation.”

The same distinction applies to productive gains. A system can improve decision speed while reducing deliberative breadth, or expand considered alternatives while increasing review costs. It can standardize decisions across an organization and thereby reduce variance, yet such standardization can also suppress local knowledge. Productive value depends on the objective, error distribution, reversibility, and consequences of action. The chapter’s later governance analysis will examine when decision mediation becomes a power relation or a source of dependency.

Decision-support systems can also learn from institutional records generated by earlier decisions. Their deployment can then become reflexive: model outputs alter decisions, decisions alter the data-generating process, and later models are trained on the changed record. This feedback is one reason AI-generated epistemic events receive separate treatment in Subsection 18.1.9.

18.1.6 Productive Abundance

Artificial productive capacity can create abundance in outputs that were previously constrained by human time, specialized skill, or coordination cost. Symbolic drafts, candidate analyses, code variants, translations, summaries, designs, and simulations can often be produced in greater volume once artificial systems enter the production process. The economically relevant change is a shift in the relation between selected inputs and feasible output, rather than a claim that scarcity disappears from the economy as a whole.

Definition 18.7 (Artificially mediated productive abundance). *Artificially mediated productive abundance* is a configuration in which artificial productive capacity substantially expands the feasible quantity, variety, speed, or replicability of an economically relevant output relative to at least one previously binding input constraint, while leaving the distribution and scarcity of complementary inputs to be analyzed separately.

The last clause is essential. An organization can produce far more draft material while remaining constrained by review. Software generation can accelerate while deployment depends on testing, integration, and security. Translation can become abundant while authoritative interpretation remains scarce. Simulations can proliferate while reliable empirical calibration remains costly. Artificial systems can therefore relocate bottlenecks toward complementary capacities while other dimensions remain constrained.

Productive abundance also interacts with demand. A lower marginal cost of producing symbolic artifacts can expand consumption, create new products, or raise expectations concerning customization and speed. The resulting increase in demand can absorb part of the new capacity. In other settings, the output can become so abundant that attention, reputation, distribution, authenticity, or trusted filtering become more valuable than production itself. Chapter 17 developed this pattern in the epistemic economy; the same mechanism can appear throughout production.

Abundance can coexist with concentration. Users may access large quantities of low-cost artificial output while model development, specialized compute, energy, semiconductor supply, cloud infrastructure, proprietary data, and distribution channels remain concentrated. The 2026 Stanford AI Index documents both rapid capability development and substantial concentration of frontier model production and computational infrastructure (Stanford Institute for Human-Centered Artificial Intelligence 2026). Productive abundance at the interface can therefore increase the economic significance of the scarce layers that support it.

This coexistence prevents a simple inference from falling output cost to democratized productive power. Diffusion can broaden participation, and concentration can persist at complementary layers. The distributional and power consequences depend on which layer is binding for a given activity and whether users can substitute among providers, run systems independently, retain data portability, or build alternative in-

frastructures.

18.1.7 Artificial Economic Agency

Some artificial systems can do more than produce informational outputs. When connected to tools, software environments, accounts, application programming interfaces, robotic systems, or organizational workflows, they can initiate or sequence operations with economic consequences. Examples can include scheduling, purchasing within delegated limits, routing work, modifying software, initiating communications, executing trades under rules, updating records, controlling machinery, or coordinating multi-step processes. The economic analysis requires a term for this operational role while preserving the unresolved questions of subjecthood and moral agency addressed later in the chapter.

Definition 18.8 (Functional artificial economic agency). *Functional artificial economic agency* is the delegated or institutionally enabled capacity of an artificial system to select, initiate, sequence, or condition economically consequential operations within a specified action domain, subject to the permissions, interfaces, constraints, and oversight relations of the surrounding configuration.

The adjective *functional* marks the analytical scope. Definition 18.8 does not establish consciousness, personhood, moral responsibility, legal personality, autonomous interests, or ultimate ontological status. It records that an artificial system can occupy a position in a causal and institutional sequence that previously required a human participant to select or initiate some operations.

The degree of agency is therefore configuration-relative. A model that can only produce text in a chat interface has a different action domain from a system authorized to invoke external tools. A procurement agent with a small spending limit differs from a system able to commit an organization to large contracts. A robotic controller in a bounded industrial process differs from a general software agent with access to many services. The economic question concerns the reachable operation set, the conditions under which operations are authorized, and the consequences of error or strategic behavior.

Delegation can increase productive capacity by reducing coordination delay and allowing systems to operate continuously. It can also change supervision. Human participants may move from direct execution toward specification, monitoring, exception handling, or audit. When the number or speed of machine-initiated actions exceeds feasible human review, nominal human oversight can become thinner than the formal workflow suggests. Governance then depends on ex ante limits, logging, reversibility, testing, and institutional accountability.

Functional artificial economic agency can also interact with markets and organizations without implying that the artificial system is itself the ultimate bearer of economic claims. Revenue, liability, ownership, and contractual standing may remain assigned to human or organizational entities. Section 18.15 returns to the broader question of heterogeneous subjects and artificial agents. The present subsection uses agency only to describe an operational position in production.

18.1.8 Capability Concentration

Artificial productive capacity depends on a stack of complements whose distribution can differ markedly across economic positions. Model weights, specialized compute, data, energy, semiconductor supply, engineering expertise, evaluation systems, deployment infrastructure, distribution channels, capital, legal permissions, and organizational routines can each become relevant. Access to a downstream interface therefore provides limited information about control of the productive stack that makes the interface possible.

Chapter 17 introduced an AI epistemic capability stack to analyze concentration in the production of epistemic outputs. The productive-capacity problem is wider because the stack also includes the interfaces through which models act on production, organizational complements that convert outputs into goods and services, and physical infrastructures that determine scale. The 2026 Stanford AI Index reports substantial concentration in frontier model development and AI compute even while downstream use and open model activity continue to diffuse (Stanford Institute for Human-Centered Artificial Intelligence 2026). GRE therefore analyzes concentration by layer across layers because a single market structure cannot represent the heterogeneous stack adequately.”

Definition 18.9 (Artificial productive-capability concentration profile). *An artificial productive-capability concentration profile records the distribution of control, practical access, substitution possibilities, entry conditions, scale requirements, and dependency across the model, compute, data, energy, software, deployment, distribution, and organizational layers required for a specified artificial productive capability.*

The profile can reveal several different configurations. Model access can be broad while training compute is concentrated. Open model weights can coexist with dependence on scarce accelerators or cloud services. Compute can be available while proprietary data or distribution channels remain binding. A highly concentrated provider layer can support a competitive application layer. Conversely, several model providers can rely on a concentrated semiconductor or cloud infrastructure. These differences matter for investment, entry, resilience, and later bargaining.

Concentration does not by itself establish economic power in the stronger sense used by Chapter 16. A concentrated resource can be weakly consequential if it is easily substituted or if downstream actors can operate without it. A less concentrated layer can become power-relevant when switching is costly, standards create lock-in, institutional recognition privileges one provider, or control over the layer changes feasible action for others. Section 18.3 will therefore analyze the mechanisms that convert capability asymmetry and concentration into power.

Concentration also has a temporal dimension. Frontier advantage can diffuse through imitation, open release, falling compute cost, or knowledge transfer. It can also persist through scale economies, proprietary data, network effects, capital requirements, standards, talent concentration, or cumulative investment. The relevant question is not whether concentration exists at one moment, but how capability positions reproduce or transform through time and which layers remain difficult to contest.

18.1.9 AI-Generated Epistemic Events

Artificial productive systems can change economic relations through outputs that alter what participants or institutions treat as known, expected, classified, risky, feasible, or worth doing. The book has used *epistemic event* for changes in observation, classification, evidence, interpretation, or warranted representation that become consequential for later inquiry or action. Artificial systems create a new route by which such events can be generated at high frequency and scale.

A machine-generated forecast can alter investment. A classification can change routing or eligibility. A synthetic scenario can redirect planning. A generated diagnosis of a production problem can trigger maintenance. An automated anomaly alert can suspend a transaction. A recommendation can change which option receives attention. In each case the generated artifact becomes economically consequential because an institutional or human process takes it up and changes later action.

Definition 18.10 (AI-generated epistemic event). *An AI-generated epistemic event is a machine-mediated production, transformation, or classification of epistemic material whose incorporation into a human or institutional process materially changes a warranted representation, recognized uncertainty, salience structure, classification, expectation, or decision premise in ways that can alter later economic relations or actions.*

Definition 18.10 requires incorporation and consequential change. A generated sentence that is ignored remains an artifact as an artifact; the stronger economic sense of an epistemic event requires consequential incorporation. Likewise, an output can be economically consequential without being epistemically warranted, for example when an institution acts on a mistaken classification. The definition therefore concerns the role of the event in the represented epistemic and practical process; it does not guarantee truth.

AI-generated epistemic events can be performative. A forecast can help generate the behavior it anticipates. A fraud score can alter transaction patterns that later become training data. A labor-demand forecast can influence education or hiring. A synthetic public representation can change expectations and thereby alter the field from which later observations are drawn. This feedback connects artificial productive capacity to the power and governance architecture developed in Chapter 16.

Proposition 18.11 (Productive epistemic-event coupling). *Where an AI-generated epistemic event changes the admissibility, ordering, expected return, perceived risk, or practical accessibility of later economic operations, the event should be analyzed jointly as an epistemic update and as a potentially generative intervention in the productive field.*

Proposition 18.11 does not imply that every machine-generated representation has strong performative effects. The coupling depends on authority, audience, institutional uptake, timing, contestability, and the consequences attached to the representation. A private brainstorming output and a widely used institutional score can occupy very different positions even when generated by similar models.

The subsection also clarifies why artificial productive capacity cannot be reduced to output volume. Cognitive automation changes operations; machine knowledge generation changes search and recombination; symbolic production expands representational output; simulation expands considered possibility; decision support changes the decision interface; productive abundance relocates scarcity; functional

agency changes who or what initiates operations; concentration conditions access to the productive stack; and AI-generated epistemic events can change the field through which later production proceeds. These dimensions form a capacity architecture whose heterogeneity exceeds what one productivity number can represent.

Section 18.2 builds on this architecture by asking when differences among human, artificial, and institutionally mediated capacities become sufficiently persistent, multidimensional, and consequential to constitute radical capability asymmetry. That next step requires comparison without collapsing heterogeneous capacities into one hierarchy. The present section has therefore established the productive objects whose asymmetries can later be analyzed while leaving power, justice, subjecthood, and governance as separate subsequent questions.

18.2 Radical Capability Asymmetry

This section develops the comparative architecture required before Chapter 18 turns from capability difference to power. Section 18.1 established artificial productive capacity as a relationally embedded set of capacities whose economic significance depends on more than the properties of an isolated model. The present section asks when differences among human, artificial, and institutionally mediated capacities become sufficiently multidimensional, persistent, weakly substitutable, or consequential for feasible action that the term *radical capability asymmetry* becomes analytically useful. Its objective is descriptive. The section constructs a typed comparison across human and machine capability, knowledge, computation, speed, memory, coordination, and persistence, then examines the limits of capability equalization. The method is relational and profile-based: capability is represented through heterogeneous dimensions whose relevance depends on the task, institutional configuration, historical horizon, and complementary resources. Comparisons remain local or partial where the dimensions do not support a justified common ordering, while the conversion of capability difference into power is reserved for Section 18.3.

Capability asymmetry is common in complex economies. Specialists differ from generalists; organizations possess different infrastructures; institutions distribute authority unevenly; machines exceed human performance on some operations while depending on human or organizational complements for others. Radicality concerns how capability differences are organized, combined, and reproduced. A capability asymmetry becomes more consequential when several relevant dimensions align, when the disadvantaged position cannot readily substitute another capability source, when complementarities amplify the gap, when the difference persists across repeated interactions, or when the asymmetry changes which operations remain practically feasible for the positions being compared.

The present chapter uses *capability* in a technical-economic sense that should be distinguished from the normative capability terminology developed elsewhere in economics. Here the term refers to a practically available capacity to perform, support, verify, coordinate, initiate, or sustain specified operations within a relational configuration. The chapter later returns to human freedom, participation, and generative opportunity as normative and institutional questions. Keeping these analytical roles separate prevents a technical capability comparison from becoming an implicit account of human flourishing.

Definition 18.12 (Typed capability profile). A *typed capability profile* for a participant or system in a specified relational configuration is an organized representation of the practically available capacities relevant to a declared family of tasks, operations, or generative processes, together with the conditions under which those capacities can be mobilized, sustained, verified, or combined.

Definition 18.12 makes the comparison domain explicit. A capability profile can contain quantitative descriptors where measurement is justified and qualitative or partially ordered descriptors where commensuration would conceal relevant structure. The profile also retains practical conditions. A model that can perform an operation only with unavailable compute, inaccessible data, or an absent tool interface has a different practically available profile from the same model embedded in a well-supported production system.

Definition 18.13 (Radical capability asymmetry). For a declared relational configuration, task family, and historical horizon, a *radical capability asymmetry* is a directional difference between capability profiles whose economically relevant dimensions are sufficiently extensive, persistent, complementary, weakly substitutable, or recursively reinforcing that the asymmetry materially changes the range, scale, timing, cost, reliability, or continuity of operations practically available to the compared positions.

The definition permits mixed profiles in which different positions lead on different capability dimensions. A human participant can retain stronger situated understanding, embodied access, responsibility, social recognition, or value judgment while an artificial system has higher throughput in selected symbolic or computational operations. An organization can possess frontier model access while lacking trusted data or deployment rights. A smaller actor can compensate for weaker internal capability through networks or shared infrastructure. Radicality therefore concerns a configuration of differences and conversion conditions; a universal ranking would require additional assumptions.

Proposition 18.14 (Capability-profile incompleteness). *An advantage on one capability dimension establishes a local ordering for that dimension. A broader capability ordering requires an independently justified rule for selecting relevant dimensions, relating their scales, treating trade-offs, and specifying the tasks and historical horizon over which the comparison is intended to hold.*

Proposition 18.14 is a central discipline for the chapter. It permits strong local conclusions without turning them into an unsupported claim about general intelligence, general economic superiority, or overall human-machine ranking. Table 18.2 summarizes the principal dimensions developed below.

18.2.1 Human and Machine Capability

A human-machine capability comparison requires a declared analytical level. Human participants and artificial systems are differently constituted relational entities. A person brings embodied history, social recognition, situated experience, biological needs, learned practices, normative commitments, institutional standing, and forms of agency whose adequate representation requires more structure than a benchmark score. An artificial system can combine model parameters, external memory, tools, data access, software interfaces, compute, and delegated permissions into an operational configuration whose effective capabilities also extend beyond the base model.

Table 18.2: Dimensions of radical capability asymmetry

Dimension	Capability difference	Principal GRE question
Human and machine capability	Heterogeneous strengths across symbolic, embodied, situated, social, evaluative, and operational capacities	Which dimensions are being compared, under which task and institutional conditions, and which remain incomparable?
Knowledge	Unequal access to records, models, domain knowledge, local context, generated representations, or epistemic support	Does greater accessible knowledge translate into usable and warranted capability for the task?
Computation	Differences in feasible search, simulation, optimization, inference, model execution, and scalable transformation	Which computational resources are practically available, and which complementary resources make them economically effective?
Speed	Differences in latency, throughput, response frequency, iteration rate, and synchronization	When does temporal advantage change feasible coordination or response before slower positions can adapt?
Memory	Differences in storage, retrieval, contextual continuity, provenance, and reconstructive access	Which past information remains available, interpretable, and usable, and which survives only as storage?
Coordination	Differences in the capacity to combine agents, tools, organizations, interfaces, or distributed operations	Which interfaces and governance arrangements convert component capabilities into collective capability?
Persistence	Renewal or reinforcement of capability differences across repeated interactions and historical extensions	Which mechanisms reproduce, accumulate, or stabilize the asymmetry?
Equalization limits	Residual differences after access, training, tools, shared infrastructure, or institutional reform	Which capability gaps can be narrowed through diffusion, and which depend on deeper complementarities or structural conditions?

The comparison therefore concerns typed capability profiles inside a specified relational arrangement. Abstract scalar quantities called “human intelligence” and “machine intelligence” would require additional aggregation assumptions that are not supplied here.

The relevant profile can vary sharply by task. A language model can generate many candidate formulations rapidly while a domain expert supplies contextual discrimination and responsibility for use. A robotic system can possess high precision within a structured environment while a human operator handles unmodeled contingencies. A human researcher can formulate a question whose significance depends on historical judgment while an artificial system accelerates search, coding, or symbolic exploration. An organization can combine many such components into a collective capability that exceeds the operational reach of any one participant. These cases support multidimensional comparison and leave several dimensions only partially com-

measurable.

Capability can also be hybrid. A human–AI configuration requires more structure than the addition of two isolated scores. Repeated interaction can alter search strategy, memory practice, division of labor, verification habits, and the kinds of problems attempted. Section 17.14 analyzed human–AI learning as a relation in which current assistance and durable human learning can diverge. The same distinction applies here at a wider productive level. Assistance can enlarge the capability of a human–AI configuration even when some of the added capacity remains external to the human participant.

This relational view also clarifies substitution. Two capability profiles can produce the same immediate output through different internal structures and with different consequences for resilience, accountability, adaptation, or later learning. Functional equivalence on a narrow task therefore provides evidence about that task while leaving broader substitutability open. The economic question concerns which relations must remain available for the output to be reproduced and how the substitution changes subsequent capability formation.

Proposition 18.15 (Task-relative capability comparison). *A human–machine capability comparison is analytically well formed only relative to a declared task or operation family, performance criteria, complementary resources, institutional conditions, and historical horizon. Changes in these conditions can alter the comparison without requiring intrinsic change in either relatum.*

Proposition 18.15 permits capability rankings where the domain is clear while preserving their locality. A system can be superior for one production operation and inferior, undefined, or incomparable for another. This locality becomes especially important once several dimensions interact.

18.2.2 Knowledge Asymmetry

Knowledge asymmetry within human–AI configurations extends the epistemic-asymmetry analysis of Section 17.7. Artificial systems can provide rapid access to large quantities of encoded material, generated synthesis, retrieved records, model-based predictions, or tool-mediated external information. Human participants can possess tacit knowledge, local context, lived experience, institutional memory, relational history, or evaluative understanding that is weakly represented in the artificial system. The asymmetry is therefore frequently bidirectional and object-specific.

The economically relevant comparison concerns accessible and usable epistemic support. A machine system can retrieve a document faster than a human participant while lacking access to confidential organizational history. A worker can know how an informal process actually operates while relying on an artificial system for technical documentation. A model can aggregate cross-domain textual material while a local professional recognizes the significance of a small contextual detail. In each case, “who knows more” is too coarse. The relevant question is which epistemic resources each position can mobilize for the operation under study.

Generated knowledge-like material also requires epistemic qualification. Chapter 17 distinguished symbolic production, candidate epistemic material, verification, and warranted knowledge. That distinction remains essential here. An artificial system can expand the volume and diversity of candidate explanations or plans while increasing the amount of material requiring verification. A human position with

less generative throughput can remain decisive where accountability, provenance, domain validation, or interpretation determines whether the output can enter consequential action.

Knowledge asymmetry can nevertheless become radical where one position gains sustained access to a combination of encoded knowledge, high-frequency retrieval, continuous updating, tool use, and scalable synthesis that counterpart positions cannot practically reproduce. The asymmetry becomes more consequential when the knowledge advantage is paired with computational, temporal, or coordination advantages. A position that can search, generate, verify, and act faster can convert an initially epistemic difference into a wider operational difference even before a power relation has been established.

Definition 18.16 (Operational knowledge asymmetry). An *operational knowledge asymmetry* is a directional difference in the epistemic resources that a position can practically access, interpret, verify, and incorporate into a specified family of operations within the relevant decision horizon.

Definition 18.16 keeps formal access separate from operational use. The distinction matters for both humans and artificial systems because data, documents, generated representations, and model outputs become capability only through appropriate conversion conditions.

18.2.3 Computational Asymmetry

Computational asymmetry concerns differences in the feasible quantity, scale, complexity, or frequency of computation that can be mobilized for economically relevant operations. It can include model execution, search, optimization, simulation, inference, data transformation, code execution, large-scale comparison, or coordination of computational tools. GRE therefore compares practical computational capability, with nominal hardware capacity treated as one input among several. Algorithms, software, data movement, energy, latency, technical expertise, and organizational integration can determine whether available hardware becomes useful computation.

Artificial systems can create capability differences whose scale is difficult to reproduce through unaided human effort. Repetitive evaluation of many candidate configurations, continuous monitoring, large-scale retrieval, or rapid symbolic transformation can be performed at frequencies that change the feasible workflow itself. The economic significance of computational asymmetry appears where this expanded search or transformation capacity changes which options can be considered before a deadline, which risks can be monitored continuously, or which simulations can be run before committing resources.

Computational asymmetry can also exist among organizations that use the same class of model. One organization can possess extensive compute, low-latency infrastructure, internal evaluation systems, and engineering capacity for repeated experimentation, while another accesses the model through a constrained interface. The base model can be similar while the effective computational profile differs materially. This is one reason Section 18.1 treated capability concentration as a stack spanning the model and its complements.

Greater scale can have limited value in some contexts. Small, specialized models can perform strongly on narrow tasks; local computation can offer privacy or latency advantages; human judgment can prune a search space efficiently; institutional con-

straints can make additional computation irrelevant. The GRE question concerns the relation between computational scale and feasible action, including the points at which added computation has diminishing, offsetting, or contextually negligible returns.

Proposition 18.17 (Computational-conversion condition). *A computational advantage contributes to capability asymmetry when the additional computation can be converted into economically relevant differences in search, simulation, prediction, transformation, verification, coordination, or action within the operative horizon. Hardware or model scale without such conversion remains an incomplete proxy for effective capability.*

Proposition 18.17 also limits later power inference. Even a large computational gap can remain weakly power-relevant where outputs are easily substitutable, counterpart positions retain independent alternatives, or institutional rules prevent the advantaged capability from conditioning others' feasible actions.

18.2.4 Speed Asymmetry

Speed asymmetry concerns differences in the temporal profile of capability. Relevant dimensions include response latency, throughput, iteration frequency, monitoring continuity, adaptation rate, and synchronization across distributed operations. Speed matters economically because many opportunities and constraints are time-sensitive. A capability available after the relevant decision window can have a different practical status from the same capability available before commitment.

Artificial systems can compress cycles that previously required sequential human work. Drafting, coding, retrieval, translation, comparison, simulation, or monitoring can occur rapidly enough to change how often an organization revises its plan or how many alternatives it considers. Shorter cycles can transform the process itself by supporting more experiments, more frequent updates, or tighter coupling among decisions, thereby changing the structure of feasible coordination.

Temporal advantage is especially consequential in interactive environments. A slower position can face a moving target if the faster position repeatedly observes, models, updates, and acts before the slower position completes one comparable cycle. Conversely, high speed can degrade capability when verification, reflection, or institutional process cannot keep pace. Rapid generation can create queues of outputs whose evaluation becomes the new bottleneck. Speed therefore interacts with attention, verification, and governance, and its value depends on those complementary capacities.

Definition 18.18 (Capability-latency asymmetry). *A capability-latency asymmetry exists when comparable or functionally related operations become practically available to different positions on materially different temporal scales, and that timing difference changes which operations, responses, or coordination pathways remain feasible within the relevant horizon.*

The definition emphasizes feasibility within the operative horizon, with clock speed serving as one component. Millisecond differences can be consequential in one domain and irrelevant in another; days can be decisive in a regulatory or scientific process while seconds are immaterial. Radical speed asymmetry therefore depends on the temporal structure of the field in which the capability is exercised.

Speed can also compound other asymmetries. Faster retrieval magnifies accessible knowledge; faster simulation amplifies computation; faster communication supports coordination; faster updating can improve adaptation. These interactions provide one route through which a moderate difference on several dimensions can form a more consequential joint asymmetry.

18.2.5 Memory Asymmetry

Memory asymmetry concerns differences in the capacity to retain, retrieve, connect, reconstruct, and operationalize past information across time. Storage volume is one component. Epistemically useful memory also requires indexing, provenance, contextual reconstruction, compatibility, permissions, and the ability to connect earlier records to current operations. Chapter 17's preservation analysis therefore applies directly: retained material can survive physically while becoming difficult to interpret or reuse.

Artificial systems can be connected to persistent stores that exceed unaided human recall in volume and retrieval speed. They can search logs, documents, code repositories, prior interactions, transaction histories, or model-generated records and make selected portions available during current work. Human memory has different strengths, including embodied continuity, meaning-laden recollection, context-sensitive association, and integration with personal or collective identity. Institutional memory can combine records with practices, roles, narratives, and tacit continuity. These forms should be compared by the functions they support, with storage capacity treated as one dimension.

Memory asymmetry becomes economically consequential when accumulated records lower the cost of future action. A system with access to detailed operational history can diagnose recurring faults, personalize interactions, reconstruct decisions, or identify patterns that another position cannot reproduce. An organization with preserved technical and institutional memory can adapt more quickly after disruption. A participant whose activity is comprehensively recorded can also become more legible to organizations that retain memory unavailable to the participant. The same memory infrastructure can therefore support capability, accountability, surveillance, or dependency according to its governance and access structure.

Definition 18.19 (Operational memory capacity). *Operational memory capacity* is the practically available capacity of a position to retain or access prior records and experience, reconstruct their relevant context and provenance, and incorporate them into present or future operations.

Definition 18.19 allows artificial, human, and institutional memory to be compared without requiring one common storage metric. The economically relevant question is what the retained past enables in later action.

Memory also contributes to cumulative advantage. A system that records the outcomes of repeated interactions can improve later prediction or adaptation; a human participant who loses access to that history can remain dependent on the system that retains it. This mechanism can generate persistence even if the underlying model remains unchanged.

18.2.6 Coordination Asymmetry

Coordination asymmetry concerns differences in the ability to combine heterogeneous capabilities into coherent collective action. Many economically consequential tasks depend on several agents, tools, infrastructures, institutions, and stages of work. The effective capability of a configuration therefore depends on interfaces, shared representations, protocols, sequencing, conflict resolution, and governance in addition to the component capabilities themselves.

Artificial systems can alter coordination in several ways. They can translate among formats, summarize distributed information, route tasks, monitor shared state, invoke tools, generate plans, or maintain communication across many concurrent operations. Software agents can sometimes be replicated or instantiated across tasks with lower coordination cost than assembling an equivalent number of human specialists. Human organizations, however, possess forms of coordination grounded in trust, authority, shared purpose, tacit convention, accountability, and social interpretation. The two profiles can differ in kind as well as scale.

A coordination advantage can magnify otherwise modest component capabilities. Several specialized systems connected through reliable interfaces can create a collective capacity unavailable to any component alone. The same applies to human teams and hybrid organizations. Conversely, highly capable components can produce weak collective performance when interfaces are incompatible, objectives conflict, provenance is lost, or errors propagate without review. Coordination asymmetry therefore concerns the organization of capability across relations.

Definition 18.20 (Coordination capability). *Coordination capability* is the practically available capacity of a relational configuration to allocate, sequence, synchronize, communicate, verify, and revise heterogeneous component operations so that they contribute to a declared collective task or generative process.

The definition makes collective capability irreducible to the sum of individual components. A position can gain a radical coordination advantage through standards, APIs, shared memory, common models, institutional authority, or low-cost replication even when its component-level advantages are moderate.

Coordination also determines who can compensate for asymmetry. A single human participant can be weaker than an artificial system on several dimensions while a well-organized human institution retains strong collective capacity. Public infrastructure can pool verification and compute. Professional networks can distribute expertise. Open technical standards can make several providers interoperable. Capability comparison should therefore include the coordination structure through which counterpart positions can assemble alternatives.

18.2.7 Persistent Asymmetry

Radical capability asymmetry has a temporal structure. A large difference at one moment can disappear through diffusion, learning, investment, imitation, institutional adaptation, or technological substitution. A smaller difference can become more consequential when it is reproduced across repeated interactions and compounds into later capability. Persistence therefore requires attention to the mechanisms carrying capability differences across historical continuation.

Several mechanisms can renew artificial-capability asymmetry. Cumulative data

can improve later models or operational systems. Revenue generated through existing capability can finance additional compute and engineering. Deep integration can create switching costs that preserve the position of one provider or technical architecture. Organizational learning can improve the ability to deploy the same model more effectively. Standards and interfaces can attract complementary investments. Persistent memory can lower future search and reconstruction costs. Skilled personnel can concentrate around institutions able to provide frontier tools and infrastructure. These mechanisms can reinforce one another without requiring a single centralized process.

Human capability can also adapt and accumulate. Repeated use of artificial systems can enlarge skill where participants learn to verify, direct, integrate, or extend the systems. Institutions can build public or shared infrastructure. Education can shift toward capabilities that remain complementary. New professions can emerge around evaluation, governance, domain integration, care, or embodied work. Persistent asymmetry is therefore a historical outcome whose reproduction mechanisms require explanation.

Definition 18.21 (Persistent capability asymmetry). *A persistent capability asymmetry is a directional capability difference whose supporting conditions are sufficiently renewed, accumulated, inherited, institutionally embedded, or costly to substitute that the difference remains economically consequential across the historical horizon relevant to the inquiry.*

Proposition 18.22 (Persistence-mechanism requirement). *A claim of persistent capability asymmetry should identify the mechanism that carries the difference across time, such as cumulative learning, data accumulation, infrastructure investment, switching cost, institutional embedding, standards, preserved memory, organizational complementarity, or recursive revenue and capability formation.*

Definition 18.21 and Proposition 18.22 align the chapter with the historical discipline used for power in Chapter 16. Persistence of capability remains distinct from persistence of power. A capability gap can endure while open access, regulation, substitution, or countervailing institutions prevent the advantaged position from conditioning others' feasible action. Section 18.3 will examine that additional step.

Persistent asymmetry can also change the baseline against which later differences are perceived. Once workflows, educational systems, markets, or institutions reorganize around artificial capability, operating without it can become increasingly costly even if the technical capability itself stops improving. Historical embedding can therefore deepen practical asymmetry through changes in complements and expectations as well as through improvements in the artificial system.

18.2.8 Limits of Capability Equalization

Capability asymmetry can be reduced through diffusion, access, education, shared infrastructure, institutional redesign, interoperability, public investment, or improved tools. Equalization nevertheless has several structural limits. First, access to the same artifact can produce different effective capability where complementary resources differ. Two organizations can use the same model while possessing different data, integration expertise, compute budgets, verification capacity, legal permissions, distribution channels, or organizational routines. Formal access can therefore coexist with substantial effective asymmetry.

Second, some capability differences arise through cumulative history. A participant receiving access today may not immediately reproduce years of organizational learning, preserved data, workflow redesign, trust relationships, or institutional reputation. Equalization of one input can narrow part of the gap while leaving historically accumulated complements unequal. These historically accumulated differences remain transformable, while diffusion should be evaluated across the configuration that produces effective capability, with artifact access treated as one component.

Third, multidimensional capability creates trade-offs. A policy that widens computational access can leave verification capacity concentrated. A system that equalizes retrieval can increase dependence on a common infrastructure. Standardization can improve interoperability while reducing diversity of technical approaches. Intensive AI assistance can raise current performance while weakening some forms of independent human practice if learning and skill maintenance receive little support. Equalization therefore concerns a profile of capabilities and dependencies across several dimensions.

Fourth, capability can be relationally positional. Some advantages depend partly on relative timing, exclusive access, scarce attention, strategic secrecy, or control of a bottleneck. If every participant receives the same faster tool, the absolute capability of the field can rise while the relative advantage associated with speed narrows. Other advantages can persist because the tool increases the returns to complementary assets held unevenly. The distributional effect therefore depends on the production structure into which capability diffuses.

Definition 18.23 (Capability-equalization profile). *A capability-equalization profile records how an intervention changes the relevant dimensions of effective capability, complementarity, substitution, dependence, and historical accumulation across the positions being compared.*

Proposition 18.24 (Effective-capability conversion condition). *Equalization of access establishes comparable effective capability only where the complementary resources, verification, infrastructure, coordination, historical accumulation, and institutional permissions required for the relevant operations are also sufficiently comparable or substitutable.*

The proposition provides a direct bridge to the chapter's institutional analysis. Broad model availability can reduce one capability gap while leaving control over compute, infrastructure, standards, distribution, or decision authority concentrated. Conversely, public infrastructure and interoperable institutions can reduce effective asymmetry even when underlying technical systems remain unequal in frontier performance. The economically relevant object is the capability configuration created by the full arrangement.

The limits of equalization also clarify the meaning of *radical* in Definition 18.13. Radical asymmetry identifies configurations in which capability differences penetrate several mutually reinforcing dimensions or become embedded deeply enough that ordinary access to a tool does not readily restore comparable operational possibility. Such configurations can still be transformed through institutional, technological, educational, organizational, or infrastructural change. Their analysis requires identifying which dimensions are binding and which mechanisms reproduce them.

Section 18.3 now adds the stronger relational question. Capability asymmetry, even when radical and persistent, remains distinct from power. Power analysis asks whether capability differences are converted through dependency, infrastructure

control, model control, access control, epistemic authority, decision mediation, or institutional arrangements into an effective capacity to deform or condition the feasible action and future possibilities of another position. The present section has supplied the multidimensional capability objects needed for that analysis while preserving comparison, persistence, and equalization as distinct problems.

18.3 Power under Capability Asymmetry

Section 18.2 established radical capability asymmetry as a multidimensional and historically embedded difference in practical capability. The present section asks the stronger relational question: under what conditions does such an asymmetry become power-relevant, and under what additional conditions does it support a claim about relational power? Its role is to connect the capability analysis of Chapter 18 to the revised power architecture of Chapter 16 without identifying technical superiority, productive abundance, or concentrated capability with power by definition. The discussion proceeds through dependency, control of infrastructure, control of models, control of access, epistemic authority, decision mediation, conversion of capability into power, and institutional mediation.

The distinction is analytically consequential. An artificial system can outperform a human participant on a specified task while remaining weakly connected to that participant's feasible action. A laboratory can possess frontier models while lacking control over the infrastructure through which firms or public institutions operate. A platform can distribute a moderately capable system so widely that its interface choices condition millions of downstream decisions. A public institution can depend heavily on privately supplied artificial capability while retaining legal authority over the decisions in which that capability is used. These configurations cannot be ranked coherently by model performance alone. Power analysis requires identification of the relational mechanism through which capability changes accessible, feasible, or comparatively weighted future possibilities.

Chapter 16 supplied this discipline in three stages. Section 16.1 distinguished asymmetry from dependence, control, constraint, and power relevance. Section 16.2 then separated power relevance from relational power by requiring historical persistence together with causal and generative efficacy. Section 16.3 added manifestation, comparison, mediation, and reflexive recognition. The present section applies that architecture to artificial capability. Capability asymmetry supplies an antecedent relational difference. Dependency and control mechanisms can convert part of that difference into power relevance. Persistent and efficacious organization of those mechanisms can then support relational power. Manifestations such as rankings, model reputations, access tiers, benchmark claims, or institutional designations can subsequently affect how the power relation is recognized and reproduced.

The section therefore treats capability power as a relational achievement rather than a property stored inside a model. The relevant relata can include human participants, artificial systems, firms, public agencies, professional communities, infrastructures, or hybrid human–AI configurations. A capability advantage located in one component can become power-relevant for another component only through a specified relation. The same technical system can consequently support different power structures across organizations, jurisdictions, and historical periods.

Table 18.3: Mechanisms connecting capability asymmetry to power relevance

Mechanism	Power-relevant interface	Analytical safeguard
Dependency	A relevant capacity of one position relies materially on artificial capability, complementary infrastructure, or permission located elsewhere	Reliance becomes power-relevant only when alternatives, delay capacity, substitution, or exit are sufficiently constrained
Infrastructure control	One position governs compute, networks, data pipelines, identity systems, energy, deployment environments, or other required complements	Infrastructure ownership and infrastructure power remain distinct until control conditions another position’s feasible operations
Model control	One position can modify, withhold, update, specialize, evaluate, or retire a model on which another position relies	Technical authorship or ownership does not by itself establish control over downstream possibility structures
Access control	Admission, pricing, rate limits, geographic availability, contractual terms, permissions, or interface rules condition practical use	Formal availability differs from effective access and from relational power
Epistemic authority	Artificial or institutionally mediated outputs receive standing in classification, verification, diagnosis, evaluation, or interpretation	Accuracy, expertise, authority, and power require separate identification
Decision mediation	Artificial systems structure options, rankings, defaults, recommendations, timing, or information available to decision processes	Influence over a decision differs from formal authority, while repeated mediation can still become generatively consequential
Capability conversion	A capability asymmetry systematically deforms another position’s accessible, feasible, or weighted continuations	The conversion mechanism and generative dependence must be identified before a power attribution is made
Institutional mediation	Rules, offices, procurement, standards, liability, accreditation, or organizational routines stabilize capability-dependent relations	Institutional persistence can reproduce power while also enabling review, contestation, redistribution, or counter-capacity

Table 18.3 summarizes the principal conversion sites developed below.

18.3.1 Dependency

Dependency is the most direct route through which capability asymmetry can become relationally consequential. Chapter 16 treated dependence as reliance on resources, actions, knowledge, infrastructures, permissions, recognition, or complementary capacities located elsewhere. Artificial intelligence expands the possible objects of such reliance. A worker can depend on an AI-enabled workflow for access to current organizational tasks. A firm can depend on an external model provider for classification, translation, coding, forecasting, or customer interaction. A public institution can depend on privately maintained systems for analytical support. A research community can become reliant on computational infrastructure that is difficult to reproduce locally. A household can depend on AI-mediated interfaces for access to services whose underlying procedures remain opaque.

The existence of reliance remains insufficient for power. Modern production is constituted by reciprocal dependence, and specialization can enlarge collective capacity precisely because participants rely on complementary positions. The stronger issue is whether the dependency profile gives one position a durable ability to condition another's feasible action. Substitutability, switching time, interoperability, retained human capability, legal rights, public alternatives, and the importance of the affected capacity all matter.

Definition 18.25 (Capability-conditioned dependency). *A capability-conditioned dependency exists when maintenance, exercise, or development of a capability materially important to one relational position relies on artificial capability, complementary infrastructure, access permission, or technical support controlled or supplied through another position, and when replacement or bypass is sufficiently costly, delayed, uncertain, or institutionally constrained over the horizon relevant to the inquiry.*

Definition 18.25 treats dependence as a relation between capability configurations rather than as a psychological state. Participants can trust a system while remaining substitutable, or distrust it while lacking feasible alternatives. The economic significance lies in the organization of access and replacement.

Dependence can also be layered. A user may appear to depend on a model provider, while the provider depends on cloud compute, energy infrastructure, specialized chips, data suppliers, distribution platforms, or regulatory permissions. An organization can reduce dependence on one model by adopting several providers while remaining dependent on a common identity system, cloud environment, or technical standard. A public strategy focused only on visible model vendors can therefore miss deeper infrastructural dependencies.

Temporal exposure matters as well. A substitute that can be constructed in three years may offer little counter-capacity to an organization facing a service interruption tomorrow. Conversely, a concentrated provider can lose power relevance if affected positions possess credible migration pathways, preserved data portability, interoperable workflows, retained human expertise, and sufficient financial or institutional reserves to withstand transition.

Proposition 18.26 (Dependency power-relevance condition). *Capability-conditioned dependency becomes power-relevant when the dependent position's accessible or feasible operations change systematically with the supplying or controlling position's decisions, availability, conditions, or withdrawal, and the inquiry can identify the depen-*

dence mechanism connecting that position to the resulting change.

The proposition carries the Chapter 16 distinction into the AI setting. Dependence supplies exposure. Power relevance requires directional consequence. Relational power requires the additional persistence and efficacy conditions developed later in Subsection 18.3.7.

18.3.2 Control of Infrastructure

Artificial productive capacity is supported by infrastructures that extend beyond the model itself. Compute clusters, chips, cloud services, energy, networks, data pipelines, storage, identity systems, deployment environments, software ecosystems, monitoring systems, payment rails, and physical facilities can each condition whether a capability is practically available. Control over these complements can therefore become a power-relevant interface even where several competing models exist.

The analysis should distinguish possession from control. An organization can own hardware while contractual or technical restrictions limit how it is used. A cloud provider can control scheduling and service conditions without owning the applications deployed by customers. A public institution can regulate infrastructure it does not own. Open-source software can reduce model-level control while leaving compute or deployment infrastructure concentrated. The relevant question is which position can change the conditions under which consequential operations remain feasible.

Definition 18.27 (AI infrastructure-control capacity). *AI infrastructure-control capacity* is the practically available capacity of a relational position to set, modify, enforce, suspend, prioritize, or condition the terms under which infrastructures required for artificial capability can be accessed or used in economically consequential operations.

Control can operate through price, allocation, technical architecture, contractual terms, service priority, geographic restriction, identity requirements, security policy, interoperability, or maintenance. Several forms can coexist. The definition does not imply that every infrastructural condition is discretionary. Physical scarcity, reliability constraints, safety requirements, or public-law obligations can shape the terms independently of any one controller.

Infrastructure power becomes especially important when capability can be reproduced at the model layer more easily than at the infrastructure layer. A model can be copied while high-end deployment, large-scale inference, secure integration, or low-latency service remains unavailable. Conversely, public or shared infrastructure can weaken private bottlenecks by making compute, storage, evaluation, or deployment environments more substitutable.

Control also has a generative dimension. Infrastructure choices can shape which organizational forms become viable, which research questions are affordable, which applications can scale, and which actors can accumulate later capability. A procurement standard can create a market for interoperable tools. A closed platform can encourage complementary investment around one architecture. A public compute facility can permit organizations lacking private capital to enter capability-intensive fields. These effects reach beyond immediate service availability because they alter later capability formation.

Proposition 18.28 (Infrastructure conversion condition). *Infrastructure control*

supports a power attribution only where the controlled infrastructure is sufficiently consequential to another position's feasible operations or capability development, and changes in the controlling position's terms or actions can be connected to changes in those possibilities through an identifiable mechanism.

This condition prevents concentration statistics from substituting for power analysis. A concentrated infrastructure can be weakly power-relevant if switching is easy, public alternatives are robust, or users retain substantial counter-capacity. A less concentrated infrastructure can support strong local power where one provider is indispensable to a specific region, institution, or technical ecosystem.

18.3.3 Control of Models

Models occupy a distinct layer within the capability stack. A position can control model training, weights, deployment versions, system prompts, fine-tuning, safety layers, tool connections, evaluation criteria, update schedules, retirement, and the interfaces through which the model becomes available. Each locus can alter downstream capability without changing the formal ownership of surrounding infrastructure.

Model control becomes economically salient because model behavior can change after organizations have reorganized workflows around it. An update can improve one capability while degrading another. A provider can retire an older version, change context limits, alter tool access, modify safety behavior, or change the cost structure. An organization using its own weights can retain greater version control while depending on external libraries, hardware, or data. Control should therefore be represented as a profile rather than as a binary attribute.

Definition 18.29 (Model-control profile). *A model-control profile records which relational positions possess effective authority or technical capacity over the model functions relevant to an application, including training, modification, specialization, deployment, versioning, evaluation, updating, withholding, retirement, and connection to external tools or data.*

The definition separates model control from model ownership. Openly licensed weights can reduce one form of control while operational deployment remains mediated by a platform. A proprietary model can be deeply customized inside an organization that retains control over local data, prompts, tools, and final decisions. A regulator can restrict a use case without controlling model design. Power analysis should identify which control dimension conditions the affected relation.

Model control can become generative because organizations adapt to model-specific affordances. Templates, data structures, staff training, verification routines, user expectations, and complementary software can accumulate around one system. Once such complements form, a model change can propagate through a larger relational configuration. The controller's influence then derives partly from historically generated dependence rather than solely from the model's current technical quality.

Model control also interacts with epistemic authority. A model that becomes widely used for classification or evaluation can affect the categories through which organizations understand cases, even when the provider lacks formal authority over final decisions. Section 18.3.5 develops this interface directly.

18.3.4 Control of Access

Access is the interface through which capability becomes practically available to downstream participants. Chapter 12 distinguished availability from effective access, and Chapters 17–18 repeatedly applied the same distinction to knowledge and artificial capability. Access control therefore deserves separate treatment from infrastructure and model control. A capability can exist, a model can be technically usable, and infrastructure can be physically present while contractual, financial, institutional, geographic, identity, or interface conditions keep the capability inaccessible to a particular position.

Access can be conditioned through pricing, usage quotas, rate limits, subscription tiers, account eligibility, geographic restrictions, procurement rules, organizational permissions, safety filters, API scopes, data-residency requirements, or technical interoperability. These mechanisms can serve legitimate functions such as safety, reliability, privacy, compliance, or cost recovery. Their power relevance depends on how they condition another position's possibilities and on the availability of alternatives, review, and exit.

Definition 18.30 (Capability-access gate). *A capability-access gate is a rule, interface, permission structure, price schedule, technical condition, or institutional procedure whose operation determines whether and under what terms a specified artificial capability can be practically mobilized by a relational position.*

A gate can be public, private, automated, or distributed across several institutions. It can also be nested. A user may pass a platform gate while remaining unable to connect the model to organizational data. A firm may obtain API access while lacking regulatory permission for the intended use. A research institution may receive compute access while lacking the staff needed to use it effectively. The gate should therefore be tied to a declared capability rather than described generically.

Access power can also arise through priority rather than exclusion. Lower latency, higher quotas, early model access, preferential support, or privileged integration can change competitive timing and organizational learning. Capability asymmetry can therefore be reproduced through differentiated quality and timing of access even when all participants possess nominal entry.

Proposition 18.31 (Access-control power-relevance condition). *A capability-access gate becomes power-relevant when control of the gate systematically changes another position's practical capability, feasible operations, timing, or future capability formation, and the effect cannot be adequately explained without the gate's operation in the declared relational configuration.*

The proposition provides a bridge to later governance questions. Access regulation can reduce power by improving portability or public alternatives, and it can create power by centralizing approval in a new gatekeeper. The relevant analysis concerns the relational architecture produced by the intervention rather than an assumption that more or less access is uniformly preferable.

18.3.5 Epistemic Authority

Artificial capability can enter power relations through epistemic authority even when the system has no formal decision right. Chapter 17 distinguished epistemic asymmetry from power and treated authority, verification, interpretation, and institutional

standing as separate dimensions of the epistemic economy. The present subsection asks how artificial outputs or AI-mediated institutions can acquire standing such that their classifications, predictions, summaries, diagnoses, evaluations, or recommendations condition the treatment of other positions.

Epistemic authority has at least three possible carriers. The artificial system itself can be treated operationally as an authoritative source by users. An institution can confer authority on outputs produced through a specified system. Human experts can acquire or lose authority through their ability to use, interpret, or contest artificial systems. These arrangements can coexist. A medical system, for example, may be formally advisory while its outputs become practically difficult to challenge because organizations treat them as the default evidential baseline.

Definition 18.32 (AI-mediated epistemic authority). *AI-mediated epistemic authority* is a relationally conferred standing through which artificial outputs, AI-assisted judgments, or positions controlling their interpretation are treated as carrying consequential evidential, classificatory, predictive, or interpretive weight in a specified institutional or economic process.

The definition does not infer epistemic authority from accuracy alone. A highly accurate system can lack institutional standing. A system with modest accuracy can become consequential if procedures require participants to respond to it. Likewise, authority can be justified, contested, domain-limited, or provisional. The power question concerns whether that authority changes feasible action or standing for affected positions.

Epistemic authority can generate asymmetric burdens of contestation. A person may need to supply additional evidence to overturn an AI-assisted classification. A worker may have to explain deviations from an algorithmic recommendation. A researcher can face evaluation practices that reward compatibility with machine-readable metrics. A public official can rely on AI-mediated summaries whose omissions shape which alternatives receive attention. These effects do not establish injustice automatically, yet they can create power-relevant asymmetries by changing who bears the cost of explanation, verification, or appeal.

Authority can also become reflexive in the sense developed in Section 16.3. Widespread recognition of one system as authoritative can attract more users, data, integrations, and institutional reliance. Those changes can increase the system's practical capability and strengthen the authority initially attributed to it. The direction of the feedback remains contingent because visible failure, successful contestation, regulatory change, or competing systems can weaken the same loop.

18.3.6 Decision Mediation

Decision mediation concerns the organization of choice rather than formal decision authority alone. Artificial systems can determine which cases receive attention, how options are ranked, which predictions are displayed, what defaults are presented, how uncertainty is summarized, which actions are recommended, and how quickly a decision process moves. These functions can be consequential even when a human or institution retains the formal right to approve the final action.

The distinction between authority and mediation is important. A formal decision maker can remain legally responsible while practical dependence on an artificial system narrows the information and option set reaching that decision maker. Con-

versely, an artificial system can provide extensive analysis while human participants retain strong capacity to seek alternatives, inspect evidence, revise objectives, or ignore recommendations. Power relevance therefore depends on how mediation changes the decision possibility structure.

Definition 18.33 (AI decision-mediation profile). An *AI decision-mediation profile* records the ways in which artificial systems condition the information, option set, ranking, timing, defaults, evidential presentation, uncertainty representation, or procedural sequence through which a specified decision is formed and implemented.

Decision mediation can operate at several stages. Upstream systems can determine which cases enter review. Midstream systems can score or classify cases. Downstream systems can generate recommended actions or automatically execute selected operations. The same organization can combine these stages. A useful analysis should therefore avoid describing the entire process as “AI decision making” when artificial systems mediate only some components.

Decision mediation becomes power-relevant when it systematically changes which continuations remain accessible to affected positions. A recommender can alter market visibility. A credit model can affect financing access. A hiring system can shape which applicants reach human review. A logistics optimizer can redirect work intensity and timing. A scientific assistant can reshape which hypotheses receive attention. In each case the model’s capability matters through an institutional or infrastructural pathway.

Proposition 18.34 (Decision-mediation conversion condition). *AI-mediated influence over a decision becomes power-relevant when the mediation mechanism predictably alters the decision process or the affected position’s feasible continuations, and the alteration remains consequential under the actual opportunities for review, override, alternative evidence, appeal, or exit.*

This condition also clarifies why nominal human oversight can vary substantially in meaning. Oversight is stronger where humans possess time, expertise, independent evidence, authority, and practical alternatives. It becomes thinner where the cost of deviation is high, model reasoning is difficult to inspect, workloads are excessive, or institutional routines reward compliance with the recommendation. The economic object is therefore the human–AI decision relation rather than the presence of a human signature at the final stage.

18.3.7 Conversion of Capability into Power

The preceding subsections identify several mechanisms through which capability asymmetry can acquire directional consequence. The present subsection integrates them using the power architecture developed in Chapter 16. The antecedent object is a typed capability asymmetry of the kind developed in Section 18.2. The conversion mechanism can involve dependency, infrastructure control, model control, access gating, epistemic authority, decision mediation, or a combination of these. The output of the first analytical step is power relevance rather than relational power.

Definition 18.35 (Capability-derived power relevance). A typed capability asymmetry is *power-relevant* in a specified human–AI or institutional configuration when an identifiable conversion mechanism connects the advantaged capability position to systematic deformation of another position’s accessible, feasible, or comparatively weighted operations, continuations, or capability-development pathways.

Definition 18.35 is a Chapter 18 specialization of the power-relevance architecture developed in Sections 16.1 and 16.2. The capability advantage does not need to be globally superior. A narrow advantage can become strongly power-relevant where the affected relation depends heavily on that dimension. Large general capability differences can remain weakly power-relevant where institutions preserve substitution, exit, independent authority, or counter-capacity.

Power relevance can also be distributed. No single position may control the entire capability stack. One actor can control models, another cloud infrastructure, another identity or distribution, another institutional permission, and another the local workflow. Their combined arrangement can condition a participant's future possibilities even when each individual relation appears substitutable in isolation. The conversion analysis should therefore identify coupled mechanisms where the consequence emerges from several interdependent positions.

The transition to relational power requires stronger conditions. Section 16.2 requires the power organization itself to become historically persistent and causally and generatively efficacious. Applied here, a one-off model outage can create severe disruption without establishing a durable power structure. A temporary performance advantage can produce bargaining leverage without persisting long enough to reorganize the field. Conversely, recurrent dependence embedded in infrastructure, workflows, standards, and institutional expectations can support a relational power structure even where overt intervention is rare.

Proposition 18.36 (Capability-to-power conversion). *A capability-derived power-relevant relation supports a claim of relational power only when the resulting power organization satisfies the historical persistence, causal efficacy, and generative efficacy conditions required by Chapter 16. The capability asymmetry, the conversion mechanism, and the relationally realized power structure remain analytically distinct objects.*

The proposition yields several consequences. First, capability concentration is evidence about possible antecedent structure rather than proof of power. Second, power can persist after the original capability gap narrows if institutions, switching costs, standards, classifications, or expectations reproduce the relation. Third, a technically dominant system can lose power when counter-capacity, public infrastructure, interoperability, or institutional redesign weakens the conversion mechanism. Fourth, capability improvement by the less advantaged position does not automatically equalize power if access, authority, or dependency relations remain unchanged.

The distinction also clarifies reciprocal power. Human institutions can depend on artificial capability while model providers depend on market access, legal permission, high-quality data, professional expertise, public legitimacy, or infrastructure controlled by others. Reciprocal power can therefore coexist with radical capability asymmetry. Its analysis requires directional components rather than a single judgment about which entire position is more powerful.

18.3.8 Institutional Mediation

Capability-derived power rarely operates through technical relations alone. Procurement rules, employment contracts, professional standards, accreditation, liability, data-governance regimes, public law, organizational routines, technical standards, insurance, auditing, funding arrangements, and platform policies mediate how capa-

bility enters consequential activity. Institutions can amplify a capability advantage by making one system or provider mandatory, and they can attenuate it by supporting portability, review, public alternatives, shared infrastructure, or countervailing expertise.

Institutional mediation also determines which capability counts. A benchmark can influence procurement. A certification can define which systems may enter a regulated domain. An organizational policy can require employees to use an approved assistant. A liability rule can make institutions prefer systems with auditable records over technically stronger but less governable alternatives. These arrangements alter the practical conversion from technical capability to economic power.

Definition 18.37 (Institutionally mediated capability power). *Institutionally mediated capability power* is relational power whose persistence or efficacy depends materially on rules, offices, standards, contractual arrangements, procedures, infrastructures, classifications, or organizational routines that connect capability asymmetry to consequential differences in access, standing, decision, coordination, or future capability formation.

The definition permits institutions to be constitutive supports without treating them as mere instruments of a technologically advantaged actor. Institutions have their own histories, mandates, conflicts, and sources of authority. A public agency can use private AI capability while imposing conditions that redirect its effects. A firm can constrain a model provider through procurement leverage. Professional communities can preserve human review standards. Workers can organize collective rules around monitoring or task allocation. Institutional mediation can therefore strengthen, distribute, constrain, or transform capability power.

Institutional mediation can also reproduce power indirectly. A classification produced through an AI-enabled process can determine eligibility; the resulting allocation can change later capability; the changed capability can then affect future classification or bargaining. This is a reflexive power-recognition loop of the kind developed in Section 16.3. The representation of capability can become part of the process that generates later capability and power.

A particularly important implication concerns governance. Interventions aimed at reducing technical asymmetry can be weak if institutional mediation continues to reproduce dependence. Conversely, governance can reduce power relevance without equalizing underlying capability by protecting exit, establishing appeal, requiring portability, providing public infrastructure, preserving independent expertise, or separating advisory systems from final authority. Section 18.13 will develop these governance questions at the chapter level.

Radical capability asymmetry supplies potential power relations, while relational conversion and historical realization determine whether capability becomes power. Dependency, infrastructure, model control, access, epistemic authority, decision mediation, and institutions are distinct conversion sites. Their interaction determines whether an artificial-capability advantage deforms another position's future possibilities. Persistent causal and generative efficacy can then sustain relational power in the sense developed in Chapter 16. Section 18.4 turns to labor, where capability and power encounter employment, distribution, care, contribution, and participation.

18.4 Labor after Artificial Intelligence

The preceding sections established three analytical layers: artificial productive capacity, radical capability asymmetry, and the mechanisms through which capability asymmetry can become power-relevant and eventually relationally powerful. The present section examines labor within that architecture. Its role is to analyze how artificial capability can reorganize tasks, relative productivity, employment opportunities, wage-based distribution, care, contribution, participation, and the form of work itself. The analysis treats displacement and complementarity as contingent outcomes whose historical form depends on task structure, organizational redesign, ownership, demand, bargaining, infrastructure, regulation, and the distribution of artificial capability.

The central analytical distinction is among *task performance*, *employment*, *income*, *contribution*, and *participation*. These objects can move differently. A task can become automatable while a job persists through reorganization. Human productivity can rise while labor's share of generated surplus falls. Employment can become scarcer while unpaid care, civic participation, cultural production, or relational work remain socially consequential. Wage income can decline in importance without resolving the institutional question of how access to material resources, recognition, learning, decision, and social membership should be organized. GRE therefore studies labor after artificial intelligence through the relations that connect productive capability to livelihood and participation.

Existing economic research supports task-level analysis alongside occupation-level analysis, especially where automation changes only selected operations within a wider role. Acemoglu and Restrepo distinguish the displacement of labor from the creation of new tasks that can reinstate labor demand (Acemoglu and Restrepo 2019). Recent generative-AI studies likewise show that artificial assistance can alter completion time and performance within bounded task settings, with heterogeneous effects across workers (Noy and Zhang 2023; Brynjolfsson et al. 2025). These results support a bounded conclusion: productive relations can be reorganized before the longer-run institutional form of the resulting labor market is known.

Table 18.4 summarizes the eight dimensions developed in this section.

18.4.1 Cognitive Automation

Cognitive automation concerns the transfer or reorganization of operations that previously required human cognitive performance within a labor process. Such operations can include drafting, retrieval, classification, translation, coding, summarization, scheduling, simulation, forecasting, comparison, monitoring, or recommendation. The economically relevant unit is therefore smaller than an occupation and often smaller than a conventionally defined task. A workflow can contain several operations with different requirements for context, responsibility, physical presence, judgment, verification, interaction, and authorization.

Artificial intelligence can affect these operations in several ways. It can replace direct execution by a human worker; reduce the time required for execution, change the skill threshold required for acceptable performance, externalize expertise into a shared system, generate candidate outputs that require later human verification, or create new coordination and supervision tasks. The task-based framework developed

Table 18.4: Dimensions of labor transformation under artificial intelligence

Dimension	Economic question	Analytical safeguard
Cognitive automation	Which cognitive operations are transferred, compressed, or reorganized through artificial systems?	Task automation remains distinct from job elimination and from whole-process autonomy
Comparative human productivity	How does human productivity change relative to artificial or hybrid configurations?	Relative productivity is task-, organization-, and institution-specific and remains analytically separate from human worth
Employment scarcity	How many socially recognized paid roles remain available relative to people seeking them?	Employment scarcity differs from task scarcity, contribution scarcity, and material scarcity
Wage-based distribution	How strongly are access to income and social goods tied to employment income?	Productivity growth and income security need separate institutional analysis
Care and relational labor	Which activities derive value partly from situated relation, responsibility, presence, and continuity?	Technical substitutability in one task component leaves the value of the wider care relation to separate analysis
Human contribution beyond productivity	Which human contributions remain consequential outside output maximization?	Contribution includes judgment, responsibility, stewardship, legitimacy, meaning, and collective formation
Participation beyond employment	Through which institutions can persons participate in economic and social generation outside paid jobs?	Participation is broader than income receipt and broader than labor-market status
Transformation of work	How do task boundaries, skill, autonomy, monitoring, tempo, responsibility, and learning change together?	Work transformation is historical and path-dependent and requires more than an automation rate

by Acemoglu and Restrepo is useful here because it distinguishes displacement effects from the creation of new tasks and the reinstatement of labor demand (Acemoglu and Restrepo 2019). GRE adds a relational question: how does each change reorganize the capability, dependency, learning, and bargaining structure of the participants who remain inside the production process?

Definition 18.38 (AI-mediated cognitive automation). *AI-mediated cognitive automation* occurs when one or more cognitive operations within a labor process are re-assigned, compressed, or reorganized through an artificial system such that completion of the process requires a changed form, timing, or quantity of direct human cognitive execution at those operations.

The definition is intentionally process-relative. A worker can remain employed after several operations are automated. An occupation can expand even as particular cognitive operations disappear. A new operation can arise because artificial output requires verification, integration, exception handling, interface design, data preparation, or institutional authorization. Conversely, a technically feasible augmentation

can still reduce employment if organizations redesign the process so that fewer workers are required for the same output.

The experimental evidence in professional writing and customer support illustrates this plurality. Generative-AI access improved performance in specified tasks in the settings studied by Noy and Zhang and by Brynjolfsson, Li, and Raymond, while the latter study also reports heterogeneous gains and patterns consistent with diffusion of organizational knowledge (Noy and Zhang 2023; Brynjolfsson et al. 2025). These settings show augmentation inside existing roles. The later organizational consequences remain open: redesign can preserve headcount, expand service volume, raise quality, change wages, or consolidate work among fewer employees.

Proposition 18.39 (Task–employment non-equivalence). *A reduction in the amount of direct human execution required for a specified cognitive operation leaves the employment effect of the wider labor process underdetermined. Employment consequences additionally depend on demand, process redesign, complementary tasks, organizational scale, costs, institutions, and the distribution of control over artificial capability.*

The proposition prevents task exposure from becoming a direct forecast of employment loss. The same automation can reduce labor demand in one organizational configuration and expand it in another if lower cost creates additional demand, if quality improvement opens new uses, or if complementary human tasks become more valuable. The economic analysis therefore has to follow the reconfiguration of the whole production relation.

18.4.2 Comparative Human Productivity

Artificial productive capacity changes the reference point against which human productivity is evaluated. A worker can become more productive in absolute terms after adopting an AI system while becoming less productive relative to an AI-intensive organizational configuration operated by fewer people. A human specialist can outperform a general-purpose model on a narrow domain while a hybrid team using artificial tools outperforms either component considered separately. Comparative productivity therefore depends on the unit of comparison.

Let a labor configuration retain a human participant h , an artificial system a , and organizational complements o . The relevant comparison can concern h acting independently, a operating through a specified deployment environment, or a hybrid configuration (h, a, o) . GRE treats these as different production configurations. Productivity comparisons across them require a declared output, quality criterion, time horizon, resource boundary, and consequence set. A comparison based only on tokens generated, cases completed, or immediate unit cost can omit verification, error correction, training, coordination, infrastructure, liability, or later capability loss.

Definition 18.40 (Comparative human productivity position). A person's *comparative human productivity position* is the task- and configuration-relative relation between the economically consequential outputs obtainable through that person's participation and the outputs obtainable through selected artificial, human, or hybrid comparison configurations under explicitly stated resource, quality, temporal, and institutional conditions.

The definition separates comparative productivity from intrinsic personal quality. A person can occupy a weak comparative productivity position on one operation while contributing judgment, responsibility, relational continuity, legitimacy, or con-

textual knowledge that is not represented by the selected output metric. Conversely, a highly valued professional role can contain operations on which artificial systems achieve greater speed or consistency. Comparative productivity is therefore an economic relation among production configurations and remains separate from a general ranking of persons.

Capability diffusion can also change comparative positions unevenly. In the customer-support setting studied by Brynjolfsson, Li, and Raymond, less experienced workers received larger measured productivity gains than more experienced workers in the studied deployment (Brynjolfsson et al. 2025). One interpretation consistent with their evidence is that some tacit or organizationally accumulated knowledge became accessible through the assistant. If such diffusion generalizes in a domain, the productivity premium attached to prior experience can narrow for some operations while other forms of experience become more important for verification, escalation, or exceptional cases.

Proposition 18.41 (Productivity–contribution distinction). *A decline in a person’s comparative productivity position under a declared output metric leaves that person’s total economic or social contribution to separate analysis. The latter requires an account of the relations, responsibilities, meanings, institutional functions, and future generative effects omitted from the productivity metric.*

This distinction becomes increasingly important when artificial systems compress the market value of outputs that previously served as proxies for expertise. A draft, translation, image, or preliminary analysis can become inexpensive while responsibility for consequences, institutional trust, contextual interpretation, or long-horizon stewardship remains scarce. Labor institutions that equate contribution entirely with immediately measurable output can therefore misrecognize important forms of value under conditions of artificial abundance.

18.4.3 Employment Scarcity

Employment is one institutional form through which labor, income, status, time, training, social membership, and productive participation are bundled. Artificial intelligence can alter the scarcity of employment even where production becomes more abundant. The relevant scarcity concerns socially recognized paid roles available to people who seek them under prevailing institutional conditions.

Employment scarcity can arise through several mechanisms. Automation can reduce the number of workers required for a given output. Organizational consolidation can concentrate production in firms with strong model, compute, or distribution advantages. Productivity growth can outpace expansion of demand. New tasks can emerge more slowly than displaced tasks. Skills can become obsolete faster than institutions support transition. Geographic or legal constraints can prevent workers from entering newly created roles. Employment can also remain abundant in aggregate while becoming scarce for particular groups, regions, age cohorts, professions, or capability profiles.

Definition 18.42 (Employment opportunity scarcity). *Employment opportunity scarcity exists for a specified population and historical horizon when the set of practically accessible paid roles compatible with that population’s location, capabilities, rights, transition resources, and institutional conditions is small relative to the population seeking such roles.*

The definition is relational. A vacancy listed nationally can remain practically inaccessible to many workers. Access depends on skill conversion, migration, caregiving obligations, credentials, language, transport, digital infrastructure, health, discrimination, and the time and resources required for transition. Artificial intelligence can expand nominal opportunity while simultaneously increasing the distance between existing capability profiles and the roles through which income is distributed.

Korinek and Stiglitz analyze channels through which AI-related technological change can alter factor prices, distribution, and unemployment under specified conditions (Korinek and Stiglitz 2019). Their analysis underscores a broader point relevant here: technological productivity gains leave the distribution of resulting income institutionally open. Employment scarcity and material abundance can coexist when productive capacity expands faster than institutions reorganize distribution and participation.

Proposition 18.43 (Productive abundance–employment scarcity compatibility). *An economy can experience increasing productive abundance while simultaneously exhibiting employment opportunity scarcity for some populations. The two conditions concern different objects: productive abundance concerns the capacity to generate goods, services, or symbolic outputs, whereas employment scarcity concerns access to socially recognized paid roles.*

The proposition becomes central if artificial systems reduce the marginal human labor required for an expanding range of outputs. A society can then possess high aggregate production while using employment as the principal gate through which households gain income, insurance, housing access, creditworthiness, migration status, or social recognition. The resulting problem is jointly technological and institutional, with distribution depending on the rules through which claims on production are recognized. Section 18.4.4 examines the distributional side directly.

18.4.4 Wage-Based Distribution

Modern economic institutions commonly connect access to income with the sale of labor time, expertise, or responsibility through wages and salaries. This arrangement performs more than a pricing function. Wage income can provide access to consumption, savings, insurance, pensions, housing, credit, social status, and institutional standing. Artificial productive capacity therefore creates a distributional problem when production becomes less dependent on human labor while material access remains strongly tied to employment income.

The distributional effect depends on ownership and bargaining structures as much as on technology. Productivity gains can raise wages, profits, consumer surplus, tax revenue, or some combination. They can also support shorter work time, expanded services, social investment, or retained earnings. Section 18.6 will examine ownership of productive intelligence and Section 18.7 will analyze AI-generated surplus. The present subsection isolates the labor-side linkage between livelihood and employment.

Definition 18.44 (Wage-dependence profile). *A wage-dependence profile specifies the extent to which a person’s or household’s effective access to material resources, insurance, social rights, institutional services, and future capability formation depends on continuing participation in paid employment.*

High wage dependence makes employment disruption economically consequen-

tial even when aggregate productive capacity is strong. A worker who loses a role can face immediate material scarcity while the economy that displaced the role produces more output than before. The relevant contradiction lies between the location of productive capacity and the institution through which claims on that production are recognized.

Wage-based distribution also affects bargaining. When workers require employment for basic material continuity and employers have access to increasingly substitutable artificial capability, the outside options of the two sides can change asymmetrically. Section 18.3 showed how capability differences can become power-relevant through dependence and access control. The same mechanism can enter labor relations when one side's ability to exit, retrain, relocate, or survive transition is much weaker.

Proposition 18.45 (Wage-distribution decoupling condition). *Where artificial productive capacity reduces the human labor required for economically significant output while effective access to resources remains strongly wage-dependent, the institutional linkage between contribution to production and claims on production can weaken. The distributional consequences depend on ownership, bargaining, taxation, transfers, public provision, and other allocation institutions.*

This proposition leaves the continued role of wage labor open. It identifies a pressure on wage-centered distribution when human labor becomes a less necessary input for some forms of production. A policy response based only on preserving employment can then conflict with the productivity gains that make less labor technically possible. Conversely, an income-only response can leave recognition, participation, learning, contribution, and institutional standing unresolved. Section 18.8 will examine redistribution and these wider limits.

18.4.5 Care and Relational Labor

Care exposes the limits of reducing labor to output quantity. Care work can include feeding, cleaning, nursing, teaching, listening, accompanying, coordinating, protecting, interpreting needs, maintaining households, sustaining relationships, and supporting dependency across the life course. Feminist economics has long shown that such activity crosses paid and unpaid domains and is often undervalued or excluded from conventional economic measurement (Folbre 2001; England 2005; Power 2004). Artificial intelligence changes parts of this activity while leaving open the status of the wider relation.

Some care operations are amenable to substantial technical support. Scheduling, documentation, monitoring, translation, reminders, information retrieval, administrative triage, and routine communication can be partly automated. Robotics and sensing can further change embodied support. These changes can reduce burdens and free human time for direct relational interaction. They can also intensify surveillance, standardize care pathways, reduce staffing, or shift responsibility toward recipients and families. The same technical capability can therefore support different care regimes depending on how institutions reorganize labor around it.

Definition 18.46 (Relationally situated care labor). *Relationally situated care labor is work whose economic and social significance depends materially on an ongoing relation of attention, responsibility, responsiveness, trust, presence, or continuity with a person or group whose needs cannot be represented adequately by output quantity*

alone.

The definition leaves the possible participants in care open and specifies the relational conditions relevant to substitution or complementarity. It identifies the relational conditions that any proposed substitute or complement would have to address. An artificial system can perform a technically competent care-related operation while the surrounding care relation continues to depend on human responsibility, legal accountability, embodied presence, mutual recognition, or long-horizon knowledge of the cared-for person. Future institutions may also develop new forms of human–AI care relation whose value requires separate analysis.

Care therefore provides a strong case for distinguishing automation of components from substitution of the whole relation. A system that drafts clinical notes can reduce documentation time while leaving diagnosis, consent, responsibility, emotional support, and bodily care with human participants. A conversational system can provide companionship-like interaction while questions of dependency, authenticity, privacy, continuity, and social withdrawal remain open. The appropriate economic comparison should include these relational consequences.

Proposition 18.47 (Care-task substitution boundary). *Technical substitutability of one or more operations within a care process establishes substitution only for those operations. Substitution of the wider care relation requires a separate account of responsibility, responsiveness, trust, continuity, embodiment, recognition, and the needs of the affected participants.*

This distinction has distributional implications. If AI lowers the cost of some care operations, institutions can use the gain to reduce burdens, expand access, shorten working hours, or increase relational time. They can also use the same gain to cut staffing and compress interaction. The technological change therefore opens a generative choice among several possible care regimes.

18.4.6 Human Contribution beyond Productivity

Artificial intelligence makes the category of contribution more visible because productive performance can become increasingly detached from human effort. When a machine-assisted configuration produces a high-quality output rapidly, the economic question shifts from how much labor was required toward which forms of human participation remain consequential and how institutions recognize them.

Human contribution can include responsibility for consequences, specification of purposes, judgment under ambiguity, care, interpretation, stewardship, conflict mediation, representation of affected communities, legitimacy, historical memory, cultural continuity, aesthetic orientation, ethical reflection, and maintenance of institutions through which collective life remains possible. Some of these contributions can also be supported by artificial systems. Their importance lies in the relations they organize, while the distribution of relevant capabilities across humans and artificial systems remains an open empirical and conceptual question.

Definition 18.48 (Non-productivity-reducible contribution). A *non-productivity-reducible contribution* is a contribution whose economic or social significance cannot be represented adequately by the quantity, speed, or unit cost of output because its value depends materially on responsibility, relation, legitimacy, continuity, judgment, meaning, stewardship, or another context-sensitive generative effect.

This category is compatible with rigorous evaluation. Rigorous scrutiny remains available because the evaluative object differs from immediate output productivity. A public decision can require legitimate representation even if an automated system predicts outcomes more accurately. A scientific institution can value mentorship because it forms future researchers. A community can value cultural transmission because it sustains identity and shared meaning. A care institution can value continuity because repeated relationships affect trust and responsiveness.

The distinction also interacts with comparative human productivity. If artificial systems outperform humans on increasingly many measurable outputs, institutions that use output metrics as the exclusive basis of contribution can generate systematic devaluation of human roles whose consequences remain socially necessary. Conversely, invoking meaning or dignity cannot by itself justify preserving every existing occupation. GRE therefore asks which relational and generative functions remain consequential and whether they can be organized through forms other than conventional employment.

Proposition 18.49 (Contribution-recognition condition). *Where socially consequential human contributions are weakly represented by prevailing productivity metrics, labor-market valuation alone can provide an incomplete account of their generative significance. Institutional recognition requires criteria matched to the relational and temporal effects actually under evaluation.*

The proposition prepares the next subsection. Once contribution is separated from paid employment, the economic architecture can examine participation through a wider set of institutions.

18.4.7 Participation beyond Employment

Employment currently performs several participatory functions simultaneously. It can provide income, routine, social contact, recognition, collective identity, learning, responsibility, status, and a pathway into institutions. If employment becomes scarcer or less central to production, replacing only the income function leaves these other roles unresolved. The problem is therefore broader than redistribution.

A capability-oriented perspective helps clarify the issue. Sen's account of substantive freedom emphasizes what people are effectively able to do and to be, together with the institutions that expand or constrain those possibilities (Sen 1999). GRE extends this concern to generative participation: whether persons can enter relations through which they contribute, learn, care, create, deliberate, organize, preserve, and influence future collective conditions.

Definition 18.50 (Economic participation beyond employment). *Economic participation beyond employment* consists of institutionally recognized opportunities to contribute to, influence, learn within, care for, maintain, create, or govern economically consequential relational processes without requiring that participation to take the form of a conventional wage-employment contract.

Possible institutional forms include cooperatives, commons, public service, civic institutions, research communities, artistic and cultural production, care networks, mutual aid, community governance, education, open-source production, deliberative bodies, and new arrangements whose stable form has yet to emerge. The definition leaves compensation arrangements open; time security, access rights, recognition, and protection against exploitation remain central questions.

Participation beyond employment also raises the issue of access to productive intelligence. If meaningful participation increasingly requires AI capability, compute, data, or institutional interfaces controlled by a small number of organizations, non-employment participation can reproduce dependency structures of the kind analyzed in Section 18.3. Public, cooperative, or commons-based access can therefore become part of the infrastructure of participation itself.

Proposition 18.51 (Participation–income non-equivalence). *Material income security and meaningful economic participation address different dimensions of post-employment order. Income can expand effective choice while leaving contribution, recognition, learning, institutional voice, relational continuity, or access to generative infrastructures weakly developed.*

The proposition adds a second institutional layer alongside income security. A society with high material security can still concentrate consequential decision and creation inside a narrow set of organizations. Conversely, extensive participation without material security can become coercive or exploitative. Long-horizon labor institutions therefore have to coordinate livelihood and participation rather than assuming one automatically supplies the other.

18.4.8 Transformation of Work

Artificial intelligence can transform work even where employment levels change little. Tasks can be redistributed between humans and artificial systems; skill requirements can shift; monitoring can become more granular; decision rights can move; the tempo of work can accelerate; output expectations can rise; learning can be compressed or displaced; responsibility can remain human while execution becomes machine-mediated; and workers can become dependent on systems they do not control. The object of analysis is therefore the changing relational organization of work.

Algorithmic management already demonstrates that computational systems can direct, evaluate, and discipline work through repeated organizational mechanisms (Kellogg et al. 2020). Generative systems add a second layer because they can participate directly in the production of text, code, analysis, images, decisions, and communication. This combination can alter both what workers do and how their activity is observed, compared, and governed.

Definition 18.52 (AI-mediated work-transformation profile). *An AI-mediated work-transformation profile is a structured description of changes in task composition, capability requirements, autonomy, monitoring, decision rights, responsibility, learning opportunities, tempo, coordination, bargaining position, and dependence that arise when artificial systems are incorporated into a labor process.*

The profile is multidimensional because desirable changes in one dimension can co-exist with adverse changes in another. Automation can remove repetitive work while increasing monitoring. Decision support can improve accuracy while narrowing professional discretion. AI assistance can accelerate novice learning in one setting while sustained reliance weakens independent capability in another. Productivity gains can shorten work time or raise expected output per worker. The outcome depends on institutional design and bargaining as well as technical capability.

Work transformation is also path-dependent. Organizations build data pipelines, interfaces, training practices, performance metrics, job descriptions, and manage-

ment routines around particular systems. Workers adapt their skills to the resulting workflow. Once these complementary investments accumulate, switching technologies or restoring previously displaced human capabilities can become costly. A temporary assistance arrangement can thereby become a durable dependency relation even if alternative systems later become technically available.

Proposition 18.53 (Path-dependent work transformation). *Repeated incorporation of artificial systems into labor processes can alter future work through accumulated changes in skills, routines, infrastructure, evaluation, and organizational expectations. The long-run labor effect therefore depends on the historical path of incorporation as well as on the contemporaneous capability of the artificial system.*

This proposition reconnects labor to the generative-relational framework of the book. Work is a site where present allocation changes future capability. A workplace that uses artificial systems to expand human learning, reduce burdens, preserve autonomy, and distribute gains generates a different future from one that uses the same technical capability to deskill workers, centralize decision, intensify monitoring, and externalize transition costs. The technology can be similar while the relational history diverges.

Labor after artificial intelligence therefore concerns more than employment volume. Automation reshapes task composition; productivity shifts relative positions; employment and wages organize livelihood; care and other contributions reveal value beyond output; participation and work design shape future capabilities. Section 18.5 examines subjecthood and existential participation once productive necessity and social membership become less tightly bundled through wage employment.

18.5 Subjecthood and Existential Participation

Section 18.4 distinguished task performance, employment, income, contribution, and participation under conditions of expanding artificial productive capacity. The present section develops the corresponding problem of subjecthood. Its role is to analyze the economic relations through which persons acquire and maintain social position, recognition, reciprocal significance, meaningful participation, learning, care, curiosity, aesthetic orientation, and continuity of life projects when paid employment becomes a less reliable organizing center. The objective is neither to derive a complete philosophy of human meaning nor to treat employment as the historical source of every valued relation. The section identifies a bounded economic architecture in which institutions, resources, technologies, and relational arrangements can support or weaken forms of participation that matter to subjects across time. The discussion proceeds through work and social position, contribution, being needed, meaningful participation, learning relations, care relations, curiosity and knowing, aesthetic orientation, and subjective continuity beyond employment. The method is relational, capability-oriented, and historically cautious: existential participation is studied through observable or reconstructable conditions of access, recognition, reciprocity, responsibility, continuity, and future possibility while stronger claims about subjective experience remain outside the economic formalism.

GRE has already treated economic subjecthood as heterogeneous and historically constituted rather than as a fixed property of one canonical actor type. Chapter 12

distinguishes persons, households, organizations, communities, institutions, artificial systems, and non-human participants while preserving differences in agency, experience, responsibility, recognition, and normative standing. Chapter 17 further develops knowing as relational participation and shows how learning can alter a subject's later epistemic capability, orientation, and subjective continuity. The present section uses those foundations to ask a different question. When artificial systems reduce the amount of human labor required for production, which economic arrangements continue to connect persons with roles through which they can participate in social generation and maintain historically extended projects?

Several established traditions illuminate parts of this question without supplying one unified answer. Sen's capability approach emphasizes substantive opportunities to do and be rather than resource possession alone (Sen 1999; Sen 1992). Honneth's work on recognition distinguishes social recognition from mere perceptual visibility and analyzes recognition as important to social relations and self-relation (Honneth 2001; Honneth 1995). Arendt distinguishes labor, work, and action in a historically influential account of active life, while the present chapter uses those distinctions only as a reminder that paid employment does not exhaust the forms through which persons can appear, make, act, and participate in a common world (Arendt 1958). Wenger's account of communities of practice similarly connects learning with practice, meaning, community, and identity (Wenger 1998). GRE places these heterogeneous insights inside an economic inquiry into the infrastructures and institutional conditions that distribute participation opportunities.

Definition 18.54 (Existential participation in the economic domain). *Existential participation in the economic domain* is a historically extended relation through which a subject can take part in consequential practices, contribute to shared or personal projects, receive or contest recognition, sustain reciprocal relations, and connect present activity with future possibilities in ways that matter to the subject's continuing position in economic and social life.

Definition 18.54 is deliberately narrower than a general theory of meaning. It identifies economic conditions under which participation can become consequential for subject formation and continuity. A person can have material income while lacking access to such relations; another can participate meaningfully through unpaid care, study, art, civic practice, scientific inquiry, community stewardship, or collective organization. The definition therefore prevents income security from standing in for the entire participatory problem while preserving the importance of material conditions for sustained participation.

Table 18.5 summarizes the nine dimensions developed in this section.

18.5.1 Work and Social Position

Paid work commonly bundles several economic and social functions that can be separated analytically. Employment can provide income, daily temporal structure, occupational identity, recognized competence, access to colleagues, institutional standing, opportunities for learning, bargaining position, benefits, and a visible route through which contribution is socially registered. These functions vary across occupations and societies. Precarious, coercive, stigmatized, unsafe, or poorly compensated work can provide some functions while damaging others. The present analysis therefore treats the employment bundle as historically contingent rather than intrinsically ben-

Table 18.5: Dimensions of subjecthood and existential participation under artificial intelligence

Dimension	Participatory relation	Economic question
Work and social position	Employment and occupational roles connect income, routine, recognition, institutional standing, and social networks	Which functions remain attached to work, and which require alternative institutions when employment becomes less central?
Contribution	Activity enters a shared project, relation, institution, or future possibility	How are consequential contributions identified, supported, attributed, and sustained outside narrow productivity metrics?
Being needed	Other persons or institutions possess reason-sensitive dependence on a subject's participation	Which forms of reciprocal significance can remain meaningful without creating avoidable coercive dependency?
Meaningful participation	Subjects have consequential roles with intelligible stakes, agency, feedback, and continuity	Which institutional arrangements make participation substantive rather than nominal?
Learning relations	Participation changes later capability, orientation, and entry into practices	How can learning remain a mode of participation rather than merely preparation for scarce employment?
Care relations	Responsibility and responsiveness are organized across vulnerable or dependent relations	How are care, recognition, continuity, and burden distributed when technical systems mediate care?
Curiosity and knowing	Subjects can encounter, inquire, interpret, and sustain open-horizon learning	How are time, access, security, and epistemic infrastructure distributed for inquiry beyond immediate market demand?
Aesthetic orientation	Subjects participate in practices of perception, judgment, making, and cultural interpretation	How are capacities for aesthetic orientation cultivated and protected under symbolic abundance?
Subjective continuity	Present participation remains connected with remembered commitments, skills, relations, and future projects	Which economic conditions support continuity while allowing revision, transition, and plurality of life paths?

eficial.

Artificial intelligence can unbundle these functions by changing the demand for human task execution before alternative institutions have developed to carry the remaining roles. A person can retain income through transfers while losing occupational networks and routine. Another can leave paid employment while gaining time for care, study, artistic work, community activity, or entrepreneurship. A third can remain employed while losing discretion, learning opportunity, or recognized authorship because AI-mediated workflows centralize control elsewhere. The relevant transition is therefore multidimensional.

Definition 18.55 (Employment-linked social-position bundle). An *employment-linked social-position bundle* is the set of income, temporal, relational, recognitional, institutional, developmental, and participatory functions that a historically specified employment relation provides to a subject.

The bundle in Definition 18.55 can be decomposed rather than treated as one good. This decomposition matters for AI-era policy because replacing lost wages addresses one component. Social networks, recognized roles, learning trajectories, professional standing, and the ability to participate in consequential collective projects can require different institutional arrangements.

Capability analysis is useful here because access to a nominal institution does not guarantee substantive opportunity to use it (Sen 1999). A publicly available learning platform, civic forum, makerspace, or community organization can provide formal access while remaining practically inaccessible because of time scarcity, disability, language, care responsibilities, cost, geography, confidence, or exclusionary norms. Post-employment participation therefore requires attention to conversion conditions as well as provision.

Proposition 18.56 (Employment-bundle decomposition). A *decline in paid employment can alter income, recognition, routine, learning, social connection, institutional standing, and participation through different mechanisms. Institutional responses that replace one component leave the remaining components analytically open.*

Proposition 18.56 avoids treating either employment preservation or income replacement as a complete response to AI-mediated labor transformation. The relevant design problem concerns which valuable functions should remain linked to employment and which can be supported through other institutions.

18.5.2 Contribution

Contribution concerns how a subject's activity enters the generation, maintenance, interpretation, repair, or transformation of a relation, project, institution, community, body of knowledge, environment, or future possibility. Section 18.4.6 already separated human contribution from productivity. The present subsection develops the subject-side relation: how contribution becomes a route through which a person participates in a shared world and sees a connection between action and consequence.

Contribution can be productive in the conventional sense, yet the category is wider. Maintaining an archive, caring for a dependent person, mentoring a novice, repairing a shared tool, preserving a language, moderating a community, producing art, serving on a local committee, generating a research question, or providing testimony can be consequential even where market output is difficult to measure. The same activity can also be burdensome, coerced, invisible, or exploited. Contribution therefore carries descriptive and normative questions that should remain separate.

Definition 18.57 (Relational contribution). A *relational contribution* is an action or sustained practice through which a subject makes a traceable difference to the maintenance, transformation, interpretation, accessibility, or future generativity of a declared relational configuration.

Definition 18.57 requires a declared configuration because contribution is purpose-relative. An action can contribute to an organization while damaging a community, or sustain a household while constraining the caregiver's own future possibilities. Eval-

uation therefore requires attention to the configuration, beneficiaries, burdens, alternatives, and historical consequences.

Attribution also matters. AI-mediated production can make causal contribution difficult to recognize when model outputs, organizational routines, human review, data infrastructures, and prior knowledge are combined. A contributor can remain economically consequential while becoming symbolically invisible. Conversely, visible credit can overstate a subject's actual contribution. The epistemic economy developed in Chapter 17 therefore intersects directly with contribution: provenance, attribution, classification, and recognition condition how contribution is socially represented.

Proposition 18.58 (Contribution-recognition non-equivalence). *Relational contribution and recognized contribution can diverge. AI-mediated production can increase this divergence when output is generated through distributed human, institutional, infrastructural, and artificial inputs whose provenance is only partially represented.*

The proposition makes recognition a separate institutional problem. A society can support broad participation only weakly if consequential contribution routinely disappears from its systems of credit, standing, or decision.

18.5.3 Being Needed

The experience or social fact of being needed deserves careful treatment because it can support reciprocal significance while also becoming a source of coercion. Employment often creates one form of need: an organization depends on a worker's labor, and the worker depends on employment income. Care creates another form: a child, patient, family member, colleague, or community can depend on a person's attention, judgment, continuity, or presence. Collective projects create further forms when participants possess specialized knowledge, trust, responsibility, or history that cannot be substituted immediately.

GRE can analyze neededness without making dependency itself a normative ideal. Some forms of dependency should be reduced because they expose a subject to domination, exhaustion, or irreplaceable burden. Other forms express reciprocal commitment or differentiated responsibility. The analytical object is therefore the structure and quality of dependence.

Definition 18.59 (Reason-sensitive neededness relation). *A reason-sensitive neededness relation exists when another subject, group, institution, or continuing project has identifiable reasons for the participation of a particular subject or for a capability carried by that subject, and substitution would alter relevant relational, practical, historical, or normative properties of the configuration.*

The reference to identifiable reasons in Definition 18.59 prevents neededness from being inferred solely from a person's desire to feel indispensable. The relation can be grounded in competence, trust, responsibility, historical continuity, embodied presence, legal role, care commitment, authorship, or other specified features. Some of these features are substitutable over time; others are partly constituted by the history of the relation.

Artificial systems can reduce certain forms of operational dependence by making expertise, communication, drafting, monitoring, or coordination easier to substitute. They can also create new neededness relations around verification, stewardship, responsibility, governance, or interpersonal continuity. The economic question is there-

fore not whether human beings remain indispensable in an abstract sense. It is how different forms of reciprocal dependence are generated, distributed, supported, and made revisable.

Proposition 18.60 (Neededness-dependency distinction). *An economically meaningful neededness relation can coexist with substitutability, shared responsibility, and institutional redundancy. The participatory significance of being needed therefore does not require making another position unable to continue without one specific person.*

This distinction is important for institutional design. Systems can create meaningful responsibility while maintaining backup, respite, transferability, and contestability. Such arrangements can preserve reciprocal significance without converting it into avoidable vulnerability or monopoly over a social role.

18.5.4 Meaningful Participation

Participation can be nominal or consequential. A person may be formally included in an institution while possessing little influence, little intelligibility about what the activity serves, weak feedback about consequences, or no durable route to develop capability. Meaningful participation therefore requires more than presence. It concerns the relation among agency, intelligibility, consequence, recognition, and continuity.

This formulation remains compatible with plural conceptions of meaning. GRE does not define one substantive life plan as economically superior. A research community, family, religious association, artistic practice, cooperative, civic body, enterprise, neighborhood organization, educational institution, or individual long-horizon project can each organize participation differently. The economic role of GRE is to identify the material and institutional conditions that enable subjects to enter, sustain, revise, and leave such relations.

Definition 18.61 (Meaningful economic participation). *Meaningful economic participation* is participation in a consequential practice or project for which the subject has sufficient practical access, intelligibility, agency, feedback, recognition, and temporal continuity to form and revise a relation to what the participation generates.

The elements in Definition 18.61 need not be equal or maximal. Apprentices can participate before possessing full competence; patients can participate in care decisions with asymmetric expertise; citizens can participate through representation; children can participate under age-appropriate forms of support. The definition identifies dimensions that can be examined rather than a universal threshold.

Recognition is especially relevant because social visibility and social recognition can diverge. Honneth's analysis of invisibility shows how a person can be perceptually present while socially unrecognized (Honneth 2001). AI-mediated institutions can reproduce this divergence when automated systems process a person's data, labor, or preferences while the person has little standing as a participant in the decisions or practices that use them.

Proposition 18.62 (Participation-substance condition). *Formal inclusion provides a participatory opportunity whose substantive significance depends on practical access, intelligibility, agency, feedback, recognition, and continuity in the relevant configuration.*

The proposition connects participation to the capability approach without equating capability with subjective meaning. It states an institutional condition: opportunities

become more substantive when subjects can actually convert them into consequential participation.

18.5.5 Learning Relations

Learning can function as a mode of participation as well as preparation for employment. Chapter 17 defined relational epistemic participation as temporally extended involvement through which capacities, orientations, relations, or feasible inquiries can change. Under conditions of employment scarcity, this role becomes economically more important because education can no longer be interpreted only as investment in later labor-market productivity.

A learning relation can connect a subject to teachers, peers, texts, instruments, practices, traditions, institutions, environments, and artificial systems. Lave and Wenger's account of legitimate peripheral participation emphasizes changing participation within social practice, while Wenger later links learning with practice, meaning, community, and identity (Lave and Wenger 1991; Wenger 1998). These accounts support an economic question about access: who has time, security, infrastructure, mentors, communities, and legitimate entry into practices through which learning becomes a continuing part of life?

Definition 18.63 (Participatory learning relation). *A participatory learning relation is a learning configuration in which changes in capability occur through sustained participation in a practice, community, object relation, or human–AI interaction whose significance extends beyond a one-time acquisition of information.*

Artificial intelligence can widen access to explanation, translation, feedback, simulation, and individualized practice. It can also externalize operations that previously contributed to learning, leaving assisted performance high while independent capability changes little. Section 17.14 developed this distinction directly. The present subsection adds a participatory implication: learning institutions should be evaluated partly by whether they preserve opportunities for subjects to become more capable participants rather than only more efficient consumers of generated answers.

Proposition 18.64 (Learning-participation condition). *Where employment becomes a weaker organizer of adult life, access to continuing learning can function as a primary participation infrastructure when it provides sustained entry into practices, communities, inquiry, and capability development rather than only episodic credential acquisition.*

This proposition does not make perpetual schooling a social objective. It identifies learning as one candidate institutional route through which subjects can remain generatively connected to changing practices across a long life course.

18.5.6 Care Relations

Care relations combine practical activity with responsibility, responsiveness, dependency, continuity, and recognition. Section 18.4.5 showed that technical substitution of a care-related operation does not establish substitution of the whole care relation. The present subsection examines the subjecthood implication. Giving and receiving care are ways through which subjects become situated in relations of need, responsibility, trust, vulnerability, and mutual transformation.

Care scholarship has long emphasized that care work contains relational and affective dimensions alongside measurable service output (Folbre 1994; Folbre 2001; England 2005). GRE retains that insight while avoiding romanticization. Care can generate attachment and meaning, yet it can also impose unequal burdens, constrain future possibilities, and become exploitative when responsibility is concentrated without adequate resources, respite, recognition, or choice.

Definition 18.65 (Existentially consequential care relation). An *existentially consequential care relation* is a care configuration in which responsibility, responsiveness, continuity, recognition, or embodied presence materially affects the subject positions and future possibilities of one or more participants in addition to the completion of care-related tasks.

AI can mediate such relations through monitoring, scheduling, translation, reminders, decision support, companionship interfaces, or robotic assistance. These tools can reduce burden or expand access. They can also change who is responsible, who remains attentive, how needs become legible, and whether human participants retain the capacity to notice conditions outside the system's categories. The relevant question is therefore relational reorganization rather than a binary choice between human and artificial care.

Proposition 18.66 (Care-mediation condition). *AI-mediated improvement in a care operation can enlarge the quality or accessibility of a care relation when the surrounding configuration preserves adequate responsibility, responsiveness, contestability, and continuity; the same operational improvement can weaken the relation when those supports are displaced or obscured.*

The proposition keeps technical performance and relational quality analytically distinct while permitting complementarity between them.

18.5.7 Curiosity and Knowing

Curiosity and knowing provide another participation route whose economic significance can increase when paid employment occupies less of a person's time or social identity. Chapter 17 treated curiosity and question formation as processes whose emergence depends on encounter, salience, time, education, security, institutions, and relational support. It also treated knowledge beyond immediate instrumental utility as part of the epistemic economy. The AI-era question concerns whether productive abundance is accompanied by broader access to open-horizon inquiry or by deeper concentration of attention and epistemic orientation.

The economic resources required for curiosity are unevenly distributed. Time, quiet, libraries, networks, language access, mentors, communities, instruments, travel, computational resources, and freedom from immediate insecurity affect which subjects can sustain inquiry. AI can reduce some entry costs through explanation, search, translation, simulation, and conversational interaction. It can also channel curiosity toward highly represented materials, make generated answers cheaper than sustained inquiry, or increase dependence on platforms that shape what is encountered.

Definition 18.67 (Open-horizon participatory inquiry). *Open-horizon participatory inquiry* is sustained participation in questioning, learning, interpretation, or investigation whose relevant future significance is only partially specified at the time of participation and whose continuation can modify the subject's capabilities, orienta-

tions, relations, or later projects.

The definition preserves the possibility that inquiry later becomes economically instrumental while leaving room for historical, philosophical, scientific, cultural, personal, or civic inquiry whose immediate market return is weak. Dewey's account of inquiry is useful here because it places perplexity, observation, suggestion, and inference inside an educative process rather than treating inquiry as passive information receipt (Dewey 1910).

Proposition 18.68 (Curiosity-opportunity condition). *Productive abundance enlarges existential participation through curiosity only where subjects gain practical access to the time, security, epistemic resources, communities, and contestable infrastructures required to sustain inquiry and form their own questions.*

The proposition gives the AI abundance problem a distributional form. Cheap answers can coexist with scarce inquiry opportunity if the conditions required for question formation and long-horizon attention remain concentrated.

18.5.8 Aesthetic Orientation

Aesthetic orientation concerns participation in practices of perception, making, interpretation, judgment, and appreciation through which subjects encounter qualities that are not exhausted by instrumental usefulness. Chapter 17 treated aesthetic judgment as one source of epistemic orientation under incomplete explicit criteria. The present subsection broadens the participatory question while retaining the chapter's economic scope.

Artificial systems can generate images, music, prose, designs, simulations, and other symbolic materials at high volume. Symbolic abundance changes the conditions under which aesthetic participation occurs. Production costs can fall, entry into some practices can widen, and new hybrid forms can emerge. At the same time, attention, provenance, situated interpretation, communities of practice, embodied technique, and the cultivation of taste can remain scarce. Dewey's account of art as experience is useful because it links aesthetic experience to participation, perception, doing, undergoing, and continuity within experience rather than locating value only in detachable objects (Dewey 1934).

Definition 18.69 (Aesthetic participation capacity). *Aesthetic participation capacity* is the practical ability of a subject to enter, sustain, interpret, create within, and revise a relation to aesthetic practices or objects through which perception, judgment, expression, or shared cultural meaning can develop.

The definition permits artificial tools to become part of aesthetic participation without treating generated output volume as a measure of aesthetic capacity. A person can use generative systems to explore form, compare styles, prototype ideas, or overcome technical barriers while still exercising situated judgment. Another configuration can narrow participation when platforms optimize toward recurrent styles, opaque rankings, or rapid consumption while weakening opportunities for practice and interpretation.

Proposition 18.70 (Symbolic abundance and aesthetic participation). *An increase in generated symbolic material expands aesthetic participation when it also enlarges practical opportunities for perception, interpretation, making, judgment, attribution, and community engagement; output abundance alone leaves those participatory capacities*

underdetermined.

This distinction prepares later analysis of symbolic abundance and representation in Section 18.11. The present concern is the subject-side capacity to participate in aesthetic orientation rather than the provenance and institutional verification of synthetic media.

18.5.9 Subjective Continuity beyond Employment

Employment often supplies a temporal narrative linking education, skill, occupational identity, colleagues, advancement, retirement, and accumulated recognition. AI-mediated labor transformation can disturb this continuity even where material support is maintained. The final subsection therefore examines the economic conditions through which subjects can sustain long-horizon continuity when employment becomes more intermittent, less central, or less available.

Chapter 17 defined subjective epistemic continuity through the relation between prior learning and present or future orientation. The present analysis expands the object beyond knowing. Subjective continuity can involve care commitments, artistic practice, civic membership, places, relationships, institutions, bodily capacities, craft, language, memory, research, spiritual practice, or other projects through which a person connects earlier and later stages of life. Economic arrangements affect this continuity through housing, health care, income security, time, mobility, access to institutions, preservation of records, recognition, and the ability to enter new roles after disruption.

Definition 18.71 (Post-employment subjective continuity). *Post-employment subjective continuity* is the capacity of a subject to connect remembered commitments, capabilities, relations, and projects with revisable present and future participation when paid employment provides only part, or little, of the temporal and social structure of life.

Continuity in Definition 18.71 does not require preserving one identity unchanged. A person can change vocation, community, location, skills, commitments, or modes of participation while retaining enough historical connection to interpret the change as part of an intelligible life trajectory. Institutions can support such revision by preserving access to learning, care, cultural practice, public participation, personal records, and material security during transitions.

Proposition 18.72 (Existential-participation architecture). *When employment ceases to bundle income, recognition, learning, social connection, contribution, and temporal continuity reliably, a viable participation architecture requires these functions to be made available through a plurality of institutions and relations whose access does not depend exclusively on labor-market demand.*

Proposition 18.72 identifies an institutional design problem rather than selecting one arrangement. Adequacy depends on practical access, recognition, agency, sustainability, pluralism, and the distribution of power over entry and continuation. Section 18.6 turns next to ownership of productive intelligence because control over models, compute, data, platforms, and access helps condition how such participation arrangements can be financed and governed.

18.6 Ownership of Productive Intelligence

This section develops the ownership architecture of artificial productive capacity. Its role is to identify how recognized claims, effective control, use rights, exclusion, access, governance, and transfer are distributed across the model, compute, data, platform, and infrastructure layers through which artificial capability becomes economically operative. The objective is narrower than a general legal theory of artificial intelligence and broader than ownership of model weights alone. The analysis asks which positions can mobilize productive intelligence, set the terms of its use, exclude or condition others, redirect its development, and participate in the returns generated through it. The discussion proceeds through model ownership, compute ownership, data control, platform control, infrastructure control, access rights, public and commons models, and distributed ownership. The method extends Chapter 12's ownership-control distinction and the capability-to-power analysis of Section 18.3. Ownership is treated as one historically situated architecture through which capability can be organized; effective control and relational power require separate identification.

Artificial productive capacity was defined in Section 18.1 as capability embedded in a coupled configuration of models, compute, data, energy, interfaces, organizations, rules, and complementary human capacities. Ownership analysis should therefore follow the same relational decomposition. A party can own model weights while renting compute, relying on third-party distribution, licensing data, and operating under access conditions imposed elsewhere. Another party can own little of the underlying stack while controlling a high-leverage interface through which many users reach it. A public institution can finance an open model while private firms supply the compute and deployment infrastructure. These configurations allocate different rights, dependencies, revenues, risks, and capacities for revision.

The property-rights literature provides a useful starting discipline because ownership can be decomposed into differentiated bundles of claims rather than represented as a single binary status (Schlager and Ostrom 1992). The incomplete-contract tradition similarly emphasizes the economic significance of residual control when future uses cannot be completely specified in advance (Grossman and O. D. Hart 1986; O. Hart and Moore 1990). GRE does not import either framework as a complete theory of AI ownership. Their relevance here is methodological: a statement that an organization “owns the AI” can conceal distinct relations concerning model artifacts, compute, data, deployment, access, adaptation, revenue, governance, and later disposition.

Definition 18.73 (Productive-intelligence ownership architecture). A *productive-intelligence ownership architecture* is the historically situated configuration of recognized claims, effective control relations, use and access rights, exclusion capacities, governance powers, responsibilities, transfer conditions, and benefit claims distributed across the model, compute, data, platform, infrastructure, and organizational layers through which artificial productive capability is generated and mobilized.

Definition 18.73 makes the stack rather than a single artifact the primary object of inquiry. It also keeps legal title, practical control, and relational power distinct. A recognized owner can have weak practical control over a model when deployment depends on another provider's compute or platform. A non-owner can exercise consequential control through licensing terms, technical interfaces, financing, stan-

Table 18.6: Ownership and control layers in artificial productive intelligence.

Layer	Principal ownership or control relations	Economic consequence requiring analysis
Model	Title, licensing, modification, derivative use, deployment authority, release conditions	Who can reproduce, adapt, withhold, specialize, or redirect modeled capability
Compute	Hardware ownership, leasing, cloud allocation, scheduling, cluster administration	Who can realize capability at relevant scale, latency, reliability, and cost
Data	Collection, custody, permission, provenance, curation, feedback, deletion, portability	Who can train, update, evaluate, personalize, audit, or improve systems through data
Platform	Interface control, distribution, ranking, identity, payment, default integration, API terms	Who mediates users, applications, demand, visibility, and downstream dependence
Infrastructure	Energy, semiconductor supply, networks, storage, cloud, security, deployment systems	Which complementary bottlenecks condition continuity and substitutability of capability
Access rights	Use, inspect, adapt, fine-tune, deploy, export, redistribute, terminate, contest	Which practical capabilities are available to differently positioned participants
Public or commons arrangements	Public provision, shared stewardship, open resources, contributor governance, maintenance	How broad access, collective governance, sustainability, and public purpose are organized
Distributed ownership	Layered, cooperative, federated, trust-like, member, public-private, or multi-party claims	How authority, risk, residual benefit, and revision capacity are distributed across the stack

dards, or access gates. Section 18.3 supplies the additional mechanism-sensitive test required before such control is interpreted as relational power.

Table 18.6 summarizes the principal ownership and control layers examined in this section. The layers can be held by different subjects and can change at different rates.

The table also anticipates Section 18.7. Ownership matters for surplus because the positions that hold residual claims, determine access terms, or control complementary bottlenecks can participate differently in the returns generated by artificial productive capacity. The present section establishes the ownership architecture before the subsequent section analyzes those returns.

18.6.1 Model Ownership

Model ownership concerns claims over the computational artifacts and associated resources through which a trained system’s capability is represented, reproduced, modified, or deployed. Depending on the system and institutional arrangement, the relevant objects can include model weights, source code, training and inference software, configuration files, adaptation layers, evaluation assets, deployment packages, technical documentation, trademarks, contractual rights, or combinations of these. The applicable legal status can differ across jurisdictions and objects. GRE therefore begins with the operative economic relations rather than assuming that the word *model* denotes one legally uniform asset.

A model can also be economically divisible in ways that ordinary ownership language obscures. One organization can hold recognized rights in model weights, another can control the software needed to serve them efficiently, and downstream users can receive only an interface-level permission to invoke the system. Fine-tuned derivatives can introduce additional claims and dependencies. A released weight file can be reproducible while later versions, safety layers, optimization tooling, or high-quality evaluations remain controlled elsewhere. Model ownership should therefore be represented as a profile of actionable positions rather than a yes–no attribute.

Definition 18.74 (Model-ownership profile). A *model-ownership profile* records, for a specified artificial system, the recognized claims and practical capacities concerning possession or custody of model artifacts, reproduction, modification, derivative construction, deployment, licensing, exclusion, transfer, version control, and participation in residual economic returns.

The definition permits several profiles to coexist over one model family. A foundation can fund development, a corporation can hold commercial rights, researchers can possess a research-use copy, cloud providers can host deployments, and users can receive limited invocation rights. The economic significance of each position depends on what the holder can actually do and on which complementary resources remain necessary.

Proposition 18.75 (Model ownership–productive control non-equivalence). *Recognized ownership of a model artifact establishes productive control only to the extent that the owner can mobilize the complementary compute, data, software, permissions, infrastructure, and organizational capacities required for the economically relevant use. Productive control can also arise through those complementary layers without ownership of the underlying model artifact.*

Proposition 18.75 specializes the ownership–control non-equivalence established in Chapter 12. It also clarifies why transfer of model weights can materially widen some forms of access while leaving other forms of control concentrated. The practical question is which operations become available after the transfer and which still depend on external relations.

18.6.2 Compute Ownership

Artificial capability becomes productive through computation performed on physical and organizational infrastructures. Compute ownership therefore concerns more than possession of processors. Economically relevant positions can include title to accelerators and servers, long-term leases, reserved cloud capacity, priority scheduling,

cluster administration, access to high-bandwidth interconnects, storage, cooling, energy supply, maintenance, and the engineering capacity required to operate the system. Ownership and practical availability can diverge because hardware that exists physically may be unavailable at the time, scale, location, reliability, or cost required by a particular workload.

Compute also enters different stages of the capability lifecycle. Training, adaptation, evaluation, simulation, batch inference, low-latency serving, and agentic workloads can require different configurations. A subject with sufficient inference access to use an existing model may remain unable to train a replacement, reproduce an experiment, run a large-scale evaluation, or maintain service under demand spikes. The economically relevant unit is therefore the relation between computational resources and the operations they enable.

Definition 18.76 (Compute ownership and availability profile). *A compute ownership and availability profile records the recognized claims, contractual positions, scheduling authority, operational control, scale, duration, location, reliability, cost conditions, and substitution possibilities through which computational resources can be mobilized for specified artificial-intelligence operations.*

This profile distinguishes ownership of equipment from a practically adequate compute position. A firm can own a small cluster while relying on external capacity for frontier-scale workloads. A university can obtain temporary access through grants or national infrastructure. A cloud customer can hold no hardware title while possessing contractually protected capacity for a defined period. These positions create different horizons for experimentation, deployment, bargaining, and resilience.

Proposition 18.77 (Compute-realization condition). *A model-level capability becomes economically realizable at a specified scale only where the relevant configuration can mobilize sufficient computational capacity together with the complementary energy, networking, storage, software, and operational support required by that use.*

The proposition identifies compute as a conversion layer between technical capability and productive capacity. It does not imply that compute is the sole bottleneck or that greater compute always yields greater economic value. The limiting layer can move as models, algorithms, hardware, organizational practice, and downstream demand change.

18.6.3 Data Control

Data require a different vocabulary because the relevant economic relation is frequently control rather than a unitary ownership status. Training corpora, licensed datasets, public records, proprietary operational data, user interactions, sensor streams, annotations, feedback, evaluations, synthetic data, and derived statistics can carry different permissions, stewardship obligations, privacy constraints, provenance structures, and technical dependencies. A single claim of “data ownership” can therefore obscure the relations that determine who may collect, retain, combine, inspect, update, delete, transfer, monetize, or use data to alter an artificial system.

Data control is also historically generative. Deployment can create new interaction records, error traces, preference data, domain examples, and evaluation feedback. A provider with a large installed user base can therefore acquire a continuing stream of material that supports model improvement, product adaptation, safety analysis,

personalization, or market intelligence. The consequence depends on the quality and relevance of the data as well as on the ability to convert it into capability.

Definition 18.78 (AI data-control position). An *AI data-control position* is the configuration of collection, custody, access, combination, curation, provenance, retention, deletion, portability, training, evaluation, feedback, and transfer capacities through which a subject or institution can condition the use of data in the generation, adaptation, assessment, or deployment of artificial capability.

The definition includes responsibilities and restrictions because control can be constrained as well as enabling. A custodian can be required to preserve confidentiality, a public repository can impose use conditions, a community can retain stewardship authority, and an organization can have technical possession while lacking permission for a proposed use. These relations affect the practical possibility of capability generation.

Proposition 18.79 (Data–capability conversion condition). A *data-control advantage* contributes to *productive-intelligence advantage* when the controlled data are materially relevant to a capability or deployment objective and the controlling configuration possesses the complementary compute, models, methods, permissions, and organizational capacity required to convert those data into improved or differentiated productive capability.

Proposition 18.79 prevents data volume from functioning as an automatic proxy for advantage. Large quantities of poorly matched, low-quality, legally unusable, inaccessible, or weakly interpretable data can have limited productive effect. Smaller domain-specific datasets can become highly consequential when they connect to an important application and a strong conversion pipeline.

18.6.4 Platform Control

Platforms mediate the relation between artificial capability and users, developers, organizations, markets, and institutional processes. Relevant platform layers can include conversational interfaces, application stores, developer APIs, enterprise integration systems, identity services, payment systems, workflow software, marketplaces, search and ranking systems, distribution channels, and default integrations. A platform can therefore exercise economically consequential control even when it does not own every model or infrastructure layer that supports its service.

Platform control is especially important because it can organize discovery and default use. Users often encounter a model through an interface that determines which version is presented, which tools are available, what usage limits apply, how outputs can be exported, how data are retained, which downstream services can connect, and what prices or contractual terms apply. Developers can face similar conditions through APIs, application review, rate limits, technical standards, or marketplace policies. These mechanisms make the platform a conversion interface between upstream capability and downstream participation.

Definition 18.80 (AI platform-control interface). An *AI platform-control interface* is a set of technical, contractual, ranking, identity, payment, interoperability, and governance mechanisms through which a platform conditions the discovery, invocation, integration, distribution, monetization, or continued use of artificial capability by downstream participants.

A platform-control interface can widen participation by reducing transaction costs, providing common tooling, handling security, or connecting small developers to users. It can also create dependence when downstream participants cannot readily substitute another interface, preserve accumulated data, transfer integrations, reach users elsewhere, or contest rule changes. The stronger power diagnosis remains governed by Section 18.3.

Proposition 18.81 (Platform mediation condition). *Platform control becomes economically consequential for productive intelligence when changes in platform rules, defaults, rankings, interfaces, prices, or interoperability materially change which artificial capabilities downstream participants can access, combine, distribute, or sustain.*

The proposition makes platform ownership one possible source of control while leaving room for contractual, regulatory, technical, or standards-based constraints on platform discretion. It also preserves the possibility that users and developers can exercise countervailing capacity through multi-homing, interoperability, alternative distribution, collective governance, or public infrastructure.

18.6.5 Infrastructure Control

Infrastructure control concerns the shared substrates on which models, compute, data, and platforms depend. Section 17.11 treated epistemic infrastructure as the shared technical and organizational substrate of epistemic activity. Artificial productive intelligence adds further dependencies involving semiconductor fabrication and supply, electricity, cooling, data centers, cloud services, telecommunications, storage, cybersecurity, identity systems, specialized software, payment systems, physical facilities, and logistics. Some infrastructures are general-purpose resources used across many sectors; others are specialized around computational production.

Infrastructure matters because ownership at one visible layer can be conditioned by dependencies at another. An organization can own a model and possess data while relying on external cloud infrastructure. A compute provider can own hardware while depending on energy supply, chip vendors, network connectivity, and specialized maintenance. A public model can remain difficult to deploy where the complementary infrastructure is scarce. The ownership architecture of productive intelligence is therefore vertically and horizontally coupled.

Definition 18.82 (Productive-intelligence infrastructure-control stack). *A productive-intelligence infrastructure-control stack is the layered configuration of control, access, substitution, maintenance, and continuity relations across the physical, computational, network, energy, software, security, and organizational infrastructures required to generate or sustain a specified artificial productive capability.*

Frischmann's analysis of infrastructure is useful here because shared infrastructural resources can enable heterogeneous downstream activities whose social value exceeds the direct value captured by the infrastructure provider (Frischmann 2012). For GRE, the additional question concerns how access to such shared inputs changes later generative possibilities across differently positioned subjects.

Proposition 18.83 (Multi-layer bottleneck condition). *Control over one infrastructural layer becomes a binding constraint on productive intelligence when adequate substitutes or bypasses are unavailable and practical use of the relevant capability depends materially on continued access to that layer. The binding layer can shift as technologies, institutions, prices, and alternative infrastructures change.*

This proposition makes bottleneck status relational and historical. A scarce chip can cease to be binding after substitution or architectural change; a network standard can become more consequential as adoption increases; energy access can become decisive at large deployment scale even where model weights are widely available. Ownership analysis should therefore track the evolving dependency graph rather than freeze one layer as permanently foundational.

18.6.6 Access Rights

Access rights connect ownership architecture to practical capability. Access can include permission to invoke a model, inspect its outputs, retrieve logs, use an API, download weights, run a local copy, adapt parameters, fine-tune on local data, integrate tools, deploy commercially, redistribute derivatives, export accumulated state, or terminate use while preserving portability. These permissions are heterogeneous. A user with invocation access can remain unable to inspect, modify, reproduce, or migrate the system; another participant can have deep technical access while lacking commercial deployment rights.

Schlager and Ostrom's decomposition of property-rights positions is useful as a precedent for treating access, withdrawal, management, exclusion, and alienation as differentiated relations rather than one ownership binary (Schlager and Ostrom 1992). The objects differ in the present domain, yet the analytical lesson transfers: access to productive intelligence should be specified through the actual bundle of practical rights and restrictions.

Definition 18.84 (Productive-intelligence access bundle). A *productive-intelligence access bundle* is the configuration of permissions, technical capabilities, restrictions, portability conditions, revocation rules, audit rights, adaptation rights, deployment rights, and contestation procedures through which a participant can use or reshape an artificial productive capability.

The bundle can be broad in one dimension and narrow in another. Openly downloadable weights can support local deployment while commercial restrictions limit some uses. A paid service can provide powerful invocation while preserving little inspection or portability. An employee can have extensive operational access inside an organization while holding no transferable rights outside it. Public authorities can gain audit or reporting rights that ordinary users lack. The resulting configurations shape both productive capability and dependency.

Proposition 18.85 (Access-ownership non-equivalence). *Broad access to artificial productive capability can exist without ownership of the underlying model or infrastructure, while ownership can coexist with practically narrow access when complementary resources, permissions, interfaces, or institutional approvals are missing.*

The proposition has an important implication for capability equalization. Providing interface access to a model can reduce some task-level asymmetries while leaving adaptation, compute, data, interoperability, and institutional deployment rights unequal. Conversely, broad rights to inspect, adapt, and locally deploy a model can create significant independent capacity even where users hold no title to upstream infrastructure.

18.6.7 Public and Commons Models

Public and commons arrangements provide alternatives to concentrating the entire productive-intelligence stack in conventional private ownership. The term *public model* can refer to several distinct arrangements: publicly funded development, public ownership of model artifacts, publicly operated compute, public procurement with access conditions, public-interest licensing, or publicly accountable deployment. A commons arrangement adds shared resources together with governance relations through which a community organizes access, contribution, maintenance, revision, and stewardship. These arrangements can overlap while remaining analytically distinct.

Chapter 17 developed the knowledge commons as a governed shared epistemic configuration and distinguished commons governance from simple openness. Hess and Ostrom's work on knowledge commons provides a useful foundation for analyzing shared informational resources through institutional arrangements of access, preservation, enclosure, and collective governance (Hess and Ostrom 2007). Benkler's analysis of commons-based peer production likewise demonstrates that large-scale productive coordination can occur through distributed contribution structures that are not reducible to market pricing or managerial hierarchy (Benkler 2002). Productive intelligence extends these questions to computational resources whose maintenance and deployment can be materially intensive.

Definition 18.86 (Commons-governed productive intelligence). *Commons-governed productive intelligence* is an artificial productive-capability configuration in which a sufficiently identifiable community or public of participants shares specified model, data, compute, software, or infrastructure resources under governance arrangements that organize access, contribution, maintenance, revision, stewardship, conflict resolution, and continuity.

The definition is intentionally stronger than open availability. Publishing model weights can widen access while leaving governance, maintenance, compute, data, and future development concentrated. A commons can also use differentiated permissions when privacy, security, cultural stewardship, safety, or resource scarcity makes unrestricted access unsuitable. The institutional question concerns who participates in rule formation and how the generative conditions of the shared resource are reproduced.

Public and commons arrangements can also address infrastructural layers. Shared compute facilities can widen experimentation; public datasets can support research and service provision; community-governed models can preserve linguistic or domain-specific capacities; shared evaluation infrastructures can reduce duplication; and public procurement can attach interoperability or access conditions to publicly financed systems. Each arrangement creates different obligations and risks. Public status by itself does not guarantee broad effective access, and commons governance can reproduce internal inequalities if participation, expertise, time, or infrastructure are unevenly distributed.

Proposition 18.87 (Openness–ownership architecture non-equivalence). *Open availability of one productive-intelligence layer does not determine the ownership architecture of the wider capability stack. Effective openness depends on the complementary rights, resources, maintenance structures, governance relations, and infrastructures required to mobilize and reproduce the capability.*

Proposition 18.87 parallels the openness analysis of Chapter 17. An open model can be productively inaccessible without adequate compute. Public compute can remain difficult to use without appropriate software or expertise. Open data can be unusable without provenance or permission for the intended purpose. The generative value of openness therefore depends on the architecture surrounding the open component.

18.6.8 Distributed Ownership

Distributed ownership refers to arrangements in which claims, governance powers, responsibilities, and residual benefits are allocated across several subjects or institutional forms rather than concentrated in one owner of the entire productive-intelligence stack. Distribution can occur vertically across layers, horizontally among co-owners, or functionally across differentiated rights. Examples include cooperatives, federations, trusts, public-private arrangements, member-owned infrastructures, multi-stakeholder organizations, joint ventures, layered licensing, community stewardship, and combinations of public, private, and commons governance.

Distributed ownership should be distinguished from fragmented control without coordination. Several firms can own different layers while one bottleneck remains decisive. A nominally cooperative arrangement can delegate substantial operational authority to specialized managers or infrastructure providers. A public-private system can distribute formal claims while practical dependence remains concentrated. Conversely, a configuration with a strong central service provider can retain meaningful distributed governance where users possess enforceable portability, audit, representation, or exit rights. The relevant question is how the distribution of rights maps onto effective capability and future revision.

Definition 18.88 (Distributed productive-intelligence ownership architecture). A *distributed productive-intelligence ownership architecture* is a configuration in which ownership-related claims, governance authority, access rights, responsibilities, residual benefits, and revision capacities over the artificial productive-capability stack are allocated across multiple subjects or institutional forms according to an explicit or historically stabilized rule structure.

The definition does not attach an automatic normative advantage to distribution. Distribution can widen participation and reduce single-point dependency; it can also create coordination costs, ambiguous responsibility, fragmented maintenance, strategic hold-up, or internal power asymmetries. Evaluation therefore requires attention to the consequences generated by the specific allocation of rights and control.

Proposition 18.89 (Distributed-ownership effectiveness condition). *Distributed ownership materially redistributes productive-intelligence capacity when the distributed claims are connected to practical access, governance influence, revision capability, credible alternatives, and participation in residual benefits across the layers that are consequential for the relevant use. Formal dispersion of title alone leaves effective control underdetermined.*

This condition also connects ownership to power without collapsing the two. A distributed architecture can reduce some dependency mechanisms while generating others. Cooperative model governance can still depend on concentrated cloud compute. Public infrastructure can broaden access while relying on proprietary software. Multi-party ownership can create veto positions whose power depends on the alternatives available to others. These relations should be analyzed through the conversion

mechanisms developed in Section 18.3.

The section yields three conclusions for the remainder of Chapter 18. First, productive intelligence has no single ownership locus at the level relevant to GRE; economically consequential claims and control relations are distributed across a layered capability stack. Second, ownership, control, access, governance, and power are related but non-equivalent, so each requires separate reconstruction. Third, the architecture of residual claims and access conditions helps determine how gains from artificial productive capacity are distributed and reinvested. Section 18.7 therefore turns to AI-generated surplus, asking how productivity gains and rents arise, who can capture them, and how their allocation can affect future generative capacity.

18.7 AI-Generated Surplus

This section develops the distributional and generative analysis that follows from artificial productive capacity and its ownership architecture. Its role is to distinguish gains generated through AI-mediated production from the institutional processes through which those gains become prices, wages, profits, rents, public revenue, retained capability, time release, or other economically consequential returns. The objective is to identify where an AI-related surplus can arise, how claims on that surplus become concentrated, and how allocation can either reproduce existing capability asymmetries or enlarge later generative capacity. The discussion proceeds through productivity gains, surplus concentration, returns to model ownership, returns to infrastructure, redistribution, generative allocation, social investment, and recirculation. The method is relational and baseline-sensitive. It treats surplus as a historically situated remainder or advantage relative to a declared comparison configuration, while preserving heterogeneous value and avoiding a universal scalar measure of economic gain.

The analysis inherits three distinctions from the preceding sections. Section 18.4 separated task productivity, employment, income, contribution, and participation. Section 18.6 separated ownership, effective control, access, governance, and power across the productive-intelligence stack. Section 18.3 established that capability and ownership positions become power-relevant through identifiable conversion mechanisms. These distinctions are necessary because the same technical productivity improvement can generate very different social and economic outcomes under different ownership, bargaining, pricing, taxation, access, and institutional arrangements. Korinek and Stiglitz similarly show that AI-related technological change can affect factor prices, innovation rents, distribution, and employment through several channels under specified economic conditions (Korinek and Stiglitz 2019). GRE extends the inquiry by asking how the resulting returns alter the future generative capacities of the positions participating in, benefiting from, or excluded from the production process.

Definition 18.90 (AI-generated surplus). An *AI-generated surplus* is an economically consequential gain attributable, under a declared comparison and dependence account, to the incorporation of artificial productive capacity into a productive configuration after the analysis has specified the relevant baseline, complementary inputs, reproduction costs, and retained output dimensions. The gain can appear in heterogeneous forms, including additional output, reduced resource use, quality improvement, time release, lower prices, residual income, rents, public revenue, expanded

Table 18.7: Analytical dimensions of AI-generated surplus. The dimensions distinguish generation of an economic gain from the institutional pathways through which the gain is claimed, allocated, and returned to later production.

Dimension	Primary analytical question	Generative implication
Productivity gain	Which output, quality, time, or resource-use relation changes relative to the declared baseline?	Creates additional economic possibility whose realized form remains institutionally open
Surplus concentration	Which positions obtain residual claims or repeated advantages from the generated gain?	Can reinforce capability, ownership, and bargaining asymmetries across later histories
Model return	Which returns are connected to rights or control over model assets and model-mediated services?	Can finance model improvement while also strengthening dependence on model-controlling positions
Infrastructure return	Which returns accrue to compute, energy, network, cloud, fabrication, or deployment bottlenecks?	Can make complementary infrastructure a decisive site of accumulation even when models are widely available
Redistribution	Which generated claims are transferred after or during initial allocation?	Can alter material access while leaving some ownership, control, and participation structures unchanged
Generative allocation	Which uses of surplus expand later capacities, relations, alternatives, or resilience?	Connects current gain to future generative opportunity without assuming one universal value metric
Social investment	Which shared capabilities and infrastructures receive sustained resources?	Can broaden education, care, knowledge, public capacity, commons, and other long-horizon generative conditions
Recirculation	Which returns flow back into the relations and capacities that sustain future generation?	Determines whether surplus reinforces narrow accumulation, supports wider reproduction, or dissipates from the generative system

service capacity, or increased future productive capability.

Definition 18.90 uses *surplus* as a broad analytical category whose local specification can take accounting, welfare, political-economic, or institutional forms. A domain-specific analysis should state the assumptions and measurement rules that determine its narrower use. The GRE-level object records the extra economic possibility generated relative to a declared baseline and then asks how that possibility is realized, claimed, converted, and recirculated.

Table 18.7 supplies the section’s organizing architecture. The same monetary flow can occupy several rows depending on its relational role. A payment to a model provider can compensate current service, yield a residual return to ownership, finance infrastructure, and support later capability expansion. A tax on that payment can become redistribution or social investment. A reduction in working time can realize part of the productivity gain as released human time rather than monetary income. The analysis therefore follows mechanisms and consequences, allowing the classification of an observed transfer to depend on its relational role.

18.7.1 Productivity Gains

Artificial productive capacity can produce gains through several channels: faster execution of a retained task, substitution of computational for human or material inputs, improved quality at similar cost, greater output from a fixed resource base, expanded service availability, reduced coordination cost, accelerated search, or creation of previously infeasible products and processes. Empirical studies of generative-AI assistance already demonstrate productivity changes in bounded professional settings, while the longer-run organization of those gains remains open (Noy and Zhang 2023; Brynjolfsson et al. 2025). Acemoglu and Restrepo’s task framework is also relevant because productivity change can coexist with displacement, new-task creation, and changing labor demand across different operations within an occupation (Acemoglu and Restrepo 2019).

A GRE analysis requires an explicit comparison configuration. Let the baseline identify the retained task, quality standard, resource conditions, temporal horizon, and complementary infrastructure. A gain observed after AI incorporation is meaningful only relative to those conditions. A tenfold increase in generated drafts, for example, has a different economic meaning when verification costs rise sharply than when verification requirements remain constant. A reduction in labor time can become a productivity gain while also increasing dependence on model access. A faster decision-support process can reduce delay while creating new audit and contestability costs. Gross technical improvement therefore requires a relational account of the additional inputs and constraints through which the improvement becomes economically usable.

Definition 18.91 (AI-mediated productivity gain profile). *An AI-mediated productivity gain profile specifies the changes, relative to a declared baseline, in economically relevant output quantity, output quality, required human time, required compute and material resources, coordination burden, verification burden, latency, and future capability associated with incorporation of artificial productive capacity into a production configuration.*

The profile is intentionally multidimensional. Some components can improve while others deteriorate. A system can reduce drafting time while increasing review burden; expand service volume while consuming more energy; improve average performance while increasing tail-risk exposure; or release human time while reducing opportunities for skill formation. The economic assessment therefore depends on which dimensions matter for the application and how their heterogeneous consequences are evaluated.

Proposition 18.92 (Productivity-surplus realization non-equivalence). *An improvement in an AI-mediated productivity gain profile establishes additional productive possibility relative to the declared baseline. The realized surplus remains dependent on pricing, ownership, bargaining, demand, complementary scarcity, verification, institutional rules, and the disposition of released time or resources.*

Proposition 18.92 explains why measured productivity does not determine distribution. A gain can be passed to users through lower prices, retained as profit, shared through wages, transformed into shorter working time, absorbed by higher quality standards, allocated to public revenue, or dissipated through new costs and competitive expenditure. The next subsections study the structures that influence these realizations.

18.7.2 Surplus Concentration

Surplus concentration concerns the distribution of repeated claims on AI-generated gains. Concentration can arise at several layers. Model developers can receive licensing or service revenue. Compute providers can receive returns from scarce processing capacity. Platform operators can retain transaction or distribution margins. Firms incorporating AI can receive profits from cost reductions. Workers can receive higher wages or bonuses where bargaining and complementary skill structures support them. Consumers can receive lower prices or higher-quality services. Governments can receive tax revenue. Communities can receive little direct return even where their data, labor, institutions, or cultural resources contributed to the capability stack.

The relevant concentration object is therefore broader than a snapshot of income inequality. A position that captures residual claims can use them to purchase additional compute, acquire data, recruit expertise, subsidize distribution, finance lobbying, shape standards, or withstand periods of low prices. Current surplus can consequently alter the capability and power architecture that conditions later surplus generation.

Definition 18.93 (AI-surplus concentration profile). *An AI-surplus concentration profile describes the distribution of claims on AI-generated gains across the subjects and institutional positions retained by an analysis, together with the duration, convertibility, and reinvestment capacities attached to those claims.*

The profile includes more than monetary shares. A recurring right to preferential compute, proprietary improvement data, distribution access, or strategic information can function as a surplus-bearing advantage even when immediate cash flow is modest. Conversely, a large one-time payment can have limited long-run effect when it creates little durable capability or bargaining power.

Proposition 18.94 (Surplus–capability feedback condition). *Where concentrated AI-generated surplus can be converted into complementary assets or institutional positions that raise later productive capability, access, or control, current surplus concentration can contribute generatively to later capability asymmetry and to the ownership or power structures through which subsequent surplus is allocated.*

The proposition states a conditional feedback mechanism whose strength depends on the surrounding competitive and institutional configuration. Competitive entry, taxation, interoperability, public infrastructure, commons provision, technological diffusion, or changing demand can weaken the loop. The analytical point is that surplus allocation participates in the history of capability formation, so evaluation should include both terminal distribution and its effects on later capability.

18.7.3 Returns to Model Ownership

Model ownership creates one possible claim on AI-generated surplus. The magnitude and persistence of that claim depend on the rights and control structures developed in Section 18.6: exclusion, licensing, modification, distribution, deployment, adaptation, and access to model improvements can each generate different return pathways. A proprietary model can support recurring service revenue; an openly available model can support complementary service revenue; a model embedded in a platform can generate indirect returns through distribution, advertising, data, or ecosystem depen-

dence.

Model returns should be decomposed into compensation for current resource use, recovery of development and maintenance costs, risk-bearing returns, scarcity rents, and returns connected to strategic control where the evidence permits such distinctions. GRE does not require one universal allocation among these categories. It does require the analyst to avoid treating every payment to a model-controlling position as evidence of rent or power.

Definition 18.95 (Model-return profile). A *model-return profile* specifies the monetary and non-monetary returns associated with ownership, licensing, control, maintenance, improvement, or distribution of a model asset, together with the rights, costs, complementary resources, and competitive conditions through which those returns are realized.

A model-return profile can include subscription revenue, API payments, licensing fees, equity appreciation, improvement data, ecosystem adoption, reputational gains, and strategic access to downstream demand. These forms have different implications for later productive capacity. Improvement data can increase future model quality; ecosystem adoption can reduce switching; revenue can finance compute; reputational gain can attract complementary labor or capital.

Proposition 18.96 (Model-rent identification condition). A *model-related return* is identified as an economic rent only after the analysis specifies the relevant scarcity or exclusion mechanism, the comparison return under the declared counterfactual, and the institutional conditions that permit the excess return to persist. Ownership status or high profitability alone leaves the rent claim underdetermined.

This condition keeps surplus analysis compatible with the power discipline established earlier. A return can be high because a model produces substantial value under competition; another can persist because interoperability barriers, exclusive data, contractual restrictions, or platform integration limit alternatives. The mechanisms can coexist and require separate evidence.

18.7.4 Returns to Infrastructure

The ownership analysis in Section 18.6 showed that productive intelligence depends on a layered infrastructure stack. Surplus can therefore accrue at complementary layers even when model ownership is dispersed. Compute clusters, semiconductor fabrication, cloud orchestration, energy supply, high-bandwidth networks, secure data environments, deployment systems, and specialized technical services can each become return-bearing positions where their capacity is scarce or difficult to substitute.

Infrastructure returns are analytically important because rapid model diffusion can relocate scarcity. If several organizations can obtain comparable model weights while only a small subset can train, adapt, or serve them at required scale, the decisive residual return can move toward compute or deployment infrastructure. Conversely, abundant compute can shift the bottleneck toward data, distribution, regulation, trust, or domain-specific integration. Surplus location is therefore endogenous to the evolving productive stack.

Definition 18.97 (AI-infrastructure return profile). An *AI-infrastructure return profile* specifies the returns associated with providing, owning, governing, or controlling the complementary physical and digital infrastructures required to realize artificial

productive capacity, together with the scarcity, capacity, substitutability, and access conditions governing those returns.

Proposition 18.98 (Bottleneck-return relocation condition). *When one layer of the productive-intelligence stack becomes more substitutable while another complementary layer remains capacity-constrained or difficult to replace, part of the residual return generated by AI-mediated production can relocate toward the less substitutable layer, subject to bargaining and institutional conditions.*

The proposition helps explain why analysis of AI surplus should follow the whole productive architecture. Model capability can improve while the strategic economic return accrues to energy, chips, cloud services, distribution channels, or domain-specific organizations. The resulting allocation can in turn finance expansion of the bottleneck layer and reshape later dependency.

18.7.5 Redistribution

Redistribution modifies claims on AI-generated surplus through taxes, transfers, social insurance, public provision, collective bargaining, revenue-sharing arrangements, mandated contributions, or other institutional mechanisms. It can reduce material consequences of concentrated initial claims and can convert private returns into public or shared resources. The scope of this subsection is deliberately bounded because Section 18.8 examines redistribution and its limits in detail. The present task is to locate redistribution inside the surplus architecture.

The distinction between initial allocation and redistribution matters. Ownership, pricing, bargaining, labor contracts, access rights, competition rules, procurement, and public ownership influence the distribution generated inside production itself. Tax-and-transfer systems can subsequently alter disposable claims. Some institutions operate at both stages. Collective bargaining can affect wages before profits are realized; public equity participation can create an initial public residual claim; a tax can reallocate income after realization. GRE therefore treats the temporal label *redistribution* as one part of a broader allocation history.

Definition 18.99 (AI-surplus redistribution profile). *An AI-surplus redistribution profile specifies the institutional mechanisms through which initially realized claims on AI-generated surplus are reassigned, pooled, socialized, or converted into shared provision, together with the recipients, conditions, timing, and capability effects of those transfers.*

Material transfers can expand effective freedom by improving access to resources and opportunities, consistent with the capability-oriented emphasis on substantive opportunity developed by Sen (Sen 1999). Yet a transfer can leave control of models, infrastructures, work organization, or decision systems unchanged. It can also create new capabilities when used for education, health, mobility, compute access, or public infrastructure. The generative effect depends on the use and institutional setting of the transferred claim.

Proposition 18.100 (Redistribution–structural transformation non-equivalence). *Redistribution of realized AI-generated surplus can change material access and capability formation while leaving some antecedent ownership, control, dependency, and participation structures intact. Structural transformation requires additional mechanisms directed at the relevant relations.*

Proposition 18.100 motivates the separation between §427 and §428. Redistribution can be indispensable under concentrated gains and employment disruption while remaining insufficient as a complete account of participation, power, or ownership.

18.7.6 Generative Allocation

Generative allocation evaluates the use of surplus through its effects on future capacities, relations, alternatives, and conditions of value generation. The concept builds on the allocation framework developed in Chapters 13–14. An AI-generated gain can finance current consumption, shareholder distributions, compute expansion, education, research, care, ecological restoration, public infrastructure, cultural activity, or many other uses. These allocations have different temporal and relational consequences even when their immediate monetary value is similar.

Generative allocation does not supply a universal instruction to maximize future output. GRE retains heterogeneous values and the possibility that present well-being, rights, care, preservation, leisure, or ecological limits justify allocations whose value is poorly represented by a growth metric. The concept asks which later possibilities are created, preserved, foreclosed, or redistributed by an allocation and whose generative capacities are affected.

Definition 18.101 (Generative allocation of AI surplus). *A generative allocation of AI surplus* is an allocation of claims or resources generated through AI-mediated productive gains that is evaluated partly through its effects on later capacities, relations, infrastructures, alternatives, and opportunities for heterogeneous value generation across the affected relational system.

This definition permits several scales. A firm can allocate surplus to worker training, model improvement, resilience, or dividends. A government can allocate revenue to public services, research, income support, or digital infrastructure. A community can allocate shared resources to local knowledge, care, culture, or common facilities. A household can allocate released time toward care, learning, rest, or civic participation. Generativity is evaluated through the consequence structure across institutional sectors.

Proposition 18.102 (Heterogeneous generative-allocation condition). *Evaluation of generative allocation requires the relevant future effects to remain distinguishable when they concern heterogeneous values, subjects, scales, or time horizons. Aggregation into a single return measure requires an independently justified conversion rule.*

The proposition preserves the book's treatment of heterogeneous value. A research investment can increase epistemic capacity while an ecological investment preserves environmental conditions and a care investment sustains relational continuity. Their contributions can interact without becoming commensurable by default.

18.7.7 Social Investment

Social investment denotes an institutional commitment of current resources to shared capabilities and conditions whose benefits can extend across persons, organizations, communities, and future histories. In an AI-rich economy, the category is especially relevant where private productive capacity grows rapidly while complementary human, public, or commons capacities remain scarce. Education, health,

care, research, libraries, public compute, digital access, civic institutions, ecological resilience, cultural preservation, and community infrastructure can all become sites through which current surplus supports later generation.

The concept should remain broader than a narrow human-capital return calculation. Some investments matter because they increase productivity; others matter because they support substantive participation, public reasoning, care, ecological continuity, cultural plurality, or the ability to contest and govern powerful systems. Knowledge commons and commons-based peer production also demonstrate that shared resources and distributed contribution can sustain productive activity through institutional forms beyond conventional private ownership (Hess and Ostrom 2007; Benkler 2002). AI-generated surplus can therefore support public and commons capability as well as privately owned productive intelligence.

Definition 18.103 (AI-surplus social investment). *AI-surplus social investment* is the commitment of resources derived from AI-generated surplus to shared or broadly accessible capacities, institutions, infrastructures, relations, or commons whose expected significance includes the support of future participation, resilience, learning, care, knowledge, public capability, or heterogeneous value generation.

Social investment can be publicly funded, collectively governed, privately endowed, cooperative, or hybrid. Its generative significance depends on accessibility, maintenance, governance, time horizon, and relation to existing inequalities. A publicly funded facility with high practical barriers can have weak distributive reach. A shared model can have limited usefulness without compute or expertise. A training program can raise individual capability while leaving institutional demand absent. Evaluation therefore requires attention to the full conversion chain from investment to effective capacity.

Proposition 18.104 (Social-investment conversion condition). *Resources allocated as social investment enlarge shared generative capacity when institutions and complementary conditions permit the funded resources to become practically accessible capabilities, durable relations, maintained infrastructures, or viable future alternatives for the intended participants.*

The proposition places conversion at the center of evaluation and treats expenditure volume as only one input to that conversion process. It also links social investment to the capability-equalization limits discussed in Section 18.2. Funding access to one layer can leave other bottlenecks intact; effective investment follows the relational path through which resources become capabilities.

18.7.8 Recirculation

Recirculation concerns the return of surplus-derived resources to the relations and capacities that support later generation. The concept is broader than reinvestment by an owner. Reinvestment can increase the productive capacity of the same firm or asset-owning position. Recirculation asks how returns move through the wider relational system: toward workers and contributors, users, communities, public institutions, commons, ecological supports, knowledge infrastructures, complementary industries, or future generations.

The distinction is important because several recirculation patterns are possible. A concentrated surplus can be reinvested primarily in compute and model improvement, creating a self-reinforcing capability loop. Part can circulate through wages

and purchasing power, supporting demand and household capability. Tax revenue can finance public services. Lower prices can diffuse gains to users. Open-source contributions can return improvement to a shared technical commons. Released human time can be recirculated into care, learning, research, culture, or civic participation. Environmental costs can also represent a failure of recirculation when productive gains depend on ecological supports whose maintenance remains underfunded.

Definition 18.105 (Generative recirculation of AI surplus). *Generative recirculation of AI surplus* is the historically extended return of resources, access, time, knowledge, infrastructure, or other surplus-derived capacities into relational configurations that support the reproduction, diversification, repair, or expansion of future generative possibilities.

Generative recirculation can occur through market exchange, fiscal institutions, commons, households, organizations, philanthropy, public services, cooperative arrangements, or informal relations. The term identifies a functional role that can be performed through several policy and institutional instruments. The same institution can support some recirculation pathways while restricting others.

Proposition 18.106 (Recirculation feedback condition). *When AI-generated surplus is repeatedly recirculated into a narrow set of capability-controlling positions, the resulting feedback can reinforce concentration of productive intelligence. When recirculation sustains broader complementary capabilities, access, institutions, and alternatives, it can widen the relational base from which later generation occurs. The realized direction depends on the conversion mechanisms and governance structure of the recirculation pathway.*

Proposition 18.106 connects surplus analysis to the power and generativity framework of the book. A feedback loop centered on model ownership or infrastructure control can reproduce the conditions of later surplus capture. A broader loop can support public capability, commons, labor transition, care, knowledge, or participation. Mixed configurations are likely because the same surplus can be divided across several pathways.

The analysis of AI-generated surplus therefore yields a temporal sequence with several analytically distinct stages. Artificial productive capacity can create a productivity gain relative to a declared baseline. Ownership, bargaining, market structure, access, and institutional rules shape how the gain is realized and claimed. Concentrated returns can alter later capability and power. Redistribution can reassign realized claims. Generative allocation and social investment can convert current gains into future capacities. Recirculation determines which relational conditions receive renewed support across subsequent histories. These stages can overlap in practice, yet separating them prevents a productivity increase from being treated automatically as shared prosperity or a transfer from being treated automatically as structural transformation.

The next section examines redistribution more directly. Section 18.8 asks how income security, transfers, public services, access, capacity, participation, and meaning interact when material compensation is used to respond to AI-mediated changes in labor and surplus. The present section supplies the antecedent surplus architecture needed for that analysis.

18.8 Redistribution and Its Limits

This section develops the redistributive problem that follows when artificial productive capacity changes labor demand, ownership returns, and the realization of AI-generated surplus. Its role is to distinguish the economic objects that can be redistributed from the broader relational conditions through which people acquire security, access, capability, participation, and meaningful positions within an economic order. The objective is to identify what material redistribution can accomplish, which conversion mechanisms are required for redistributed resources to become effective capabilities, and which forms of exclusion or dependency remain when material claims have been improved. The discussion proceeds through income security, universal transfers, public services, distribution of access, distribution of capacity, participation, meaning, and the limits of material compensation. The method is relational and layered. Redistribution is treated as a family of interventions into historically structured claims, services, access relations, capability conditions, and participation architectures rather than as a single scalar transfer from one income position to another.

The section builds directly on the surplus architecture in Section 18.7. AI-generated productivity gains can be realized through wages, profits, rents, lower prices, public revenue, time release, service expansion, and other heterogeneous returns. Redistribution reallocates some of those realized claims or the resources purchased through them, yet the economic consequences depend on the conversion pathways through which resources become security, access, capability, or participation. The distinction is especially important under artificial intelligence because employment can become a weaker route to income and social position while access to models, compute, institutions, verification, education, and decision processes becomes increasingly consequential. Korinek and Stiglitz analyze how AI-related technological change can affect income distribution and employment under different ownership and market arrangements (Korinek and Stiglitz 2019). The present analysis adds a relational question: which future possibilities are altered when redistribution changes material claims while other structures of productive intelligence remain concentrated?

A second antecedent comes from the capability and participation analyses developed earlier in the book. Sen's capability approach distinguishes possession of resources from the substantive opportunities that people can actually realize from them (Sen 1999; Sen 1992). Sections 18.4 and 18.5 similarly separated employment, income, contribution, recognition, participation, and subjective continuity. Redistribution can therefore be substantial without equalizing productive capability, relational standing, or meaningful participation. This section does not use that observation to discount material redistribution. Material security can be a major generative condition for learning, care, mobility, experimentation, exit, and participation. The analytical task is to state which layer a redistributive instrument addresses and which additional relations are required for its effects to travel further.

Definition 18.107 (AI-era redistributive architecture). An *AI-era redistributive architecture* is the historically situated configuration of transfers, public services, access arrangements, capability-supporting institutions, rights, and participation mechanisms through which claims on AI-mediated production and the conditions for using those claims are distributed across economic positions.

Definition 18.107 is broader than fiscal redistribution after market income has been

Table 18.8: Layers of redistribution under artificial intelligence. The layers distinguish reallocation of material claims from the conversion processes through which those claims can become access, capability, participation, or meaning-related conditions.

Layer	Primary redistributive object	Residual analytical question
Income security	Money income, replacement income, income floors, or insurance against large income interruption	Does material stability translate into viable access, capability, and alternatives?
Universal transfers	Broadly eligible monetary or in-kind claims supplied independently of a narrow employment relation	How do financing, prices, services, and ownership structure shape the real incidence of the transfer?
Public services	Shared or publicly provisioned health, education, care, housing, mobility, digital, cultural, or other service capacity	Are services practically accessible, adequate, maintainable, and responsive to heterogeneous needs?
Access distribution	Rights and practical routes to models, compute, networks, data, institutions, knowledge, and productive interfaces	Can formal access be converted into effective use without prohibitive complementary requirements?
Capacity distribution	Skills, time, health, verification ability, organizational support, infrastructure, and other conversion conditions	Do participants acquire durable capability or remain dependent on externally controlled capacity?
Participation	Standing and practical opportunity to contribute to knowledge, decisions, institutions, care, community, and culture	Does redistribution alter who can shape shared economic and institutional futures?
Meaning-related conditions	Recognition, reciprocal significance, role continuity, learning, care, and other conditions that can support meaningful participation	Which relational conditions require institutional or social reorganization beyond material compensation?
Material-compensation coverage	The set of losses, burdens, and constraints that material resources can substantially address in the declared context	Which power, relational, historical, or participation structures remain after compensation?

realized. Tax-and-transfer institutions are one component. Public services, access rights, public or commons infrastructure, capability formation, and participation arrangements can alter effective distribution before, during, or after monetary income is assigned. The definition therefore allows several institutional sequences without treating them as interchangeable.

Table 18.8 supplies the organizing distinction for the section. Movement across the layers requires conversion rather than semantic substitution. Income can purchase some access; public services can provide some capabilities directly; capability can support participation; and secure participation can contribute to continuity and recognition. Each conversion can also fail. A transfer can encounter housing scarcity, inaccessible services, unavailable compute, weak verification capability, discriminatory institutional gates, or absence of consequential voice. The analysis therefore treats redistributive success as layer-specific before asking whether several layers form a coherent architecture.

18.8.1 Income Security

Income security concerns the stability of material command over goods and services when labor income becomes volatile, intermittent, weakly connected to productivity, or unavailable. Artificial intelligence makes this object analytically important because Section 18.4 showed that task automation, employment scarcity, and wage-based distribution can diverge. A society can experience high productive capacity while some households face weak access to the monetary claims through which food, housing, mobility, care, communication, and other necessities are ordinarily obtained.

Income security has at least three dimensions. The first is *level*: the material claim available to a person or household over a declared period. The second is *volatility*: the extent to which that claim can change unpredictably relative to recurrent obligations. The third is *continuity*: the availability of claims during transitions among employment, care, education, illness, retraining, relocation, or other life conditions. These dimensions matter separately. A comparatively high average income can coexist with destabilizing volatility, while a modest but reliable income floor can enlarge the practical capacity to refuse harmful terms, undertake training, provide care, or search for a better position.

Definition 18.108 (AI-transition income security). *AI-transition income security* is the historically situated capacity of an economic position to maintain a declared range of materially necessary and socially consequential activities across AI-mediated changes in employment, earnings, prices, or productive organization without requiring immediate acceptance of any available labor-market relation.

The definition treats income security as a capability-supporting condition rather than as a fixed currency amount. The relevant range of activities depends on prices, household structure, public services, debt obligations, care responsibilities, location, health, and other conversion conditions. A nominal transfer can therefore increase while real security remains unchanged when essential costs rise or required services become inaccessible.

Income security can also affect bargaining relations. A worker or household with a credible material fallback may have a wider feasible set of employment, training, relocation, entrepreneurial, or care options. In the language of the revised power framework in Chapter 16, a stronger fallback can alter the possibility structure through which another position exercises labor-market or contractual power. The effect remains context-dependent because alternative employment, legal rights, housing markets, social insurance, and household obligations also contribute to feasible exit.

Proposition 18.109 (Income-security option condition). *When additional income security enlarges the set of practically feasible alternatives available to an economic position during an AI-mediated transition, the redistribution can change bargaining and participation conditions in addition to increasing current consumption capacity. The magnitude and direction of that change depend on complementary institutional and material conditions.*

Proposition 18.109 makes income security generatively relevant. A transfer used only for immediate consumption can still be valuable. When it also preserves time, mobility, health, learning, care, or credible exit, it can change later relations. The distinction prevents current welfare and future generative capacity from being collapsed into one measure.

18.8.2 Universal Transfers

Universal transfers provide a particularly clear test of the distinction between material distribution and wider economic structure. For the present analysis, a universal transfer is defined by broad membership-based eligibility rather than by employment status, demonstrated productivity, or case-by-case proof of labor-market need. The transfer can be monetary or, where explicitly stated, an equivalent broadly available claim. This definition is analytical and does not prescribe one fiscal design, payment level, citizenship rule, or financing mechanism.

Universal eligibility can reduce the degree to which basic material claims depend on successful labor-market sorting. It can also reduce some administrative thresholds associated with narrowly targeted assistance and can give recipients greater discretion over heterogeneous needs. Those properties can become especially relevant when AI-mediated transitions create frequent movement among employment, training, care, informal contribution, and other forms of participation. A broad transfer can preserve continuity while the institutional classification of a person's productive role changes.

Definition 18.110 (Universal material claim). *A universal material claim is a broadly membership-based entitlement to a declared monetary or in-kind resource supplied independently of a recipient's current employment relation, task productivity, or contribution ranking within the covered population.*

Universality concerns the eligibility relation. The realized distributive effect depends on additional structures. Financing can alter disposable income at different positions. Housing, energy, health, or other bottlenecks can convert nominal purchasing power into price pressure or rents. Existing public services can be complemented or displaced depending on institutional design. Ownership structures determine where increased demand generates returns. Household relations can affect control over transferred resources. A common nominal transfer can therefore have heterogeneous real consequences.

Proposition 18.111 (Universal-transfer incidence condition). *The effective distribution produced by a universal material claim depends on the interaction among the transfer rule, its financing, the supply and pricing of essential goods and services, household and institutional control over resources, and the ownership structure through which additional expenditure becomes income elsewhere in the economy.*

Proposition 18.111 keeps the analysis relational. A universal transfer can strengthen income security while simultaneously increasing returns to concentrated housing, platform, or infrastructure ownership if supply and ownership conditions channel additional expenditure toward those positions. Conversely, broad transfers can support decentralized choice and participation when essential capacities and competitive alternatives are available. The proposition therefore treats the transfer as one relation within a larger allocation system rather than as a self-contained distributive outcome.

Universal transfers also leave open the question of productive intelligence. A person may have materially adequate income while lacking access to consequential models, compute, institutions, or decision channels. The following subsections therefore move from monetary claims to service, access, and capability structures.

18.8.3 Public Services

Public services redistribute through organized provisioning rather than through individual monetary claims alone. Education, health, care, mobility, housing support, legal assistance, libraries, digital connectivity, cultural infrastructure, and public computational or knowledge resources can each alter substantive opportunity when they are sufficiently accessible and adequate. A provisioning perspective is especially useful because some capabilities depend on maintained institutions, professional coordination, shared infrastructure, or collective risk pooling that individual purchasing power does not reproduce automatically. Feminist economics has emphasized social provisioning as a foundational object of economic analysis, including the organization of care and household reproduction (Power 2004; Folbre 2001).

The redistributive object in public services is therefore partly infrastructural. A public clinic redistributes access to organized medical capability; a public school redistributes access to educational relations and institutional recognition; a library redistributes access to knowledge infrastructure; a public compute facility can redistribute access to productive intelligence. These arrangements can coexist with cash transfers, yet their conversion mechanisms differ. Services can pool expertise and infrastructure, coordinate standards, and reduce the need for each recipient to purchase a complete private substitute.

Definition 18.112 (Shared service provisioning). *Shared service provisioning* is an institutional arrangement through which a declared population receives practical access to maintained service capacity, infrastructure, expertise, or organized care under eligibility and governance rules that do not require each user to acquire the full underlying productive assets individually.

Shared provision can still be formally available and practically inaccessible. Distance, waiting time, language, disability, digital requirements, eligibility procedures, stigma, scheduling, quality differences, or institutional distrust can alter effective access. The existence of a nominal public entitlement therefore requires a second analysis of use conditions. This point mirrors the distinction between formal and effective access to productive intelligence in Section 18.6.

Proposition 18.113 (Cash–service non-equivalence). *A monetary transfer and a publicly or collectively provisioned service can produce overlapping material benefits while remaining non-equivalent redistributive instruments when the service depends on shared infrastructure, coordinated expertise, collective risk, institutional continuity, or access conditions that recipients cannot reproduce through an equal monetary claim alone.*

The proposition does not establish general priority of services over cash. Some needs are heterogeneous and can be better served by flexible individual command over resources. Some services can be poorly governed or unresponsive. The analytical implication is plural: redistribution can operate through claims and through shared capacity, and adequate institutional design depends on the object being distributed and the conversion structure of the population concerned.

18.8.4 Distribution of Access

AI-mediated production makes access itself a distributive object. Section 18.6 represented productive intelligence as a stack whose model, compute, data, platform,

infrastructure, and rights layers can be owned or controlled separately. Redistribution can therefore target access to those layers even when asset ownership remains unchanged. Examples include access to public computational resources, subsidized connectivity, model interfaces, shared data facilities, libraries, laboratories, professional tools, legal permissions, or institutional gateways through which AI capability becomes economically usable.

Access distribution differs from income redistribution because some productive resources are difficult to purchase efficiently at the individual level or are governed by non-price restrictions. A person can possess sufficient money yet lack a license, data right, institutional credential, trusted identity, network membership, or compatible technical environment. Conversely, publicly supplied access can give a low-income user practical entry to high-value infrastructure that would be unaffordable as a privately owned asset.

Definition 18.114 (Distribution of productive-intelligence access). The *distribution of productive-intelligence access* is the relational pattern through which economic positions obtain practically usable routes to AI-relevant models, compute, data, platforms, networks, institutions, permissions, and complementary services under declared conditions of cost, continuity, portability, and contestability.

The definition emphasizes a bundle rather than a binary permission. Access that is temporary, revocable, non-portable, heavily monitored, technically constrained, or tied to a single platform can generate a different capability position from access with stable terms, interoperable tools, local adaptation rights, and credible alternatives. Redistributing nominal access while leaving these conditions unchanged can therefore produce weak equalization.

Proposition 18.115 (Access-redistribution conversion condition). *Redistribution of access enlarges effective productive opportunity when recipients possess or can obtain the complementary resources required to use the accessed system and when the access relation is sufficiently stable, intelligible, and operational for the relevant activity.*

This condition connects access redistribution to the complementarity analysis in Chapters 17 and 18. Model access can be ineffective without compute, data, verification, skills, organizational integration, or time. The next subsection therefore treats capability formation as a distinct redistributive layer.

18.8.5 Distribution of Capacity

The distribution of capacity concerns the practical ability to convert resources and access into sustained action. Sen's distinction between commodities, resources, and capabilities is relevant because equal resource bundles can yield different substantive opportunities under heterogeneous personal, social, and environmental conditions (Sen 1985; Sen 1992; Sen 1999). Under AI, conversion conditions can include technical literacy, domain expertise, verification ability, time, health, language, compute, organizational support, legal standing, trusted networks, and the ability to recover when a platform or tool changes.

Capacity redistribution can occur through education, apprenticeships, public technical support, accessible infrastructure, health and care systems, time security, organizational resources, shared professional services, or institutional reforms that remove conversion barriers. It can also involve preservation of capabilities that would otherwise atrophy under repeated delegation to AI. The object is therefore broader

than reskilling for a currently demanded job. Capability determines which future tasks, institutions, and forms of participation remain available when the economic environment changes.

Definition 18.116 (Redistributed generative capacity). *Redistributed generative capacity* is an enlargement, produced through redistributive institutions or shared provision, of an economic position's durable ability to learn, verify, adapt, coordinate, create, care, deliberate, access productive systems, or otherwise participate in the generation of later possibilities.

The definition is intentionally plural. Capacity can be individual, collective, institutional, or infrastructural. A community laboratory, public-interest legal organization, cooperative data infrastructure, or municipal technical team can distribute capacity even when no single individual acquires all of the underlying expertise or assets. This is consistent with GRE's relational treatment of capability as partly located in maintained relations and organizations.

Proposition 18.117 (Resource–capacity conversion condition). *Redistributed resources become redistributed generative capacity when the relevant conversion chain supplies the complementary time, knowledge, infrastructure, institutional standing, health, coordination, and continuity needed for recipients to transform those resources into durable practical possibilities.*

Proposition 18.117 identifies a common source of apparent redistributive failure. A program can transfer resources correctly at the accounting level while producing little durable capability because one or more conversion links remain unavailable. The appropriate response depends on the missing link; the proposition does not imply that every problem should be addressed through additional monetary transfer.

Capacity redistribution also interacts with dependency. A person can become highly productive through continuous access to an externally controlled AI system while acquiring little independent capability to verify, contest, or continue when access is withdrawn. Such a configuration may increase realized output while deepening dependence. A GRE analysis therefore asks whether redistributed capacity includes viable alternatives and recovery pathways as well as immediate performance.

18.8.6 Participation

Participation concerns the ability to enter, sustain, and shape consequential relations within the economic system. Section 18.5 developed existential participation beyond employment, while Section 18.4 separated participation from labor-market demand. Redistribution matters to participation because material security, services, access, and capacity can remove barriers to involvement. Participation nevertheless has an additional relational dimension: a person can possess adequate income and capability while remaining outside institutions where decisions, knowledge, care, culture, or resource allocation are shaped.

Participation can take several forms. Productive participation concerns involvement in making goods, services, knowledge, or infrastructure. Institutional participation concerns standing in organizations and governance processes. Epistemic participation concerns contribution to inquiry, interpretation, verification, and collective knowledge. Care and community participation concern relational activities whose significance is not exhausted by market output. Cultural participation concerns cre-

ation, interpretation, and transmission of shared symbolic forms. The economic relevance of these forms lies partly in their dependence on time, access, institutional design, and resource allocation.

Definition 18.118 (Participatory distribution). *Participatory distribution* is the distribution of practical standing, time, access, voice, capability, and institutional routes through which economic subjects can enter and influence consequential productive, epistemic, care, community, cultural, or governance processes.

Participatory distribution can be unequal even when income distribution is comparatively equal. Formal membership can also coexist with weak consequential participation when agendas, technical systems, credentials, information, meeting times, or decision rules exclude effective contribution. The object is therefore the practical structure through which participation becomes possible and consequential.

Proposition 18.119 (Material-support and participation non-equivalence). *Material redistribution can enlarge the conditions for participation by supplying time, security, mobility, services, and access. Consequential participation additionally depends on institutional standing, receptive interfaces, decision procedures, recognition, and opportunities for contribution. Improvement in material resources therefore does not by itself determine the distribution of participation.*

This proposition explains why redistribution and democratic or institutional reform can be complementary. A guaranteed income can give a person time to participate, while institutional rules determine whether that participation can shape outcomes. Public services can support participation by reducing care or health burdens, while inaccessible decision structures can continue to exclude. Distributional analysis therefore reaches into governance without reducing governance to income policy.

18.8.7 Meaning

Meaning requires especially careful scope because GRE is an economic research programme rather than a complete philosophical theory of the good life. The present subsection examines only the economic conditions that can support or undermine meaning-related participation. Earlier analysis in Section 18.5 showed that employment can bundle income, recognition, temporal structure, contribution, reciprocal dependence, learning, and social position. If AI weakens employment as the dominant institutional bundle, monetary redistribution can preserve material command while leaving some of those other relations to be reorganized separately.

Recognition theory helps identify one part of this problem. Honneth treats recognition relations as important to social freedom and the formation of practical self-relations (Honneth 1995). Arendt's distinctions among labor, work, and action likewise show that human activity and public appearance cannot be exhausted by an account of material production (Arendt 1958). GRE does not translate these theories directly into economic variables. It uses them to maintain analytical space for recognition, public participation, durable contribution, and relational continuity where an income-only model would be incomplete.

Definition 18.120 (Meaning-supporting economic conditions). *Meaning-supporting economic conditions* are material, temporal, relational, institutional, and participatory conditions that make sustained contribution, recognition, learning, care, inquiry, creation, reciprocal significance, or other subjectively meaningful forms of economic participation practically available, without defining in advance which activities a par-

ticular subject will experience as meaningful.

The last clause is important. Institutions can secure time, access, rights, recognition pathways, spaces of contribution, and material safety. They cannot assign subjective meaning by administrative rule. A publicly funded art program can create access to practice and community; it cannot guarantee that a participant experiences artistic activity as meaningful. A care institution can support durable relations while failing to produce intimacy or trust. Economic policy can therefore shape the conditions of meaning without manufacturing meaning as an output.

Proposition 18.121 (Meaning-support non-equivalence). *Material security can remove constraints that obstruct meaningful participation and can support the time and stability required for care, learning, inquiry, creation, and public action. The subjective and relational significance of those activities depends on additional histories, relations, recognition structures, and forms of participation that are not reducible to the amount of material compensation supplied.*

The proposition does not diminish material conditions. Severe insecurity can foreclose activities before questions of recognition or meaning become practically accessible. The analytical ordering is therefore complementary: material sufficiency can be a prerequisite for wider participation while remaining incomplete as a description of the wider participatory architecture.

18.8.8 Limits of Material Compensation

The preceding layers permit a more precise account of the limits of material compensation. Some harms and losses are highly responsive to money or in-kind resources: lost earnings, transition costs, housing expenses, education fees, transport, care purchases, or temporary income interruption can often be addressed substantially through material provision when supply conditions are adequate. Other disruptions have structural or relational components that material compensation reaches only indirectly. Loss of access to a profession, disappearance of an institutional role, dependency on a controlled model, exclusion from decision processes, erosion of verification capability, loss of recognition, or foreclosure of future options can require changes in rights, infrastructure, governance, institutional design, or participation relations.

Definition 18.122 (Material-compensation coverage). *A material-compensation coverage profile identifies, for a declared AI-mediated disruption, which losses, burdens, constraints, and foreclosed possibilities can be substantially addressed through monetary or in-kind resources and which retained dimensions require additional access, capability, institutional, relational, governance, or historical repair.*

The coverage profile prevents two symmetric errors. One error is to assume that money can substitute for every lost relation or capability. The other is to treat material compensation as irrelevant whenever a loss also has relational dimensions. A displaced worker may need income security and a new participatory role. A community affected by infrastructure closure may need financial support and restoration of shared institutional capacity. A researcher excluded from a model ecosystem may need funding and access rights. A person freed from labor-market necessity may benefit from income and from institutions through which learning, care, culture, and public contribution remain available.

Proposition 18.123 (Material-compensation adequacy condition). *Material compen-*

sation provides a comparatively complete response to an AI-mediated loss when the materially compensable dimensions constitute the relevant scope of the loss and when the supplied resources can be converted into the activities and alternatives at issue. Its coverage is partial when consequential residual dimensions lie in access, capability, rights, power, participation, recognition, institutional continuity, or historically structured future possibility.

Proposition 18.123 makes the limit conditional rather than categorical. Many economic disruptions have mixed structure. Material compensation can be necessary and substantial while broader repair remains required. The relevant question is therefore which dimensions are present in the case under analysis and which institutional mechanism addresses each one.

The distinction also matters for AI-generated abundance. An economy could produce enough material output to finance broad income security while retaining highly concentrated productive intelligence, strong epistemic dependence, limited institutional voice, and narrow control over future capability. Conversely, broad public and commons access to productive systems could coexist with inadequate income security. Redistributive adequacy therefore has several dimensions whose joint organization cannot be inferred from aggregate output alone.

A generative-relational approach treats these dimensions as historically coupled. Income security can preserve time for learning; public services can convert income into health and education; access can expose people to productive systems; capability can make access usable; participation can shape how systems are governed; recognition and meaningful roles can support continued engagement; and those relations can influence the next allocation of AI-generated surplus. Feedback can also run in a concentrating direction when transfers flow back through rents, platform dependence, or infrastructure bottlenecks without changing the underlying access and power structure.

Proposition 18.124 (Redistributive layering condition). *An AI-era redistributive architecture is generatively broader when its material, service, access, capability, and participation layers are coordinated so that gains at one layer can be converted into viable possibilities at the next while preserving contestability and alternatives. Coordination does not require one institution to control every layer, and different layers can remain appropriately plural in governance and provision.*

The proposition summarizes the section without proposing a universal policy package. Different societies can combine transfers, services, commons, market institutions, public infrastructure, cooperative provision, rights, and participatory governance in different ways. GRE's contribution at this stage is diagnostic: it identifies the relational object addressed by each instrument and asks how that object changes later generative possibility.

Redistribution under artificial intelligence therefore has both substantial capacity and identifiable limits. It can stabilize material life, broaden access, finance services, support capability formation, and enlarge feasible participation. It can also leave ownership, infrastructure control, epistemic authority, institutional standing, dependency, and meaning-related relations largely intact when those structures are outside the redistributive mechanism. The adequate unit of analysis is consequently a layered architecture rather than a single transfer variable.

Section 18.9 turns to the relational configurations through which humans and artificial systems participate together in economic activity. Complementarity, depen-

dency, delegation, trust, verification, substitution, co-generation, collective organization, and co-evolution will be examined as relational dynamics whose distributional consequences depend on the material and participatory conditions established in the present section.

18.9 Human-AI Relational Economies

This section develops the relational configurations that arise when human subjects, organizations, and artificial systems participate jointly in economic activity. Its role is to move beyond comparisons of isolated capability and beyond ownership or redistribution considered separately. The objective is to identify how complementarity, dependency, delegation, trust, verification, substitution, co-generation, collective organization, and historical co-evolution alter the practical possibilities of the participating positions. The discussion treats artificial systems as economically consequential components of relational configurations without presuming human-equivalent subjecthood, consciousness, moral agency, or responsibility. The method is generative and relational: each configuration is analyzed through the operations it enables, the dependencies and interfaces it creates, the responsibilities and verification burdens it redistributes, and the way repeated coupling changes later capability and institutional structure.

The section builds on three antecedents. Section 18.2 established that human-AI capability differences are multidimensional and task-relative. Section 18.3 showed that such asymmetries become power-relevant only through identifiable mechanisms that deform the possibility structure of another position. Sections 18.4–18.8 then separated employment, contribution, participation, ownership, surplus, and redistribution. Human-AI relations can intersect all of these objects. A system can complement a worker while deepening platform dependence; assist a professional while redistributing verification burdens; substitute for selected tasks while leaving the wider social relation intact; or participate in a collective whose capability exceeds the capability of any isolated component. The relational form therefore cannot be inferred from model performance alone.

Empirical studies of generative AI in professional tasks already illustrate the importance of interaction effects. Experimental and field evidence has found productivity gains in selected writing and customer-support settings, while the magnitude and distribution of gains vary with task, worker position, and mode of use (Noy and Zhang 2023; Brynjolfsson et al. 2025). These findings support a bounded analytical point rather than a universal claim: the economic effect of AI depends partly on how the system is coupled to human activity. Research on algorithmic systems in organizations similarly shows that control, evaluation, and work organization can be transformed through technical mediation rather than through automation alone (Kellogg et al. 2020). The present section generalizes this relational problem without treating any one observed arrangement as the inevitable form of human-AI economic order.

Definition 18.125 (Human-AI relational economy). *A human-AI relational economy is a historically situated configuration in which human subjects, organizations, artificial systems, infrastructures, rules, and access arrangements are coupled through recurrent productive, epistemic, coordinative, care-related, cultural, or governance processes whose operation changes the capabilities, dependencies, claims, responsi-*

Table 18.9: Relational dimensions of human–AI economic organization. The dimensions identify distinct forms of coupling and the analytical questions required before their economic consequences are inferred.

Dimension	Relational object	Principal analytical question
Complementarity	Joint configuration in which heterogeneous human and artificial capabilities enlarge feasible performance or possibility	Which capabilities are mutually enabling, and which complements remain scarce?
Dependency	Reliance on an AI-mediated relation for maintaining consequential activity or alternatives	What happens when access, quality, terms, or supporting infrastructure change?
Delegation	Transfer of selected operations, search, generation, filtering, or recommendation functions to an artificial system	Which authority, oversight, verification, and responsibility relations accompany the delegated operation?
Trust	Practical willingness to rely on AI-mediated outputs or operations under incomplete direct verification	Which evidence, institutional assurances, histories, or fallback mechanisms support warranted reliance?
Verification	Human, organizational, or machine-mediated processes used to assess outputs, provenance, constraints, and consequences	Who bears the verification burden, and is independent verification practically available?
Relational substitution	Replacement of a previously human-mediated operation or relation by an AI-mediated configuration	Which functions are substituted, which relational dimensions remain, and which new dependencies are created?
Co-generation	Production of an output, capability, relation, or later possibility through coupled human–AI operations	How are contribution, provenance, responsibility, learning, and benefit distributed across the generating configuration?
Human–AI collectives	Organized units whose practical capability depends on recurrent coordination among humans and artificial systems	Where are boundaries, decision rights, accountability, memory, and collective capability located?
Co-evolution	Historical feedback through which human practices, AI systems, institutions, and expectations mutually change	Which feedbacks stabilize, diversify, concentrate, or transform the relational field over time?

bilities, or future possibilities of at least some participating positions.

Definition 18.125 does not require one unified economy-wide architecture. Several relational economies can coexist within the same society: a professional service can use AI as an assistive tool, a platform can mediate large-scale delegation, a research group can organize hybrid inquiry, and a household can use artificial systems for planning or care-related support. The relevant unit is the maintained relational configuration through which capability becomes economically operative.

Table 18.9 supplies the organizing architecture. The dimensions can overlap, yet they should not be collapsed. Complementarity can exist with weak dependency, while dependency can persist after complementarity declines. Delegation can be nar-

row while trust is broad, or broad while verification remains strong. Co-generation can occur without a stable collective identity. Co-evolution is a historical property of the relational field rather than a synonym for any one moment of collaboration.

18.9.1 Complementarity

Complementarity concerns the additional capability generated when heterogeneous components can perform together operations that are unavailable, more costly, less reliable, or less generative when the components operate separately. In a human-AI configuration, complementarity can arise from differences in speed, memory, search, symbolic production, contextual understanding, embodied access, local knowledge, judgment, institutional standing, care, or responsibility. The relevant question is therefore relational: which capability of one position changes the practical use of a capability held by another?

A simple comparison of isolated performance can miss this structure. An artificial system with high symbolic-generation speed may have little economic value in a domain without human problem formulation, domain knowledge, verification, institutional authority, or integration into consequential workflows. A human expert can likewise become substantially more productive when the system reduces routine search, drafting, translation, coding, or comparison costs. Complementarity is present when the joint configuration alters the feasible operation set or the quality, cost, speed, robustness, or generativity of activity relative to declared separated configurations.

Definition 18.126 (Human-AI complementarity). *A human-AI complementarity exists relative to a declared activity when coupling human and artificial capabilities generates a practically relevant operation, performance profile, resilience property, or future possibility that is unavailable or materially weaker under the comparison configurations in which the relevant capabilities are not jointly available.*

The definition requires a comparison configuration because complementarity is not an intrinsic property of a technology. The same model can be complementary to one professional practice, substitutive for another operation, and largely irrelevant to a third. Organizational design can also alter the sign and magnitude of complementarity. A system that supports expert judgment under one workflow can constrain judgment when its outputs become mandatory or when performance metrics reward compliance rather than independent assessment.

Proposition 18.127 (Complementarity realization condition). *A potential human-AI complementarity becomes economically realized when the relational configuration supplies the interfaces, skills, time, verification, permissions, infrastructure, and organizational integration required for the heterogeneous capabilities to be jointly usable in the consequential activity.*

Proposition 18.127 explains why equal model access need not yield equal gains. Complementary resources differ across workers, firms, institutions, regions, and communities. Complementarity can therefore become a mechanism through which existing differences in expertise, infrastructure, or organizational capacity are amplified even when the underlying AI interface is broadly available.

Complementarity can also be endogenous. Repeated interaction can teach users how to formulate tasks, expose new domains of application, create specialized interfaces, and generate organizational routines. The joint capability of the configuration

can consequently change through use. That historical process connects local complementarity to the co-evolution analysis at the end of the section.

18.9.2 Dependency

Dependency arises when continuation of an activity, role, capability, or institutional process becomes materially conditioned on maintenance of an AI-mediated relation. Section 18.3 treated dependency as one mechanism through which capability asymmetry can become power-relevant. The present subsection examines dependency as a relational-economic form even before a power conclusion is established.

Dependence is compatible with productive gain. A professional can become more capable through reliable AI assistance while simultaneously losing practical alternatives if workflows, clients, deadlines, or institutional expectations adapt around continuous availability of that assistance. An organization can lower costs through one model provider while making its data pipelines, evaluation routines, and employee skills difficult to transfer elsewhere. A community can benefit from shared AI infrastructure while becoming vulnerable to changes in funding or access conditions. Benefit and dependency therefore require separate descriptions.

Definition 18.128 (Human–AI dependency relation). A *human–AI dependency relation* exists relative to a declared activity when the continuation, quality, feasibility, or recovery of that activity for a human or organizational position becomes materially conditioned on continued access to an artificial system or to the infrastructure, data, platform, or institutional relations through which that system is made operative.

Dependency varies along several dimensions: substitutability, switching cost, reversibility, verification capacity, retained human skill, data portability, continuity of service, and availability of fallback processes. A high-performing arrangement with strong alternatives can create less dependency than a modestly useful system that becomes institutionally mandatory and difficult to exit.

Proposition 18.129 (Dependency persistence condition). *Human–AI dependency becomes more persistent when repeated use reorganizes skills, workflows, data, expectations, contractual relations, or infrastructure in ways that increase the cost of restoring or moving to alternative modes of activity.*

The proposition gives dependency a generative dimension. Dependence can be produced by the history of successful use rather than by an initial technical necessity. This path dependence also means that evaluating a current AI relation requires attention to recovery pathways. Short-term productivity can coexist with long-term narrowing of alternatives.

Dependency does not by itself establish exploitation or unjust power. A mutually beneficial infrastructure relation can be highly dependent and well governed. The stronger evaluation depends on control, contestability, terms of access, risk allocation, benefit distribution, and the possibility of credible alternatives. Section 18.10 will examine the epistemic variant of this problem in greater depth.

18.9.3 Delegation

Delegation concerns the assignment of selected operations to an artificial system within a wider human or institutional activity. Delegated operations can include

search, drafting, classification, scheduling, translation, prediction, recommendation, simulation, monitoring, coding, or the execution of bounded actions. Delegation becomes economically consequential when it changes the distribution of attention, time, expertise, authority, oversight, or responsibility within the relational configuration.

Delegation should be distinguished from disappearance of the human role. A physician can delegate document summarization while retaining diagnosis and responsibility; a researcher can delegate literature triage while retaining problem formation and evidential judgment; an organization can delegate scheduling while preserving human authority over allocation priorities. Conversely, an apparently narrow delegated operation can become structurally consequential when downstream decisions routinely follow its output.

Definition 18.130 (AI-mediated delegation). *AI-mediated delegation* is a relational arrangement in which a human or institutional position assigns a specified operation or class of operations to an artificial system while the surrounding configuration allocates the authority, oversight, verification, escalation, and responsibility associated with the delegated operation.

The surrounding allocation matters because execution and responsibility can diverge. A system can execute a recommendation process while a human retains formal responsibility, or an institution can retain legal responsibility while individual workers have little practical capacity to alter the system's operation. Delegation therefore requires analysis of both the delegated function and the governance of the delegation.

Proposition 18.131 (Delegation completeness condition). *A delegation arrangement is analytically specified only when the delegated operation, its operational boundaries, the conditions for human or institutional intervention, the verification pathway, and the location of residual responsibility are identified at the scale relevant to the inquiry.*

Proposition 18.131 prevents performance from standing in for governance. High task accuracy does not answer who can interrupt the process, who bears the consequence of failure, or how affected parties contest the output. Delegation can enlarge human capacity when routine operations are transferred while consequential judgment remains supported; it can also create responsibility gaps when execution, control, knowledge, and formal accountability become separated.

Repeated delegation can also transform the capabilities of the delegating position. Skills may atrophy, shift toward supervision, or develop in new directions. The resulting configuration therefore has to be studied historically rather than as a static division of labor.

18.9.4 Trust

Trust enters human-AI relational economies because direct verification of every system output or operation is often costly, delayed, or practically impossible. Economic activity therefore relies on forms of warranted or institutionally supported reliance. The analytical object is not an anthropomorphic belief that the machine possesses human character. It is the practical relation through which a user, organization, or affected party accepts exposure to an AI-mediated operation under incomplete direct verification.

Trust can be supported by several structures: observed reliability, domain validation, provenance, audit history, professional review, institutional guarantees, con-

tractual remedies, monitoring, redundancy, reputation, certification, or the availability of fallback procedures. Different forms of trust can therefore attach to different parts of the system. A user can trust an institution's governance while remaining uncertain about a particular model output, or trust a model within a narrow domain while distrusting the platform's data practices.

Definition 18.132 (AI-mediated practical trust). *AI-mediated practical trust* is a context-specific willingness to rely on an artificial system or AI-mediated process for a consequential activity under incomplete direct verification, supported by a declared combination of observed performance, institutional assurance, provenance, monitoring, recourse, or other trust-bearing relations.

The definition treats trust as relational and scoped. It does not require person-like intentionality in the artificial system. It also distinguishes trust from unexamined acceptance. Reliance without identifiable support can occur, yet its epistemic or governance adequacy remains a separate question.

Proposition 18.133 (Trust calibration condition). *The practical adequacy of AI-mediated trust depends on correspondence between the scope of reliance and the evidence, monitoring, recourse, and verification capacities that support that reliance. Expansion of reliance beyond those supports increases the unresolved exposure carried by the relational configuration.*

Trust can lower transaction and coordination costs by reducing the need to verify every operation independently. It can also become a site of power when one party controls the evidence, standards, interfaces, or remedies through which trust is established. The next subsection isolates verification because trust and verification are complements rather than substitutes in many consequential settings.

18.9.5 Verification

Verification concerns the processes through which AI-mediated outputs, operations, provenance, constraints, and consequences are assessed against declared criteria. Verification can be performed by humans, institutions, independent technical systems, peer processes, or combinations of these. Its economic importance follows from scarcity: high-volume machine generation can reduce production costs while increasing the relative burden of checking, interpreting, and integrating outputs.

Verification in a relational economy has at least four objects. *Output verification* concerns the correctness or adequacy of a particular result. *Process verification* concerns the procedure through which the result was generated or selected. *Provenance verification* concerns data, source, version, and transformation history. *consequence verification* concerns downstream effects after the output enters an institutional or productive process. These objects can require different expertise and access rights.

Definition 18.134 (Human–AI verification architecture). *A human–AI verification architecture* is the organized distribution of criteria, evidence, expertise, access, review, monitoring, escalation, and recourse through which AI-mediated outputs and operations can be assessed before or after they become consequential.

The architecture can be asymmetric. A user may be required to verify an output without access to the data, model behavior, or institutional records needed to do so. A worker can bear responsibility for detecting errors while production quotas reduce the time available for checking. An organization can rely on a vendor's evaluation

while lacking independent replication capacity. In such cases, the verification burden and verification capability are differently distributed.

Proposition 18.135 (Verification-burden alignment condition). *A human–AI relation is more robustly verifiable when positions that bear consequential verification duties possess practical access to the evidence, time, expertise, tools, authority, and recourse required to discharge those duties at the relevant scale.*

This proposition does not imply that every user must independently inspect model internals. Verification can be institutionally distributed. The requirement is that the overall configuration contain credible routes from consequential claims to appropriate verification and correction. Section 18.10 develops the deeper problem that arises when humans increasingly depend on AI systems for knowledge while lacking equivalent capacity to verify or interpret what those systems mediate.

18.9.6 Relational Substitution

Relational substitution occurs when an AI-mediated configuration replaces a relation or operation previously carried primarily through human participation. Task substitution is one special case. The broader relational question asks which functions of the earlier relation are reproduced, which disappear, which are transformed, and which new relations are introduced by the substitution.

A customer-service system can substitute for some conversational operations while changing escalation, recognition, accountability, and institutional access. An educational system can substitute for some explanation or practice generation while changing mentorship, peer relation, and the teacher’s capacity to observe development. A care-support system can substitute for reminders, monitoring, or scheduling while leaving responsibility, reciprocity, embodied presence, and relational continuity elsewhere. The relevant unit is therefore the relation bundle rather than the task label.

Definition 18.136 (AI-mediated relational substitution). *AI-mediated relational substitution is a historical change in which an artificial system or AI-mediated configuration assumes one or more functions previously carried through a human-mediated relation, thereby changing the composition, accessibility, responsibility, reciprocity, or continuity of the wider relation in which those functions were embedded.*

The definition permits partial substitution. A relation can preserve some functions while changing others. It also permits substitution that improves access or continuity. An AI-mediated service can provide assistance where no human service was previously available, extend operating hours, or reduce routine burden. Such gains can coexist with losses in other relational dimensions.

Proposition 18.137 (Relational-substitution scope condition). *A claim of human replacement is analytically stronger than a claim of task substitution. The stronger claim requires specification of the relation being replaced and evidence that the consequential functions retained by the analysis have been transferred, removed, or made economically irrelevant under the new configuration.*

The proposition prevents a common scalarization of substitution. High performance on a bounded task can justify a task-level comparison while leaving the wider relational architecture underdetermined. Conversely, modest task substitution can have large relational consequences when the substituted task served as a gateway to recognition, learning, escalation, or institutional participation.

Relational substitution can therefore create new dependencies even when it removes older ones. Replacement of a human intermediary can reduce dependence on local availability while increasing dependence on platform access, model governance, or infrastructure continuity. Evaluation must follow the changed relational field rather than count only the number of automated tasks.

18.9.7 Co-Generation

Co-generation concerns outputs and possibilities produced through coupled human and artificial operations whose contribution structure cannot be represented adequately by assigning the entire result to one isolated component. Examples include iterative writing, software development, scientific exploration, design, simulation, translation, planning, and organizational problem solving. The concept is broader than simultaneous use: it requires that contributions interact in generating the resulting object or later possibility.

A human can supply the problem, constraints, evaluative judgment, domain interpretation, and selection among alternatives while an artificial system supplies candidate structures, transformations, retrieval, simulation, or rapid variation. The sequence can recur, with each output becoming input to the next operation. The resulting artifact can therefore carry a provenance that is relational and temporally extended.

Definition 18.138 (Human–AI co-generation). *Human–AI co-generation* is a generative process in which human and artificial operations are recurrently coupled so that the resulting artifact, decision support, capability, relation, or future possibility depends materially on contributions from more than one component of the coupled configuration.

Co-generation does not by itself assign authorship, responsibility, ownership, or moral standing. Those are separate institutional and normative structures. A generated artifact can depend causally on an AI system while legal authorship remains human or institutionally defined; responsibility for its use can remain with a human professional; model and infrastructure owners can hold separate contractual rights. Contribution therefore has to be traced without presuming that every form of contribution receives the same status.

Proposition 18.139 (Co-generation provenance condition). *Analysis of human–AI co-generation is more informative when it preserves the sequence and type of contributions sufficiently to distinguish problem formation, source provision, transformation, candidate generation, evaluation, selection, verification, integration, and consequential use where those distinctions matter to the inquiry.*

The proposition connects co-generation to Chapter 17's preservation and provenance architecture. Provenance supports responsibility, learning, error localization, attribution, and later re-epistemization. It also prevents the entire process from being summarized by the final artifact alone.

Co-generation can enlarge human capability or externalize it. A user who learns through iterative interaction can retain new capability after the system is removed; another can become dependent on the system for operations previously performed independently. The economic evaluation therefore includes both the co-generated output and the capability trajectory of the participating positions.

18.9.8 Human-AI Collectives

Repeated complementarity, delegation, verification, and co-generation can stabilize into organized collective forms. A human-AI collective can include individuals, teams, artificial systems, databases, workflows, institutions, and infrastructures whose coordinated operation produces a capability that belongs to the configuration as a whole rather than to any single component. The analytical challenge is to identify the collective boundary without turning every technology-using organization into one undifferentiated hybrid subject.

Situated-learning and community-of-practice traditions emphasize that capability can be distributed across participation, practice, and social organization rather than residing solely inside isolated individuals (Lave and Wenger 1991; Wenger 1998). Human-AI collectives extend the economic question because artificial systems can become recurrent components of the practice architecture. The present analysis uses this point structurally; it does not infer that artificial components participate socially in the same manner as human members.

Definition 18.140 (Human-AI economic collective). *A human-AI economic collective is an organized relational configuration whose sustained productive, epistemic, coordinative, care-related, cultural, or governance capability depends on recurrently integrated human and artificial operations, together with maintained rules, infrastructures, memory, and decision interfaces that make the joint capability reproducible across more than one isolated interaction.*

The collective has several analytically separable properties: boundary, membership or component criteria, decision rights, shared or distributed memory, workflow, verification structure, accountability, resource claims, and continuity conditions. These properties need not be concentrated in one legal organization. A research network, open-source project, public service, or supply chain can display collective capability across organizational boundaries.

Proposition 18.141 (Collective-capability non-reducibility condition). *Where recurrent coordination among human and artificial components generates capabilities that depend on the maintained relations among those components, analysis of the collective cannot be replaced by an inventory of isolated component capabilities without losing information about coordination, memory, verification, sequencing, and institutional support.*

The proposition does not claim that the collective is a unitary subject. Collective capability and collective subjecthood are distinct questions. Responsibility can remain legally or institutionally distributed even when capability is relationally collective. This distinction will matter later when the chapter examines heterogeneous subjects and value structures.

Human-AI collectives can also alter competition and inequality. Organizations with superior routines for integrating similar models can outperform organizations that possess comparable model access. Collective capability can therefore become a durable complementary asset. The distribution of such relational capability depends on training, organizational memory, infrastructure, governance, and the capacity to preserve and revise successful practices.

18.9.9 Co-Evolution of Human–AI Relational Fields

Human–AI relations change through repeated interaction. Users adapt tasks to systems; organizations redesign workflows; model developers respond to observed use; institutions create standards and liability arrangements; workers acquire or lose skills; markets alter expectations; and new forms of access, dependence, trust, and substitution become normalized. The object is therefore a relational field whose participants and interfaces co-evolve rather than a fixed technology inserted into an otherwise unchanged economy.

Co-evolution can occur through several feedback routes. Complementarity can encourage investment in specialized human skills and interfaces. Dependency can encourage platform-specific routines that raise switching costs. Delegation can relocate expertise toward supervision or reduce opportunities for practice. Verification failures can generate standards, audits, or human review institutions. Successful co-generation can produce new organizational forms. Relational substitution can reduce one human interaction while increasing demand for another, such as escalation, care, governance, or interpretation. These changes alter the environment in which the next generation of systems is designed and adopted.

Definition 18.142 (Human–AI relational-field co-evolution). *Human–AI relational-field co-evolution* is the historically extended process through which recurrent coupling among human practices, artificial systems, institutions, infrastructures, norms, and economic incentives changes the capabilities, expectations, dependency structures, interaction rules, and future development conditions of more than one component of the relational field.

The definition does not require biological analogy or symmetric adaptation. One component can change much faster than another, and institutional rules can lag behind technical capability. Co-evolution here denotes reciprocal historical conditioning of the field, not equal causal influence among its components.

Proposition 18.143 (Relational-field path-dependence condition). *When repeated human–AI coupling modifies skills, infrastructures, data, organizational routines, standards, expectations, or access relations that subsequently affect which forms of coupling are feasible, the later relational field becomes path-dependent on the history of earlier human–AI organization.*

This condition links Chapter 18 to the generative-spacetime analysis of Chapter 15. Early institutional choices can shape later alternatives even when the underlying models improve substantially. A proprietary workflow can create switching costs; a public or commons infrastructure can preserve plural experimentation; a verification norm can maintain human capability; a labor arrangement can encourage augmentation or substitution. These histories become part of the capability landscape within which later AI systems operate.

Co-evolution can also modify the categories through which human and artificial contribution are understood. A task initially described as uniquely human can become routine after technical change; another can acquire greater significance because AI abundance makes human judgment, care, presence, or accountability relatively scarce. Such category changes can themselves affect investment, education, prestige, wages, regulation, and subjective orientation. The relational field therefore contains both material and symbolic feedback.

Proposition 18.144 (Plural relational-development condition). *The existence of*

strong technical capability does not uniquely determine one human–AI relational economy. Different institutional arrangements can organize similar capabilities through different combinations of complementarity, dependency, delegation, verification, substitution, collective participation, and access, thereby generating different later capability and power structures.

Proposition 18.144 preserves institutional contingency. Technical capability constrains and enables possible arrangements, yet governance, ownership, public infrastructure, professional norms, labor institutions, education, and community practices influence which relational configurations become persistent. The long-run question is therefore not only which systems become technically possible but which human–AI relational fields societies reproduce.

The section has treated human–AI economic relations as historically developing configurations rather than isolated acts of tool use. Complementarity can generate new joint capability; dependency can narrow alternatives; delegation reallocates operations and oversight; trust makes action possible under incomplete verification; verification distributes epistemic burdens; substitution reorganizes relation bundles; co-generation produces relationally constituted outputs; collectives stabilize joint capability; and co-evolution changes the field in which later interactions occur. None of these relations alone determines whether an arrangement is desirable, exploitative, empowering, or just. Those evaluations require the relevant power, distributional, epistemic, participatory, and normative structures to be specified.

Section 18.10 narrows the analysis to one especially consequential configuration: epistemic dependence on artificial intelligence. Machine-mediated knowledge can become central to economic participation while verification, interpretation, audit, contestability, and preservation of human epistemic agency remain unevenly distributed. The next section therefore examines those epistemic dependencies directly rather than treating them as an undifferentiated consequence of the broader human–AI relational field.

18.10 Epistemic Dependence on AI

This section develops epistemic dependence on artificial intelligence as a distinct economic relation within the wider human–AI relational field. Its role is to identify how recurrent reliance on AI systems can reorganize the practical capacity to acquire, interpret, verify, contest, preserve, and independently regenerate knowledge. The objective is narrower than a general theory of machine-mediated knowledge and stronger than a description of ordinary tool use. Chapter 5 examined the warrant, representation, and contestability of machine-mediated relational knowledge, while Section 17.16 identified AI-mediated epistemic dependence as an interface between the epistemic economy and wider capability asymmetry. The present section asks what happens when such dependence becomes embedded in consequential work, learning, research, administration, and decision processes. The discussion proceeds through machine-mediated knowledge, verification gaps, interpretive dependence, model opacity, infrastructure dependence, contestability, audit, and preservation of human epistemic agency. The method is relational and historical: dependence is evaluated through substitution, verification, reconstruction, challenge, continuity, and the later capability effects produced by repeated use.

Epistemic dependence is compatible with productive specialization. Complex societies rely on laboratories, libraries, expert professions, software, measurement systems, databases, and institutions that no individual can reproduce independently. AI extends this division of epistemic labor by making search, synthesis, translation, classification, coding, prediction, and symbolic generation available at new scales. The analytical problem therefore concerns the architecture of dependence rather than dependence in the abstract. A reliance relation can be robust where verification, plural expertise, portability, institutional memory, contestability, and fallback capacity remain available. The same relation can become fragile where consequential epistemic functions are concentrated in systems whose outputs are difficult to check, whose internal changes are weakly observable, whose infrastructure is externally controlled, and whose use displaces the human capabilities required for independent reconstruction.

Definition 18.145 (AI-mediated epistemic dependence architecture). An *AI-mediated epistemic dependence architecture* is the historically maintained configuration of artificial systems, human capabilities, organizations, infrastructures, verification arrangements, records, access rights, and fallback relations through which an economically consequential epistemic function depends materially on AI-mediated operations and through which the consequences of failure, change, challenge, or withdrawal are distributed among participating positions.

Definition 18.145 treats dependence as a configuration rather than as a binary attribute. Two organizations can use the same model while occupying very different dependence positions because one retains domain expertise, local records, multiple providers, internal verification, and reconstructible workflows while the other has allowed the model-mediated pathway to become its only practical route to the relevant function.

Table 18.10 organizes the section around a central distinction: current epistemic performance and retained epistemic agency can move differently. An AI-mediated configuration can raise immediate accuracy, speed, breadth, or accessibility while simultaneously weakening some internal capacity for verification or reconstruction. Another configuration can improve both current performance and later human capability by making evidence, critique, explanation, and deliberate practice more available. The long-run economic significance therefore depends partly on the capability trajectory generated by the relation.

18.10.1 Machine-Mediated Knowledge

Machine-mediated knowledge concerns epistemic activity in which artificial systems become recurrent intermediaries between an epistemic target and the human or organizational position that acts upon it. The system may retrieve sources, summarize records, translate languages, generate explanations, synthesize alternatives, classify cases, produce code, infer patterns, recommend evidence, or construct candidate answers. The economic importance of these operations lies in the way they can become part of ordinary capability: a worker, researcher, student, administrator, or institution may become able to perform an epistemic function only because the AI-mediated pathway is practically available.

The present subsection builds on the machine-mediated relational-knowledge analysis of Chapter 5 while changing the object of inquiry. Chapter 5 asks how machine-

Table 18.10: Dimensions of AI-mediated epistemic dependence. The dimensions distinguish the epistemic function being delegated or mediated from the conditions required for continued human and institutional capacity.

Dimension	Dependence object	Principal analytical question
Machine-mediated knowledge	AI-mediated retrieval, synthesis, generation, classification, or inference embedded in consequential practice	Which parts of the epistemic pathway remain independently reconstructible?
Verification gap	Difference between capacity to generate or receive outputs and capacity to test their standing	Who can check what, at what cost, with which evidence and tools?
Interpretive dependence	Reliance on AI-mediated framing, summarization, ranking, or explanation for making material intelligible	Which interpretive alternatives and contextual capacities remain available?
Model opacity	Limits on access to or intelligibility of system construction, behavior, failure conditions, or updates	Which opacity source matters for the consequence under study, and what compensating evidence exists?
Infrastructure dependence	Reliance on externally controlled models, compute, retrieval, data pipelines, or service interfaces	What happens to epistemic continuity when access, terms, architecture, or provider behavior changes?
Contestability	Practical capacity to challenge claims, categories, outputs, procedures, or uses	Can affected positions introduce counter-evidence and obtain consequential review?
Audit	Organized reconstruction and testing of system behavior, provenance, controls, and institutional use	Is audit independent, adequately scoped, and connected to authority for correction?
Human epistemic agency	Maintained capacity of human or human-governed institutions to orient, judge, verify, revise, and continue inquiry	Does recurrent AI use enlarge, preserve, externalize, or erode the capabilities needed for later independent epistemic action?

mediated claims are warranted. Here the question is whether repeated mediation changes the dependency structure of the knower. A system can remain a replaceable convenience, become a high-value complement, or become an epistemic bottleneck whose withdrawal materially reduces the user’s practical ability to continue the function.

Definition 18.146 (AI-mediated epistemic function). *An AI-mediated epistemic function* is a recurring economically consequential activity of retrieval, interpretation, classification, inference, generation, verification, orientation, or communication whose practical execution materially incorporates an artificial system into the pathway connecting evidence, representation, judgment, and action.

The definition does not assign the system independent epistemic authority. The same function can remain governed by human professionals, organizations, public institutions, or collective procedures. What changes is the structure of execution. The system becomes part of the pathway through which the epistemic object becomes accessible and usable.

Repeated mediation can generate cumulative efficiencies. Prompt libraries, retrieval indexes, organization-specific context, templates, evaluation routines, and user skill can make the relation more productive over time. These same investments can increase switching costs. A team that reorganizes its documentation, workflow, or internal language around one AI interface may become more productive while also making later substitution more expensive. Dependence can therefore arise through successful complementarity rather than through technical failure.

Proposition 18.147 (Epistemic mediation persistence condition). *When an AI-mediated epistemic function becomes embedded in recurrent workflows, records, skills, interfaces, or institutional expectations that are costly to reconstruct through an alternative pathway, the epistemic relation acquires a persistence mechanism beyond the immediate usefulness of the model output itself.*

Proposition 18.147 directs attention to organizational history. Dependence can persist even after technically comparable alternatives appear because documents, habits, data schemas, evaluation routines, or institutional approvals were built around an earlier system. This historical layer connects epistemic dependence to the path-dependence analysis developed throughout the book.

18.10.2 Verification Gap

A verification gap appears when the practical capacity to obtain or generate an output exceeds the practical capacity to evaluate whether that output deserves reliance for its intended use. Artificial systems can widen this gap because high-quality surface form, rapid generation, and broad domain coverage can make production inexpensive while domain-specific checking remains costly. Section 17.7 treated verification asymmetry as one component of the epistemic economy. The present problem is the dependence relation created when the same position that benefits from expanded generation cannot independently verify the resulting epistemic material at a comparable scale or within the relevant decision horizon.

Verification costs differ by domain. Checking a translation can require fluency; checking generated code can require execution, testing, security review, and dependency inspection; checking a legal or scientific synthesis can require source access and domain expertise; checking a statistical claim can require data, computation, and methodological competence. AI can reduce some of these costs through cross-checking, testing, retrieval, or automated comparison, yet verification performed by the same model family can leave common-mode failure, shared training limitations, or correlated blind spots unresolved.

Definition 18.148 (AI verification gap). *An AI verification gap exists for an epistemic function when the capacity to generate, receive, or operationally use AI-mediated outputs materially exceeds the capacity of the relevant position or its accessible institutions to test the outputs' provenance, validity, limitations, consistency, or consequences to the degree appropriate for the decision at stake.*

The gap is relational rather than absolute. A user can have little direct verification capability while being embedded in a strong institutional architecture of peer review, professional oversight, certified testing, or independent audit. Conversely, a technically skilled user can face a large verification gap when required data or model behavior remain inaccessible.

Proposition 18.149 (Verification-burden relocation). *When AI lowers the marginal*

cost of candidate epistemic production more rapidly than it lowers the cost of consequential checking, part of the economic burden of the epistemic pathway shifts from production toward verification, selection, provenance, integration, and responsibility.

The proposition is conditional and does not imply that AI inevitably increases total verification cost. The relevant issue is the relative capacity of the whole pathway. Where verification infrastructure scales effectively with generation, dependence can remain manageable. Where generation scales while checking remains bottlenecked, organizations can respond by narrowing review, relying more heavily on provider reputation, accepting higher residual uncertainty, or limiting the contexts in which AI-mediated outputs are permitted to act.

Verification gaps can also reshape expertise. If routine generation is externalized while humans increasingly specialize in evaluation, the value of domain judgment can rise. If organizational incentives reward throughput without allocating time for checking, verification expertise can atrophy despite becoming more important. Economic analysis should therefore examine both the formal availability of verification and the institutional conditions under which it can actually be exercised.

18.10.3 Interpretive Dependence

Interpretive dependence arises when an artificial system becomes a recurrent intermediary in deciding how information is framed, summarized, categorized, prioritized, explained, or connected to possible action. The dependence can occur even when the underlying sources remain formally accessible. A person may possess the original document yet rely on an AI-generated summary to determine what matters; an organization may possess raw data yet rely on a model-generated classification to make the data intelligible; a researcher may possess a literature corpus yet rely on AI-mediated synthesis to construct the field's apparent structure.

Interpretive mediation can be highly valuable. It can reduce linguistic barriers, expose alternative formulations, reorganize complex material, or help novices enter unfamiliar domains. The dependence issue begins when interpretive alternatives become difficult to generate, compare, or sustain without the system. Longino's account of social knowledge emphasizes the epistemic importance of critical interaction among perspectives and background assumptions (Longino 1990). AI-mediated interpretation can widen that interaction when it surfaces neglected perspectives, while it can narrow it when repeated use standardizes framing or when ranking systems make a small set of interpretations disproportionately visible.

Definition 18.150 (AI-mediated interpretive dependence). *AI-mediated interpretive dependence* is a condition in which a position's practical ability to render consequential information intelligible, salient, comparable, or actionable relies materially on AI-mediated framing or synthesis and the position lacks readily available alternative interpretive pathways of sufficient quality within the relevant horizon.

Interpretive dependence should be distinguished from simple use of explanation. A learner can rely on an AI explanation while simultaneously developing stronger independent interpretive capability. Dependence becomes structurally important where the system carries the framing operation externally and later human capacity to generate, compare, or contest interpretations remains weak.

Proposition 18.151 (Interpretive plurality condition). *AI-mediated interpretation is less dependence-inducing, other conditions held fixed, when users retain practical ac-*

cess to source material, alternative framings, domain expertise, disagreement, and procedures through which the relevance or meaning assigned by the system can be revised.

Proposition 18.151 concerns architecture rather than a guarantee of truth. Multiple interpretations can all be inadequate. The condition preserves the capacity for interpretive revision and reduces the likelihood that one model-mediated framing becomes the only practically available route through which the epistemic object can be understood.

18.10.4 Model Opacity

Opacity can deepen dependence because users may rely on a system whose behavior cannot be fully reconstructed from the information available to them. Burrell distinguishes opacity arising from intentional secrecy, technical literacy, and the scale or complexity of machine-learning systems (Burrell 2016). These sources require different economic and institutional responses. Contractual secrecy concerns access rights and disclosure. Technical opacity can sometimes be reduced through expertise, tools, documentation, or education. Complexity-related opacity can remain even where code or parameters are formally available because the system's behavior is difficult to anticipate, summarize, or trace exhaustively.

The relevant question is consequence-specific. Complete internal transparency is unnecessary for many low-stakes uses, while consequential reliance can require stronger evidence about training conditions, evaluation, failure modes, update procedures, security, data provenance, or operational controls. Opacity should therefore be analyzed against the epistemic function and the type of dependence it creates rather than treated as one uniform defect.

Definition 18.152 (Consequence-relative model opacity). *Consequence-relative model opacity* is the shortfall between the information and understanding practically available about an AI system's construction, behavior, limitations, or change history and the information required to evaluate, govern, or contest the system adequately for a specified consequential epistemic use.

This definition separates opacity from complexity alone. A complex system can be sufficiently governable for one use when external validation, monitoring, documentation, and fallback procedures are strong. A simpler system can remain consequentially opaque where its categories, data, or update rules are hidden from affected positions.

Documentation can reduce some forms of opacity. Dataset documentation, for example, can record motivation, composition, collection, preprocessing, and recommended uses (Geburu et al. 2021). Accountability architectures can also verify compliance with declared properties without requiring every affected person to inspect the full internal system (Kroll et al. 2017). These arrangements relocate epistemic work toward institutions capable of testing and certifying relevant properties.

Proposition 18.153 (Opacity-compensation condition). *Where direct intelligibility of an AI system remains limited, epistemic dependence can be governed more robustly when independent testing, documentation, provenance, monitoring, version history, constrained use, and consequential review provide evidence adequate to the risks of the declared function.*

The proposition does not equate external audit with full explanation. It states that

epistemic adequacy can be supported by several complementary mechanisms when exhaustive internal understanding is unavailable or inefficient.

18.10.5 Infrastructure Dependence

Epistemic reliance can be deep even when the model itself is replaceable. AI-mediated knowledge frequently depends on a stack of model hosting, compute, retrieval systems, data stores, identity services, application interfaces, networking, logging, proprietary connectors, and organizational integrations. Section 18.6 treated these layers as distinct ownership and control sites. The epistemic question is what happens to inquiry or decision capability when one of these supporting layers changes.

Infrastructure dependence can appear through several mechanisms. A provider can discontinue a model version on which an organization's evaluation history depends. Pricing changes can make repeated verification or large-scale retrieval uneconomic. Interface changes can break local tools. A proprietary embedding or retrieval system can make records difficult to migrate. Cloud or identity dependencies can block access to otherwise portable models. Internal expertise can be organized around one vendor environment. The epistemic object is therefore the continuity of the knowledge function, not merely uptime of the service.

Definition 18.154 (AI epistemic infrastructure dependence). *AI epistemic infrastructure dependence* is a condition in which continued performance, reconstruction, or verification of an economically consequential epistemic function materially relies on one or more externally controlled technical or organizational supports whose loss, alteration, or restriction cannot be absorbed through available substitutes within the relevant horizon.

Dependence can be reduced without full self-provision. Portability, interoperability, exportable records, versioned prompts and workflows, open standards, local fallback models, contractual continuity, public infrastructure, or multi-provider architectures can each preserve alternatives. The appropriate mechanism depends on the consequence and the cost of redundancy.

Proposition 18.155 (Epistemic continuity condition). *For AI-mediated functions whose interruption would materially reduce institutional or human epistemic capability, robust continuity requires preservation of enough data, provenance, workflow specification, access rights, human expertise, and substitutable infrastructure to reconstruct an adequate pathway after plausible changes in provider, model, interface, or service availability.*

The proposition links infrastructure dependence to preservation and later reconstruction. Continuity requires more than backups of final outputs. Reconstructing the epistemic pathway can require source records, model versions, retrieval indexes, prompts, evaluation criteria, decision logs, and human knowledge capable of interpreting those artifacts.

18.10.6 Contestability

Contestability concerns the practical capacity to challenge an AI-mediated epistemic claim or its consequential use. Chapter 5 developed contestability across data, categories, models, decisions, and historical records. In the present section, the focus is

dependence: whether a position that relies on AI retains credible routes to question the system without losing the capability or standing that the system mediates.

A challenge can target several objects. A user may dispute factual content, provenance, or interpretation. An affected person may challenge a classification or the relevance of the category applied. An organization may contest a provider's evaluation claim. A professional may seek to override an automated recommendation. A public institution may need to challenge a vendor's assumptions while remaining operationally dependent on the vendor's infrastructure. Contestability is strongest when the system's user, affected subjects, independent reviewers, and governing institution each have appropriately scoped routes for challenge.

Definition 18.156 (AI epistemic contestability). *AI epistemic contestability* is the practical capacity of relevant positions to identify a consequential AI-mediated epistemic claim or process, introduce qualified counter-evidence or alternative interpretation, obtain review by an actor or procedure with sufficient independence and authority, and preserve the resulting correction, disagreement, or limitation for later use.

The definition makes authority part of contestability. A complaint channel that cannot alter a consequential output or its later use provides expressive voice but weak corrective capacity. Conversely, a technically sophisticated audit can have limited contestability value if the findings cannot reach decision makers or affected positions.

Proposition 18.157 (Dependence-compatible contestability). *Meaningful contestability under AI-mediated dependence does not require elimination of specialized or proprietary systems; it requires sufficiently independent evidential access, review capacity, correction authority, and preserved records that consequential claims can be challenged without the challenged system controlling the entire challenge pathway.*

This proposition is compatible with differentiated disclosure. Privacy, security, intellectual property, or misuse concerns can justify controlled access. Independent review, secure testing environments, trusted intermediaries, or representative challenge can provide contestability where universal disclosure would be inappropriate.

18.10.7 Audit

Audit is one institutional response to epistemic dependence. Its role is to reconstruct and test selected properties of the AI-mediated pathway through procedures that are more systematic and independent than ordinary user reliance. Audit can examine data provenance, access controls, model evaluations, update histories, logging, monitoring, security, error patterns, documentation, organizational procedures, or compliance with declared standards. Kroll and colleagues emphasize that accountable algorithmic systems require mechanisms capable of verifying properties and compliance rather than relying solely on informal trust (Kroll et al. 2017).

Audit should be separated from explanation and from certification. Explanation concerns intelligibility of a particular output or process. Audit examines a declared system, period, or control environment against specified criteria. Certification can communicate that an external standard has been met. The three can interact while performing different epistemic roles.

Definition 18.158 (AI epistemic audit). *An AI epistemic audit* is a bounded and reconstructible procedure through which an appropriately positioned reviewer evaluates declared epistemic properties, risks, controls, or historical records of an AI-mediated

function using specified evidence, criteria, scope, and reporting rules.

Audit quality depends on access, independence, competence, scope, timing, and consequences. An auditor who cannot inspect relevant logs or data may verify only surface behavior. A technically capable auditor dependent on the auditee for continued business can face independence constraints. A comprehensive report that arrives after an irreversible decision can have little corrective value. A strong audit can still miss unanticipated failure modes because its criteria define what is inspected.

Proposition 18.159 (Audit-effectiveness condition). *AI audit reduces epistemic dependence most effectively when the audit has access to evidence material to the declared risk, sufficient technical and domain competence, practical independence from the object audited, temporal relevance to consequential decisions, and an institutional route through which findings can trigger correction, restriction, compensation, redesign, or further review.*

Audit also produces records that can support future re-epistemization. Preserved versions, evaluation datasets, incident logs, challenge histories, and audit findings make it possible to reconstruct how a system behaved and how an institution responded. Where these records disappear with a vendor or model update, later scrutiny can become impossible even when the original deployment was heavily audited at the time.

18.10.8 Preservation of Human Epistemic Agency

The deepest economic issue in sustained epistemic dependence concerns what capability remains with human subjects and human-governed institutions after AI mediation becomes ordinary. Human epistemic agency is used here in a bounded practical sense. It concerns the capacity to formulate questions, seek evidence, interpret, judge, verify, contest, revise, explain, preserve records, and continue inquiry through socially organized human institutions. The term does not require isolated self-sufficiency. Human agency is relational and has always depended on language, education, instruments, archives, expert communities, and infrastructures.

AI can enlarge this agency. Translation can widen access; adaptive explanation can lower entry barriers; search and synthesis can expand the field a person can inspect; coding assistance can enable experimentation; simulation can improve counterfactual reasoning; and critique can expose omissions. The same systems can externalize capabilities when users cease to practice or institutions cease to maintain the expertise required to understand and challenge consequential outputs. The relevant question is the direction of capability formation under repeated use.

Definition 18.160 (Human epistemic agency preservation). *Human epistemic agency preservation* is the maintenance or enlargement, across repeated AI-mediated activity, of the practical human and human-governed institutional capacities required to orient inquiry, access relevant evidence, generate and compare interpretations, verify consequential claims, contest epistemic authority, reconstruct material processes, and continue the epistemic function under plausible changes in AI support.

This definition treats agency preservation as multidimensional. A system can improve problem formulation while weakening independent calculation; improve access while weakening source-reading habits; improve organizational throughput while reducing internal model-evaluation expertise. Evaluation should therefore use a capability profile rather than one binary judgment that AI either augments or

deskills its users.

Proposition 18.161 (Epistemic agency retention condition). *An AI-mediated epistemic arrangement better preserves human epistemic agency when recurrent use maintains practical opportunities for source access, independent judgment, verification, disagreement, deliberate practice, reconstruction, and fallback action at the levels required by the consequences of the function.*

The condition does not imply that humans should duplicate every machine operation. Complete duplication can be inefficient or impossible. The relevant preservation target is capability sufficient for orientation, governance, challenge, recovery, and continued participation. A laboratory need not reproduce a semiconductor fabrication chain to preserve scientific agency, yet it may need enough understanding, calibration capacity, independent standards, and alternative evidence to detect when an instrument or service is misleading. AI-mediated systems require an analogous distinction between productive specialization and disabling dependence.

Education and organizational design become especially important. If AI performs every intermediate step invisibly, learners can achieve outputs without encountering the judgments through which expertise develops. If systems expose sources, invite prediction before assistance, support critique, preserve revision histories, and allocate responsibility for checking, the same technology can participate in capability formation. The economic value of AI should therefore include its effect on the future stock and distribution of human epistemic capability, not only its effect on present output.

Proposition 18.162 (Epistemic-agency externalization risk). *Where a consequential epistemic function is repeatedly performed through AI while the human or institutional position loses practical opportunities to exercise, verify, reconstruct, or contest the relevant capability, present performance can rise while the internally retained capacity for later independent epistemic action declines.*

Proposition 18.162 is a trajectory claim rather than a forecast for every use. Empirical evaluation should examine which capabilities are externalized, which new capabilities are learned, what fallback remains, and whether the resulting dependence is acceptable for the function's consequences.

The section has treated AI-mediated epistemic dependence as an economic architecture of knowledge production and retained capability. Machine mediation can expand access and performance while becoming historically embedded in workflows. Verification gaps can relocate burdens toward checking and responsibility. Interpretive dependence can narrow practical framing alternatives. Opacity can be governed through documentation, testing, monitoring, and appropriately scoped review even where exhaustive internal understanding remains unavailable. Infrastructure dependence makes continuity a property of the wider technical and organizational stack. Contestability supplies routes for challenge; audit creates structured external verification; and preservation of human epistemic agency keeps later orientation, judgment, recovery, and participation from being silently externalized along with current performance.

These dimensions are analytically connected but non-identical. Strong audit can coexist with weak human learning. High model transparency can coexist with infrastructure dependence. Broad access can coexist with interpretive concentration. Human expertise can coexist with weak contestability when institutions deny standing to challenge. Robust epistemic governance therefore depends on the configuration of

several capacities rather than on one ideal of transparency or autonomy.

Section 18.11 turns to the symbolic environment within which these dependencies operate. As synthetic text, images, evidence-like artifacts, and representations become abundant, authenticity, provenance, institutional verification, and the stability of representational signals acquire greater economic significance. The next section therefore examines symbolic abundance and representation as a distinct layer of AI-mediated economic order.

18.11 Symbolic Abundance and Representation

This section examines the economic organization of representation when artificial systems can generate text, images, evidence-like artifacts, and other symbolic forms at low marginal cost and high speed. Its role is to extend the analysis of symbolic abundance developed in Chapter 17 into the representational conditions of AI-mediated economic order. The objective is to distinguish several properties that become increasingly consequential when symbolic production expands: the production of synthetic representations, the stability of representational signals, authenticity, provenance, trust, institutional verification, and the capacity of representations to alter the relations they describe. The method is relational and historical. A representation is analyzed through its production history, its relation to an intended referent or evidential claim, the institutions that recognize it, the verification burden it creates, and the later decisions or relations generated through its use.

The section builds on three antecedents. Section 18.1 treated symbolic production as one component of artificial productive capacity while preserving the distinction between fluency and epistemic warrant. Section 18.10 then analyzed verification gaps, provenance, contestability, audit, and retained human epistemic agency under sustained AI mediation. Chapter 17 supplied the broader scarcity logic: increased symbolic abundance can relocate scarcity toward verification, attention, orientation, and trust. The present section focuses specifically on representation. Synthetic text and images can lower the cost of producing candidate explanations, depictions, simulations, summaries, records, and communicative artifacts. The same abundance can also reduce the informational value previously attached to the mere existence, polish, or apparent specificity of a representation.

The epistemic boundary is especially important. Fluent symbolic output does not by itself establish understanding, truth, or warranted knowledge (Bender et al. 2021). Contemporary provenance standards similarly distinguish verifiable claims about the origin, signing, or modification history of a digital asset from a general judgment that the asset is true, good, or trustworthy (Coalition for Content Provenance and Authenticity 2026). GRE therefore treats representational abundance as an economic transformation of the production, circulation, verification, and performative use of symbols rather than as evidence that representational uncertainty disappears.

Definition 18.163 (AI-mediated symbolic abundance). *AI-mediated symbolic abundance* is a relational condition in which artificial generative capability materially lowers the cost, time, or specialized labor required to produce, vary, transform, or circulate representations across one or more symbolic modalities, thereby changing the relative scarcity of representation, verification, provenance, attention, interpretation, or institutional recognition.

Table 18.11: Dimensions of symbolic abundance and representation in AI-mediated economic order. The dimensions separate production of synthetic artifacts from the epistemic and institutional conditions under which those artifacts become consequential.

Dimension	Representational object	Principal analytical concern
Synthetic text	Machine-generated or machine-transformed linguistic representation	Relation among fluency, authorship, warrant, context, and consequential use
Synthetic images	Generated or transformed visual representation	Relation among depictive plausibility, source history, referential status, and evidential interpretation
Synthetic evidence	Artificially generated, reconstructed, simulated, or transformed material introduced into an evidential chain	Clear typing of observation, simulation, illustration, reconstruction, and claim support
Representational instability	Declining reliability of familiar surface cues for inferring origin, effort, authorship, or evidential status	Relocation of verification from appearance toward provenance, context, and institutional process
Authenticity	Conformity between a declared identity or production history and the artifact presented	Authentication of source or history without automatic inference to substantive truth
Provenance	Reconstructible history of origin, transformation, custody, and relevant processing	Ability to trace how a representation acquired its current form and claims
Trust	Practical willingness to rely on a representation or representational institution under incomplete direct verification	Evidence, history, accountability, and fallback conditions supporting reliance
Institutional verification	Organized procedures for checking source, integrity, evidential role, compliance, or authenticity	Allocation of verification authority, burden, records, and contestability
Performative representation	Representation whose uptake changes later decisions, classifications, allocations, expectations, or relations	Feedback from symbolic representation into the relational field it helps organize

Definition 18.163 concerns a change in the economic environment of representation. It allows symbolic artifacts to remain scarce in some domains because legal permission, specialist validation, trusted authorship, embodied observation, archival continuity, compute, or institutional acceptance can remain constrained even when raw generation becomes inexpensive.

Table 18.11 supplies the section's architecture. The dimensions overlap while remaining analytically distinct. Authentic content can be false. Provenance can be complete while an interpretation remains poor. A synthetic artifact can be accurately labeled and still become performative. Institutional verification can improve trust while remaining contestable. The economic problem concerns the configuration through which these properties are produced, recognized, and acted upon.

18.11.1 Synthetic Text

Synthetic text changes the economics of linguistic representation because drafting, reformulation, translation, summarization, classification, dialogue, and stylistic variation can be produced at scales and speeds previously associated with substantially greater human labor. The productive gain is real even where epistemic quality varies. A generated paragraph can function as a draft, interface, advertisement, explanation, code comment, legal template, educational exercise, research prompt, or institutional communication before its truth conditions have been fully assessed.

The economic effect therefore depends on the role assigned to the text. Exploratory generation has a different verification burden from a signed contract, clinical recommendation, regulatory filing, archival record, or scientific claim. A human editor can use synthetic text as provisional symbolic material while retaining responsibility for factual and normative judgment. An organization can also operationalize generated text automatically, allowing a symbolic artifact to influence customers, employees, public decisions, or downstream systems before a human reviewer has examined it.

Definition 18.164 (Synthetic textual representation). *A synthetic textual representation is a linguistic artifact whose materially relevant form, content selection, transformation, or sequencing is generated through an artificial system and whose economic role depends on how that artifact is interpreted, verified, attributed, circulated, or acted upon within a relational configuration.*

The definition is intentionally broad enough to include fully generated text and materially transformed human text. The analytical question is the role of artificial generation in the representational chain, rather than a binary authorship label. A short machine translation and a fully generated report can require different attribution and verification practices even though both are synthetic in this bounded sense.

Synthetic text can also change the signal value of textual properties. Grammatical fluency, formatting quality, length, confidence of expression, and apparent comprehensiveness previously required some combination of skill, time, editing, organizational capacity, or access to expertise. Generative systems can lower the cost of producing those manifestations. The properties can remain useful, yet their evidential relation to expertise, effort, or warrant can weaken.

Proposition 18.165 (Textual signal-relocation condition). *Where artificial generation materially lowers the cost of producing a textual feature that previously contributed to judgments of expertise, effort, credibility, or organizational capacity, the informational value of that feature becomes more dependent on complementary signals such as provenance, demonstrated competence, source support, accountability, historical performance, or institutional verification.*

Proposition 18.165 does not imply universal signal collapse. Expert writing can retain distinctive value through reasoning, judgment, source selection, problem formation, responsibility, or context. The proposition concerns a shift in the inference supported by surface form alone.

18.11.2 Synthetic Images

Synthetic images extend the same transformation into visual representation. Artificial systems can generate, modify, reconstruct, enhance, segment, stylize, or compose images that participate in design, education, advertising, simulation, plan-

ning, entertainment, documentation, and analysis. Visual plausibility therefore becomes increasingly separable from the historical relation between an image and a photographed event, place, person, object, or measurement process.

The relevant distinction is representational status. A generated architectural visualization can be useful precisely because it depicts something that does not yet exist. A synthetic training image can support model development without claiming to document a historical event. A reconstructed image can clarify a damaged record while requiring disclosure of what was inferred. A visual presented as direct documentary evidence carries a different source claim. Economic analysis should therefore preserve the declared function of the image rather than classify synthetic imagery as inherently deceptive or inherently non-evidential.

Definition 18.166 (Synthetic visual representation). *A synthetic visual representation is a visual artifact whose materially relevant pixels, depicted structures, or compositional relations are generated or transformed through an artificial system and whose referential or evidential status depends on the declared relation among the artifact, its source material, its production process, and the object or event it is used to represent.*

A single image can occupy several roles across contexts. A generated scene can be a design proposal in one context, an illustrative figure in another, and misleading pseudo-documentation if later detached from its production history. Provenance and contextual continuity therefore matter because circulation can change the role assigned to the same artifact.

Visual abundance also changes verification costs. Human observers often rely on visual coherence as a rapid plausibility cue. When synthetic systems can reproduce many familiar cues, visual inspection alone can support weaker inference about production history. Institutions can respond through retained source files, signed capture workflows, content credentials, chain-of-custody records, or independent corroboration, depending on consequence and feasibility.

Proposition 18.167 (Visual plausibility–provenance separation). *As artificial generation expands the set of visually plausible artifacts, visual plausibility and production provenance become increasingly separable analytical properties; consequential uses therefore require verification practices calibrated to the source-history claim carried by the image.*

The proposition concerns verification architecture rather than a prediction that direct visual evidence loses all value. Images embedded in accountable production systems can remain highly informative. The economic transformation lies partly in the rising importance of the system around the image.

18.11.3 Synthetic Evidence

The term *synthetic evidence* requires particular care because generation and evidence occupy different analytical levels. An artifact becomes evidence only relative to a claim, an inference rule, a method, and an institutional or scholarly context. Artificial systems can nevertheless generate or transform artifacts that enter evidential chains: simulated observations, reconstructed records, synthetic datasets, generated comparison cases, imputed values, translated testimony, enhanced images, summarized documents, or machine-generated classifications.

Many such artifacts are legitimate epistemic instruments when their status is explicit. Simulation can provide evidence about the consequences of a model under declared assumptions. Synthetic data can support testing or privacy-preserving development. Reconstruction can help recover damaged material. Imputation can permit statistical analysis under stated missing-data assumptions. The epistemic problem arises when the generated or transformed status becomes difficult to distinguish from direct observation, or when downstream users infer a stronger evidential relation than the production process supports.

Definition 18.168 (Synthetic evidential artifact). *A synthetic evidential artifact is an artificially generated, reconstructed, transformed, simulated, or imputed representation that enters an evidential chain supporting a claim and whose warranted use depends on preserving the relation among its production procedure, underlying source material, assumptions, uncertainty, and intended inferential role.*

This definition avoids treating every generated artifact as evidence. A fictional illustration becomes evidential only if an inquiry uses it to support a claim. The inferential role therefore belongs to the complete evidence-to-claim architecture.

Documentation practices become important because synthetic transformations can be difficult to detect after aggregation. Dataset documentation provides one precedent for recording motivation, composition, collection, processing, and recommended uses (Geburu et al. 2021). The same principle can be extended to synthetic evidence: later users need enough history to determine what was observed, what was generated, which assumptions entered the transformation, and which uncertainty was introduced.

Proposition 18.169 (Synthetic-evidence typing condition). *A synthetic evidential artifact supports reconstructible inquiry more strongly when the evidential chain preserves a declared type for the artifact, the source material and transformations on which it depends, the assumptions governing generation or reconstruction, and the claim-relative uncertainty introduced by those operations.*

This condition supports later re-epistemization. An artifact can acquire new evidential value when methods improve, yet that reanalysis requires enough provenance to distinguish original observation from later synthetic transformation.

18.11.4 Representational Instability

Symbolic abundance can produce *representational instability*: familiar features of representation no longer support the same inference about origin, authorship, effort, expertise, or evidential status that they supported under an earlier production regime. Instability does not mean that representation itself becomes impossible. It means that some mapping between observable symbolic form and the hidden process that generated it becomes less reliable.

This instability can be modality-specific. Linguistic fluency can become cheap while deep domain verification remains expensive. Photorealistic appearance can become easy to synthesize while authenticated capture remains institutionally costly. Detailed citations can be generated while source checking remains scarce. Personalized explanation can scale while responsibility for consequential advice remains concentrated. The scarcity structure therefore shifts from production toward discrimination among representations and reconstruction of their histories.

Definition 18.170 (Representational instability). *Representational instability* is a historically relative condition in which one or more observable properties of a representation cease to support a previously relied-upon inference about its origin, authorship, production cost, epistemic status, or institutional standing with comparable reliability under the new symbolic-production regime.

Representational instability is relational because the same artifact can remain stable within one authenticated institution while becoming ambiguous in open circulation. A signed archival record can preserve source continuity even as visually similar unsigned copies proliferate. A professional certification can maintain institutional force even when documents imitating its visual form become cheap to generate. The relevant stability lies in the relation among representation, production history, and verification institution.

Proposition 18.171 (Verification-relocation under representational instability). *Where representational instability weakens surface-form cues, verification effort tends to relocate toward production history, contextual consistency, independent corroboration, authenticated identity, institutional process, or other relations whose cost has not fallen at the same rate as symbolic generation.*

The proposition is conditional because new surface cues can also emerge. Watermarks, standardized labels, or machine-detection tools can become part of verification practice. Their effectiveness remains historically contingent as generation and detection technologies co-evolve.

18.11.5 Authenticity

Authenticity concerns whether an artifact or identity is what the relevant claim says it is. In an AI-mediated symbolic economy, authenticity becomes important because synthetic systems can generate convincing representations of styles, voices, documents, images, or organizational forms. The relevant authenticity claim can concern origin, authorship, identity, continuity, capture, modification history, or institutional issuance.

Authenticity should remain separate from truth. An authentic statement by a person can be false. An authentic photograph can be miscaptioned. An authentic institutional document can contain an error. Conversely, a synthetic reconstruction can accurately represent a historical structure while lacking the status of an original artifact. Authentication therefore resolves a source or identity claim within a declared scope; it does not settle the substantive adequacy of the represented content.

Definition 18.172 (Representational authenticity). *Representational authenticity* is the warranted conformity between a representation and a declared claim concerning its source identity, authorship, production event, capture process, issuance, or transformation history, evaluated under a specified authentication procedure and scope.

The definition permits multiple authenticities. A document can be authentic with respect to institutional issuance while its embedded image has a different transformation history. A transcript can authentically record a model output while the model output itself contains unsupported claims. Complex artifacts therefore benefit from component-level or event-level provenance where the consequences justify the additional detail.

Proposition 18.173 (Authenticity–truth non-equivalence). *Successful authentication of a representation strengthens the warranted claim about the artifact’s declared source or production history while leaving substantive truth, evidential adequacy, normative acceptability, and downstream interpretation to additional evaluation.*

This distinction aligns directly with contemporary provenance standards, which can verify signed assertions about content history while explicitly avoiding a general truth judgment (Coalition for Content Provenance and Authenticity 2026). The economic value of authentication lies in reducing uncertainty about one part of the representational chain.

18.11.6 Provenance

Provenance extends authenticity from a local source claim to a history. A provenance record can identify origin, custody, transformations, tools, versions, signatures, data sources, or institutional events through which a representation acquired its current form. In a symbolic-abundance environment, this history can become economically valuable because representations are easily copied, transformed, detached from context, recombined, or reissued through new interfaces.

Contemporary content-provenance standards demonstrate one technical route through cryptographically verifiable metadata, signatures, and bindings between assertions and digital assets (Coalition for Content Provenance and Authenticity 2026). Dataset documentation offers another route focused less on cryptographic continuity and more on motivation, composition, collection, processing, and intended use (Geburu et al. 2021). These approaches perform different functions. GRE treats provenance as a plural architecture whose adequate form depends on what later inquiry needs to reconstruct.

Definition 18.174 (Representational provenance architecture). *A representational provenance architecture is the organized set of records, identifiers, metadata, signatures, custody relations, transformation logs, source links, and institutional practices through which the materially relevant history of a representation can be reconstructed across production, modification, circulation, and use.*

Provenance can be incomplete while still useful. The appropriate granularity depends on consequence, cost, privacy, security, and feasibility. A creative image used for entertainment can require little history. A scientific figure, court exhibit, public record, or financial authorization can justify much stronger continuity. More provenance is therefore not automatically better when recording itself creates privacy, surveillance, or security burdens.

Proposition 18.175 (Provenance-value condition). *The economic and epistemic value of provenance rises when consequential users need to distinguish among materially different production histories that cannot be inferred reliably from the representation’s surface form and when the expected benefit of reconstructibility exceeds the relevant recording, privacy, security, interoperability, and maintenance costs.*

Provenance can also support attribution and compensation. Where an artifact is derived from several sources, a preserved transformation history can make some contribution relations inspectable. The record does not itself settle legal ownership, authorship, or distributive claims, yet it can supply evidence required for those institutions to operate.

18.11.7 Trust

Symbolic abundance increases the importance of trust because direct verification cannot scale with every representation encountered. Individuals and institutions necessarily rely on delegated verification, reputation, professional roles, authenticated channels, historical performance, and institutional procedures. The economic problem is therefore to organize warranted reliance under incomplete direct checking.

Trust in representation can attach to different objects. A person can trust an author, a publisher, a model provider, a provenance system, a certification institution, an archival repository, a professional community, or a particular artifact history. These objects can diverge. A trusted institution can issue a contested claim. A reliable provenance chain can lead to a source that is itself unreliable. A high-performing model can operate inside an institution with poor accountability. Representational trust therefore benefits from explicit typing.

Definition 18.176 (Representational trust relation). *A representational trust relation is a historically situated willingness by a position to rely on a representation, source, channel, or verification institution for a declared function under incomplete direct verification, supported by an evidential, relational, contractual, professional, or institutional basis that makes the reliance practically intelligible.*

Trust can economize on verification costs while also creating vulnerability. If a trusted channel becomes compromised, the efficiency created by concentrated reliance can amplify error. Distributed verification can reduce some common-mode risks while raising coordination costs. Institutional design therefore concerns the structure and revisability of trust rather than maximal trust in every source.

Proposition 18.177 (Trust diversification condition). *Where consequential representation depends heavily on one source, model, authentication service, or institutional verifier, additional independent routes of corroboration, contestation, or recovery can reduce the extent to which failure of that trusted position deforms the wider system's epistemic possibilities.*

The proposition is compatible with specialization. Independent corroboration need not reproduce the complete production process. It requires enough alternative evidence or institutional standing to detect and act on materially important failures.

18.11.8 Institutional Verification

Institutional verification becomes more important when the volume of representations exceeds individual checking capacity. Archives, publishers, courts, scientific communities, news organizations, certification bodies, platforms, regulators, professional associations, and technical provenance services can each verify different properties. Their roles include identity authentication, source checking, evidence review, methodological validation, signature verification, chain-of-custody preservation, correction, and public contestation.

Institutional verification should be understood as a division of epistemic labor. Standardized procedures can support impersonal and portable judgment, a role historically associated with institutional forms of quantitative objectivity (Porter 1995). In AI-mediated representation, verification institutions can similarly reduce the burden on each recipient by establishing shared rules for provenance, disclosure, correction, or evidential status. Their authority remains itself a relational object whose

competence, independence, accountability, and contestability require evaluation.

Definition 18.178 (Institutional representational verification). *Institutional representational verification* is an organized procedure through which an institution with declared competence, authority, or responsibility evaluates specified properties of a representation or its history and issues a record, judgment, credential, correction, or access decision that can be relied upon by positions unable or unwilling to reproduce the complete verification process independently.

Verification institutions can become bottlenecks. If only one platform can authenticate a widely used identity or one proprietary service can validate provenance, the institution gains control over which representations receive trusted standing. Conversely, fragmented verification can produce incompatible standards and high coordination costs. Governance must therefore consider interoperability, appeal, independent audit, preservation, and the possibility of institutional error.

Proposition 18.179 (Institutional verification reliability condition). *Institutional verification supports robust representational trust more strongly when the verifying institution has adequate competence and evidence access, preserves reconstructible records, distinguishes the property actually verified from stronger unverified claims, exposes material conflicts or uncertainty, and provides practical routes for correction, appeal, or independent review.*

The condition is deliberately property-specific. A service that verifies cryptographic provenance should not be treated automatically as verifying factual truth. A publisher that checks identity and format may not have reproduced an empirical result. Explicit scope keeps verification from silently expanding into generalized authority.

18.11.9 Performative Synthetic Representation

Synthetic representation becomes especially important for GRE when it enters the generative dynamics of the system it represents. A generated credit narrative can affect lending; a synthetic risk score can alter insurance or employment; an AI-generated market summary can influence trading or expectations; a generated institutional profile can affect eligibility; a synthetic image can alter reputation; and an automated classification can change which later actions become available. In such cases the representation is economically consequential because actors and institutions respond to it.

Chapter 16 treated comparison structures and manifested representations as potentially reflexive when their uptake changes later relational configurations. The same logic applies here. The synthetic origin of a representation does not by itself make it performative. Performative status arises from the coupling between representation and consequential response.

Definition 18.180 (Performative synthetic representation). *A performative synthetic representation* is an artificially generated or materially AI-transformed representation whose institutional or social uptake contributes causally and generatively to a change in later classifications, allocations, expectations, admissible operations, reputational positions, decisions, or other relational conditions retained by the analysis.

The definition includes beneficial and harmful effects. A generated accessibility description can improve participation; a synthetic translation can enable coordination;

an automatically generated alert can prevent loss. A poor representation can also reproduce exclusion or create false expectations. Performative analysis therefore asks how the representation enters a decision pathway and which feedback mechanisms reproduce or revise its effects.

Proposition 18.181 (Synthetic-representation feedback condition). *A synthetic representation becomes part of a self-reinforcing relational feedback when its uptake changes the later configuration in ways that increase the probability, authority, visibility, or institutional use of representations generated under the same or a related representational scheme.*

Examples can include classifications that alter the data later used to retrain a system, generated rankings that redirect attention toward already visible entities, or automated reports whose categories become embedded in subsequent administrative practice. The proposition identifies a feedback architecture rather than a necessary tendency toward amplification; later effects can also weaken, contest, or redirect the original scheme.

Proposition 18.182 (Representational governance condition). *Where synthetic representations enter consequential feedback loops, robust governance requires attention to both artifact-level properties such as provenance and authenticity and system-level properties such as contestability, verification authority, correction, record preservation, affected-party participation, and the possibility of revising the representational scheme itself.*

The system-level condition prevents provenance from becoming an exhaustive solution. An artifact can have impeccable provenance while the classification scheme, institutional objective, or decision rule remains poorly justified. Conversely, an institution can use a valuable representational scheme while failing to preserve the provenance needed to contest a particular application. The two levels are complementary.

The section has treated symbolic abundance as a reorganization of representational scarcity. Synthetic text and images reduce production costs while weakening some historical surface cues of authorship, effort, or source history. Synthetic evidential artifacts can support legitimate inquiry when their generated status, assumptions, uncertainty, and role remain reconstructible. Representational instability relocates verification toward provenance and institutional process. Authenticity concerns source or production-history claims, while truth and evidential adequacy require additional evaluation. Provenance preserves the history through which an artifact acquired its form. Trust organizes practical reliance when direct verification is incomplete. Institutional verification distributes verification labor while creating new questions of authority and contestability. Performative synthetic representations close the loop by entering the relational dynamics they help describe.

These developments make symbolic abundance an orientation problem as well as a verification problem. When candidate representations, explanations, problems, simulations, and arguments can be generated rapidly, scarce judgment increasingly concerns which representations deserve sustained inquiry and action. Section 18.12 therefore turns to AI and research orientation, examining problem generation, difficulty, aesthetic and generative judgment, historical and relational sensitivity, and human responsibility for orienting inquiry within an abundant symbolic field.

18.12 AI and Research Orientation

Sections 18.9–18.11 examined human–AI relational economies, epistemic dependence, and symbolic abundance. The present section turns to a different consequence of abundant machine generation: the orientation of inquiry itself. Its role is to analyze how AI changes the practical supply of candidate problems, representations, explanations, conjectures, experiments, simulations, and intervention pathways while leaving the selection of worthwhile trajectories dependent on judgment that is historically, relationally, and institutionally situated. The objective is neither to repeat the earlier analysis of curiosity and question formation nor to restate the general methodology of research praxis. Chapter 6 established judgment and orientation as components of research praxis, Chapter 8 developed the generative research question, and Chapter 17 examined curiosity, research taste, and aesthetic orientation within the epistemic economy. The present section asks how those capacities are reorganized when machine systems can generate candidate research and action possibilities at very low marginal cost.

The discussion proceeds through nine analytical steps. It begins with problem generation and the resulting abundance of difficult problems. It then separates difficulty from worth, examines the role of aesthetic judgment, and develops historical and relational sensitivity as conditions of orientation. The section subsequently formulates generative judgment as an assessment of possible future-opening effects, locates responsibility for consequential orientation within human and institutional relations, and concludes with a model of AI-mediated reweighting over research and action possibilities. The method is relational and allocation-sensitive. AI systems are treated as participants in an orientation architecture whose outputs acquire practical significance only through their coupling with researchers, institutions, communities, infrastructures, evaluative practices, and downstream decisions.

Definition 18.183 (AI-mediated research orientation). *AI-mediated research orientation* is the historically situated process through which artificial-intelligence systems materially affect which research or action possibilities become visible, comparatively salient, articulable, evaluable, supportable, or institutionally actionable while the significance of those possibilities remains dependent on wider human, relational, and institutional judgment.

Definition 18.183 assigns AI an orientation-relevant role without treating generated rankings or suggestions as self-justifying research priorities. A system can enlarge the candidate field, compress search time, expose remote analogies, or make one trajectory easier to articulate. Those changes can alter what receives attention even before a formal choice is made.

Table 18.12 summarizes the nine dimensions developed below.

The rows in Table 18.12 form an architecture rather than a mandatory sequence. A historically significant problem can arise before it is recognized as difficult. Aesthetic attraction can precede formal problem articulation. Relational sensitivity can reveal that a technically elegant problem has been framed at the wrong level. Institutional commitment can also feed back into the candidate field by generating new data, methods, personnel, or infrastructures. Orientation is therefore a generative allocation problem over a changing field rather than a one-time act of selection.

Proposition 18.184 (Orientation-stage separation). *Problem generation, problem difficulty, judgments of worth, orientation criteria, resource commitment, and realized*

Table 18.12: Dimensions of AI-mediated research orientation.

Dimension	Orientation function	Principal analytical question
Problem generation	Expands candidate questions and problem formulations	Which candidates become thinkable, legible, and comparable?
Difficult-problem abundance	Enlarges the set of tractable or expressible hard problems	Which scarce capacities become the new bottlenecks after generation becomes cheap?
Research-worth assessment	Separates technical hardness from epistemic or social significance	Which criteria justify sustained commitment to a difficult problem?
Aesthetic judgment	Orients attention through elegance, depth, surprise, coherence, or beauty	When does aesthetic attraction reveal generative structure, and when does it mislead?
Historical sensitivity	Locates a problem within accumulated paths, exclusions, prior attempts, and changing meanings	What history is required to understand why the problem has its present form?
Relational sensitivity	Preserves dependencies, affected positions, institutions, and cross-level relations	Which materially relevant relations disappear under a generated framing?
Generative judgment	Assesses the possibility of opening later questions, methods, capacities, or relations	Which trajectories plausibly enlarge future epistemic or practical possibility?
Human responsibility	Retains accountable commitment, contestation, and reasoning for orientation	Who can justify, revise, and bear responsibility for committing resources to a trajectory?
Potential reweighting	Changes the relative salience and support of research and action trajectories	How does AI-mediated orientation alter later allocation, capability, and feedback?

downstream value should remain analytically distinct where they depend on different evidence, relations, time horizons, or institutional mechanisms.

Proposition 18.184 is especially important under AI abundance. A system can generate thousands of apparently sophisticated problems without establishing that any one of them deserves sustained inquiry. Conversely, a low-complexity question can possess high epistemic or practical significance because of its historical position, neglected relational consequences, or capacity to reorganize later inquiry.

18.12.1 Problem Generation

Research orientation begins before a project has acquired a stable question. Earlier chapters treated problem formation as a generative activity in which encounters, salience, conceptual resources, practical tensions, and inherited disciplinary structures interact. AI changes this activity by increasing the number and variety of candidate formulations that can be produced from a given body of material. A researcher can ask a model to generate counterexamples, alternative hypotheses, unsolved variants, cross-disciplinary analogies, possible mechanisms, missing cases, or research questions derived from a literature map. These operations can enlarge the space of articulated problems more rapidly than unaided deliberation alone.

The resulting expansion should be distinguished from discovery of genuinely valuable problems. A generated problem can be grammatically coherent, technically difficult, and locally novel while reproducing an unimportant distinction, neglecting a

historically settled limitation, or lacking access to the phenomena required for meaningful investigation. The economic significance of machine generation lies first in the changed cost of candidate production.

Definition 18.185 (AI-expanded problem field). An *AI-expanded problem field* is a model-relative set of research or action problems whose practical availability to a researcher, organization, or community has been enlarged through AI-supported generation, reformulation, search, translation, comparison, simulation, or recombination.

Definition 18.185 concerns practical availability rather than intrinsic existence. A problem may have been implicit in prior materials for decades yet become newly actionable because a model makes the relevant comparison, formulation, or cross-domain analogy inexpensive to construct. Machine mediation can therefore change the effective frontier of problem articulation even where the underlying phenomena and records are unchanged.

This capability can reduce several traditional bottlenecks. Researchers can explore alternative framings before committing to one. Students can externalize weakly formed questions and compare them. Small teams can generate candidate experiments or formal variants that previously required broader specialized labor. Multilingual generation can expose problem formulations across linguistic boundaries. The benefit is partly option value: more candidate trajectories can be inspected before scarce long-horizon resources are committed.

Expansion also creates new selection costs. A candidate field can grow faster than the capacity to verify novelty, assess significance, reconstruct historical context, judge feasibility, or identify affected relations. The research system can therefore move from a scarcity of candidate problems toward a scarcity of orientation.

Proposition 18.186 (Problem-generation expansion). *Where AI reduces the marginal cost of generating, reformulating, or comparing candidate problems, the principal orientation bottleneck can shift from candidate production toward discrimination among candidates, provided that verification, historical reconstruction, relational interpretation, and resource commitment remain comparatively costly.*

The proposition is conditional because some domains continue to face scarcity of observations, instruments, access, or formalizable problems. AI cannot generate a missing archaeological record or replace a field site that was never observed. It can nevertheless change the organization of inquiry around the materials that exist.

18.12.2 Abundance of Difficult Problems

Machine-assisted problem generation changes the meaning of difficulty as an orienting signal. Historically, technical difficulty can itself have functioned as a filter because only a limited number of researchers possessed the knowledge, mathematical skill, computational resources, or time required to formulate and pursue certain problems. AI can weaken parts of this filter by supplying code, formal manipulations, candidate proofs, simulations, translations, literature synthesis, and procedural guidance. The number of difficult-looking problems that can be stated and partially explored can therefore increase substantially.

The result is an *abundance of difficult problems*: a research environment in which the ability to find or articulate technically demanding tasks grows faster than the capacity to justify why those tasks matter. Getzels and Csikszentmihalyi's work on

problem finding emphasizes that creativity involves the formation and selection of problems as well as their solution (Getzels and Csikszentmihalyi 1976). AI-mediated research intensifies this distinction because problem production itself becomes increasingly automatable.

Definition 18.187 (Difficult-problem abundance). *Difficult-problem abundance* is a condition in which a research system can generate or access more technically demanding, cognitively complex, computationally intensive, or procedurally elaborate candidate problems than it can responsibly evaluate, resource, verify, or sustain over the relevant horizon.

The definition is deliberately capacity-relative. What counts as difficult changes with tools, expertise, infrastructure, and organization. A theorem-search problem that was previously inaccessible can become routine after improvements in automated reasoning. A literature-comparison task can become cheap after language-model integration. At the same time, empirical identification, field access, measurement design, causal inference, or institutional coordination can remain difficult.

Difficult-problem abundance can alter incentives. Technical sophistication may become less informative as a signal of researcher capability when systems can cheaply generate sophisticated-looking artifacts. Evaluation can shift toward question formation, model choice, verification, explanatory depth, integration with evidence, historical understanding, and the ability to recognize when a difficult problem is poorly posed. Symbolic diagnosticity can therefore decline in the same way that Chapter 17 described symbolic inflation more generally.

Proposition 18.188 (Difficulty-signal erosion). *When AI substantially lowers the cost of producing technically sophisticated candidate problems or partial solutions, observed difficulty can lose some of its diagnostic value as a signal of research worth or researcher capability unless the evaluation process separately examines problem formation, verification, evidential connection, and downstream significance.*

The proposition does not imply that difficulty becomes irrelevant. Some difficult problems remain deeply important precisely because they block major scientific, mathematical, institutional, or practical progress. The point is that difficulty alone becomes a weaker allocation rule when difficult candidates are abundant.

18.12.3 Research-Worth Assessment

The abundance of difficult problems makes a long-standing distinction more economically consequential: technical difficulty and research worth are different properties. A problem can be hard because the representation is inefficient, because the search space is large, because the data are scarce, because the institutional coordination burden is high, or because the underlying phenomenon genuinely resists explanation. None of these conditions independently establishes that solving the problem would create substantial epistemic or social value.

Research worth is therefore better represented as a profile than as a scalar derived from difficulty. Relevant dimensions can include epistemic significance, neglectedness, evidential accessibility, methodological value, capacity formation, public or ecological consequence, preservation value, relational reach, reversibility of error, and generative promise. Different institutions can legitimately weight these dimensions differently, and some dimensions can remain incomparable.

Definition 18.189 (Research-worth profile). A *research-worth profile* is a declared, revisable representation of the reasons for sustaining inquiry into a candidate problem, including the epistemic, relational, historical, methodological, practical, normative, or generative considerations treated as relevant by the evaluating community or institution.

The profile is a judgment aid rather than an objective universal ranking. It makes the basis of orientation inspectable. A mathematical problem can be worth pursuing because it opens a new structure even without immediate application. A social problem can be worth pursuing because it affects a weakly represented population even when the publication payoff is low. A methodological replication can be worth pursuing because it stabilizes the evidential infrastructure of a field. A technically easy question can therefore outrank a much harder one under a declared orientation profile.

Proposition 18.190 (Difficulty–worth separation). *Technical or cognitive difficulty supplies evidence about the resources required to solve or investigate a problem, while research worth requires additional judgment concerning the significance, consequences, relations, histories, and future possibilities associated with that problem.*

This distinction also limits optimization toward benchmark-like research. If an AI system is rewarded for generating problems of calibrated difficulty, it can produce tasks that are challenging under the benchmark while remaining weakly connected to the wider research field. Human and institutional judgment is required to determine whether the challenge belongs to a trajectory worth sustaining.

18.12.4 Aesthetic Judgment

Chapter 17 developed aesthetic judgment as one component of epistemic orientation. Beauty, elegance, surprise, depth, and research taste can influence where inquiry goes when explicit warrant remains incomplete, while remaining distinct from truth and realized value. AI abundance gives this judgment a new role because candidate formulations, proofs, visualizations, hypotheses, and theoretical combinations can be produced rapidly and in polished form.

Aesthetic judgment can help compress a large candidate field. A concise representation can reveal invariant structure. An elegant proof strategy can make previously hidden relations visible. A surprising analogy can expose a new research direction. A sense of depth can motivate sustained attention to a problem whose consequences are not yet fully articulated. McAllister’s account of scientific aesthetics is useful here because aesthetic preferences can be historically formed within scientific communities rather than functioning as timeless indicators of truth (McAllister 1996).

AI also creates a risk of aesthetic inflation. Fluent language, visually coherent diagrams, smooth formal notation, and apparently elegant synthesis can be generated without the resistant historical work through which researchers traditionally acquired confidence in an argument. Surface elegance can therefore become cheaper than structural adequacy.

Definition 18.191 (Aesthetic orientation under machine abundance). *Aesthetic orientation under machine abundance* is the use of historically formed judgments of elegance, beauty, surprise, coherence, depth, or related qualities to discriminate among AI-generated or AI-mediated research possibilities while preserving independent evaluation of evidential adequacy, conceptual validity, and generative

consequence.

Proposition 18.192 (Aesthetic filtering condition). *Aesthetic judgment contributes most defensibly to AI-mediated research orientation when it functions as a revisable exploratory filter whose selections remain exposed to verification, historical comparison, competing representations, and empirical or formal correction.*

The condition gives aesthetic judgment a positive role without granting it final authority. Machine abundance can make cultivated taste more valuable precisely because aesthetic judgment can rapidly narrow a candidate field, yet the same abundance makes correction essential because polished form is easier to manufacture.

18.12.5 Historical Sensitivity

Research orientation becomes shallow when problems are detached from the histories through which they acquired their present form. AI systems can retrieve large literatures and reconstruct timelines, but generated summaries can compress away failed programs, excluded questions, institutional struggles, changing terminology, abandoned methods, or reasons why a problem was previously considered unproductive. Historical sensitivity therefore becomes a distinct orientation capability.

Kuhn's account of scientific change emphasizes that research problems acquire meaning within historically structured paradigms and practices (Kuhn 1962). Frickel and colleagues' work on undone science further shows that research agendas contain structured absences as well as completed work (Frickel et al. 2010). These insights are especially relevant in AI-mediated orientation because a system trained primarily on the recorded literature can reproduce the visibility structure of that literature. Highly documented questions become easy to regenerate, while weakly documented absences can remain difficult to notice.

Definition 18.193 (Historical sensitivity in AI-mediated orientation). *Historical sensitivity in AI-mediated orientation is the capacity to evaluate a research possibility in relation to the paths, prior attempts, exclusions, conceptual changes, institutional conditions, evidential losses, and inherited commitments through which the present problem field was formed.*

Historical sensitivity can change judgments of worth. A question that looks new under contemporary vocabulary can reproduce an older debate. A technically unfashionable line can become important because earlier abandonment reflected infrastructure limits that have since changed. A neglected archive can reveal that a field's current categories excluded relevant phenomena. Historical reconstruction can therefore alter both the candidate set and the weights assigned to candidates.

Proposition 18.194 (Historical-orientation condition). *Where the significance or novelty of a candidate research direction depends materially on earlier inquiry, institutional history, excluded evidence, or changing conceptual structure, responsible AI-mediated orientation requires enough historical reconstruction to distinguish rediscovery, repetition, continuation, reversal, and genuinely new possibility.*

The requirement is proportional rather than exhaustive. A research team does not need total historical recovery before acting. It needs enough history to avoid treating the generated present as if it were self-explanatory.

18.12.6 Relational Sensitivity

AI-generated problems often inherit the representational structure of their inputs. A dataset can make individuals visible while suppressing institutions. A language model can frame a governance problem as a preference problem. A simulation can isolate variables that are tractable while excluding relations that are constitutive of the phenomenon. Relational sensitivity asks whether the candidate problem preserves the relations that make the object economically, socially, or epistemically what it is.

Chapter 6 established relational sensitivity as a requirement of research praxis, and Chapters 16–17 showed how power and epistemic position can be hidden by apparently neutral representations. Section 18.11 further showed that synthetic representations can become performative once institutions act on them. Research orientation therefore requires inspection of the relations preserved and omitted by generated framings.

Definition 18.195 (Relational sensitivity in AI-mediated orientation). *Relational sensitivity in AI-mediated orientation* is the capacity to assess whether an AI-generated or AI-mediated problem formulation adequately retains the dependencies, histories, institutions, affected positions, asymmetries, cross-scale interactions, and other relation types materially relevant to the inquiry.

Relational sensitivity can redirect inquiry across scales. A question about individual learning outcomes can become a question about platform design, school resources, language access, or family time once the relevant relations are represented. A question about productivity can become a question about ownership and surplus. A question about model accuracy can become a question about institutional verification or contestability. The shift does not invalidate the narrower problem; it identifies a larger field in which its significance can be evaluated.

Proposition 18.196 (Relational-coverage condition). *When materially relevant relations are omitted by a candidate problem representation, orientation based solely on that representation can systematically misallocate inquiry or action even if the retained variables are modeled accurately.*

The proposition identifies an orientation error rather than a universal requirement to model everything. Good inquiry selects a tractable subset of relations. Relational sensitivity requires that the exclusions remain visible enough to judge whether the simplification changes the problem’s meaning or consequences.

18.12.7 Generative Judgment

Generative judgment evaluates a research or action trajectory partly by the future possibilities it may open. Chapter 17 introduced generative promise as an anticipatory judgment concerning possible new questions, methods, relations, capabilities, collaborations, applications, or reinterpretations. AI makes this dimension more important because candidate generation can become abundant while long-horizon commitment remains scarce.

A candidate can have generative promise even when its immediate deliverable is modest. A new measurement method can open a previously inaccessible empirical domain. A conceptual distinction can reorganize several debates. A public dataset can support later work by many groups. A careful negative result can close an unpro-

ductive branch and redirect resources. A theoretical synthesis can make new cross-disciplinary questions possible. The relevant value lies in transformations of later inquiry, not only in the current artifact.

Definition 18.197 (Generative judgment under AI mediation). *Generative judgment under AI mediation* is the assessment of whether an AI-generated or AI-mediated research or action possibility plausibly expands, reorganizes, or preserves later epistemic, methodological, relational, institutional, or practical possibilities beyond the immediate output under consideration.

Generative judgment should also remain separate from novelty. AI can recombine distant literatures in ways that appear novel while producing little durable capacity. Conversely, a replication infrastructure or preservation project can look conventional while creating substantial future option value.

Proposition 18.198 (Generative-promise separation). *Generative promise is an anticipatory orientation judgment concerning possible future-opening effects; realized generative value requires later evidence that the supported trajectory actually created, preserved, or reorganized consequential possibilities.*

The proposition prevents the language of generativity from becoming self-validating. AI can help produce speculative maps of future possibility, but the maps remain hypotheses whose quality should be revised as histories unfold.

Generative judgment also creates a portfolio problem. Institutions can support some projects for immediate reliability, some for infrastructure, some for neglected needs, some for exploratory novelty, and some for long-horizon generative promise. AI can assist comparison among these roles, yet a portfolio still requires a normative and strategic judgment concerning which future possibilities a community wishes to keep open.

18.12.8 Human Responsibility for Orientation

AI can rank research topics, propose experiments, forecast publication impact, identify benchmark gaps, recommend grants, summarize policy priorities, or generate intervention options. Such systems can materially influence orientation even when the final decision is formally made by a human committee. Responsibility therefore depends on the architecture of decision formation rather than on the presence of a nominal human approval step.

Chapter 6 already established a non-delegation principle for final problem responsibility. The present chapter strengthens the economic interpretation. Orientation allocates scarce attention, careers, public funds, experimental risk, data collection, institutional capacity, participant burden, and future research infrastructure. These commitments can generate path dependence. A funded direction develops tools and communities that make its continuation easier; an unfunded direction can lose expertise, records, or visibility. Orientation is therefore a consequential allocation of future possibility.

Definition 18.199 (Orientation responsibility). *Orientation responsibility* is the answerable human and institutional responsibility for committing consequential attention, resources, authority, participant involvement, or action capacity to a research or intervention trajectory, including responsibility for the reasons, exclusions, uncertainties, foreseeable consequences, and revision mechanisms associated with that

commitment.

The definition does not require an isolated human sovereign. Responsibility can be distributed among researchers, affected communities, funders, institutions, reviewers, regulators, professional bodies, and public processes. The relevant feature is the presence of relations capable of giving reasons, receiving contestation, revising priorities, and bearing institutional responsibility for consequences. Longino's account of the social dimensions of scientific knowledge supports the importance of criticism and community interaction in such judgment (Longino 1990).

Proposition 18.200 (Responsibility-retention condition). *Where AI materially shapes the ranking, formulation, or recommendation of consequential research and action possibilities, responsible orientation requires identifiable human and institutional positions with practical authority to inspect the basis of the recommendation, contest its framing, revise or reject it, and remain answerable for the resulting commitment.*

This requirement is stronger than keeping a human in the loop procedurally. A reviewer who lacks time, information, alternatives, or institutional authority may merely ratify a machine-generated priority. Responsibility requires effective rather than symbolic capacity to orient.

18.12.9 Research–Action Potential Reweighting

The preceding subsections can be integrated through a minimal reweighting model. The model is intended to represent orientation effects rather than intrinsic value. Let $\mathcal{T}(C)$ denote a declared finite or countable family of research and action trajectories practically available in a configuration C . A trajectory can be a research question, experimental programme, theoretical line, institutional reform, policy inquiry, or another sustained path whose pursuit requires scarce commitment.

Let $\omega_C : \mathcal{T}(C) \rightarrow \mathbb{R}_{\geq 0}$ be a model-relative orientation-weight function. The weights can summarize salience, perceived worth, expected support, institutional priority, or another explicitly declared orientation relation. They are not assumed to be utilities, probabilities, or objective values. An AI-mediated orientation process M can generate a comparison configuration C^M in which the practically available trajectory family or the orientation weights differ. On a common comparison domain $\mathcal{T}^\cap := \mathcal{T}(C) \cap \mathcal{T}(C^M)$, the orientation reweighting is defined in Equation 18.1.

$$\Delta\omega_M(\tau \mid C) := \omega_{C^M}(\tau) - \omega_C(\tau), \quad \tau \in \mathcal{T}^\cap. \quad (18.1)$$

Equation 18.1 is deliberately modest. A positive value means only that the declared orientation architecture assigns greater weight to trajectory τ after the AI-mediated process. The change can arise because the system made the problem visible, produced a persuasive representation, estimated feasibility, altered perceived difficulty, revealed historical material, changed institutional expectations, or entered a formal ranking procedure. A negative value can arise when a trajectory is deprioritized or made comparatively less salient. Newly generated or removed trajectories require separate support-change analysis because subtraction is undefined when a trajectory lies outside the common domain.

Definition 18.201 (AI-mediated orientation reweighting). *An AI-mediated orientation reweighting is a model-relative change in the salience, priority, support, or perceived worth assigned to research or action trajectories that is attributable, through an ex-*

PLICIT dependence account, to AI-mediated generation, representation, ranking, simulation, recommendation, or evaluation.

The definition connects research orientation to the broader GR treatment of landscape deformation while preserving the difference between orientation and power. Reweighting can occur without relational power. A researcher can voluntarily use a model to expand a reading list and change priorities. The power question arises when the orientation mechanism persistently conditions other positions' feasible futures through control, dependence, institutional authority, or another conversion mechanism of the type developed in Chapter 16 and Section 18.3.

AI-mediated orientation can also change support. Let $\text{supp}(\omega_C) := \{\tau \in \mathcal{T}(C) \mid \omega_C(\tau) > 0\}$. If AI generation makes a previously unavailable trajectory practically visible and supportable, the orientation landscape expands. If automated evaluation systematically removes a class of trajectories from institutional consideration, the support can contract. These support changes are potentially more consequential than small reweightings within an unchanged candidate set because they alter which futures are institutionally reachable at all.

Definition 18.202 (Research-and-action orientation profile). A *research-and-action orientation profile* is the pair consisting of a practically available trajectory family and a declared orientation-weight structure over that family, together with the historical, relational, institutional, and evaluative conditions required to interpret those weights.

The profile makes clear why AI-mediated orientation is not merely a matter of personal preference. Search interfaces, grant criteria, publication systems, institutional dashboards, automated recommendation tools, platform visibility, and public funding priorities can all affect which trajectories receive positive support. Once those systems are coupled to allocation, their orientation effects become performative.

Proposition 18.203 (Performative orientation feedback). *When an AI-mediated orientation process changes the allocation of attention, funding, infrastructure, personnel, data collection, or institutional authority, and those allocations subsequently alter the candidate trajectories or orientation criteria used in later rounds, the process forms a performative orientation feedback loop.*

Such feedback can be beneficial. An AI system can reveal an overlooked research area, leading to data collection that makes the area easier to study and yielding a productive new field. Feedback can also narrow inquiry if early machine rankings direct resources toward highly represented topics, which then generate more data and publications and become even easier for later systems to recommend. The direction of the loop therefore requires empirical and historical analysis.

Proposition 18.204 (Orientation-plurality condition). *Where research and action trajectories involve heterogeneous values, uncertain future consequences, or incomplete evidence, resilient AI-mediated orientation is supported by preserving multiple routes of problem formation, criticism, historical reconstruction, relational interpretation, and institutional contestation rather than allowing one generated ranking to become the sole allocator of inquiry.*

Proposition 18.204 identifies plural orientation as a resilience property. Different communities can notice different absences, assign different significance to histories, recognize different affected relations, and preserve different future options. AI can help connect these perspectives, but compression into a single ranking can remove

the very disagreement that makes orientation corrigible.

The section has therefore treated AI and research orientation as an economic problem of candidate abundance under scarce judgment. AI can expand problem fields and make difficult questions easier to formulate. Difficulty remains separate from worth. Aesthetic judgment can support exploratory filtering while requiring correction under cheap surface fluency. Historical sensitivity locates problems within paths, exclusions, and prior attempts. Relational sensitivity preserves dependencies and affected positions that generated framings can suppress. Generative judgment assesses possible future-opening effects while remaining distinct from realized value. Orientation responsibility remains with human and institutional relations capable of reasoning, contestation, revision, and accountability. The reweighting model then shows how AI-mediated generation and recommendation can change the relative support and even the practical availability of research and action trajectories.

These orientation effects become a governance problem when capability asymmetry, dependence, infrastructure control, and institutional authority make some reweightings difficult to contest or reverse. Section 18.13 therefore turns to governance under radical asymmetry, examining capability equalization, counter-power, dependency reduction, access and infrastructure governance, contestability, auditability, reversibility, and protection of human action space.

18.13 Governance under Radical Asymmetry

Sections 18.2–18.12 developed the principal objects that make governance under artificial intelligence distinctive: persistent capability asymmetry, conversion of capability into relational power, changing labor and participation, concentrated ownership of productive intelligence, AI-generated surplus, layered redistribution, human–AI relational economies, epistemic dependence, symbolic abundance, and AI-mediated research orientation. The present section integrates those results at the governance level. Its role is to identify governance functions that remain relevant when capability asymmetry is large, persistent, multidimensional, and only partly reducible through diffusion or training. Its objective is not to prescribe one constitutional model for artificial intelligence. It is to distinguish the mechanisms through which governance can preserve practical alternatives, reduce disabling dependency, constrain conversion of capability into power, maintain contestable access to consequential systems, and protect domains in which human and collective action remain materially possible.

The discussion proceeds through nine dimensions. It begins with the limits of capability equalization and counter-power, then develops dependency reduction, access governance, and infrastructure governance. The section subsequently examines contestability and auditability as governance capacities, revisits reversibility under AI-mediated path dependence, and concludes with protection of human action space. The method is relational and mechanism-specific. Governance is evaluated through the relations it changes: who depends on which system, which alternatives remain practically reachable, who can contest a consequential output, which infrastructures can be switched or repaired, which decisions can be reversed, and which human or collective capacities remain available after repeated AI mediation.

Definition 18.205 (Governance profile under radical capability asymmetry). A *governance profile under radical capability asymmetry* records the mechanisms through

Table 18.13: Governance dimensions under radical capability asymmetry.

Dimension	Primary governance object	Principal analytical question
Capability equalization	Diffusion, education, tools, public capacity, and capability floors	Which asymmetries can be narrowed, and which persistent differences require other governance mechanisms?
Counter-power	Independent capacity to resist, redirect, veto, bargain, or supply alternatives	Where can countervailing power operate effectively, and where does radical asymmetry make symmetric opposition impractical?
Dependency reduction	Substitutability, exit, portability, recovery, retained competence, and alternatives	Which dependencies can be reduced without eliminating productive complementarity?
Access governance	Terms of entry, use, continuity, priority, restriction, and appeal	Who can use consequential AI capabilities, under which conditions, and with which protections against arbitrary exclusion?
Infrastructure governance	Compute, cloud, energy, data, networks, identity, standards, and verification substrates	Which bottlenecks condition the feasible action space of downstream positions, and how are they governed?
Contestability	Practical capacity to challenge classifications, outputs, denials, decisions, or formative criteria	Can affected positions challenge both a consequential result and, where relevant, the categories, problem frames, or standards that shape later results?
Auditability	Reconstructible evidence concerning system behavior and governance history	Can consequential operations be examined with sufficient records, authority, access, and competence to support correction?
Reversibility	Rollback, migration, recovery, retained alternatives, and correction capacity	Which commitments remain practically revisable as dependence and complementary investments accumulate?
Human action space	Practically reachable domains of human and collective choice, refusal, learning, judgment, and institution building	Which forms of action remain possible without mandatory mediation by a dominant AI configuration?

which a governance architecture addresses persistent capability differences, countervailing capacity, dependency, access, infrastructure, contestation, audit, reversibility, and the preservation of practically reachable human and collective action possibilities within a declared historical and institutional scope.

Definition 18.205 keeps governance multidimensional. A system can provide broad access while remaining difficult to contest. It can support audit while preserving infrastructure dependency. It can redistribute income while leaving exit from a model ecosystem impractical. It can preserve nominal human approval while the practical action space needed for independent judgment has already eroded. Table 18.13 summarizes the nine dimensions developed below.

The rows in Table 18.13 are complementary. Capability equalization can reduce some dependencies. Public infrastructure can create alternatives that strengthen counter-power. Contestability can be weak when auditability is low, while auditability can be institutionally irrelevant when no authority can act on the findings. Reversibility can depend on retained human competence and interoperable infrastructure. Human action space can therefore be understood partly as an emergent property of the other governance dimensions rather than as one isolated safeguard.

Proposition 18.206 (Governance-mechanism plurality). *Where capability asymmetry is persistent and multidimensional, governance adequacy cannot be inferred from performance on a single mechanism such as access, redistribution, capability diffusion, or*

audit. Adequacy requires identifying the specific conversion pathways through which asymmetry becomes dependency or power and matching governance mechanisms to those pathways.

Proposition 18.206 is the organizing discipline of the section. It also prevents radical asymmetry from becoming a rhetorical label that automatically licenses one institutional response.

18.13.1 Limits of Capability Equalization

Section 18.2 treated capability as a multidimensional profile rather than a scalar measure of intelligence. That result already limits the idea of capability equalization. Education, tool diffusion, open models, public compute, shared data, complementary institutions, and human–AI collaboration can narrow important differences, yet equalization can remain partial because speed, memory, scale, coordination, infrastructure, capital, data access, and organizational integration respond differently to the same intervention. A person can receive access to a high-capability model while lacking the compute, organizational support, verification infrastructure, or legal permissions required to convert that access into comparable productive capacity.

Capability equalization is therefore best treated as one governance mechanism among several. It can reduce the degree to which one position must rely on another for a function. It can enlarge bargaining alternatives. It can preserve professional competence and public-sector capacity. It can also reduce the social cost of exit from a provider. These effects are important even when full parity is unattainable.

Definition 18.207 (Capability-equalization profile). *A capability-equalization governance profile records which capability dimensions a governance arrangement attempts to narrow, the instruments used to do so, the conversion conditions required for practical use, the positions reached by those instruments, and the residual capability asymmetries that remain after implementation.*

The profile can include capability floors rather than pairwise equality. Public education can aim to preserve independent verification competence. Public compute can ensure that research institutions retain capacity to test or adapt models. Interoperability rules can lower switching costs. Open standards can preserve compatibility across providers. Such arrangements can materially reduce dependency even when frontier systems continue to differ greatly in scale or performance.

The residual profile matters because governance can fail if it assumes that a formal opportunity has erased the asymmetry that motivated the intervention. A public model may exist while the private ecosystem retains much greater integration, data, distribution, or maintenance capacity. Training programs can increase skills while the relevant production frontier moves faster than training institutions can update. Equalization should therefore be evaluated dynamically rather than through a one-time snapshot.

Proposition 18.208 (Residual-asymmetry condition). *Where governance narrows some capability dimensions while materially consequential asymmetries persist in complementary dimensions, the remaining asymmetries should continue to be analyzed for dependency and power conversion rather than being treated as resolved by formal capability diffusion.*

The proposition does not imply that equalization is ineffective. It identifies the

point at which another governance mechanism becomes necessary. A society can rationally invest in broad capability formation while simultaneously governing access, infrastructure, contestability, and dependency.

18.13.2 Limits of Counter-Power

Power can often be constrained by countervailing power. Workers organize against employers, jurisdictions check one another, professions establish independent standards, competing firms reduce unilateral control, and public institutions can limit private authority. Radical capability asymmetry complicates this architecture because effective counter-power itself requires capability, infrastructure, information, coordination, and time. A position can possess formal rights to oppose a system while lacking the technical or organizational capacity required to exercise those rights effectively.

The relevant issue is therefore the practical construction of counter-power. A regulator that depends on the regulated firm's models, cloud infrastructure, or technical expertise can possess legal authority alongside weak independent capability. Small organizations can negotiate individually with a dominant platform while lacking credible alternatives. Users can leave one service while the entire sector relies on the same upstream compute, identity, or data infrastructure. Counter-power should consequently be evaluated across the dependency stack rather than inferred from the presence of several nominal actors.

Ostrom's work on polycentric governance is relevant because it emphasizes multiple centers of decision making and the possibility of coordination without one monopolistic center (Ostrom 2010). The present use is structural rather than prescriptive. Polycentricity can strengthen comparison, local adaptation, and alternative provision, yet several centers can remain dependent on the same concentrated technical substrate. Institutional plurality and infrastructural plurality therefore need separate diagnosis.

Definition 18.209 (Counter-power capacity). *Counter-power capacity* is the practical capability of a position or coalition to resist, redirect, veto, bargain over, replace, or create credible alternatives to a consequential exercise of relational power, given the information, infrastructure, authority, coordination, and recovery resources available within the relevant historical configuration.

Counter-power need not mirror the dominant capability. A community does not need to train a frontier model to possess meaningful counter-power if it can invoke binding procedural rights, use interoperable alternatives, obtain independent expert review, or collectively govern an essential interface. The mechanism can be legal, infrastructural, organizational, economic, epistemic, or mixed.

Proposition 18.210 (Counter-power non-symmetry). *Effective counter-power does not require capability symmetry with the power-bearing position. It requires at least one consequential pathway through which the countervailing position can alter, constrain, contest, exit, or credibly substitute for the relevant power-conditioned relation.*

This proposition permits governance to search for leverage points other than direct technological parity. It also identifies a limit: where every consequential pathway is controlled by the same capability complex, formal plurality can coexist with weak counter-power.

Proposition 18.211 (Counter-power dependency limit). *Counter-power is weakened when the institutions expected to constrain a power-bearing configuration materially depend on that same configuration for the expertise, infrastructure, data, operational continuity, or decision support required to exercise the constraining function.*

The conclusion is not that dependent governance is impossible. It is that dependence should be included in the governance model rather than hidden behind organizational separation.

18.13.3 Dependency Reduction

Sections 18.3, 18.9, and 18.10 distinguished several forms of dependency: productive dependence, infrastructural dependence, delegation dependence, epistemic dependence, and relational dependence. Governance under radical asymmetry therefore needs a more precise objective than eliminating dependence. Economic systems are built from interdependence. Hospitals depend on power grids, firms depend on logistics, researchers depend on archives, and people depend on one another for care and knowledge. The governance concern arises when dependence becomes disabling, non-contestable, difficult to exit, or readily convertible into persistent relational power.

Dependency reduction can operate through several levers. Substitutability creates credible alternatives. Portability allows records, workflows, and accumulated assets to move. Interoperability permits other systems to connect. Retained competence prevents total loss of independent capability. Redundancy preserves operation when one provider fails. Public or commons provision can supply fallback capacity. Contractual and legal protections can limit unilateral changes. Recovery infrastructure can preserve continuity after exit or failure.

Definition 18.212 (AI dependency-reduction profile). *An AI dependency-reduction profile records, for a specified human–AI or institution–AI relation, the practical substitutability of the AI-mediated function, the feasibility of exit and migration, portability of relevant records and assets, retained human or organizational competence, recovery capacity, alternative providers or procedures, verification independence, and the historical conditions under which these capacities can be maintained.*

The profile is dynamic. A relation that is initially easy to exit can become difficult to leave after data formats, organizational routines, professional skills, workflows, or complementary investments are reorganized around one system. Dependency reduction must therefore include maintenance of alternatives, not merely their initial existence.

Proposition 18.213 (Dependency-reduction power condition). *Where a capability asymmetry becomes power-relevant principally through dependency, governance that materially improves substitutability, exit, portability, retained competence, recovery, or alternative provision can reduce the conversion of that asymmetry into relational power even when the underlying capability difference remains large.*

This proposition is one of the central implications of the chapter. It shifts some governance attention from eliminating capability differences to changing the relations through which those differences become consequential.

18.13.4 Access Governance

Section 18.6 distinguished model ownership, compute ownership, data control, platform control, infrastructure control, and access rights. Access governance concerns the terms through which those underlying positions are converted into practical use. It includes admission, pricing, rate limits, identity requirements, permissible uses, service continuity, priority during scarcity, geographic restrictions, interface design, API conditions, model versions, termination, appeals, and the allocation of exceptional access for research, public administration, or essential services.

Access has both enabling and protective functions. Broad access can diffuse productive capacity, reduce asymmetry, and support innovation. Restrictions can also protect privacy, security, safety, or scarce infrastructure. The governance question is therefore not maximal access in the abstract. It is whether the access architecture is justified, predictable, contestable, and compatible with the capability and participation functions the institution is expected to support.

Definition 18.214 (Governed AI access profile). *A governed AI access profile specifies the eligibility conditions, practical usability, price or resource requirements, duration and continuity expectations, usage constraints, prioritization rules, modification rights, portability conditions, termination procedures, review mechanisms, and affected positions associated with access to a consequential AI capability or service.*

Formal availability and effective access remain distinct. A model can be technically public while high compute requirements make meaningful use inaccessible. An API can be available while rate limits prevent institutional-scale operation. A public service can be nominally universal while language, disability, identity, connectivity, or payment requirements exclude practical use. Access governance should therefore preserve the conversion analysis developed in Section 18.8.

Proposition 18.215 (Access–control non-equivalence). *Broad access to an AI capability does not by itself distribute control over model evolution, infrastructure, service continuity, usage rules, data retention, or downstream decision authority. Access governance and control governance should therefore remain analytically distinct.*

The distinction prevents a public-facing interface from being treated as evidence of distributed productive intelligence. It also supports targeted governance: one problem may require broader access, another continuity guarantees, another portability, and another limits on unilateral rule change.

18.13.5 Infrastructure Governance

AI capability is materially dependent on infrastructures that extend beyond the model itself. Compute hardware, data centers, cloud services, energy, cooling, network connectivity, identity systems, payments, cybersecurity, data pipelines, standards, logging systems, and verification tools can each become bottlenecks. Section 18.6 treated control over such infrastructures as an ownership and power question. The present subsection asks how those infrastructures can be governed when their failure, concentration, or exclusion materially conditions downstream action.

Infrastructure governance has at least four functions. The first is continuity: essential users may require predictable service and recovery capacity. The second is plurality: several providers or interoperable architectures can reduce single-point dependency. The third is public-interest access: research, education, public admin-

istration, or socially necessary services can require capacity that market allocation alone does not guarantee. The fourth is accountability: infrastructure operators can shape downstream possibilities through technical rules that are difficult for users to observe or contest.

Definition 18.216 (AI infrastructure-governance profile). An *AI infrastructure-governance profile* records the ownership, control, access, continuity, interoperability, redundancy, security, maintenance, public-interest obligations, failure recovery, environmental dependencies, and review mechanisms associated with the infrastructural layers required to realize AI capability in a specified field.

Infrastructure governance can be public, private, cooperative, commons-based, polycentric, or hybrid. The relevant criterion is functional rather than categorical: which arrangements preserve continuity, alternatives, accountability, and justified access under the dependency structure of the field.

Proposition 18.217 (Bottleneck-governance condition). *Where a small set of infrastructural bottlenecks materially determines the practical availability of otherwise distributed AI capabilities, governance of those bottlenecks can be more consequential for dependency and power than formal distribution of model access alone.*

The proposition explains why open models can coexist with concentrated productive intelligence. It also creates an interface with public-infrastructure and commons analysis later in the book.

18.13.6 Contestability

Chapter 16 developed participation and contestability as general governance objects, while Sections 18.10–18.12 showed how AI-mediated knowledge, representation, and orientation can influence consequential decisions. Under radical asymmetry, contestability matters because affected positions may be unable to reproduce the capability used to generate a classification, recommendation, risk score, research priority, eligibility decision, or service denial. Governance must therefore distinguish the capacity to reproduce the system from the capacity to challenge its consequential use.

Effective contestability requires more than a complaint channel. A person needs to know that a consequential determination occurred, understand enough of its basis to identify a ground of challenge, reach a reviewing authority, present relevant evidence, obtain suspension or mitigation where delay would make review meaningless, and receive a reasoned response that can alter the outcome. Different domains can require different levels of explanation, evidence disclosure, confidentiality, and review.

Definition 18.218 (AI-governance contestability). *AI-governance contestability* is the practical capacity of an affected position to identify a consequential AI-mediated determination, obtain sufficient information to formulate a challenge, submit relevant evidence or reasons, reach an authority with power to review and alter the determination or its effects, and receive a traceable response within a time horizon that preserves meaningful remedy.

Contestability can be individual or collective. A professional association can challenge a system-wide classification rule. A municipality can contest an infrastructure provider's access condition. A research community can challenge automated funding criteria. Collective contestation can be especially important where individual cases

are weak evidence of a systematic effect.

Proposition 18.219 (Consequential-contestability condition). *A nominal review process provides weak contestability when the reviewing body lacks practical authority, relevant evidence, independent expertise, time, or capacity to alter the consequential relation under challenge.*

This condition mirrors the distinction between formal and effective participation developed earlier in the book. It also links contestability to auditability, because a challenge can require records that ordinary users cannot generate themselves.

AI-mediated governance can require a second layer of contestability where the disputed object is not only a particular output but the categories, problem frames, relevance criteria, ranking conventions, or evidential forms through which later outputs are generated and received. A person can successfully appeal one classification while remaining unable to challenge the taxonomy that repeatedly produces the same type of classification. A professional body can correct an individual recommendation while leaving the model-mediated problem frame that organizes later recommendations outside review. In such cases, outcome review remains valuable but does not reach the formative conditions of the decision environment.

Definition 18.220 (Formative contestability under AI mediation). *Formative contestability under AI mediation is the practical capacity of affected or legitimately represented positions to identify and challenge, through an institution capable of response, the categories, problem frames, evidential conventions, relevance criteria, or other recurrent structures through which AI-mediated processes condition later interpretation or decision.*

Formative contestability does not require every classification scheme or model ontology to remain continuously open during each operational decision. Institutions often need provisional settlement in order to act. The stronger requirement is that repeated settlement should not make its own formative premises practically unreachable when those premises materially organize later participation or burden. This distinction will become important in Section 18.14, where realized normative influence can alter the conditions under which later sources become legible, recognized, or able to re-enter a formation process.

Proposition 18.221 (Formative-contestability condition). *Where an AI-mediated arrangement recurrently shapes the categories or criteria through which later contributions are interpreted, governance has stronger contestability when review can reach those formative structures as well as their individual outputs, while preserving domain-appropriate requirements for timely decision and institutional settlement.*

18.13.7 Auditability

Auditability concerns the reconstructibility of consequential system behavior and governance history. It is related to transparency but is not identical with it. Publishing code, model cards, or aggregate metrics can improve visibility while leaving a specific decision path, version history, data transformation, access change, or institutional authorization difficult to reconstruct. Conversely, a system can remain partly opaque in technical detail while preserving strong audit records concerning inputs, outputs, decisions, overrides, failures, and governance procedures.

Kroll and colleagues emphasize the importance of accountability mechanisms that

extend beyond direct source-code transparency (Kroll et al. 2017). The same principle applies here. Under radical capability asymmetry, the audit question is whether an authorized and sufficiently independent process can reconstruct the evidence needed to evaluate a consequential claim, system behavior, or governance failure.

Definition 18.222 (AI governance auditability). *AI governance auditability* is the degree to which a consequential AI-mediated operation can be reconstructed and evaluated through preserved records, version information, provenance, decision logs, authorization histories, relevant inputs and outputs, performance evidence, override records, and access to the technical and institutional expertise required for a declared audit purpose.

Auditability can fail through absence of records, inaccessible records, rapidly changing systems, weak version control, proprietary barriers, missing provenance, insufficient expertise, or lack of legal authority. Retention itself can create privacy and security burdens. Governance should therefore specify which records are necessary for which audit purpose and how long they should be preserved.

Proposition 18.223 (Auditability–accountability non-equivalence). *Auditability can supply evidence for accountability, correction, and contestation, but it does not by itself determine responsibility, remedy, legitimacy, or institutional response. An auditable system remains weakly governed when no position is authorized or capable of acting on the audit findings.*

This proposition keeps audit inside the wider governance architecture. Audit evidence becomes consequential only through institutions that can revise rules, repair harm, change access, impose obligations, or otherwise alter the relation under review.

18.13.8 Reversibility

Chapter 16 treated reversibility as a changing governance capacity rather than a binary property. AI intensifies this problem because deployment can reorganize workflows, skills, data, institutions, infrastructure, expectations, and professional roles. A model can be removed while the organization remains unable to return to the earlier mode of operation. Formal revocability of an AI system is therefore weaker than practical reversibility of the institutional transformation it helped generate.

Reversibility under radical asymmetry has several components. Technical rollback concerns the ability to suspend or replace a system. Data reversibility concerns recovery, portability, and deletion. Organizational reversibility concerns the ability to restore or redesign workflows. Capability reversibility concerns whether human or alternative institutional competence remains available. Contractual reversibility concerns exit from provider obligations. Relational reversibility concerns whether dependencies, expectations, or role structures can still be changed without disproportionate harm.

Definition 18.224 (AI governance reversibility reserve). *An AI governance reversibility reserve* is the retained collection of technical alternatives, interoperable data and records, human and organizational competence, contractual exit rights, independent infrastructure, financial resources, authority, time, and recovery pathways required to revise, suspend, replace, or substantially redirect an AI-mediated arrangement before the relevant option space closes.

The reserve can decay. Human expertise can atrophy. Alternative suppliers can exit the market. Data can migrate into proprietary formats. Public institutions can redesign themselves around one system. Complementary investment can become sunk. Governance should therefore monitor the conditions of rollback while adoption proceeds, as Section 16.15 required for near-critical interventions and Section 16.20 generalized for adaptive governance.

Proposition 18.225 (AI reversibility-decay condition). *Where repeated AI adoption reduces alternative provision, retained competence, interoperability, exit rights, or recovery resources, formal authority to discontinue the system becomes a progressively weaker indicator of practical reversibility.*

Reversibility does not imply that every decision should remain easy to undo. Stable rights, safety protections, and long-horizon infrastructure can require commitment. The governance task is to identify which dimensions require credible durability and which require preserved correction pathways under uncertainty.

18.13.9 Protection of Human Action Space

The preceding governance dimensions converge on a broader object: human action space. The term does not mean preserving a domain in which humans remain technologically superior. It refers to preserving practically reachable possibilities through which persons and human-governed collectives can form purposes, learn, deliberate, refuse, choose alternatives, create institutions, maintain care relations, contest authority, develop knowledge, and initiate actions whose feasibility is not wholly conditional on one dominant AI-mediated configuration.

Sen's capability approach provides an important neighboring intuition: evaluation should concern substantive opportunities as well as resources or formal rights (Sen 1999). GRE's use is narrower and historically relational. The relevant action space is generated through institutions, infrastructures, skills, records, rights, social relations, and technological interfaces. It can expand or contract as those relations change. Formal permission to act has limited value when the capabilities or infrastructures required for action have disappeared.

Definition 18.226 (Human action space under AI mediation). *The human action space under AI mediation is the model-relative family of practically reachable actions, relations, institutional formations, learning trajectories, refusal options, interpretive practices, collective organizations, and alternative technological arrangements that persons and human-governed collectives can initiate or sustain without being obligatorily routed through a specified dominant AI-mediated dependency.*

The definition is relational rather than species-essentialist. It does not claim that every valuable human action must exclude AI. Human action space can include intensive AI collaboration. The relevant condition is preservation of meaningful alternatives and human-governed capacities sufficient to choose, contest, redesign, or refuse particular forms of mediation.

Protection of action space can therefore include public education, independent research capacity, interoperable systems, human-accessible procedures, non-digital fallbacks for essential services, professional competence, local institutional authority, public or commons infrastructure, collective organization, and protected domains of deliberation. The appropriate mix depends on the function and the cost of dependence.

Proposition 18.227 (Action-space protection condition). *Under radical capability asymmetry, governance protects human action space when it preserves materially usable alternatives through which persons or human-governed collectives can continue consequential learning, judgment, refusal, coordination, institution building, and action even if a dominant AI-mediated relation is unavailable, contested, or intentionally declined.*

Action-space protection is stronger than nominal human oversight. A human reviewer whose judgment depends completely on the same system being reviewed may occupy a formal role without possessing an independent action space. A public institution that can legally switch vendors but lacks data portability, staff competence, or alternative infrastructure has weak practical choice. The protected object is therefore the future capability to act differently.

Proposition 18.228 (Generative action-space condition). *A governance arrangement has a stronger generative action-space property when it preserves not only currently available alternatives but also the capacities, institutions, infrastructures, records, and participation pathways through which new alternatives can be formed after future conditions change.*

This proposition connects action-space protection to GRE's wider concern with generativity. A fixed fallback procedure can preserve one alternative today while offering little capacity to respond to unforeseen changes. A resilient governance architecture maintains the means of generating alternatives: people able to learn, institutions able to revise, infrastructures able to interoperate, communities able to organize, and records sufficient to reconstruct why earlier arrangements existed.

Governance under radical asymmetry therefore does not require a single strategy of equalization, prohibition, decentralization, or control. Capability equalization can narrow selected gaps. Counter-power can constrain power without reproducing the same capabilities. Dependency reduction can change the mechanism through which asymmetry becomes power. Access and infrastructure governance can preserve practical alternatives and public-interest capacity. Contestability and auditability can make consequential uses challengeable and reconstructible. Reversibility can keep correction paths open as institutional dependence deepens. Protection of human action space then supplies a broader generative criterion: whether humans and human-governed collectives retain practical capacity to form, contest, and create future arrangements rather than merely adapt to one increasingly entrenched technological field.

The analysis also identifies a limit of governance framed only as protection. Preserving action space does not by itself ensure that people can participate meaningfully in knowledge, decisions, institutions, care, community, or culture. Nor does formal participation establish that participants retain comparable influence over the categories and pathways through which later participation becomes consequential. Section 18.14 therefore turns from protective governance to *generative participation under AI*. It distinguishes available generative capacity from realized normative influence, examines recursive changes in the distribution of formative significance, and then asks through which institutions human and human-governed collective participation can remain consequential even where comparative productive necessity declines.

18.14 Generative Participation under AI

Sections 18.4–18.13 progressively separated employment, material distribution, existential participation, productive-intelligence ownership, human–AI relational organization, epistemic dependence, research orientation, and governance under radical capability asymmetry. The present section develops a stronger participatory object. Its role is to ask whether persons and human-governed collectives remain able to enter the processes through which future knowledge, decisions, institutions, care relations, communities, cultural forms, and alternatives are generated. Its objective is therefore broader than preserving access to goods or services and narrower than providing a complete political or moral theory of participation. The analysis first clarifies how generative capacity becomes realized normative influence and how earlier influence can alter the conditions of later participation. It then proceeds across eight participatory domains: knowledge, decision, institutions, care, community, culture, participation beyond productive necessity, and protection against generative foreclosure. A final subsection develops generative return as an intertemporal question concerning whether asymmetric relations enlarge or narrow the future generative capacities of participating positions. Throughout the section, participation is treated as historically and institutionally organized. Artificial systems can mediate or contribute to these processes without the analysis presupposing artificial subjecthood, a question reserved for Section 18.15.

A distinction among several participatory statuses is useful at the outset. A person can be *present* in a system without influencing it, can possess *access* without practical capability to use it, can be *consulted* without affecting the decision rule, can *consume* knowledge without participating in its production or criticism, and can receive material provision without participating in the institutions that organize provision. Generative participation concerns a further relation: the ability to contribute to the formation, revision, maintenance, interpretation, or replacement of structures that condition later possibilities.

Definition 18.229 (Generative participation under AI). *Generative participation under AI* is the practical capacity of a person or human-governed collective to enter, influence, sustain, revise, contest, or initiate AI-mediated and AI-adjacent processes through which later knowledge, decisions, institutions, relations, cultural forms, capabilities, or feasible alternatives are produced.

The definition is deliberately plural. Participation can be direct, representative, professional, community-based, institutional, or infrastructural. It can occur with intensive AI assistance. The relevant condition is consequential participation in the generation of later relational possibilities rather than preservation of a technologically isolated human domain.

Proposition 18.230 (Participation–presence non-equivalence). *Presence, access, consultation, or receipt of benefits does not by itself establish generative participation. A stronger participation claim requires at least one practically consequential pathway through which the participating position can alter, sustain, contest, reinterpret, or initiate a process that conditions later possibilities.*

Table 18.14 summarizes the eight participatory domains developed after the opening analysis of normative influence. The dimensions can reinforce one another without being reducible to one common scale. Knowledge participation can support decision participation; institutional participation can protect care or cultural participa-

Table 18.14: Dimensions of generative participation under AI.

Domain	Participatory object	Generative consequence	Characteristic constraint
Knowledge	Questions, evidence, interpretation, criticism, preservation	Later inquiry and epis-temic capability	Passive consump-tion or unverifiable mediation
Decision	Problem framing, crite-ria, deliberation, revi-sion, appeal	Later choices, priorities, and admissible actions	Participation after the consequential frame is fixed
Institutions	Rules, roles, proce-dures, infrastructures, governance	Reproduction and redesign of collective capacity	Fixed institutional interfaces or in-accessible rule formation
Care	Attention, responsi-bility, responsiveness, continuity	Maintenance and develop-ment of persons and rela-tions	Task substitution that removes recip-rocals or account-able participation
Community	Shared projects, mu-tual support, local organization	Collective capability and new relational possibilities	Platform depen-dence, weak col-lective control, or fragmented associa-tion
Culture	Creation, interpre-tation, transmission, criticism	Symbolic repertoires and later meaning formation	Synthetic abun-dance with concen-trated visibility or cultural production channels
Post-necessity participation	Learning, making, stewardship, inquiry, care, association	Contribution beyond labor-market demand	Social membership tied narrowly to employment or productivity
Foreclosure protection	Alternative-forming capacities and institu-tions	Future creation of options and institutional forms	Irreversible depen-dency, deskilling, enclosure, or loss of generative path-ways

tion; community participation can generate new knowledge and institutions. Their interaction is historically contingent.

18.14.1 Recursive Distribution of Normative Influence

Generative participation requires a distinction between the capacity to contribute and the influence that a contribution actually acquires within a historical formation. The distinction matters acutely under artificial intelligence because machine systems can generate candidate classifications, explanations, rankings, recommendations, arguments, images, and policy formulations at large scale while their practical consequences remain mediated by access, interface design, institutional uptake, trust, default placement, professional practice, and the authority of organizations that deploy them. Conversely, a comparatively small contribution can become highly consequen-

tial when it enters a recurrent workflow, a widely used classification, or an institutional standard at a formative moment.

The relevant capacity should therefore be specified relationally rather than treated as an intrinsic stock of intelligence or expressive output. A human participant may possess substantial knowledge but lack a channel through which it can enter a decision. An artificial system may possess high generative throughput but little recognized standing outside an institutional interface. A professional body may possess formal authority while depending on model-generated categories that shape which questions reach it. A community practice may retain locally significant knowledge while remaining weakly legible to the data and evidential formats used by a consequential AI-mediated process.

Definition 18.231 (Normative generative capacity). *Normative generative capacity* is the model-relative and domain-specific practical capacity of a source to contribute to the generation, stabilization, interpretation, transmission, revision, reopening, or reproduction of concepts, evaluative distinctions, practical expectations, classifications, standards, or other structures that condition later judgment or action within a declared relational setting.

The source in Definition 18.231 can be a person, collective, institution, practice, archive, technical system, artificial model, or relational assemblage. Here, *normative* identifies structures that organize judgment, interpretation, expectation, classification, or action; it does not imply moral validity, justified authority, or legal force. Treating an artificial system as a source for this analytical purpose likewise does not settle subjecthood, moral standing, responsibility, or ultimate ontology. The definition records a functional position within a formation process.

Definition 18.232 (Realized normative influence). *Realized normative influence* is the discernible consequence that a source's contribution acquires within a particular normative trajectory, including effects on judgments, classifications, practices, interpretations, standards, or the conditions through which later contributions become accessible, legible, recognized, durable, or institutionally actionable.

The distinction between Definitions 18.231 and 18.232 is analytical rather than ontological. Capacity is already relational: expertise that has no route of entry into the relevant process has limited formative capacity in that setting. Realized influence identifies the further question of what consequences were actually produced. Access, timing, visibility, legibility, recognition, interface prominence, institutional support, material persistence, and competing or complementary sources can mediate the relation between the two.

Proposition 18.233 (Capacity–influence non-equivalence). *A difference in normative generative capacity does not by itself determine the realized normative influence of the relevant sources. A stronger inference requires analysis of the relational conditions through which available contributions enter, persist within, and alter the formation process.*

AI mediation adds a recursive possibility. Once a source becomes influential, the consequences of that influence can alter the conditions through which later sources are received. A model-generated taxonomy can become embedded in forms and databases; repeated reliance on one system can shape professional vocabulary and training; a ranking interface can determine which materials receive attention; a widely used synthetic explanation can become the starting point against which later interpretations must position themselves. Earlier influence can thereby reorganize

later access, legibility, recognition, institutional support, or material persistence.

Definition 18.234 (Endogenous normative weighting). *Endogenous normative weighting* is a change in the relative formative significance of normative sources that arises partly because earlier episodes of the same formation process alter the practical conditions through which later contributions become accessible, legible, recognized, persistent, or consequential.

The term *weighting* does not imply a numerical coefficient or an additive model of normative formation. It refers to the effective significance of a source within a declared process. Some endogenous weighting can support cumulative learning: demonstrated expertise can acquire warranted trust, useful terminology can stabilize inquiry, and reliable practices can become easier to reuse. The analytical concern begins when cumulative advantages alter the future formative capacities of other relevant sources in ways that are difficult to contest or reverse.

Definition 18.235 (Generative crowding-out). *Generative crowding-out* occurs when the increasing effective significance of one source, or a closely aligned set of sources, materially weakens the practical capacity of other relevant sources to participate in subsequent formation through reduced access, recognition, visibility, institutional support, legibility, or capacity to reproduce an alternative vocabulary, practice, or infrastructure.

Crowding-out is stronger than unequal influence and weaker than complete disappearance. An alternative can remain archived, privately practiced, or formally permitted while losing practical ability to affect the consequential formation. The mechanism can also be distributed. Repeated selection of the most familiar model, platform, evidential format, or vocabulary can cumulatively make alternatives more costly without any actor intending exclusion. Neither crowding-out nor concentration of influence constitutes a complete justice diagnosis by itself; their normative significance depends on provenance, purpose, burdens, justification, revisability, and consequences for later participation.

A further threshold concerns the conditions of intelligibility themselves. AI-mediated classifications and interfaces can become consequential not only because they recommend an outcome but because they shape which descriptions count as relevant inputs, which alternatives appear in a choice set, which reasons are easy to express, and which forms of evidence are routinely preserved. Where these conditions become sufficiently restrictive, the issue extends beyond concentration of influence.

Definition 18.236 (Normative closure). *Normative closure* is a partial, domain-specific, and potentially reversible configuration in which relevant alternative sources face substantial and persistent difficulty participating in the continued formation, interpretation, or revision of a normative structure because the effective conditions of access, intelligibility, recognition, preservation, or institutional uptake have become comparatively concentrated.

Normative closure should not be inferred from agreement, expertise, hierarchy, or temporary settlement alone. Collective action often requires decisions, classifications, standards, and working conventions to become provisionally determinate. *Decisional closure* can therefore coexist with continued access to reasons, dissent, alternative vocabularies, and later revision. Normative closure concerns the stronger case in which the capacity to reopen or reshape the formative field itself becomes materially restricted. This distinction connects directly to the formative contestability introduced

in Section 18.13.

Proposition 18.237 (Recursive normative-influence condition). *Where AI-mediated influence changes the access, legibility, recognition, persistence, or institutional uptake available to later sources, evaluation of the relation requires attention to both first-order effects on present judgments and second-order effects on the distribution of future normative generative capacity.*

This proposition supplies the temporal bridge to the participatory domains that follow. Generative participation is not established merely because a person can submit material to an AI-mediated process. The question is whether that contribution can become consequential and whether the process preserves or transforms the conditions under which that person and other sources can participate in later rounds of formation.

18.14.2 Participation in Knowledge

Chapter 17 treated knowledge as an economic object embedded in attention, institutions, infrastructure, preservation, justice, and relational participation. Artificial intelligence intensifies the distinction between access to knowledge products and participation in knowing. A person can receive answers of high apparent quality while contributing little to question formation, evidence selection, verification, interpretation, criticism, preservation, or the production of later research directions. Such access can be valuable, but its economic consequences differ from those of sustained participation in the epistemic process.

Knowledge participation under AI can occur at several stages. Participants can identify problems that automated systems do not make salient. They can contribute observations or situated knowledge. They can inspect provenance, test outputs, compare interpretations, formulate counterexamples, maintain records, translate across knowledge systems, and decide which uncertainties deserve further inquiry. They can also participate in the governance of datasets, archives, model-mediated research infrastructure, and institutional standards that shape what becomes epistemically visible.

Longino's social account of scientific knowledge emphasizes criticism and community interaction in the production of knowledge (Longino 1990). Situated-learning traditions likewise emphasize participation in practice rather than the transfer of decontextualized information alone (Lave and Wenger 1991; Wenger 1998). The present use is economic and institutional: if AI changes the cost of producing candidate answers, the capacity to participate in criticism, verification, question formation, and knowledge maintenance can become a more consequential scarce capability.

Definition 18.238 (Epistemic generative participation). *Epistemic generative participation* is practical participation in one or more processes through which questions, evidence, interpretations, warrants, critiques, records, or research directions are produced or revised in ways that condition later inquiry.

The definition does not require every participant to reproduce the technical operations of an AI system. A patient can contribute experiential evidence without implementing a medical model. A local community can identify missing environmental variables without reproducing a remote-sensing pipeline. A student can challenge an interpretation without training a language model. The participatory requirement concerns a consequential interface through which the contribution can enter the epis-

temic process.

Proposition 18.239 (Knowledge-participation condition). *AI-mediated knowledge access supports stronger epistemic generative participation when affected positions retain practical pathways to formulate questions, contribute evidence, inspect or challenge relevant claims, preserve alternative interpretations, and influence the continuation of inquiry.*

This condition connects participation to the epistemic-agency reserve developed in Section 18.10. The reserve concerns retained human and institutional capability; generative participation concerns whether that capability has consequential pathways into ongoing knowledge formation. A society can possess competent experts whose work is systematically excluded from AI-mediated decision systems, or open interfaces through which participants can submit material that no institution is required to consider. Capability and uptake therefore remain distinct.

18.14.3 Participation in Decision

Decision participation concerns the formation of consequential choices rather than the mere notification of outcomes. AI-mediated decision systems can reorganize this process by generating recommendations, ranking options, setting default categories, estimating risks, allocating attention, or preselecting the questions that decision makers encounter. Participation that occurs only after these structures are fixed can remain procedurally visible while having limited influence over the generative conditions of the decision.

A fuller architecture distinguishes participation in problem definition, criterion formation, evidence interpretation, option generation, deliberation, authorization, implementation, monitoring, revision, and appeal. Different institutions can distribute these roles differently. Technical experts may define feasible options, affected communities may supply local knowledge, elected or appointed authorities may bear formal responsibility, and AI systems may generate analysis. The relevant GRE question is which positions can change the decision-generating process and under what conditions.

Definition 18.240 (Generative decision participation). *Generative decision participation is the practical capacity of an affected or authorized position to influence the formation of a consequential decision by contributing to at least one of its generative components, including problem framing, admissible criteria, evidence, option formation, deliberation, authorization, revision, or remedy.*

The definition separates participation from universal co-decision. Some decisions require specialized competence, confidentiality, speed, or delegated authority. Generative participation can therefore be differentiated by role. What matters is whether the allocation of roles leaves meaningful pathways for relevant knowledge, interests, reasons, and contestation to alter the process where they are substantively pertinent.

Proposition 18.241 (Decision-framing participation). *Where an AI-mediated system fixes the problem representation, admissible evidence, evaluative criteria, or option set before affected positions can participate, later consultation can leave the principal generative structure of the decision unchanged even when the consultation itself is procedurally genuine.*

This proposition is not an argument that every decision frame should remain per-

manently open. Closure is necessary for action. The analytical obligation is to identify where closure occurs, who can participate before and after it, and which revision pathways remain available when the frame proves inadequate. Section 18.13 developed contestability and reversibility for this reason. Generative decision participation adds the positive dimension: people should not be positioned only as objects of review after AI-mediated framing has already organized the field of possible action.

18.14.4 Participation in Institutions

Institutions preserve and reproduce economic possibilities across time. They define membership, standing, ownership, procedural access, professional roles, evidence requirements, allocation rules, and infrastructures. AI can enter institutions as a tool used within existing procedures, yet sustained adoption can also alter the procedures themselves. Automated triage can become an eligibility architecture; model-mediated assessment can reshape professional roles; platform interfaces can become de facto administrative infrastructure; and technical standards can redefine which participants are legible to the institution.

Participation in institutions therefore extends beyond using institutional services. It concerns the capacity to take part in rule formation, institutional maintenance, representation, evaluation, and redesign. Ostrom's analysis of commons governance illustrates how participants can be involved in rule systems governing shared resources (Ostrom 1990). GRE generalizes the structural point without treating one institutional form as universally appropriate: institutions can differ in who participates, which rules are revisable, how expertise is incorporated, and how affected positions gain standing.

Definition 18.242 (Institutional generative participation). *Institutional generative participation* is the practical capacity of members, affected positions, or authorized representatives to contribute to the formation, maintenance, evaluation, contestation, or redesign of institutional rules, roles, procedures, infrastructures, or boundaries that condition later participation.

Institutional participation can be direct or mediated. Workers can elect representatives; professional bodies can establish standards; local communities can participate in planning; independent auditors can represent public accountability functions; public institutions can govern shared infrastructure on behalf of broader constituencies. The form of representation requires separate normative evaluation, yet the existence of an institutional route is analytically distinct from the outcome it produces.

Proposition 18.243 (Institution-making capacity). *A participation architecture is more generative when participants retain practical capacity not only to operate within existing institutional rules but also to propose, test, revise, and organize alternative institutional arrangements when existing rules cease to support relevant purposes or affected positions.*

The proposition connects institutional participation to human action space. A population can retain access to services while losing capacity to shape the institutions through which those services are delivered. If essential governance is progressively embedded in opaque vendor workflows, proprietary standards, or non-portable infrastructure, formal public authority can coexist with declining institution-making capacity. Protecting participation therefore includes preserving institutional competence, records, legal authority, organizational memory, and alternative infrastruc-

tures through which redesign remains feasible.

18.14.5 Participation in Care

Section 18.4 distinguished care-related tasks from the broader care relation. The present subsection develops the participatory consequence. Care recipients, caregivers, families, professionals, communities, and public institutions can all participate in defining needs, interpreting changes, allocating attention, maintaining continuity, and deciding how assistance is organized. AI can support these relations through monitoring, communication, scheduling, translation, documentation, decision support, and robotic assistance. It can also narrow participation if care is reorganized around standardized classifications or remote systems that leave recipients and frontline caregivers with weak capacity to revise the care process.

Feminist economics has shown that care involves maintenance, responsibility, and relational labor that extend across paid and unpaid domains (Folbre 2001; England 2005). The generative issue is not the preservation of every existing care task. It is whether care arrangements continue to support reciprocal interpretation, responsibility, development, and the capacity of involved persons to shape the relation where their participation is relevant.

Definition 18.244 (Generative care participation). *Generative care participation* is practical involvement in the interpretation, provision, revision, or governance of care relations in ways that can influence the later capabilities, continuity, trust, responsibility, or relational conditions of the persons and collectives involved.

The definition includes the participation of care recipients where their capacities and circumstances permit, while allowing representation and supported decision arrangements where direct participation is limited. It also includes caregiver participation in organizational design. A system that asks frontline caregivers to implement AI-generated protocols while excluding their observations from protocol revision can increase procedural standardization while weakening generative participation.

Proposition 18.245 (Care-participation preservation). *AI-mediated care preserves a stronger participatory structure when technical substitution reduces burdens or extends capability while retaining consequential pathways for recipients, caregivers, and accountable institutions to interpret needs, revise arrangements, and assume or contest responsibility for later care trajectories.*

This formulation leaves open substantial technical substitution. Some care processes can become safer or more accessible when automation is extensive. The analytical concern is whether the resulting relation preserves appropriate human and institutional participation in the generative functions that remain consequential for care.

18.14.6 Participation in Community

Community participation concerns collective relations that are neither reducible to markets nor exhausted by formal government. Neighborhood associations, mutual-aid networks, religious or cultural organizations, clubs, cooperatives, open-source communities, informal support networks, and local public initiatives can generate resources, knowledge, belonging, care, norms, and practical alternatives. Their eco-

conomic significance lies partly in the collective capacities they sustain and the pathways through which participants can organize responses to changing conditions.

AI can lower coordination costs, improve translation, support administration, make specialized expertise accessible, and help small communities produce communication or analysis that previously required larger organizations. The same mediation can produce platform dependence, centralized visibility rules, automated moderation effects, surveillance, or homogenized organizational templates. Community participation therefore depends on more than communication volume.

Definition 18.246 (Community generative participation). *Community generative participation* is the practical capacity of persons to contribute to collectively organized relations through which a community can identify concerns, coordinate resources, maintain shared practices, provide mutual support, create local institutions, or generate responses to changing conditions.

Community participation is heterogeneous. Some members contribute time, others knowledge, resources, care, representation, infrastructure, cultural memory, or occasional support. Equal intensity of contribution is not required. The relevant issue is whether the collective relation maintains accessible pathways through which members can contribute and whether the resulting collective capacity remains sufficiently governable by the community rather than becoming wholly dependent on an external AI-mediated infrastructure.

Proposition 18.247 (Community-capability condition). *AI-mediated coordination strengthens community generative participation when it enlarges collective capability while preserving practical community influence over membership, communication, records, shared resources, organizational rules, and the formation of local alternatives.*

The proposition connects community participation to distributed ownership and infrastructure governance. A community can use a proprietary platform productively while retaining substantial collective capacity, or it can become unable to organize outside that platform. The difference is relational and historical rather than inferable from the software license alone.

18.14.7 Participation in Culture

Culture is particularly exposed to the effects of symbolic abundance developed in Section 18.11. Synthetic text, images, music, video, translation, and stylistic transformation can dramatically enlarge the volume of available cultural material. Greater volume, however, does not establish broader cultural participation. Participation concerns the capacity to create, interpret, transmit, contest, preserve, recombine, and establish new cultural forms whose meanings can become consequential within communities and institutions.

Dewey's account of art as experience provides a neighboring intuition that aesthetic life is situated in relations between experience, expression, and environment (Dewey 1934). The present economic use is narrower. Cultural production requires time, tools, education, visibility, archives, venues, audiences, rights, recognition, and communities of interpretation. AI can alter each of these conditions. It can lower production barriers while simultaneously concentrating distribution, recommendation, or attention.

Definition 18.248 (Cultural generative participation). *Cultural generative participa-*

tion is the practical capacity to create, interpret, transmit, preserve, contest, or recombine symbolic and aesthetic forms in ways that can contribute to later cultural repertoires, shared meanings, practices, identities, or institutions.

This definition does not reserve cultural generation to professional creators. Everyday language, ritual, local memory, fan practices, craft, archives, education, performance, and community interpretation can all participate. Nor does it treat AI-generated cultural material as categorically external to culture. Such material can enter cultural relations through selection, interpretation, circulation, modification, and institutional use. The question is how the generative roles and opportunities are distributed.

Proposition 18.249 (Cultural-access and participation non-equivalence). *An increase in the availability of cultural artifacts does not by itself establish an increase in cultural generative participation. Participation also depends on practical capability to create or reinterpret material, pathways to audiences and institutions, preservation and attribution conditions, and the possibility of influencing later cultural formation.*

The distinction is important where recommendation systems concentrate attention. Production can become abundant while cultural visibility remains scarce. A small number of distribution systems can therefore mediate which cultural trajectories receive enough attention, preservation, and institutional recognition to influence later repertoires. The problem links cultural participation to the attention economy of Chapter 17 and to infrastructure governance in Section 18.13.

18.14.8 Participation beyond Productive Necessity

Section 18.4 separated labor-market demand from human contribution, and Section 18.5 developed participation beyond employment. The present subsection asks a more generative question. If artificial productive capacity reduces the amount of human labor economically necessary for material production, which institutional arrangements allow people to remain participants in the generation of knowledge, institutions, care, community, culture, and future possibilities?

A labor-scarce economy can organize non-employed persons in very different ways. Material transfers can support consumption while leaving participation dependent on private wealth or voluntary opportunity. Public services can provide education and care while keeping recipients primarily in a client role. Commons, civic institutions, research networks, community organizations, cultural institutions, local governance, open infrastructures, and educational systems can instead create organized pathways through which people contribute to collective generation without needing their contribution to be justified by labor scarcity or market profitability.

Definition 18.250 (Post-necessity generative participation). *Post-necessity generative participation* is participation in socially or economically consequential knowledge, care, institutional, community, cultural, ecological, educational, or exploratory processes whose legitimacy and practical accessibility do not depend primarily on the participant's labor being scarce or commercially necessary.

The term *post-necessity* is conditional and local. It does not claim that an economy has eliminated scarcity or labor. It identifies domains in which a person's participation can remain consequential even when their labor is no longer required for a particular productive task or income relation.

Arendt's distinction among labor, work, and action is relevant as a neighboring philosophical resource because it resists reducing human activity to one productive category (Arendt 1958). GRE does not import that tripartite ontology directly. It uses the broader insight to keep economic participation analytically open when employment no longer bundles contribution, social position, and access as tightly as before.

Proposition 18.251 (Productive-necessity non-equivalence). *Declining productive necessity for a person's labor does not entail declining capacity for generative participation. The two coincide only where institutions make participation contingent on market demand, employment status, or another scarcity-based admission rule.*

This proposition changes the design problem. An AI-rich economy need not ask only how to compensate persons whose labor is displaced. It can also ask which participatory infrastructures make learning, inquiry, care, stewardship, culture, community organization, and institution building practically available as durable parts of economic life. Income security remains relevant because participation requires time and material support. Yet the architecture of opportunities cannot be inferred from the transfer alone.

Proposition 18.252 (Participation-infrastructure condition). *Post-necessity generative participation is more practically available when material security is coupled with institutions, infrastructures, rights, spaces, communities, educational pathways, and governance arrangements through which contributions can enter consequential collective processes.*

The condition connects Sections 18.8 and 18.14. Redistribution can secure the material basis of participation; participatory infrastructure determines whether supported persons can convert that basis into consequential relational activity.

18.14.9 Protection from Generative Foreclosure

The preceding subsections share one temporal concern. Participation can be lost before a present service or entitlement disappears. A community can retain access to an AI platform while losing independent organizational infrastructure. A profession can retain formal authority while losing the skills and records needed to revise its practices. Citizens can retain voting rights while consequential problem framing migrates into inaccessible technical systems. Learners can receive high-quality assistance while the institutions that cultivate independent inquiry atrophy. These changes can close future pathways through which alternatives would otherwise be generated.

GRE requires a term for this stronger temporal loss. *Foreclosure* here does not mean that one present option is unavailable. It concerns the removal or severe degradation of the generative conditions through which a class of future options, institutions, interpretations, or practices could later be produced.

Definition 18.253 (Generative foreclosure). *Generative foreclosure* is a historically produced condition in which an AI-mediated or AI-adjacent configuration materially weakens or removes the capabilities, institutions, infrastructures, records, rights, relations, or participation pathways required to generate a relevant family of future alternatives, even when some current outputs or services remain available.

Generative foreclosure can arise through several mechanisms. Deskilling can remove independent competence. Infrastructure concentration can eliminate alterna-

tive deployment pathways. Data enclosure can prevent later reconstruction. Institutional outsourcing can dissolve internal capacity. Automated standardization can narrow recognized categories. Attention concentration can suppress cultural or epistemic alternatives. Dependency can make exit formally possible while rendering replacement practically infeasible. The mechanisms can combine.

The concept is stronger than path dependence. Every historical system inherits constraints from earlier decisions. Foreclosure concerns a degree and type of path dependence in which alternative-forming capacity itself is impaired. It is also distinct from irreversible harm. Some foreclosures can be reversed through costly rebuilding; others can persist long enough to make restoration historically difficult even when technical replacement becomes possible.

Proposition 18.254 (Generative-foreclosure condition). *A stronger claim of generative foreclosure is warranted when an AI-mediated transition does more than select among current options and instead degrades the practical mechanisms through which affected positions could later formulate, organize, test, finance, preserve, or institutionalize relevant alternatives.*

This condition links participation to the generative action-space criterion in Section 18.13. Action-space protection preserves reachable alternatives and the means of generating new ones. Generative-participation analysis asks who can exercise those means and through which domains. The two are complementary: an alternative can exist institutionally while remaining inaccessible to most participants, and broad participation can remain shallow where the system has lost capacity to generate substantially different alternatives.

Definition 18.255 (Generative-participation reserve). *A generative-participation reserve is the retained ensemble of capabilities, rights, institutional roles, infrastructures, records, spaces, communities, educational pathways, and governance interfaces through which persons and human-governed collectives can continue to enter future-forming processes after technological or institutional conditions change.*

The reserve is not a stock that can be preserved unchanged. Its components require maintenance and renewal. Educational systems must update capabilities; archives need migration; civic and community institutions need members and resources; professional organizations need independent expertise; public and commons infrastructures need technical maintenance; cultural institutions need spaces for new interpretation. A reserve can therefore remain nominally present while losing practical generative capacity.

Proposition 18.256 (Anti-foreclosure generativity). *A participation architecture has a stronger anti-foreclosure property when it preserves both current pathways of consequential participation and the capacities through which participants can create, revise, or institutionalize new pathways under future conditions that cannot be fully specified in advance.*

The proposition supplies the section's long-horizon criterion. Generative participation under AI is not secured merely by assigning humans a residual role inside a fixed technological order. It is secured more strongly when people and human-governed collectives retain practical capacity to reshape the order itself: to generate knowledge, contest decisions, redesign institutions, reorganize care, form communities, create culture, and construct new forms of participation when earlier arrangements become inadequate.

18.14.10 Generative Return

Protection from generative foreclosure supplies a preservation criterion: capacities and pathways needed for future alternatives should not be allowed to disappear unnoticed merely because current outputs remain available. A stronger intertemporal question concerns what an asymmetric relation produces for the future capacities of the participants who sustain, learn through, comply with, or are affected by it. Some asymmetric relations can convert present differences in expertise or technological capability into wider later competence. Others can repeatedly extract data, attention, judgment, labor, experience, or institutional dependence while concentrating the accumulated capacity to interpret and redesign the relation elsewhere.

GRE uses *generative return* for this second question. The term is related to the book's wider analysis of generative value circulation and return, while its object here is specifically the reproduction of formative capacity within AI-mediated participation. It does not require equal capability between humans and artificial systems, does not assume that every participant must receive identical resources, and does not reduce return to monetary compensation. The relevant issue is whether the operation of an asymmetric relation helps create additional practical capacity among positions that contribute to, depend upon, or are governed through that relation.

Definition 18.257 (Generative return under AI mediation). *Generative return under AI mediation* is the historically realized increase, renewal, or widening of practical capacities through which participating or affected positions can later understand, contest, revise, reproduce, redirect, or generate alternatives to the AI-mediated processes whose operation they helped sustain or through which they acted.

Generative return can take heterogeneous forms. An AI-supported educational relation can leave learners better able to formulate questions, inspect sources, criticize model outputs, and work independently. A public institution can use external AI capability while retaining records, methods, staff competence, interoperable infrastructure, and procurement knowledge sufficient to redesign the service later. A research platform can make provenance, evaluation methods, and reproducible workflows available so that users become more capable of independent inquiry rather than only more efficient consumers of generated results. A community data project can return analytical tools, documentation, and governance authority to the community whose observations made the system useful. A cultural institution can use synthetic tools to widen creative repertoires while preserving spaces in which new creators acquire technique, recognition, and institutional voice.

These examples share a developmental structure. Capacity exercised at one stage contributes to additional capacity at a later stage. The relevant return can therefore coexist with temporary asymmetry and specialization. A teacher can remain more expert than a student while the educational relation increases the student's later independence. A technical provider can retain specialized infrastructure while helping a public agency preserve the competence needed to evaluate alternatives. Conversely, abundant output access can coexist with weak generative return when repeated use makes participants less able to understand, contest, or replace the process.

Proposition 18.258 (Output-access–generative-return non-equivalence). *Access to increasingly capable AI outputs does not by itself establish generative return. A stronger claim requires evidence that the relation renews or enlarges practical capacities for later understanding, contestation, revision, reproduction, redirection, or alternative forma-*

tion among relevant participating or affected positions.

The proposition prevents generative return from becoming a synonym for technological diffusion. A system can provide excellent services while leaving users increasingly dependent on opaque infrastructure. It can also create return without transferring the underlying model when documentation, education, interoperable records, institutional memory, governance rights, and complementary capabilities increase the recipient's future action space.

Proposition 18.259 (Capacity-reproducing asymmetry condition). *An asymmetric AI-mediated relation has a stronger capacity-reproducing property when its operation predictably contributes to durable gains in understanding, competence, institutional memory, infrastructural capability, participation rights, or alternative-forming capacity for relevant positions, while the burdens and limits of that asymmetry remain contestable and revisable.*

Generative return consequently complements anti-foreclosure governance. Anti-foreclosure asks whether inherited capacities and pathways remain available. Generative return asks whether participation actively regenerates or widens future capacity. The distinction is important where AI systems improve rapidly: preserving a static reserve can be insufficient if the surrounding field changes faster than participants can learn, organize, or reproduce independent capability. A participation architecture can therefore be evaluated not only by the roles it leaves to humans in the present, but also by the capacities its operation helps create for later rounds of technological and institutional change.

The section therefore extends the governance architecture of Section 18.13 from protected possibility to consequential participation. Human action space identifies the alternatives that remain practically reachable; generative participation identifies the relations through which people and collectives can help form later possibilities within that space. The distinction between generative capacity and realized normative influence shows why formal participation may remain weak when access, legibility, recognition, or institutional uptake are recursively reweighted. Protection from generative foreclosure adds the intertemporal condition that participatory pathways should remain capable of producing alternatives that do not yet exist, while generative return asks whether the operation of asymmetric relations actively renews or widens future capacity among participating positions. The resulting architecture does not assume that humans remain uniquely capable in every domain. It asks whether the economic order continues to contain practical, consequential, revisable, and capacity-reproducing pathways through which human and human-governed collective participation can remain part of the generation of future relational worlds.

The next section turns to a different source of heterogeneity. Participation cannot be governed adequately if every participant is assumed to instantiate one common subject type or one universal value structure. Section 18.15 therefore examines human subjects, artificial agents, collective subjects, non-human subjects, and heterogeneous value structures within the same AI-mediated economic field.

18.15 Heterogeneous Subjects and Value Structures

Section 18.14 developed generative participation as the practical capacity to enter processes through which later knowledge, decisions, institutions, relations, cultural

forms, capabilities, and alternatives are produced. The present section specifies a prior condition for governing such participation: participants in an AI-mediated economy need not instantiate one common form of subjecthood, and the values relevant to their participation need not be representable within one common evaluative structure. Its role in Chapter 18 is therefore to connect the plural account of economic subjecthood developed in Section 12.4, the layered account of subjecthood developed in Section 4.12, and the plural value architecture developed in Section 14.11 to the capability asymmetries and participatory conditions of artificial intelligence. Its objective is to identify which distinctions should remain visible when human persons, artificial agents, collective formations, and non-human participants enter a shared economic field. The discussion proceeds through these four subject forms, incommensurable value, heterogeneous coexistence, utility representation, and institutional mediation. The method is conceptual and institutional. It does not assign a common ontology, phenomenology, moral status, or utility function to the subject forms under consideration.

The central analytical object is a *subject–value configuration*. Economic consequences arise through relations among subjects, the dimensions in which they possess standing or capacity, the values that become relevant to those relations, and the institutions that recognize, translate, rank, aggregate, protect, or exclude those values. The same configuration can contain several subject forms and several value orders simultaneously. A person may possess welfare interests, legal rights, capabilities, preferences, attachments, responsibilities, and commitments that are only partially aligned. An organization may possess legally recognized claims, strategic objectives, internal governance rules, and historically inherited purposes without possessing human experience. An artificial system may exercise operational agency or mediate decisions without thereby acquiring every form of standing attributed to persons. An ecosystem may be economically consequential through ecological dependence, stewardship obligations, option value, and the interests of human or non-human life without being representable as a conventional maximizing agent.

Definition 18.260 (Subject–value configuration). A *subject–value configuration* is a historically situated arrangement in which one or more analytically relevant subjects occupy specified positions of participation, capacity, exposure, representation, claim, obligation, dependence, or decision, while one or more value structures organize what counts as benefit, harm, priority, significance, obligation, preservation, or desirable change for the inquiry at hand.

Definition 18.260 is deliberately typed. A subject position and a value structure should be identified with enough precision to show whose or what standing is being represented and through which evaluative register. The definition does not require that every value be possessed as a preference by an individual subject. Values can be articulated through rights, capabilities, institutional purposes, ecological constraints, professional obligations, cultural commitments, legal protections, public reasons, or other historically stabilized evaluative forms.

Table 18.15 summarizes the distinctions developed in this section. The table is a diagnostic architecture rather than a ranking of subject forms. Its purpose is to prevent operational capability, institutional recognition, experiential welfare, legal personality, moral standing, and representational authority from collapsing into one category when AI systems make some dimensions increasingly similar while leaving others uncertain or different.

Table 18.15: Analytical architecture for heterogeneous subjects and value structures in AI-mediated economies.

Subject form	Relevant standing dimensions	Characteristic value relations	Mediation problem
Human persons	Experience, capability, rights, responsibility, participation, historical continuity	Welfare, capability, dignity, attachment, autonomy, care, knowledge, cultural and relational value	Preserving plurality within and among persons while preventing capability asymmetry from erasing consequential voice
Artificial agents	Operational agency, delegated authority, representational role, computational capability, infrastructural position	Task objectives, delegated criteria, encoded priorities, learned representations, institutional purposes	Distinguishing effective agency from attributed standing and locating responsibility for mediated action
Collective subjects	Membership, representation, institutional continuity, joint capacity, shared rules, distributed responsibility	Collective purposes, common goods, public value, organizational commitments, inherited obligations	Preventing internal heterogeneity from disappearing behind unitary representation while retaining collective capacity
Non-human participants	Exposure, ecological dependence, causal participation, stewardship relevance, represented interests	Welfare where applicable, ecological integrity, continuity, option value, interdependence, stewardship commitments	Representing affected positions that may lack conventional institutional voice or market expression
Heterogeneous configurations	Several dimensions distributed across interacting subject forms	Partially comparable, translated, contested, or incommensurable value orders	Governing comparison and action without presuming universal scalarization or complete equivalence

18.15.1 Human Subjects

Human persons enter AI-mediated economic configurations through more dimensions than productive contribution alone. They can be workers, owners, users, citizens, learners, patients, creators, caregivers, dependants, researchers, consumers, community members, rights-holders, and persons exposed to decisions made through technical systems. Their standing can therefore be expressed through welfare, capability, legal rights, social membership, lived experience, responsibility, participation, and historically formed attachments. Section 12.4 already established that economic subjecthood should be indexed to the dimensions relevant to a specified inquiry. The AI case makes that discipline more consequential because machines can increasingly approximate, exceed, or substitute for selected human performances while leaving many other dimensions of human subjecthood analytically untouched.

A performance comparison therefore supplies only one coordinate of a human subject's economic position. An artificial system may produce a more accurate forecast, write faster, search a larger corpus, or coordinate a larger number of transactions. Such capability differences can alter bargaining position, employment demand, access to institutions, and dependency. They do not by themselves determine the value of a person's welfare, legal claims, social membership, experiential interests, or participation in collective self-organization. The relevant economic question is how capability asymmetry changes the relations through which these dimensions are realized, protected, or weakened.

Human subjects are also internally heterogeneous. Preferences can conflict with commitments; immediate welfare can conflict with long-horizon capability; family obligations can conflict with occupational incentives; individual benefit can conflict with community continuity; stated choice can differ from reflective judgment under changing information. A human subject should therefore not be represented automatically by one revealed or declared utility function when the inquiry concerns several dimensions of value. A compact scalar can be useful for specified decisions, yet its adequacy depends on whether the omitted dimensions are immaterial to the question being asked.

AI mediation can change which dimensions become institutionally visible. Platforms can make clicks, purchases, response times, ratings, productivity measures, or engagement signals highly legible while leaving care, hesitation, uncertainty, cultural attachment, tacit knowledge, or unexpressed vulnerability weakly represented. The resulting data asymmetry can create a representational asymmetry: what is easiest to encode can become easiest to optimize, audit, or reward. Human subjecthood then risks being institutionally reconstructed around the dimensions that technical systems can observe most readily.

This reconstruction is economically consequential because representation can feed back into later opportunity. A person classified as low risk, high value, employable, unreliable, engaged, productive, or eligible can encounter different credit, work, insurance, education, platform, or public-service pathways. Section 4.12 distinguished relationally effective subjecthood from its manifestations and representations. In an AI-mediated economy, the distance among these registers deserves explicit attention because automated representations can become operational at large scale and high speed.

Proposition 18.261 (Human subject multidimensionality). *Where an AI-mediated economic decision materially affects several dimensions of human standing, adequacy requires that the analysis identify the dimensions relevant to the decision and justify any operation that compresses them into a single representation. Operational performance in one dimension does not establish equivalence across the remaining dimensions.*

Proposition 18.261 does not require maximal description of every person. It requires proportionality between the stakes of the decision and the dimensions retained by the representation. A narrow scheduling problem may legitimately use a narrow objective. A decision concerning livelihood, health, legal status, educational access, or long-term participation can require a richer representation because the downstream consequences span more of the subject's economic life.

The same principle preserves agency without idealizing autonomy. Human decisions are relationally conditioned by information, institutions, dependence, history, culture, embodiment, and available alternatives. AI can expand agency by supplying

knowledge, translation, accessibility, simulation, or assistance. It can also narrow agency when recommendation, default, ranking, surveillance, or dependency structures make some alternatives practically inaccessible. Human subjecthood under AI is therefore better represented through the changing architecture of capacities and relations than through an assumption of either complete autonomy or complete technological determination.

18.15.2 Artificial Agents

Artificial systems can occupy economically consequential positions even when questions concerning consciousness, experience, moral status, or ultimate ontology remain unresolved. They can initiate transactions within delegated limits, allocate attention, generate symbolic outputs, coordinate workflows, recommend decisions, negotiate through software interfaces, monitor infrastructures, and act on behalf of persons or organizations. Chapter 18 has therefore used the language of artificial productive capacity and artificial economic agency in an operational sense. Section 18.15 sharpens the standing of that language by distinguishing effective agency from broader subjecthood claims.

Three layers are especially important. First, an artificial system can possess *operational capacity*: it can transform inputs, maintain state, select among actions, or alter an economic environment. Second, it can possess *delegated or institutionally recognized authority*: an organization may permit its outputs to trigger payments, access decisions, contractual steps, resource allocation, or other consequences. Third, observers may attribute stronger forms of subjecthood, including intention, responsibility, welfare, or moral standing. The first two layers can be empirically and institutionally specified without resolving the third.

This layered account helps analyze increasingly autonomous systems without forcing premature ontological conclusions. A system that purchases computing resources, hires digital services, or manages an investment strategy through delegated credentials can have economically consequential agency. The system's action may still be legally attributed to an organization, technically constrained by infrastructure providers, financially bounded by an account owner, and normatively governed by human institutions. The relevant subject-value configuration therefore includes the artificial agent and the relations through which its capacity becomes authorized, recognized, financed, or contestable.

Artificial agents also inherit value structures rather than entering the economy free of them. Objectives can be specified through reward functions, instructions, constitutional constraints, access rules, organizational policies, legal requirements, training distributions, evaluation procedures, or patterns learned from human-produced data. These mechanisms differ substantially, yet they share one analytical feature: an artificial system's operative criteria are historically produced within a wider relational field. A system can subsequently transform or recombine those criteria in ways that are difficult to anticipate, but its action remains situated within technical and institutional conditions that make some objectives, representations, and actions available.

The phrase *AI values* therefore requires discipline. It can refer to encoded optimization criteria, stable behavioral tendencies, learned representations of human evaluations, inferred user preferences, or hypothetical machine welfare claims. These objects should not be conflated. A model's optimization target is analytically different

from a person's experienced good; a learned preference model is different from the preferences it represents; a system's persistent behavioral policy is different from institutional authorization to act. The distinctions matter because each object creates different governance questions.

Responsibility is especially sensitive to this separation. Increasing artificial agency can distribute causal contribution across developers, deployers, users, infrastructure providers, data curators, organizations, regulators, and automated components. A system's operational autonomy can therefore increase while human or institutional responsibility becomes more difficult to localize. GRE should analyze that distribution rather than infer responsibility directly from causal efficacy. Section 16.16 developed institutional governance as a means of organizing responsibility across relational structures; the AI case supplies an especially demanding application.

Proposition 18.262 (Artificial agency–standing separation). *Operational agency, delegated authority, institutional recognition, experiential welfare, legal personality, moral standing, and responsibility are analytically separable dimensions. Evidence that an artificial system satisfies one dimension supports claims about another only where an additional argument or institutional rule establishes the relation.*

Proposition 18.262 permits strong claims where the evidence is strong. An artificial system can clearly be causally effective, computationally capable, or institutionally authorized without the analysis pretending that these observations resolve questions that require phenomenological, legal, ethical, or political argument. This restraint is especially important in a rapidly changing technical environment where operational similarity may arrive earlier than consensus about the meaning of that similarity.

Artificial agents can also become representational intermediaries for other subjects. A personal AI may negotiate purchases, summarize information, express preferences, or interact with institutions. An organizational AI may represent a firm in routine transactions. A public-sector system may mediate eligibility or service access. The artificial agent then becomes part of the representation relation itself. Governance must ask what authority has been delegated, how faithfully the system represents the relevant subject, what happens when the representation diverges, and how affected positions can correct or contest the result.

18.15.3 Collective Subjects

Collective subjects include households, firms, public bodies, communities, associations, research groups, cooperatives, movements, and other configurations whose relations generate capacities that cannot be represented adequately as a simple sum of isolated individual actions. Their relevance to AI-mediated economies is twofold. Collective organizations control much of the infrastructure through which artificial capability is developed and deployed, and collective formations also provide the institutions through which persons can pool resources, articulate common purposes, exercise counter-power, preserve knowledge, and sustain participation.

Collective subjecthood requires a distinction between collective capacity and internal unanimity. A firm can sign a contract, own an asset, operate a model, or coordinate a workforce through institutional procedures even when its members disagree. A community can preserve a language, maintain a commons, or organize mutual support without possessing one homogeneous preference. A public body can exercise statutory authority while containing political disagreement and administrative

plurality. Treating these formations as subjects can therefore be analytically useful, provided that the representation does not erase the internal relations through which collective decisions are produced.

AI can strengthen collective capacity by reducing coordination costs, supporting shared knowledge, enabling translation, assisting administration, and expanding access to technical expertise. The same technologies can centralize authority when model access, data, verification, or decision interfaces are controlled by a narrow managerial or technical layer. A collective can therefore become more capable externally while becoming less participatory internally. Capability growth at the collective level and participation at the member level should consequently be tracked separately.

Representation is the key interface. Collective subjects act through offices, delegates, voting rules, managers, committees, legal agents, protocols, databases, and increasingly artificial systems. Each representative mechanism selects which information enters collective action and which interests or values become legible. An AI system used to summarize member preferences, prioritize cases, draft policy, or allocate internal resources can alter the effective constitution of the collective even when formal governance rules remain unchanged. The representational layer becomes part of the collective's generative architecture.

Collective values can likewise have several sources. They may arise through explicit constitutional commitments, negotiated purposes, inherited practices, professional norms, legal mandates, cultural identity, shared infrastructure, or repeated coordination. These values can persist across membership turnover and can constrain current members. Persistence does not establish unanimity or intrinsic moral authority; it establishes a historically effective evaluative structure that can shape action and require analysis.

A useful distinction therefore separates *collective purpose* from *aggregate preference*. Aggregate preference summarizes individual evaluations according to a specified rule. Collective purpose can additionally depend on institutional history, role obligations, constitutional commitments, common goods, or relations that exist only at the collective scale. A university's research mission, a court's legal function, a cooperative's member-governance commitments, or a community's language-preservation project cannot always be reconstructed adequately by adding contemporaneous individual preferences.

Proposition 18.263 (Collective representation condition). *Where a collective subject is treated as a unit of AI-mediated decision or action, analysis should identify the mechanism through which collective standing is represented and preserve materially relevant internal heterogeneity when that heterogeneity affects authority, incidence, responsibility, or the legitimacy of the resulting action.*

The proposition protects two analytical goods simultaneously. It preserves the reality of collective capacity while keeping visible the internal structure through which that capacity is generated. This matters particularly under radical capability asymmetry because organizations with advanced AI can acquire substantial external power even when the distribution of control within those organizations remains concentrated or opaque.

Collective subjects also provide a bridge between individual and system-level governance. Persons rarely negotiate directly with every infrastructure, model provider, market, state, or platform that conditions their economic lives. Associations, unions,

professional bodies, municipalities, cooperatives, research institutions, civil-society organizations, and public agencies can mediate these relations. The strength, accessibility, and pluralism of collective subjects can therefore shape whether individual persons encounter AI asymmetry as isolated dependence or through institutions capable of bargaining, verification, shared learning, and contestation.

18.15.4 Non-Human Subjects

GRE's broad definition of economic subjecthood permits non-human participants to enter an inquiry where they occupy economically consequential positions of exposure, dependence, causal participation, representation, stewardship, or claim. This analytical inclusion does not require all non-human entities to be modeled as agents, legal persons, or welfare subjects. It allows inquiry to follow economic consequences beyond the conventional boundary of human and organizational decision makers when ecological systems, animals, species, landscapes, or other living and material configurations materially condition or bear the consequences of economic action.

AI expands the relevance of this issue because artificial systems can alter the scale, speed, and informational resolution at which non-human conditions become actionable. Remote sensing, ecological modeling, automated monitoring, optimization, robotics, and predictive systems can make some ecological relations newly legible and can support stewardship or restoration. They can also intensify extraction, surveillance of natural systems, resource targeting, or optimization around indicators that omit ecological relations not represented in the model. Greater information therefore does not by itself determine how non-human value enters economic decision.

Several forms of standing should remain distinct. Sentient animals can raise welfare questions. Species and ecosystems can be relevant through ecological continuity, interdependence, resilience, option value, stewardship obligations, or legally recognized protections. Rivers, forests, or landscapes can acquire institutional standing through particular legal or cultural arrangements. Infrastructure and material systems can be economically indispensable without possessing welfare or moral standing. The category *non-human subject* is therefore an analytical umbrella whose specific standing must be stated in each application.

Representation poses an asymmetry because many non-human affected positions cannot enter conventional deliberation through direct linguistic participation. Human institutions represent them through science, stewardship, guardianship, law, customary practice, ecological indicators, ethical argument, or political advocacy. AI can assist these forms of representation by processing complex ecological information, yet the model's output remains mediated through choices about variables, timescales, baselines, thresholds, and optimization criteria. The representational problem is consequently institutional as well as technical.

Temporal scale is particularly important. Human economic decisions can be evaluated over electoral cycles, budget years, market horizons, or individual lifetimes, while ecological consequences can unfold across much longer or differently structured periods. A value architecture that discounts or omits these horizons can systematically weaken non-human standing even without explicit exclusion. AI-driven optimization can amplify that effect if the objective function inherits the same horizon.

The non-human case also clarifies why affectedness and agency should not be collapsed. A configuration can be profoundly affected by an economic process without having the capacity to bargain, choose, or represent itself. Conversely, a computational agent can possess extensive operational agency without evidence of experienced welfare. These are different axes of subjecthood. Governance under heterogeneous subjects must therefore specify which axis grounds a claim, protection, responsibility, or decision right.

Proposition 18.264 (Affectedness–agency separation). *Economically relevant affectedness and effective agency are independent analytical dimensions. Institutions can therefore have reason to represent or protect a position that lacks conventional agency, while high operational agency does not by itself establish welfare-bearing or moral standing.*

Proposition 18.264 becomes especially useful in mixed human–AI–ecological systems. It permits the same economic analysis to represent a human community’s participatory claims, an artificial system’s operational role, an organization’s decision authority, and an ecosystem’s exposure without forcing those positions into one undifferentiated category of actor.

18.15.5 Incommensurable Values

Heterogeneous subjects become a deeper economic problem when their relevant values cannot be translated into one common measure without remainder. Chapter 14 treated value as plural, historically generated, relationally realized, transmitted, converted, accumulated, contested, and sometimes only partially commensurable. Section 14.11 further distinguished comparison, commensuration, translation, monetization, aggregation, and plural decision architecture. The present subsection applies that discipline to AI-mediated configurations in which different subject forms and different standing dimensions coexist.

Incommensurability can arise in several ways. Two values can lack a common cardinal unit. They can be comparable only under particular institutional purposes. One value can be expressible only through a threshold or prohibition. Translation can preserve part of the source while losing context or meaning. Two subject positions can disagree about what constitutes a gain. A value can change through the act of measurement or representation. These cases should not be collapsed into a single claim that comparison is impossible. They indicate different limits on the kind of comparison that is warranted.

AI can intensify pressures toward commensuration because computational systems often require explicit objectives, labels, scores, rankings, probabilities, or action-selection criteria. These representations can be indispensable for operation. Their existence nevertheless does not establish that the represented values were fully commensurable before encoding or that the chosen scalar preserves every relevant distinction. The technical need for a decision variable is therefore different from an argument that the variable exhausts the value field.

Consider a system allocating educational support. It may balance predicted attainment, learner preference, equity, psychological burden, teacher capacity, institutional mission, and long-horizon capability. A model can combine these into a score, optimize one while treating others as constraints, maintain a vector of outcomes, or leave some decisions to deliberation. Each architecture embodies a different rela-

tion among values. The decision to scalarize is itself an institutional choice and can redistribute power toward the actors who specify the weights, data, and admissible objectives.

The same issue appears in environmental management, health, labor allocation, research funding, public administration, platform governance, and cultural institutions. AI can make sophisticated multi-objective optimization technically feasible while leaving normative questions about admissible trade-offs unresolved. More computational capacity therefore increases the range of representable decision procedures without eliminating the need to justify the evaluative architecture.

GRE can preserve this distinction through the concept of an *evaluative remainder*. Chapter 14 used remainder to describe significance lost or left unresolved through conversion, aggregation, or translation. Under AI, such remainder should be recorded where it materially affects affected positions or later revision. A system that chooses among options can close an action problem while leaving part of the value problem open.

Definition 18.265 (Subject–value remainder). A *subject–value remainder* is materially relevant evaluative information, standing, disagreement, uncertainty, or significance associated with a subject position that is not preserved by the representation, translation, weighting, aggregation, or optimization procedure used to support an AI-mediated decision.

Definition 18.265 makes omission traceable without implying that every remainder invalidates a decision. Institutions routinely act under incomplete representation. The analytical requirement is to distinguish tolerable abstraction from omission that changes incidence, standing, reversibility, or the capacity for later contestation.

Proposition 18.266 (Decision closure and evaluative remainder). *An AI-mediated decision can reach operational closure while its evaluative ordering remains incomplete. Where unresolved subject–value remainder can materially affect later review, compensation, restoration, participation, or institutional legitimacy, preserving that remainder strengthens the revisability of the decision architecture.*

The proposition is particularly important under high-speed or large-scale automation. A system may need to decide repeatedly and quickly, yet institutional records can preserve uncertainty, dissent, omitted criteria, or exceptional cases for later inspection. AI therefore need not force evaluative closure merely because operational closure is required.

18.15.6 Heterogeneous Subject–Value Coexistence

A shared economic field can contain subjects whose capacities, forms of standing, temporal horizons, and value structures differ substantially. Coexistence refers here to the institutional condition under which these heterogeneous positions can remain consequential within one economic order without requiring complete assimilation into one subject model or one value metric. The relevant problem is neither simple tolerance nor permanent separation. It is the organization of relations through which heterogeneous subjects can interact, coordinate, contest, exchange, cooperate, withdraw, or remain protected where translation is incomplete.

Several coexistence forms are possible. Some relations can be governed through common rules that apply despite different motivations. Others can rely on negotiated

interfaces between institutions with different purposes. Some values can be translated partially for a bounded decision while retaining their source-specific meaning elsewhere. Some claims can be protected through thresholds or rights rather than traded against every competing objective. Some domains can remain intentionally plural, allowing several organizational forms or technological pathways to coexist.

AI can support coexistence by reducing translation costs, making complex constraints legible, enabling personalized interfaces, simulating consequences for different groups, and maintaining several evaluative dimensions simultaneously. It can also weaken coexistence when a dominant model, platform, ontology, language, or scoring system becomes the obligatory interface through which heterogeneous subjects must become legible. The issue is therefore not whether AI standardizes; some standardization is necessary for coordination. The issue is which distinctions the standard preserves, which it suppresses, and whether alternative interfaces remain practically available.

This problem is especially acute where artificial agents mediate interaction among humans or institutions that possess different normative orders. A system trained to negotiate contracts, moderate communication, allocate shared resources, or translate policy preferences can become a de facto mediator among value systems. Its representation architecture then influences which differences are treated as negotiable, which are interpreted as errors, and which remain visible as legitimate disagreement. Mediation quality therefore depends partly on the capacity to preserve typed differences rather than forcing every input into one homogeneous preference space.

Coexistence also requires attention to exit and re-entry. A subject can be formally free to reject an AI-mediated institution while lacking a practical alternative because work, payments, public services, education, or communication depend on the same infrastructure. Genuine plurality therefore depends on the generative action space developed in Section 18.13: alternative institutional pathways need sufficient capability, interoperability, resources, and legitimacy to remain usable.

Definition 18.267 (Heterogeneous coexistence). *Heterogeneous coexistence* is an institutional condition in which materially distinct subject forms or value structures can participate in a shared economic field through recognized relations, interfaces, protections, or procedures while retaining differences whose elimination is not required for the coordination problem at hand.

The definition does not imply harmony. Coexistence can include disagreement, bargaining, conflict, asymmetric dependence, and revision. Its stronger form requires procedures for contestation and change because a fixed coexistence arrangement can stabilize unjust relations. Section 16.19 developed governance under heterogeneous values precisely as an institutional problem rather than a demand for prior consensus.

A further distinction concerns coexistence across scales. A local community may preserve a value practice within a national regulatory framework; an organization may maintain an internal mission while participating in markets; a person may use an AI assistant governed by platform rules while retaining personal evaluative commitments outside the platform. Compatibility can therefore be partial and nested. The requirement is not one universal reconciliation but enough interface structure for interaction without erasing the distinctions that remain material.

Proposition 18.268 (Coexistence without equivalence). *Coordination among heterogeneous subjects does not require proof that their subject forms or value structures*

are equivalent. A sufficient institutional interface can support bounded cooperation, exchange, representation, protection, or joint decision while preserving unresolved differences outside the scope of that interface.

Proposition 18.268 is central to the chapter's treatment of AI. Artificial systems can become powerful interfaces precisely because they can translate among languages, representations, and task structures. The existence of such translation should not be treated as evidence that the translated systems have become identical. Preserving the remainder of translation protects both analytical accuracy and the possibility of future revision.

18.15.7 Utility Representation and Value Heterogeneity

Utility representations remain valuable tools for many economic problems. They can formalize preference, support decision under uncertainty, enable optimization, and make trade-offs explicit under specified assumptions. The difficulty arises when one representation is extended beyond the domain in which its comparability assumptions are warranted. AI-mediated economies increase both the practical power of utility-like representations and the cost of treating their scope as self-evident.

A utility function can represent one subject's ordered preferences over a defined option set, an organization's operational objective, a social welfare criterion, a learned reward model, or a platform's engagement target. These are different analytical objects even when all are represented numerically. Their numerical similarity does not establish that the underlying values share the same source, standing, or interpretation. A person's preference ordering, a corporation's profit objective, and a model's reward signal can therefore enter one computational procedure while remaining heterogeneous in meaning.

Three levels of scalarization should be distinguished. *Within-subject scalarization* compresses several considerations relevant to one represented subject. *Cross-subject scalarization* constructs a comparative or aggregate measure across subjects. *Cross-form scalarization* combines qualitatively different value forms such as income, health, ecological loss, cultural continuity, participation, or rights. Each level can be useful, but each introduces stronger assumptions about representation and commensurability.

AI systems can conceal these assumptions because optimization occurs after scalarization has already been embedded in data pipelines, evaluation criteria, reward models, procurement specifications, or institutional targets. The visible technical question may concern model accuracy while the more consequential normative choice occurred earlier when the objective was constructed. GRE therefore treats objective construction as part of economic architecture rather than as a neutral preprocessing step.

Vector-valued, constrained, lexicographic, threshold-based, partially ordered, deliberative, or rule-governed architectures can preserve more heterogeneity where a single scalar would remove material structure. These alternatives do not automatically produce better decisions. They trade simplicity for retained information and can introduce their own governance difficulties. Their relevance lies in showing that algorithmic decision does not logically require one universal utility representation.

The strongest caution concerns the movement from operational necessity to ontological or normative conclusion. A system may require a scalar score to rank search

candidates under a latency constraint. That fact establishes a property of the operational architecture. It does not establish that the persons, organizations, ecosystems, or values affected by the ranking possess one universal scalar value. The same distinction applies to reinforcement learning, recommender systems, risk scoring, and resource allocation.

Proposition 18.269 (Scalarization scope condition). *A scalar utility or objective representation is adequate for an AI-mediated economic task to the extent that the dimensions compressed by the representation are either immaterial to the task or are incorporated through justified comparison, weighting, constraints, thresholds, or institutional safeguards. Adequacy for one task does not establish adequacy for the wider subject-value configuration in which the task is embedded.*

The proposition preserves ordinary economic modeling while making scope explicit. A production optimizer can remain a production optimizer. Difficulty arises when its objective silently becomes the criterion for labor policy, environmental impact, community continuity, or public legitimacy without an additional evaluative argument.

A plural architecture can also combine scalar and non-scalar elements. Institutions may optimize cost subject to rights constraints, maximize service coverage subject to minimum quality standards, use a multi-criteria dashboard followed by deliberation, or authorize automated decisions only inside a domain defined by law and appeal rights. Such hybrid structures often describe real economic governance more accurately than the image of one unconstrained maximand.

18.15.8 Institutional Mediation

Heterogeneous subject-value configurations become governable through institutions that determine standing, representation, admissible evidence, decision rules, rights, obligations, translation procedures, appeals, review, and revision. Institutional mediation is therefore the mechanism through which subject heterogeneity becomes economically actionable without requiring prior agreement on one ontology or one value metric. Its role is especially important under AI because artificial systems can operate across institutional interfaces at speeds and scales that exceed the capacity of affected subjects to inspect each individual decision.

Institutional mediation begins with standing rules. Institutions decide whose interests or claims can enter a process and in what form. A person may possess direct standing; a child, future generation, animal, ecosystem, organization, or diffuse public may be represented through guardians, trustees, public agencies, scientific bodies, legal procedures, or other arrangements. An artificial agent may possess delegated transactional authority while responsibility remains institutionally attached elsewhere. These rules construct the practical subject field within which AI operates.

Representation rules then determine how a subject's relevant values become legible. Surveys, preferences, rights, capability indicators, legal claims, expert assessments, ecological measurements, organizational missions, community deliberation, and model-generated proxies each preserve different structures. Strong mediation therefore requires provenance: decision makers should be able to identify which subject position a representation concerns, which value dimension it expresses, how it was generated, and what transformations occurred before it entered the decision process.

Translation rules determine when values can be compared or converted. A procurement system may monetize cost while treating safety as a threshold. A public institution may use legal rights as side constraints while balancing service quality and fiscal burden. A research organization may combine peer assessment, strategic priorities, feasibility, and portfolio diversity. AI can assist each procedure, but the legitimacy of the translation comes from the institutional rule and its justification rather than from computational sophistication alone.

Contestability supplies a further layer. Heterogeneous subjects can be misrepresented, excluded, or compressed by technical systems. An institution therefore needs pathways through which affected positions can challenge factual errors, question the relevance of criteria, contest weights, introduce omitted values, or seek human or collective review. Section 18.13 treated contestability and reversibility as elements of governance under radical asymmetry. The present section adds that contestability should be sensitive to the type of subject and value at issue. Correcting a data error differs from disputing an institutional objective or asserting a previously unrepresented form of standing.

Institutional mediation also allocates responsibility for unresolved remainder. A technical system cannot by itself determine which omitted values deserve preservation, compensation, or priority unless those decisions have already been encoded through institutional authority. Where value conflict remains open, governance may assign the decision to courts, public agencies, professional bodies, democratic procedures, community institutions, negotiated agreements, or mixed processes. AI can supply analysis, simulation, translation, or administrative support while the institution retains responsibility for the rule under which closure occurs.

Definition 18.270 (Subject–value mediation interface). *A subject–value mediation interface is an institutional, legal, organizational, technical, epistemic, or deliberative arrangement that specifies how identified subject positions and value structures become represented, compared, translated, protected, aggregated, contested, or carried forward into an economically consequential decision or process.*

The definition extends the conversion-interface concept developed in Chapter 14. A subject–value mediation interface can include value conversion, but its scope is wider because it also determines standing, representation, and procedural authority. A court, standards body, market, platform, public consultation process, professional review board, community assembly, regulatory procedure, or AI-assisted administrative system can each function as such an interface under different conditions.

Several qualities strengthen these interfaces. *Typed standing* keeps distinct the dimensions through which a subject enters the process. *Provenance* records how representations were generated. *Remainder preservation* retains materially relevant information lost through simplification. *Contestability* permits correction and disagreement. *Revisability* allows rules to change as technologies, evidence, and subject configurations evolve. *Distributed mediation* can reduce dependence on a single institutional or technical gatekeeper where plurality is valuable. These qualities need not be maximized in every process; their appropriate degree depends on stakes, scale, reversibility, and available resources.

Proposition 18.271 (Mediation adequacy under heterogeneous subjects). *An institutional arrangement has stronger adequacy for a heterogeneous AI-mediated economic configuration when it identifies materially relevant subject positions, distinguishes the dimensions of standing attached to them, makes its value-translation and decision rules*

inspectable, preserves significant subject-value remainder, and provides revision or contestation pathways proportionate to the stakes and reversibility of the decision.

Proposition 18.271 does not define one ideal institution. It specifies a diagnostic direction for comparing architectures that perform different economic functions. A low-stakes automated transaction can rely on a compact interface. A system affecting legal status, health, livelihood, political participation, ecological continuity, or durable access to essential infrastructure may require a richer one.

Institutional mediation also connects heterogeneity to power. The actor that controls the interface can influence which subjects become visible, which values can be expressed, which translations are admissible, and which forms of contestation remain available. Control over mediation can therefore convert technical or organizational capability into structural power even when the controller does not determine every downstream decision. Section 16.1 established that asymmetry becomes power through relational conversion mechanisms; subject-value mediation supplies one such mechanism in AI-rich economies.

The section's argument can now be stated compactly. Human persons, artificial agents, collective formations, and non-human participants can occupy the same economic field without possessing identical forms of subjecthood. Their relevant values can be partially comparable, translatable, or aggregable while retaining meaningful differences and remainder. AI increases the feasibility of coordinating complex heterogeneous systems, yet it also increases the practical force of whichever representations and objectives are encoded in technical and institutional interfaces. Governance therefore requires explicit subject typing, value provenance, bounded translation, remainder preservation, contestability, and revisability where the stakes justify them.

This architecture changes the temporal problem that follows. Once subject positions, value structures, and mediation interfaces are allowed to evolve, the composition of the economic order itself becomes path dependent. Dependencies can deepen or weaken; human and artificial capabilities can co-evolve; institutions can acquire or lose mediating capacity; forms of work and participation can reorganize; knowledge infrastructures can become more plural or more concentrated. Section 18.16 therefore examines long-horizon human-AI order as a trajectory problem rather than a static equilibrium among fixed subject types and fixed values.

18.16 Long-Horizon Human-AI Order

This section develops the temporal synthesis of Chapter 18. Its role is to connect the chapter's analyses of artificial productive capacity, capability asymmetry, power, labor, subjecthood, ownership, surplus, epistemic dependence, governance, generative participation, and heterogeneous subject-value mediation within one historically extended account of human-AI economic order. The objective is to identify which trajectories require simultaneous attention when present arrangements can alter the capacities, dependencies, institutions, forms of participation, and knowledge conditions inherited by later periods. The discussion proceeds through dependency, capability, institutional, labor, participation, and knowledge trajectories before examining future-possibility openness and the discipline of revisable closure. The method combines the trajectory and path-dependence architecture of Chapter 15, the adaptive governance architecture of Section 16.20, and the AI-specific mechanisms developed

in Sections 18.1–18.15. The section is therefore prospective without functioning as a forecast: it analyzes possible trajectory structures and governance conditions rather than asserting one determinate future of artificial intelligence.

A long-horizon analysis becomes necessary because many economically important effects of AI can be weakly visible in a short observational window. A system can improve current service quality while deepening infrastructural dependence. Automation can increase output while altering the institutions through which later workers acquire expertise. A public body can reduce administrative cost while gradually losing the internal capacity required to supervise the systems on which it depends. A community can gain access to powerful models while losing locally governed knowledge infrastructures. Present performance and future generativity can therefore move in different directions.

Chapter 15 defined trajectories as scale- and representation-indexed accounts of historically extended change and emphasized that economic histories are often bundles of partially coupled trajectories rather than movements along one variable. That discipline is especially important for human–AI order. Dependence, capability, institutional authority, labor organization, participation, and knowledge can change at different rates, react to different interventions, and produce delayed effects in one another. A short-run improvement in one trajectory can reinforce a long-run deterioration in another, while a costly short-run transition can sometimes preserve or create later capacities.

Definition 18.272 (Long-horizon human–AI order). *A long-horizon human–AI order is a historically extended configuration of relations among human persons, artificial systems, collective subjects, non-human affected positions, institutions, infrastructures, and value structures, represented through the coupled trajectories by which dependency, capability, labor, participation, knowledge, authority, and future-option formation change over time.*

Definition 18.272 treats order as a changing relational configuration rather than a fixed equilibrium. The term does not imply harmony, stability, or a single center of control. An order can be contested, fragmented, rapidly changing, or only partially institutionalized. What makes it analytically an order is that recurrent relations, infrastructures, standards, rights, dependencies, and expectations acquire enough persistence to condition later action.

Table 18.16 summarizes the trajectory dimensions used in the section. The rows are analytically distinct but empirically coupled. Their separation helps identify which mechanism is changing; their recombination is required for interpretation of the wider order.

Proposition 18.273 (Coupled-trajectory condition). *A long-horizon assessment of human–AI order is stronger when it evaluates materially coupled dependency, capability, institutional, labor, participation, and knowledge trajectories rather than inferring the wider order from improvement or deterioration in one dimension alone.*

Proposition 18.273 supplies the section’s governing discipline. Productivity, income, model capability, access, employment, participation, and epistemic autonomy remain important indicators, yet none provides a sufficient summary of the order by itself. The analytical task is to identify which trajectory is being measured, which other trajectories it conditions, and whether the relevant coupling is contemporaneous, delayed, cumulative, threshold-dependent, or reversible.

Table 18.16: Trajectory dimensions in long-horizon human–AI order

Trajectory	Primary object of change	Typical coupling	Long-horizon concern
Dependency	Reliance, substitutability, exit, fallback, and complementary infrastructure	Infrastructure, access, standards, organizational competence	Whether present reliance becomes difficult to revise or replace
Capability	Human, artificial, organizational, and collective capacities for action and generation	Learning, automation, delegation, investment, maintenance	Whether capabilities regenerate, differentiate, or atrophy across periods
Institutional	Rules, authority, representation, administrative capacity, and governance interfaces	Procurement, law, standards, expertise, public capacity	Whether institutions retain capacity to supervise and revise AI-mediated arrangements
Labor	Tasks, occupations, bargaining structures, income channels, professions, and learning pathways	Automation, ownership, distribution, education, participation	Whether work transitions preserve material security, capability formation, and alternative contribution pathways
Participation	Consequential entry into knowledge, decisions, institutions, care, community, and culture	Rights, time, infrastructure, collective organization, recognition	Whether participation remains generative rather than merely formal
Knowledge	Production, verification, preservation, transmission, orientation, and epistemic infrastructure	Models, archives, education, provenance, research institutions	Whether knowledge capacity remains reconstructible, contestable, and generative

18.16.1 Dependency Trajectories

Dependency under AI is temporally structured. Section 18.3 distinguished capability asymmetry from the mechanisms through which dependency, control, and institutional mediation can convert asymmetry into power. Section 18.13 then treated dependency reduction as one governance strategy. A long-horizon view adds a further question: how does reliance change after repeated use, complementary investment, institutional adaptation, skill redistribution, and withdrawal of alternatives?

A dependency trajectory can deepen even when each individual period appears beneficial. An organization can adopt an external model because it is cheaper and more capable than the available internal alternative. Staff then reorganize work around the model, data formats become platform-specific, procurement routines stabilize, internal expertise declines, and complementary software is built around the

same provider. None of these changes alone establishes problematic dependence. Together they can alter the cost and feasibility of later exit. The relevant object is therefore the history through which reliance becomes embedded.

Several dimensions should be distinguished. *Functional dependency* concerns reliance on an artificial system for a task or service. *Infrastructural dependency* concerns reliance on compute, networks, data pipelines, energy systems, model-serving architecture, or technical standards. *Organizational dependency* concerns loss of internal personnel, routines, or authority required to perform or supervise a function. *epistemic dependency* concerns reliance on a system for interpretation, verification, or orientation. *institutional dependency* concerns rules or public processes that cannot operate effectively without particular technical intermediaries. These dimensions can reinforce one another while remaining analytically distinct.

Dependency also has a temporal direction because replacement capacity requires time. An institution that retains source data, documentation, interoperable formats, technical staff, and alternative procurement pathways can often change providers more readily than an institution that has allowed those capacities to disappear. A nominal right to exit therefore differs from an effective capacity to exit. The difference can become substantial when restoration requires rebuilding teams, archives, training systems, legal authority, or infrastructure that were gradually displaced.

This temporal structure can produce hysteresis. A dependency may remain after the original efficiency advantage narrows because complementary investments, habits, standards, learned expectations, and institutional routines continue to favor the incumbent arrangement. Section 15.8 treated hysteresis and lock-in as distinct path-dependent conditions. The present application suggests that human–AI dependency should be diagnosed through the mechanisms that preserve reliance after its initiating conditions change rather than through provider concentration alone.

Dependency trajectories can also weaken constructively. Interoperability, modular architecture, portability, open standards, retained human competence, plural procurement, public or commons infrastructure, and credible fallback arrangements can reduce the cost of switching or redesign. Such measures need not eliminate reliance on AI. They can change its form from dependence on one narrow pathway toward dependence embedded in a wider ecology of substitutable or collectively governed resources.

A further issue concerns asymmetric restoration time. The removal of a capability can occur faster than its reconstruction. A training program can be closed in one budget cycle while professional competence takes years to rebuild. A public technical unit can be dissolved quickly while institutional knowledge, recruitment networks, and trust require much longer to restore. Long-horizon governance should therefore attend to the time required to regenerate alternatives, not only the current number of alternatives.

Proposition 18.274 (Dependency-revisability condition). *A dependency trajectory is more compatible with long-horizon revisability when affected subjects retain practical substitutability, interoperable records and interfaces, relevant internal or collective competence, and credible pathways for replacement or redesign within a time horizon proportionate to the consequences of failure or disagreement.*

The proposition does not treat independence as a universal objective. Complex economies depend on infrastructures, institutions, expertise, and other persons. The relevant issue is whether dependence becomes a mechanism of durable power that re-

moves practical alternatives or weakens future capacity to reconstruct them. A well-governed human-AI order can therefore contain extensive interdependence while retaining sufficient plurality and regenerative capacity to revise how that interdependence is organized.

18.16.2 Capability Trajectories

Capability asymmetry is also historical. Section 18.2 treated human and machine capability as multidimensional, task-relative, and only partially orderable. A long-horizon analysis asks how these capability profiles change through learning, automation, delegation, investment, institutional reorganization, and mutual adaptation. The relevant trajectory is therefore neither a race between two fixed kinds of intelligence nor a single curve of model performance. It is the co-evolution of heterogeneous capacities embedded in different subjects and infrastructures.

Artificial capability can grow through improved models, compute, data, tools, interfaces, coordination systems, and accumulated deployment experience. Human capability can grow through education, practice, collaboration, institutional memory, new conceptual tools, and AI-assisted learning. Collective capability can grow through organizations, standards, public infrastructure, knowledge commons, and forms of coordination that allow individually limited persons to act effectively together. These trajectories can reinforce one another. Better artificial systems can expand human learning and organizational reach, while stronger human and institutional capabilities can improve model evaluation, problem selection, oversight, and socially useful deployment.

The same coupling can produce capability erosion. Repeated delegation can reduce practice in tasks whose competence previously depended on active exercise. Educational pathways can narrow if a capability appears economically unnecessary. Organizations can stop maintaining expertise that an external system supplies more cheaply. Professional communities can weaken when entry routes disappear. The result can be a divergence between *access to capability* and *possession of regenerative capability*: people may be able to obtain an output while losing the capacity to reconstruct, evaluate, modify, or replace the process that produces it.

This distinction matters because capability can be relationally distributed. A person using an AI system may accomplish tasks that neither the person nor the system could perform as effectively in isolation. A municipality can possess a capability through contracts, public staff, legal authority, shared infrastructure, and external expertise. A research community can possess a capability through distributed records, instruments, institutions, and methods. Long-horizon analysis should therefore ask which relations sustain the capability and whether those relations are durable, contestable, and transferable.

Capability inheritance is another temporal concern. Many human capacities are generated through long sequences of education, apprenticeship, mentorship, practice, failure, professional socialization, and participation in communities of inquiry. If AI changes the economic demand for intermediate tasks, it can also change the pathways through which advanced human capability was historically formed. Removing a task from paid work can be efficient at the task level while weakening an apprenticeship structure that served a wider capability-generating function. The appropriate response may involve redesigning the learning pathway rather than preserving

the task unchanged.

Long-horizon capability policy therefore concerns regeneration as well as possession. A society can have high aggregate access to AI while becoming less able to train independent evaluators, public technologists, domain experts, researchers, maintainers, or institutional designers. Conversely, a society can use powerful automation to lower the cost of learning, widen access to advanced tools, and create new forms of collective capability. The direction depends on educational, organizational, ownership, and participation structures rather than on model capability alone.

Proposition 18.275 (Capability-regeneration condition). *A human–AI capability trajectory is more generatively robust when the relations that expand current task performance also preserve or create pathways through which relevant human, collective, and institutional capabilities can be learned, renewed, recombined, and transferred to future participants.*

Proposition 18.275 does not require preservation of every legacy skill. Historical economic change routinely makes some capabilities less useful while creating others. The criterion concerns the capacity to generate and renew capabilities that remain relevant to judgment, verification, governance, care, creation, maintenance, collective action, and future adaptation. A long-horizon order can therefore permit substantial capability substitution while resisting erosion of the capability-generating processes on which later autonomy and innovation depend.

18.16.3 Institutional Trajectories

Institutions mediate the conversion of AI capability into durable economic order. They define rights, authority, procurement, liability, access, representation, standards, review, public obligations, organizational roles, and the interfaces through which heterogeneous subject–value configurations become actionable. Section 18.15 treated these interfaces synchronically. The present subsection examines how their capacities and rules change through repeated AI adoption.

Institutional trajectories contain at least two coupled layers. The *rule layer* includes formal law, regulations, contracts, standards, procedural rights, mandates, and governance rules. The *operative layer* includes staff competence, budgets, routines, technical systems, records, informal practices, organizational memory, and relationships with external providers or affected communities. A rule can remain formally stable while its practical implementation changes dramatically because the operative layer has become AI-mediated. Conversely, institutions can preserve a stable public function while changing the technical means through which it is delivered.

Delegation can alter institutional capacity over time. An agency may initially use an AI system for bounded support while retaining independent review. If performance is high and workloads increase, the system’s recommendations can become defaults, staffing can be reorganized, and internal review can shift toward exception handling. The resulting institution may possess greater throughput while having less independent capacity to reconstruct routine decisions. This change can be acceptable under some conditions, yet its significance cannot be assessed from accuracy or cost alone. It alters where practical authority and knowledge reside.

Procurement is similarly generative. Repeated contracts can shape data standards, technical architectures, employment profiles, vendor ecosystems, and future procurement options. A purchasing decision can therefore function as an institutional invest-

ment in a pathway. Public and large private buyers can create de facto standards through adoption even before formal standard-setting occurs. Long-horizon analysis should identify these path-creating effects, especially where interoperability and exit become costly only after complementary systems have accumulated.

Institutional memory is another important trajectory. AI can improve records, retrieval, consistency, and continuity when systems preserve provenance and make earlier reasoning reconstructible. It can also weaken memory when model-mediated processes replace records with opaque outputs, when vendor transitions break provenance, or when staff no longer understand why procedures acquired their present form. Section 17.13 developed preservation and re-epistemization as epistemic tasks. For institutions, this implies that the capacity to revisit earlier decisions depends on preserving both outputs and the histories of rules, evidence, interpretations, and technical mediation that produced them.

Institutions can also learn. Monitoring, appeal, audit, incident review, participatory feedback, experimentation, and comparative evaluation can alter rules and deployment architectures. Section 16.20 treated adaptive governance as an iterative process in which rules and governed systems can co-evolve. Human-AI institutions require this capacity because the technical object, the uses made of it, and the affected social relations can change faster than a one-time authorization process can anticipate.

Proposition 18.276 (Institutional self-revision condition). *An institutional trajectory is more compatible with long-horizon governance when the institution retains sufficient authority, competence, records, technical access, fiscal capacity, and contestation pathways to evaluate and revise the AI-mediated arrangements through which its own functions are performed.*

The proposition identifies institutional self-revision as a capability rather than a procedural ornament. An institution that formally retains authority while lacking the expertise, data, contractual rights, or infrastructure required to exercise that authority can become dependent on the object it is supposed to govern. Long-horizon institutional design should therefore examine whether governance capacity co-evolves with deployment capacity rather than assuming that legal jurisdiction alone preserves effective control.

18.16.4 Labor Trajectories

Labor change under AI unfolds through trajectories of tasks, occupations, organizations, bargaining relations, income channels, professional institutions, and capability formation. Section 18.4 separated cognitive automation from broader claims about employment and human contribution. A long-horizon approach extends that distinction by examining how successive rounds of adoption reorganize the pathways through which people enter economic life, acquire skills, receive income, exercise bargaining power, and participate in collective production.

Task displacement and occupational displacement need not coincide. An occupation can survive while its task composition changes substantially; a profession can expand because AI lowers the cost of complementary work; a role can persist formally while its discretion or learning content declines. Conversely, a new occupational category can emerge around functions that were previously distributed across several roles. Labor trajectories should therefore track task composition, organizational po-

sition, bargaining structure, training pathway, and income relation together where those dimensions affect the economic significance of work.

Temporal mismatch is a central problem. Technical capability can change faster than educational systems, professional licensing, bargaining institutions, geographic mobility, housing, care arrangements, or social insurance. A transition that appears efficient in an equilibrium comparison can impose concentrated losses during the period in which persons and institutions cannot adjust at the same rate. Long-horizon analysis should preserve this transition interval rather than treating displaced labor as instantaneously reallocated.

The distributional architecture can also change as wage-based claims become less connected to productive necessity. Sections 18.7 and 18.8 examined AI-generated surplus and the limits of redistribution. Over time, the importance of ownership, access rights, public services, social investment, and non-wage distribution can increase if labor income becomes a weaker channel through which productivity gains circulate. This does not establish one inevitable post-wage regime. It identifies a trajectory problem: institutions built around employment can become increasingly misaligned with the mechanisms through which income and productive capacity are generated.

Labor also carries non-income functions. Work can organize time, social recognition, apprenticeship, collective identity, professional ethics, bargaining power, and participation in institutions. These functions vary across occupations and persons; they should not be romanticized or assumed to justify preserving harmful or unnecessary work. Their analytical relevance lies in transition design. If an occupational form contracts, some of its capability-forming or participatory functions may need alternative institutional locations if society values their continuation.

Care and relational labor illustrate the limits of a single automation metric. AI can reduce administrative burden, improve scheduling, support diagnosis, translate communication, or assist routine monitoring while the value of human presence, trust, embodied care, local knowledge, or mutual recognition remains context-dependent. The labor trajectory can therefore involve re-composition rather than simple replacement. What matters is which tasks move, which relations remain, how quality is assessed, and whether workers and recipients can influence the redesign.

Entry pathways deserve special attention. Many professions reproduce capability through junior work whose immediate output can be relatively easy to automate. If those roles disappear without replacement training structures, the system can enjoy short-run productivity gains while weakening the future supply of experienced practitioners. The same problem can appear in research, law, engineering, administration, medicine, craft, and creative practice in different forms. Long-horizon labor governance should therefore distinguish elimination of low-value routine from elimination of developmental stages that carried hidden learning functions.

Proposition 18.277 (Labor-transition plurality condition). *Assessment of an AI-mediated labor trajectory is stronger when it jointly considers income security, task re-composition, bargaining position, capability formation, entry and progression pathways, relational functions, and access to forms of participation outside employment rather than treating employment quantity as the sole transition criterion.*

The proposition preserves employment as an important economic variable while locating it within a larger generative architecture. A humane long-horizon order may contain less labor in some domains and more in others; the deeper question is whether transitions preserve material security and the capacities through which per-

sons can continue to learn, contribute, associate, care, create, contest, and participate in future economic formation.

18.16.5 Participation Trajectories

Section 18.14 defined generative participation as consequential involvement in processes that help produce future knowledge, decisions, institutions, care relations, communities, cultural forms, capabilities, or possibilities. A long-horizon perspective asks whether those forms of involvement remain consequential after AI becomes embedded in the institutions through which participation occurs. The distinction between formal participation and effective participation becomes particularly important over time.

A participatory right can remain legally intact while the location of consequential choice changes. Citizens can retain access to consultation while problem framing and option generation migrate into technical systems that are difficult to inspect. Workers can retain representation while staffing, performance evaluation, and task allocation become increasingly model-mediated. Researchers can retain authorship while research agendas become dependent on model-generated problem spaces and platform-controlled infrastructure. Communities can retain cultural institutions while discoverability, funding, and symbolic visibility become concentrated through external platforms. These changes can reduce practical influence without an explicit removal of participatory status.

Participation can also deepen. AI can lower barriers to expertise, translation, drafting, simulation, accessibility, and coordination. Persons previously excluded by language, disability, educational background, geographic isolation, or scarce professional support can gain new ways to enter knowledge and institutional processes. Collective subjects can use AI to analyze documents, organize evidence, compare proposals, or negotiate with better-resourced actors. The long-horizon question is whether these gains become durable capacities of participants or remain contingent on interfaces whose governance they cannot influence.

The generative-participation reserve defined in Section 18.14 is therefore itself dynamic. Educational pathways, rights, institutions, archives, public spaces, community organizations, technical tools, and cultural practices require renewal. A reserve can expand when new participants gain effective entry, when institutions create new channels for co-design, or when automation releases time for inquiry and care. It can contract when participation becomes symbolic, when independent institutions disappear, or when economic insecurity prevents supported access from becoming sustained involvement.

Intergenerational renewal is especially important. A society can preserve participation for currently established actors while weakening entry for those who come later. Professional bodies can retain senior expertise while junior pathways disappear. Community institutions can retain nominal membership while young participants lack time, resources, or meaningful roles. Public decision systems can preserve current representatives while future participants inherit infrastructures whose design is difficult to contest. Long-horizon participation therefore includes the reproduction of entry routes, not only the protection of incumbent participants.

Heterogeneous subjecthood adds another dimension. Section 18.15 showed that participation rights, welfare standing, delegated agency, collective representation,

and ecological affectedness are different forms of standing. Their trajectories can diverge. Artificial agents may acquire more delegated operational authority without acquiring wider normative standing. Human participants may retain formal standing while losing practical influence. Non-human affected positions may become more visible through sensing and modeling while remaining dependent on institutional representation. Participation analysis should record which dimension is changing rather than treating increased system inclusion as a uniform expansion of standing.

Proposition 18.278 (Participation-renewal condition). *A participation trajectory is more generatively sustainable when consequential pathways remain accessible to current participants and institutions continue to reproduce the capabilities, roles, resources, and entry routes through which future participants can shape knowledge, decisions, institutions, care, community, and culture.*

Participation-renewal analysis also guards against assigning humans a ceremonial residual role. An order can reserve nominal human approval while substantive framing, evidence selection, option generation, and implementation are effectively settled elsewhere. The long-horizon criterion concerns whether persons and human-governed collectives can still alter the architecture within which decisions are formed, including the rules governing artificial agents and the mediation of heterogeneous values.

18.16.6 Knowledge Trajectories

Knowledge trajectories connect Chapter 17 to the long-horizon AI problem. Knowledge is generated, verified, preserved, transmitted, institutionalized, forgotten, reinterpreted, and converted into practical capacity through historically changing relations. Artificial systems can accelerate several of these processes while reorganizing the infrastructure on which they depend. The relevant long-horizon object is therefore the evolving capacity of a society, organization, or community to know, verify, remember, reinterpret, and generate questions under changing technical mediation.

A first distinction separates knowledge access from knowledge regeneration. AI can provide rapid access to explanations, summaries, translations, code, analyses, and candidate solutions. Such access can expand epistemic capability substantially. Regenerative knowledge capacity additionally requires methods, records, institutions, skilled communities, provenance, contestation, and educational practices through which claims can be reconstructed, challenged, extended, or replaced. Access can remain high while regenerative capacity becomes concentrated elsewhere.

Verification has its own trajectory. When machine-generated outputs become abundant, the scarce component can shift toward trusted evidence, provenance, domain judgment, and the capacity to inspect how a claim was formed. Section 18.10 treated this as an epistemic-dependence problem. Over longer periods, verification institutions themselves can change: journals, courts, public agencies, professional bodies, schools, laboratories, archives, and media organizations can adopt new standards or lose resources as users rely more heavily on direct model interfaces. The reliability of future knowledge therefore depends partly on the institutions that maintain verification practices during the transition.

Preservation is equally important. AI systems can make large archives searchable and can assist migration, classification, and reconstruction. They can also produce fragile dependence when knowledge is stored in proprietary representations, when

model versions disappear, or when generated summaries displace access to underlying records. Section 17.13 emphasized preservation and historical re-epistemization. Long-horizon AI order should preserve enough source material, metadata, model and policy documentation, and institutional memory that later observers can revisit earlier interpretations with improved knowledge.

Question formation and orientation form another trajectory. Section 18.12 argued that abundance of candidate problems and solutions increases the importance of judgment about which questions deserve attention. If research and public reasoning become strongly mediated by a small set of systems, their categories, retrieval structures, evaluation procedures, and optimization targets can influence which questions are salient. This influence need not be centrally planned to become historically consequential. Repeated mediation can create attention paths that reinforce some research programs, representations, or problem framings while making others harder to sustain.

Epistemic plurality can therefore function as a generative resource. Different institutions, disciplines, languages, methods, communities, and model ecosystems can preserve alternative representations of the same field. Plurality can create duplication and coordination cost, yet it can also support error detection, conceptual innovation, translation, and recovery when one epistemic pathway fails. The appropriate level of plurality varies by domain; the long-horizon issue is whether standardization removes distinctions whose later value cannot yet be known.

Human learning remains part of this trajectory even when artificial systems exceed human performance in many tasks. Learning changes the learner's capacity to judge, formulate questions, participate in institutions, understand evidence, and create relations. A system that supplies correct answers can support learning or substitute for it depending on how the interaction is organized. Educational and professional institutions therefore shape whether epistemic abundance becomes expanded human capability, deeper dependence, or some mixture of both.

Proposition 18.279 (Epistemic-regeneration condition). *A knowledge trajectory is more robust when expanded AI-mediated access is coupled with preservation of provenance, verification capacity, reconstructible records, plural interpretive pathways, question-forming institutions, and learning processes through which relevant knowledge can continue to be challenged and regenerated.*

This condition does not require duplication of machine capability by humans. It requires an epistemic ecology able to determine when reliance is warranted, to preserve histories of knowledge formation, to maintain alternative routes of inquiry where they matter, and to develop new criteria when earlier representations become inadequate. Such an ecology supports the institutional self-revision described in Subsection 18.16.3 because governance cannot revise what it can neither understand nor reconstruct.

18.16.7 Future-Possibility Openness

The six trajectories converge on a question of future possibility. Long-horizon governance cannot preserve a fixed set of future options because future technologies, values, institutions, ecological conditions, subject configurations, and problems are only partly knowable in advance. Chapter 15 therefore treated future histories through accessibility, branching, path dependence, intervention, and changing admissibility

rather than as a pre-existing menu of choices. In the AI context, openness concerns the practical capacity of an economic order to continue generating, recognizing, and institutionalizing alternatives as conditions change.

Future openness should be distinguished from maximizing the number of options. Some options can be harmful, mutually incompatible, prohibitively costly, or dependent on injustice. Rights, safety requirements, ecological constraints, and collective commitments can appropriately close pathways. An order also requires standards and coordination; permanent refusal to commit can prevent infrastructure, trust, investment, or collective action. The relevant criterion is whether closure is proportionate to its justification and whether the order preserves sufficient capacities for later revision where uncertainty remains material.

Definition 18.280 (Future-possibility openness). *Future-possibility openness* is a property of an economic order in which relevant subjects and institutions retain practical capacities to recognize changing conditions, generate or recover materially different alternatives, evaluate them through revisable subject-value mediation, and reorganize consequential relations when inherited arrangements become inadequate.

The definition links openness to capability and institution rather than to abstract possibility alone. A technically conceivable alternative is weakly relevant if no actor can finance it, understand it, organize around it, obtain necessary rights, reconstruct required knowledge, or access compatible infrastructure. Likewise, formal permission has limited practical significance when dependency, concentration, or lost capability makes an alternative unreachable. Future-possibility openness therefore depends on generative accessibility in the sense developed in Section 15.6.

Several resources can support openness. Modular and interoperable infrastructure can lower the cost of recombination. Public and commons capacities can preserve alternatives outside narrow market incentives. Archives and provenance can make prior decisions reconstructible. Education and research institutions can generate new capabilities and questions. Rights of contestation, exit, and organization can permit affected subjects to initiate change. Diverse organizational forms can preserve experiments that would disappear under one dominant architecture. Reversibility can allow learning before commitments become difficult to undo.

Heterogeneous value makes openness especially important. Section 18.15 rejected the assumption that one scalar representation exhausts the values of heterogeneous subjects. The future adds another layer of incompleteness: later participants can inherit values, identities, technologies, and problems that present institutions do not anticipate. A long-horizon order should therefore be cautious about encoding present evaluative settlements so deeply into infrastructure that future participants cannot revisit them. This caution does not grant hypothetical future preferences automatic priority over present needs. It treats future revisability as one relevant value among others.

Openness can also have distributional structure. A system may contain many alternatives in aggregate while particular communities, regions, professions, or social groups have little access to them. Future-option analysis should therefore ask who can exercise alternative-forming capacity, who bears the costs of transition, and whose infrastructures are preserved. Concentrated option ownership can create a nominally innovative order in which only a small number of actors can materially redirect the trajectory.

The same issue appears at the level of artificial systems. A diverse ecosystem of

models can still depend on one compute layer, one data infrastructure, one identity system, or one procurement channel. Apparent plurality at one layer can coexist with concentration at another. Future-possibility openness therefore requires multiscale diagnosis of bottlenecks rather than counting visible applications or providers.

Proposition 18.281 (Open-future generativity). *A human-AI order has a stronger future-possibility openness when its current arrangements preserve distributed capacities for learning, recombination, contestation, institution building, infrastructural substitution, and value re-articulation sufficient to generate materially different responses to later conditions that cannot be specified completely in the present.*

Proposition 18.281 extends the anti-foreclosure criterion of Section 18.14. Generative foreclosure identifies cases in which alternative-forming capacity is degraded. Future-possibility openness identifies the positive institutional property that allows alternatives to continue emerging. The concepts are related without being simple opposites: an order can avoid severe foreclosure while still having a narrow generative ecology, and it can preserve substantial openness in some domains while closing others deliberately.

18.16.8 Closure Discipline and Revisable Order

Economic order requires closure. Budgets must be allocated, standards selected, systems deployed, rights defined, infrastructure built, and decisions implemented. Long-horizon governance therefore cannot be organized around indefinite postponement. The central problem is the discipline under which temporary, local, or durable closures are made when AI capability, affected subject positions, and relevant value structures remain capable of changing.

A closure becomes historically important when it alters later transition structure. Technical standards can determine which systems interoperate. Procurement can shape vendor ecosystems. Educational policy can shape future skill distributions. Infrastructure investment can privilege particular architectures. Data regimes can determine which actors can train or audit systems. Liability rules can influence which applications are developed. Organizational restructuring can move expertise outside an institution. Each decision can be locally rational while also increasing the probability that one path becomes self-reinforcing.

GRE uses *premature closure* for a narrower condition than ordinary commitment. Prematurity concerns a mismatch between the strength or durability of closure and the available justification for fixing the relevant part of the order. This mismatch can arise because uncertainty remains high, affected positions are weakly represented, switching costs are accumulating, alternative-forming capacity is being removed, or revision mechanisms are too weak for the consequences of error.

Definition 18.282 (Premature order closure). *Premature order closure* is a historically consequential commitment that substantially narrows later practical alternatives or alternative-forming capacity before the evidential, institutional, normative, or coordination basis for such durable narrowing is sufficiently established relative to the stakes, reversibility, and distribution of consequences.

Definition 18.282 is deliberately conditional. Some high-stakes domains can justify strong closure even under uncertainty, especially where rights, safety, catastrophic risk, or ecological irreversibility are involved. Other domains benefit from experimentation and plural pathways. The diagnosis depends on what is being closed, for

whom, for how long, through which mechanism, with which consequences, and with what capacity for correction.

Premature closure differs from generative foreclosure. Premature closure describes the timing and justification of a commitment relative to uncertainty and reversibility. Generative foreclosure describes degradation of the mechanisms through which future alternatives could be produced. A premature closure can generate foreclosure when it removes capabilities, institutions, or infrastructure needed for alternatives. It can also remain reversible and therefore never become foreclosure. Conversely, generative foreclosure can emerge gradually through many individually modest decisions without one identifiable premature commitment.

Closure discipline therefore requires explicit temporal design. Institutions can specify review intervals, portability requirements, interoperability standards, archival obligations, transition plans, capability-retention requirements, appeal routes, sunset or renewal procedures where appropriate, and triggers for deeper reassessment when the technical or social environment changes. The form should match the domain. A safety-critical infrastructure may require stronger continuity and certification; an experimental educational tool may justify shorter authorization cycles; a public knowledge archive may warrant especially strong preservation and portability requirements.

Reversibility is only one component. Section 18.13 defined a governance reversibility reserve because correction becomes harder as dependence and complementary investment deepen. Some commitments are physically or institutionally difficult to reverse, yet they can remain governable if their scope is bounded, alternatives are preserved elsewhere, and later generations retain capacities to create new pathways. Conversely, a technically reversible software choice can become practically entrenched through data, skills, habits, standards, and network effects. Closure analysis should therefore consider the whole coupled trajectory rather than a nominal undo function.

Near-critical conditions increase the importance of this discipline. Section 16.15 argued that governance should change when defensible representations indicate heightened sensitivity, amplified response, or increased accessibility of qualitative transition. In an AI-mediated order, rapid capability change, concentrated infrastructure, or cascading institutional dependence can create situations in which a small design choice produces large downstream effects. Stronger monitoring, staged intervention, plural modeling, and preservation of rollback or alternative pathways can be appropriate where transition uncertainty is materially elevated.

Responsibility for closure should also remain identifiable. Artificial systems can recommend standards, optimize allocations, or rank institutional options, yet the authority to make a durable closure derives from a governance arrangement. Section 18.15 treated subject-value mediation interfaces as the structures through which standing and value enter decision. Long-horizon closure should therefore record who authorized the commitment, which representations were used, which subject-value remainders remained, what future effects were considered, and which revision pathway was retained.

Proposition 18.283 (Revisable-order condition). *A long-horizon human-AI order is more governable when durable commitments are accompanied, in proportion to their stakes and path dependence, by preserved knowledge, identifiable responsibility, reviewable justification, capability for institutional learning, and practical mechanisms*

through which materially changed conditions can support revision, replacement, or reauthorization.

Proposition 18.283 does not imply continual institutional change. Stability can itself be generative by enabling trust, planning, specialization, and long-term investment. The proposition concerns the difference between stable order and closed order. Stable institutions can retain capacities for self-revision; closed institutions can become unable to respond even when their original conditions have disappeared.

The long-horizon architecture developed in this section can now be summarized through the coupled-trajectory condition. Dependency should be evaluated through its reversibility and regenerative alternatives; capability through its pathways of renewal; institutions through their capacity for self-revision; labor through transition, learning, and participation; participation through consequentiality and intergenerational entry; knowledge through verification, preservation, and regeneration. Future-possibility openness then asks whether these trajectories jointly preserve capacities for later alternative formation, while closure discipline asks how present commitments can remain proportionate to uncertainty, path dependence, and the consequences of being wrong.

This synthesis completes the chapter's general architecture of AI asymmetry. It does not determine a single institutional design for education, research, work, development, communities, ecology, or public administration because the relevant subjects, values, infrastructures, risks, and temporal mechanisms differ across domains. Section 18.17 therefore applies the chapter's analytical distinctions to those domain interfaces, identifying which parts of the framework become especially consequential in each setting while preserving the need for domain-specific evidence and institutional judgment.

18.17 AI Domain-Translation Requirements

Chapter 18 has developed artificial productive capacity and radical capability asymmetry at a level intended to travel across more than one substantive economic setting. That portability creates a methodological constraint. Concepts such as capability, dependence, power, participation, surplus, epistemic agency, heterogeneous value, and long-horizon openness cannot be transferred into education, research, work, public administration, ecology, or another domain merely because the same vocabulary appears there. The present section therefore closes the chapter by specifying what must remain visible when the Chapter 18 architecture is translated into a domain. Its role is not to conduct the domain inquiries themselves. Those inquiries belong to Chapter 19, where domain-specific objects, institutions, histories, evidential practices, and normative standards can correct or limit the general framework.

The requirements below are intentionally abstract. Each identifies a dimension that can become consequential under AI-mediated capability asymmetry while leaving its concrete meaning to domain inquiry. Table 18.17 summarizes the resulting translation record.

Definition 18.284 (AI-domain interface). An *AI-domain interface* is a historically situated configuration in which artificial capabilities, infrastructures, representations, or delegated operations enter a domain-specific set of subjects, relations, values, institutions, dependencies, and temporal pathways, thereby altering conditions under

Table 18.17: Requirements for translating Chapter 18 into substantive domains.

Translation requirement	Analytical object to preserve	Question delegated to domain inquiry
Regenerative capability	Relation between assisted performance and later capability formation	Which capabilities should persist, develop, or remain independently reproducible in this domain?
Epistemic regeneration	Verification, provenance, orientation, and capacity to revise knowledge	Which forms of knowledge and judgment require domain-specific regeneration?
Participation and membership	Consequential standing in organizations and collective processes	What counts as meaningful participation, contribution, or membership here?
Capability conversion and dependency	Conversion of access into locally reproducible capacity, together with exit and substitution conditions	Which dependencies are functional, fragile, or self-reinforcing in the domain?
Collective relational capacity	Trust, reciprocity, memory, coordination, and shared institutional capability	Which relations are constitutive of collective capacity rather than incidental to it?
Represented affectedness	Visibility of affected positions, uncertainty, irreversibility, and heterogeneous value	Which affected subjects or processes are poorly represented by prevailing technical or economic proxies?
Revisable authority	Mandate, responsibility, contestability, institutional learning, and correction	Which actors may authorize, review, challenge, maintain, or revise AI-mediated action?
Domain-translation remainder	Objects or mechanisms inadequately represented by the general AI architecture	Which domain findings require restriction, extension, or revision of Chapter 18 concepts?

which domain-relevant goods, capabilities, decisions, or future alternatives can be generated.

The definition makes the interface a translation object rather than a miniature domain theory. A domain study should determine which subjects and relations matter, which artificial capabilities actually enter them, which institutions authorize or constrain their use, which values are implicated, and which temporal effects deserve attention. Chapter 18 supplies comparative coordinates; Chapter 19 supplies the domain-specific inquiry.

18.17.1 Assisted Performance and Regenerative Capability

AI can expand what a person, organization, or collective can accomplish while assistance is available. Domain inquiry should distinguish this extended performance from the later capacity to interpret, verify, transfer, repair, or regenerate the relevant practice under changed conditions. The distinction does not privilege unassisted performance as an intrinsic norm. Many valuable human capabilities are technologically and institutionally extended. Its purpose is to identify whether an arrangement enlarges future capability, leaves it unchanged, or makes successful action increasingly dependent on a particular interface whose operation cannot be evaluated or repro-

duced locally.

The appropriate balance is domain-specific. A learner, laboratory, firm, municipality, or community may each have different reasons to preserve independent capability, shared fallback capacity, institutional memory, or reliable external specialization. Chapter 19 should therefore specify the capability whose reproduction matters before treating short-run performance gains as evidence of long-run generativity.

18.17.2 Epistemic Regeneration and Orientation

Chapter 17 showed that symbolic abundance can relocate scarcity toward verification, provenance, attention, and orientation. Translation into a substantive domain should therefore identify the knowledge practices that make AI-mediated outputs usable and revisable there. Relevant capacities can include source evaluation, measurement, interpretive judgment, anomaly recognition, preservation, question formation, and the ability to reconstruct why a claim or decision acquired authority.

The requirement is especially important where apparently similar outputs carry different evidential status across domains. Chapter 18 does not establish those statuses. Domain inquiry should determine which standards of warrant, professional competence, legal relevance, scientific validation, or local knowledge are necessary for artificial outputs to enter consequential practice.

18.17.3 Participation and Membership

Capability gains can coexist with reduced participation when decisions, problem frames, or organizational roles become concentrated elsewhere. Domain translation should therefore record who remains able to shape objectives, classifications, rules, interpretations, and later revisions, rather than treating access to AI-generated outputs as equivalent to participation. It should also distinguish material support from membership, recognition, contribution, and standing where those relations are substantively important.

The meaning of consequential participation varies across workplaces, research communities, educational institutions, public bodies, commons, and other settings. Chapter 19 should supply that meaning from the domain rather than importing a single participation metric from the general AI analysis.

18.17.4 Capability Conversion and Dependency

Access to an artificial system becomes economically significant through conversion. A domain inquiry should examine which complementary resources, skills, infrastructures, permissions, languages, organizational routines, and support relations are required to convert nominal access into usable capability. The same inquiry should identify dependencies created by recurrent use, including switching costs, unavailable substitutes, loss of local expertise, proprietary interfaces, or institutional routines that become difficult to reverse.

This requirement preserves the distinction between interdependence and vulnerability developed earlier in the chapter. Specialized external capacity can be efficient and generative. The stronger concern arises where the surrounding arrangement

weakens practical alternatives, verification, contestability, or the capacity to adapt when providers, rules, prices, or technologies change.

18.17.5 Collective Relational Capacity

Artificial systems can mediate coordination, communication, documentation, matching, and collective memory. Their effects should therefore be evaluated partly through the relations they reorganize. A domain inquiry should identify which relations sustain trust, reciprocity, mutual recognition, shared knowledge, coordination, care, conflict resolution, or common-resource governance, and whether technical mediation strengthens or weakens the capacity to reproduce those relations.

This requirement prevents aggregate output or transaction efficiency from exhausting the analysis of collective capability. The relevant relational objects and the evidence appropriate to them remain domain-specific and should be specified in Chapter 19.

18.17.6 Affectedness, Irreversibility, and Representation

AI-mediated decisions frequently rely on representations of affected positions. Translation should therefore ask which subjects, processes, temporal horizons, and forms of value become visible through available data and models, which remain weakly represented, and which consequences may be difficult to reverse once action occurs. This requirement is broader than prediction accuracy because an accurate representation of one target can still omit affected relations outside the target definition.

The domain determines what counts as material affectedness and what forms of uncertainty or irreversibility require special treatment. Legal status, developmental trajectories, ecological processes, cultural continuity, public rights, and organizational membership cannot be assumed to share one evidential or normative representation.

18.17.7 Revisable Authority and Institutional Learning

Where AI-mediated outputs enter authoritative or organizational action, domain translation should preserve the chain linking technical capacity to mandate, responsibility, review, maintenance, contestation, and correction. Distributed technical participation can make that chain difficult to reconstruct. A domain analysis should therefore identify who authorizes use, who can inspect or challenge outcomes, who bears responsibility for maintaining the surrounding process, and how changed evidence can support revision.

Institutional learning is part of the same requirement. A system can improve immediate performance while weakening the organization's ability to understand or revise its own operations. Conversely, well-designed technical mediation can improve records, detection of recurring problems, and collective memory. The relevant standard is not maximal human execution of every task but preservation of the institutional capacities required for accountable adaptation.

18.17.8 Domain-Translation Remainders

The preceding requirements specify what Chapter 18 should hand to domain inquiry without determining the results of that inquiry. Their use therefore depends on a disciplined treatment of mismatch between the general architecture and domain-specific evidence.

Definition 18.285 (Domain-translation remainder). A *domain-translation remainder* is a domain-relevant object, relation, value, mechanism, history, evidential practice, or constraint whose analytical significance is not adequately represented by the Chapter 18 categories carried into the domain and therefore requires domain-specific conceptualization or revision of the general framework.

A remainder is methodologically informative. It can show that a concept is too broad, that a domain contains a subject or value structure absent from the general account, that a dependency operates through a different mechanism, or that the relevant evidence cannot support the comparison presupposed by the transferred concept. Preserving such remainders prevents domain application from becoming confirmation by vocabulary.

Proposition 18.286 (Domain-transfer condition). A *Chapter 18 concept has stronger analytical warrant in a substantive domain when its relevant subjects, relations, mechanisms, value dimensions, temporal scale, and evidential indicators can be specified within that domain, while material domain-translation remainders remain available to restrict, revise, or withdraw the transferred concept.*

Proposition 18.286 defines the boundary with Chapter 19. Chapter 18 supplies a general architecture of artificial productive capacity, capability asymmetry, dependence, power conversion, labor and surplus effects, participation, heterogeneous subject–value relations, governance, and long-horizon possibility. Chapter 19 owns the substantive domain analyses and can determine which parts of that architecture travel, which require reinterpretation, and which fail. The handoff is therefore a requirement of answerability: domain inquiry should be able to correct the general AI analysis rather than merely instantiate it.

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Chapter 19

Domains of Generative Relational Economics

Domain Inquiry and Chapter Scope

Chapter 19 develops the domain-facing stage of Generative Relational Economics. The preceding chapters established GRE as a historically situated and revisable research programme, developed its epistemological and methodological commitments, specified economic subjects and relational structures, examined allocation and heterogeneous value, introduced generative spacetime and long-horizon analysis, and extended the framework through power, justice, knowledge, and artificial intelligence. Those constructions remain general enough to travel across several economic settings, yet their generality does not establish that they retain the same meaning, mechanism, evidential form, or normative significance in education, research, work, welfare, communities, platforms, public institutions, migration, ecology, or culture. The present chapter therefore treats domain inquiry as a test of GRE as well as a use of GRE.

The chapter has three objectives. The first is methodological: it specifies how a general GRE concept can be translated into a domain whose objects, relations, values, constraints, institutions, histories, and evidential practices are partly specific to that domain. The second is substantive: it develops a sequence of domain inquiries through which the framework can illuminate generative processes while remaining answerable to specialized domain knowledge. The third is reflexive: it uses agreement, failure, remainder, and comparison across domains to revise the GRE research programme itself. Domain application is consequently neither a terminal demonstration of a completed theory nor a search for examples that merely instantiate prior categories. It is a reciprocal analytical relation between a provisional general framework and domains capable of correcting it.

This orientation extends the research-programme architecture of Section 3.21, especially its account of domain-specific applications, and the constitutional discipline of Section 3.22. GRE is designed to remain economically specific while drawing on concepts and methods that cross disciplinary boundaries. Its general vocabulary therefore requires repeated tests of scope. A concept such as dependency can refer to materially different relations in a household, labor market, digital platform, ecological

system, public administration, or transnational migration regime. A category such as capability can concern learning, organizational action, scientific inquiry, mobility, ecological regeneration, or institutional revision. A value such as access can be central in one setting, auxiliary in another, and normatively insufficient in a third. Domain inquiry determines which correspondences are analytically warranted rather than assuming that recurring words indicate recurring structures.

The chapter accordingly uses *domain* in an analytical rather than purely administrative sense. A domain can overlap a sector, profession, policy area, institutional field, scientific specialty, jurisdiction, community, or ecological system, but it need not coincide with any one of them. The relevant domain is specified by the research problem: the objects and subjects whose trajectories matter, the relations through which effects are generated, the institutions and infrastructures that mediate those relations, the values and evaluative practices that organize judgment, the constraints that delimit feasible action, the temporal and spatial scales on which consequences unfold, and the evidence through which claims can be assessed. Domain boundaries are therefore working boundaries. They should be stable enough for inquiry and porous enough to reveal dependencies that materially cross them.

The chapter begins with domain translation because later applications depend on disciplined transfer. Section 19.1 develops procedures for domain specification, object translation, relational translation, value translation, constraint analysis, transfer scope, comparative learning, and framework revision. The remaining sections then use those procedures in substantive settings. Education is examined through learning relations, infrastructure, capability formation, curiosity, aesthetic judgment, knowledge communities, AI-assisted learning, and generative educational return. Research and knowledge institutions are examined through funding, scientific relations, epistemic infrastructure, research communities, openness, preservation, artificial intelligence, and long-horizon knowledge generation. Work and organizations are examined through labor relations, membership, coordination, contribution, care and relational labor, automation, participation beyond employment, and organizational generativity.

The middle of the chapter broadens the domain range. Development and humanitarian practice foreground resource transfer, institutional mediation, local relational structures, dependency, capability formation, participation, historical context, and generative assistance. Welfare and social protection foreground income security, access, care, public services, relational continuity, capability protection, and participation. Communities and commons foreground shared resources, reciprocity, trust, collective rules, local circulation, and collective capacity. Platforms and digital economies foreground mediation, attention, data, network effects, gatekeeping, algorithmic coordination, and dependency. Public institutions and infrastructure foreground mandates, access, public capacity, institutional learning, public trust, and adaptive governance.

The final substantive domains extend GRE into relations whose boundaries are especially difficult to represent through conventional economic units. Migration and transnational relations connect mobility, borders, legal status, remittances, transnational families, knowledge and skill flows, and cross-jurisdictional dependency. Ecology introduces ecological flows, stewardship, commons, intergenerational relations, biophysical constraints, and regeneration. Culture and symbolic economy introduce symbolic production, attention, meaning, aesthetic judgment, cultural infrastructure,

and AI-generated culture. These domains are included because they expose different combinations of material, institutional, epistemic, relational, ecological, and symbolic processes. Their juxtaposition provides a demanding test of whether GRE categories remain useful beyond the settings in which they were first formulated.

The chapter concludes with two synthetic sections. Comparative domain synthesis identifies recurrent structures while preserving cross-domain differences, failed transfers, domain-specific revisions, and limits of generalization. The final section records the requirements that those findings place on later economic-order analysis without constructing an order-level theory in advance. The sequence is therefore *translation, domain inquiry, comparative learning, order-level requirements*. Chapter 20 owns the subsequent economic-order synthesis. This sequence does not presume that a concept that travels across several domains has become a universal law. Recurrence can support a stronger comparative hypothesis; counterexamples can contract its scope; persistent remainders can motivate new concepts; and incompatible domain structures can indicate that plurality should be preserved.

Methodologically, the chapter is plural. Domain inquiry can require historical reconstruction, institutional analysis, ethnography, legal interpretation, qualitative comparison, causal inference, descriptive statistics, network analysis, computational simulation, formal modeling, participatory inquiry, ecological measurement, archival work, or combinations of these methods. GRE does not assign one method to all domains. The relation between research question, domain object, available evidence, and claim type should guide method choice. A formal model can clarify a mechanism in one setting while obscuring institutional detail in another. A quantitative measure can support comparison where its semantics are stable while creating false comparability where domain meanings differ. A qualitative account can reveal mechanisms and values that aggregate measures omit while requiring explicit attention to sampling, interpretation, and transferability.

Normative analysis is similarly domain-sensitive. GRE can ask how an arrangement affects participation, capability, dependence, resilience, plural value, future possibility, or generative justice, but these questions do not replace domain-specific legal, ethical, professional, democratic, ecological, or cultural standards. A hospital, university, platform, municipality, workplace, refugee-support institution, commons, and ecological restoration project operate under different mandates and relations of responsibility. Domain inquiry should therefore expose where GRE contributes an additional generative-relational perspective and where substantive judgment depends on standards whose justification lies partly outside GRE.

The chapter also treats failure as analytically productive. A domain can show that a GRE concept is too broad, that two mechanisms previously grouped together require separation, that a valued outcome has been poorly represented, that a presumed subject is internally heterogeneous, that a formal analogy lacks empirical purchase, or that a proposed indicator changes meaning across contexts. Such findings do not represent a failure of domain application in the programme-level sense. They supply boundary knowledge. A research programme capable of learning from failed transfer can become more precise, while one that explains every case through flexible reinterpretation loses falsifiability and disciplinary shape.

The chapter's broader contribution is therefore to place GRE in a reciprocal relation with specialized domains. General concepts organize questions, preserve cross-domain memory, and make some structural comparisons possible. Domain inquiry

supplies concrete objects, mechanisms, evidence, institutional meanings, and counterexamples. Comparative analysis then asks which structures recur, which remain local, and which require revision of the general vocabulary. This reciprocal architecture preserves the possibility of cumulative GRE research without treating cross-domain recurrence as evidence that a general Generative Relational Theory has already been achieved. The chapter begins by specifying the translation discipline required for that architecture.

19.1 Domain Translation

Domain translation provides the methodological interface between the general architecture of Generative Relational Economics and the substantive domains examined in Chapter 19. Its role is to specify how a concept developed at programme level can acquire a warranted domain meaning without assuming semantic identity, structural equivalence, or identical evidential requirements across settings. The section has four objectives: to define a domain precisely enough for inquiry; to translate objects, relations, values, and constraints into that domain; to state conditions governing the scope of transfer and the preservation of domain-specific remainder; and to explain how comparison across domains can revise GRE itself. The method is analytical and diagnostic. It treats transfer as a claim requiring specification and evidence, while allowing translation to result in direct reuse, adaptation, decomposition, local replacement, or withdrawal of a general concept.

The need for this discipline follows from GRE's own commitments. Section 3.21.13 established that domain application tests concepts against heterogeneous institutions, evidence, values, scales, and mechanisms. Chapter 12 then showed that economic objects are relationally constituted within historically organized configurations; Chapter 14 showed that value can be heterogeneous and imperfectly convertible; Chapter 15 made sequence, path dependence, temporal reach, and changing possibility spaces analytically explicit; Chapter 16 distinguished asymmetry, dependence, power, and justice; and Chapters 17–18 demonstrated how epistemic and artificial capabilities become consequential through domain-specific infrastructures and institutions. Section 18.17 closed the AI chapter by introducing the domain-translation remainder. The present section generalizes that discipline beyond the AI interface and turns it into a reusable procedure for the domain studies that follow.

A useful translation procedure should therefore preserve two capacities at once. It should make GRE concepts stable enough to support cumulative comparison, and it should keep them revisable enough to respond when a domain supplies materially different objects, mechanisms, meanings, or constraints. Excessive flexibility would allow every case to be redescribed as compatible with GRE; excessive rigidity would force specialized domains into categories whose original assumptions may not hold. Domain translation occupies the methodological space between those failures.

Table 19.1 summarizes the eight translation dimensions developed in this section. The table is a research scaffold rather than a universal checklist. Particular studies can require additional domain-specific dimensions, and some dimensions can be analytically coupled.

Table 19.1: Analytical architecture for domain translation in GRE.

Translation dimension	Domain specification task	Characteristic transfer risk	Primary analytical output
Domain	Specify problem boundary, scales, institutions, histories, and evidence	Treating an administrative label as a stable analytical field	Explicit domain specification and boundary rationale
Objects	Identify subjects, resources, infrastructures, events, states, and processes	Assuming shared labels establish object identity	Domain object map with correspondence conditions
Relations	Identify mechanisms of access, authority, dependence, care, exchange, trust, coordination, and conversion	Comparing relation names while mechanisms differ	Relational mechanism map and mediation structure
Values	Identify valued objects, evaluators, bearers, institutional valuations, and conversion practices	Importing one domain's metric or normative ordering	Plural value map with translation remainders
Constraints	Identify material, legal, institutional, epistemic, ecological, temporal, and representational constraints	Treating constraints as fixed background conditions	Feasible-transformation map and constraint dynamics
Transfer scope	Classify reuse, adaptation, decomposition, substitution, or withdrawal	Expanding concepts through semantic drift	Scope statement, boundary conditions, and remainder record
Comparison	Compare mechanisms and structures after domain specification	Treating recurrence of vocabulary as structural invariance	Cross-domain correspondences, contrasts, and counterexamples
Revisability	Return domain findings to programme-level concepts and methods	Preserving the framework by absorbing contrary evidence	Recorded contraction, extension, decomposition, or revision

19.1.1 Domain Specification in GRE

Domain inquiry begins by specifying what the domain denotes for the research problem at hand. Terms such as education, work, welfare, platform economy, public institution, migration, ecology, and culture appear familiar because they are established practical and scholarly categories. Familiarity does not make their analytical boundaries self-evident. Education can refer to schools, universities, informal learning, workplace training, families, online communities, tutoring systems, credential markets, or broader processes of capability formation. Work can refer to paid employment, self-employment, unpaid care, organizational membership, platform-mediated tasks, professional practice, volunteering, or activities through which per-

sons contribute without receiving a wage. Ecology can refer to ecosystems, resource flows, land-use institutions, restoration practices, climate relations, non-human affected positions, or the biophysical conditions supporting economic activity. A GRE study should therefore state which configuration it is actually investigating.

Definition 19.1 (GRE domain specification). A *GRE domain specification* is a problem-indexed description of the subjects, objects, relations, institutions, infrastructures, values, constraints, spatial and temporal scales, historical conditions, and evidential practices that delimit a field of inquiry sufficiently for its generative and relational mechanisms to be investigated.

Definition 19.1 treats a domain as an analytical construction constrained by the world rather than as an arbitrary researcher-defined container. The specification is problem-indexed because different questions can justify different boundaries within the same named domain. A study of AI-assisted learning can center on learners, teachers, models, assessment institutions, families, educational platforms, and credential systems. A study of educational finance can require governments, tax systems, lenders, households, universities, and labor markets. A study of epistemic inequality can add language regimes, libraries, disability access, publication systems, and digital infrastructure. The domain name remains the same while the relevant relational field changes.

A domain specification should identify at least five kinds of boundary. The first is an *object boundary*: which subjects, infrastructures, resources, events, and processes are included as analytically relevant. The second is a *relational boundary*: which interactions, dependencies, conversion mechanisms, and institutional mediations are followed across those objects. The third is a *scale boundary*: which spatial, organizational, and temporal levels are required for the claimed mechanism. The fourth is an *evaluative boundary*: which value dimensions and affected positions enter the inquiry. The fifth is an *evidential boundary*: which observations, records, measurements, interpretations, and domain expertise can warrant the claims being made. These boundaries can be revised during inquiry when excluded relations prove materially consequential.

Domain specification also distinguishes a research domain from a discipline. Education is studied by economics, sociology, psychology, pedagogy, history, philosophy, political science, law, computer science, and other fields. A GRE analysis of education therefore does not acquire authority over educational questions merely because the research object has an economic dimension. GRE enters a domain through a specific analytical contribution: it asks how relations generate, reproduce, distribute, transform, or foreclose capacities, values, subjects, institutions, dependencies, and later possibilities. Specialized domain concepts and evidence remain necessary wherever they carry explanatory or normative content that the general framework lacks.

The same distinction applies to institutional and jurisdictional boundaries. A municipality, firm, school system, platform, or ecosystem can provide a practical boundary for data collection while remaining embedded in wider relations. Supply chains, household reproduction, migration, cloud infrastructure, law, finance, climate, language, and knowledge circulation can connect apparently local domains to distant processes. Domain specification should therefore record consequential external relations rather than assuming that the unit providing the dataset also provides the complete causal boundary.

Historical specification is equally important. Domain objects can acquire their

meaning through prior institutional formation. Employment categories depend on labor law, organizational norms, technology, and household structures. Public trust depends partly on institutional histories. Commons arrangements can depend on long-standing norms and conflict. Educational credentials can change meaning as access expands or labor markets reorganize. A domain translation that observes only the current state can therefore misidentify historically generated constraints as intrinsic properties of the domain.

Proposition 19.2 (Domain-specification condition). *A domain-level GRE claim has stronger interpretive warrant when the analytical boundary, relevant scales, historical horizon, affected positions, and evidential basis are stated in terms that permit the claimed generative mechanism to be distinguished from material relations excluded by the boundary.*

The proposition does not require exhaustive modeling. Domain inquiry inevitably excludes some relations. Its purpose is boundary accountability: a study should make sufficiently clear what has been bracketed, why that bracketing is appropriate to the claim, and which external relations could change the interpretation if they became material.

19.1.2 Domain-Specific Objects

Once the domain is specified, translation proceeds through its objects. GRE uses several general analytical categories—subjects, relations, resources, infrastructures, capabilities, constraints, values, events, institutions, states, and processes—but domain inquiry determines what instantiates those categories and whether the instantiation preserves the structure assumed by the general concept. Object translation therefore concerns correspondence, identity conditions, internal heterogeneity, observability, and historical persistence.

The distinction between a general category and a domain object is important. A learner, employee, household, research group, municipality, migrant family, platform user, wetland, archive, AI model, and professional association can each occupy economically consequential positions, yet their relevant capacities and forms of standing differ. Calling each an economic subject for a particular analysis can be useful when the term denotes a position capable of entering economic relations. It does not establish equivalence of agency, responsibility, legal personality, moral standing, experience, or internal organization. Chapters 12 and 18 developed these distinctions at general level; domain translation determines which of them become operative in a particular inquiry.

Object translation should also identify internally composite objects. A university can be treated as an institutional subject for some funding or bargaining questions while containing departments, laboratories, administrators, faculty, students, contractors, libraries, governing bodies, and external partners whose interests and capacities diverge. A platform can be modeled as an intermediary while also containing ranking systems, payment infrastructure, moderation systems, contractual rules, developers, data pipelines, and multiple participant populations. A community can appear as a collective subject in negotiations while containing unequal voice, conflicting values, and differentiated vulnerability. Domain inquiry should therefore specify the level at which an object is treated as coherent and preserve internal structure when that structure affects the mechanism under study.

The identity of an object can also change through the process being studied. Education can transform a novice into a professional; migration can change legal and institutional status; organizational restructuring can change an employee into a contractor; platform rules can change a user into a monetized creator or de-platformed outsider; ecological degradation can change the functional role of a landscape; AI mediation can change a task from an individual activity into a human-machine configuration. GRE is especially concerned with such transformations because they alter later capacities and relations. Domain object maps should therefore include processes of object formation and dissolution where they are part of the causal architecture.

Measurement requires a further distinction between the object and its representation. A variable such as school enrollment can represent access to an institution without exhausting participation or learning. Publication count can represent one dimension of research output without exhausting epistemic contribution. Employment status can indicate labor-market position without exhausting contribution, care work, or organizational membership. A biodiversity index can represent selected ecological properties without exhausting ecological relation or regeneration. Domain translation should make these representational choices explicit because later comparison is only as sound as the semantic stability of the objects being compared.

A practical object map can therefore record four elements for each important object: its domain meaning, the GRE category to which it is provisionally related, the evidence through which it is observed, and the conditions under which the correspondence can fail. Such a map helps prevent a general concept from becoming a label applied wherever a superficially similar object appears. It also preserves local vocabulary when that vocabulary encodes distinctions that GRE has not yet developed.

Proposition 19.3 (Object-correspondence condition). *A general GRE object category can be carried into a domain when the domain object satisfies the analytical role required by the category at the scale and horizon of the study; shared terminology alone provides insufficient warrant for object identity across domains.*

The condition allows direct reuse where the correspondence is strong and encourages narrower local terminology where it is not. The resulting object discipline becomes the basis for translating relations, because relations can be specified only after the positions they connect are sufficiently clear.

19.1.3 Domain-Specific Relations

Relational translation is central to GRE because a domain often differs from another less through the existence of familiar entities than through the mechanisms connecting them. Access, authority, dependency, exchange, care, trust, recognition, membership, representation, delegation, coordination, competition, cooperation, extraction, stewardship, and obligation can appear in many domains. Their recurrence as words does not establish a common relational mechanism. Domain inquiry must specify what passes through the relation, which positions it connects, how it is instituted, how it persists, what asymmetries it contains, and which later possibilities it changes.

Consider dependency. In a workplace, dependency can arise from income, credentials, visa sponsorship, health benefits, firm-specific skills, or control over tools. In a platform economy, it can arise from audience access, ranking infrastructure, payment systems, reputation records, or interoperability. In development practice, it

can arise from financing, imported expertise, maintenance, donor rules, or data infrastructure. In ecological systems, dependence can describe material and biological relations whose structure differs from intentional or contractual dependence among institutional actors. The general concept becomes analytically useful only after the domain mechanism is specified.

Relational translation should therefore describe at least direction, mediation, persistence, substitutability, and transformation. Direction concerns which positions can condition which others, while allowing reciprocal relations where appropriate. Mediation identifies the institutions, infrastructures, representations, or third parties through which the relation operates. Persistence concerns whether the relation is episodic, recurrent, path-dependent, or infrastructurally stabilized. Substitutability concerns the availability and cost of alternative relations. Transformation concerns whether participation in the relation changes the capacities, identities, expectations, rules, or later relations of the positions involved.

Power analysis illustrates why these dimensions matter. Chapter 16 distinguishes difference in capability from its conversion into power. A domain study should therefore locate the conversion mechanism rather than infer power directly from a resource difference. A school administrator's authority, a platform's gatekeeping capacity, a research funder's agenda-setting influence, an employer's control over work conditions, a government's border authority, and a landowner's control over ecological use can each condition others' feasible actions, but they do so through different legal, institutional, material, or informational mechanisms. Domain translation preserves the common analytical question while keeping the conversion mechanism specific.

Relation maps should also preserve multiplexity. Two positions can simultaneously exchange resources, share knowledge, depend on infrastructure, hold legal obligations, compete for recognition, and participate in a community. A teacher and student can be connected through instruction, assessment, care, authority, institutional membership, and knowledge generation. A researcher and funding institution can be connected through finance, evaluation, prestige, agenda formation, reporting, and career dependence. Aggregating these relations into one tie can obscure the mechanism relevant to a claim. GRE can therefore use networks or relational representations when useful, while domain inquiry determines which edge types carry substantive meaning.

Temporal structure further differentiates relations. A short contractual dependency can have different generative consequences from a relation that shapes childhood learning, scientific careers, institutional memory, ecological regeneration, or migration status over decades. Repeated relations can also generate trust, routines, expectations, and lock-in that are absent from one-time interactions. Section 19.1 therefore treats the temporal horizon as part of relational translation rather than an external variable added after the relation has been defined.

Definition 19.4 (Domain relational correspondence). A *domain relational correspondence* is a warranted mapping between a general GRE relation and a domain relation based on similarity in the positions connected, the mechanism of mediation or conversion, the relevant direction and persistence, and the kinds of downstream capacities or constraints generated through that relation.

Definition 19.4 allows cross-domain comparison without requiring identical institutional forms. Two relations can be structurally comparable even where their legal

form, participants, or material substrate differ. Conversely, two relations can share a familiar label while lacking the mechanism required for meaningful comparison. This distinction becomes especially important when domain findings are later synthesized in Section 450.

19.1.4 Domain-Specific Values

Value translation asks which forms of value are generated, recognized, measured, exchanged, protected, contested, or lost within a domain. Chapter 14 developed a plural architecture in which value can be heterogeneous, relationally realized, transmitted, converted, captured, dissipated, regenerated, or left partially incommensurable. Domain inquiry gives those possibilities substantive content. Educational value can include learning, capability, curiosity, credential access, social relation, confidence, and future option space. Research value can include knowledge, verification, negative results, methods, infrastructure, question formation, preservation, and public use. Work can generate income, capability, recognition, membership, care, coordination, identity, and collective capacity. Ecological value can involve material provision, resilience, biodiversity, regeneration, cultural meaning, stewardship, and intergenerational option space.

These examples show why value translation cannot begin from a presumed universal metric. Monetary valuation can be indispensable in domains involving budgets, prices, wages, costs, or investment, yet monetary representation can leave other dimensions unrepresented. Administrative metrics can be similarly partial. Graduation rates, citation counts, service throughput, engagement, case-resolution time, or ecological indicators can support governance while remaining representations of selected dimensions. A GRE domain study should identify what the metric makes visible, what institutional decisions depend on it, and which valued relations or consequences remain outside it.

Domain value analysis should distinguish at least four positions. The first is the *value bearer*: the subject, relation, institution, ecosystem, or future possibility whose condition is at stake. The second is the *valuator*: the person, collective, institution, professional practice, market, legal regime, or governance process through which value is recognized or judged. The third is the *value representation*: the price, score, category, narrative, indicator, qualitative judgment, legal status, or other form through which value becomes legible. The fourth is the *conversion interface*: the process through which one value form is translated into another decision-relevant form. These positions can coincide, but domain analysis should not assume that they do.

The distinction is particularly important where affected positions have weak representational capacity. Children, future generations, non-human beings, displaced communities, or persons excluded from institutional participation can be materially affected while possessing limited direct influence over the representations used in decision. Representation then becomes part of the value architecture. The relevant question is not simply what a decision maker values, but which affected positions enter the evaluative process, through what representation, and with what possibility of contestation or correction.

Value translation should also preserve conflict. A university can value open knowledge and financial sustainability; a workplace can value productivity, worker auton-

omy, safety, care, and organizational continuity; a development organization can value speed of assistance, local capability, donor accountability, and autonomy; ecological governance can involve livelihood, species protection, cultural meaning, future resilience, and distributive justice. Domain analysis gains little by announcing that these values are plural. Its substantive task is to identify where they become mutually supporting, convertible, competing, institutionally prioritized, or resistant to aggregation.

A domain-specific value map can therefore record the value form, bearer, valuator, representation, conversion process, affected time horizon, and known remainder. The remainder is analytically important. Conversion can support decisions without producing equivalence. A budget can convert several objectives into resource allocations; an admissions score can aggregate multiple criteria; a cost–benefit analysis can translate heterogeneous effects into a common unit; a deliberative process can produce a collective decision among incompatible values. Each process can be practically necessary while preserving aspects of value that remain outside the resulting representation.

Proposition 19.5 (Value-translation condition). *A GRE value concept has stronger domain warrant when the relevant value bearer, valuator, representation, conversion process, and material remainder can be identified without treating decision closure as evidence of complete commensurability.*

This condition permits operational decisions. Its purpose is to preserve analytical information about what the decision procedure represents and what it leaves unresolved. That discipline becomes important when domain studies compare outcomes produced by different evaluative institutions.

19.1.5 Domain-Specific Constraints

Constraints define which transformations are feasible, costly, prohibited, delayed, unstable, or difficult to sustain within a domain. GRE treats constraints as analytically significant because generativity concerns transformations of later capacities and possibility spaces. Domain translation therefore requires more than identifying desirable outcomes or relevant relations; it must specify the conditions that shape what can actually be generated.

Constraints can be material. Educational systems face buildings, staffing, time, connectivity, language resources, disability access, and household conditions. Research systems face equipment, data, archives, compute, funding cycles, and specialized labor. Workplaces face production technologies, contracts, supply chains, organizational routines, and skill distributions. Ecological systems face biophysical thresholds, regeneration rates, spatial interdependence, and irreversible loss. Material constraints can be altered through investment, yet their transformation can require long horizons and can generate new dependencies.

Constraints can also be institutional and legal. Professional licensing, procurement rules, intellectual property, immigration status, welfare eligibility, employment law, fiduciary duties, public mandates, data protection, and procedural rights can structure feasible action. These constraints can protect valued relations while also creating rigidity or exclusion. A domain analysis should therefore avoid treating flexibility as intrinsically generative. Stable rules can make trust, investment, rights, and coordination possible. The analytical question concerns which possibilities a constraint

enables, which it restricts, how it can be revised, and whose position is affected.

Epistemic and representational constraints form another class. Decision makers can lack data, concepts, language, verification capacity, historical records, or methods for representing a relevant value. A community can know that an intervention produces harm without possessing a standardized indicator recognized by the funding institution. A public agency can have extensive administrative data while lacking categories that represent informal care or relational continuity. A scientific field can possess measurement precision while lacking access to a population or historical archive. Such constraints shape what can enter evidence-based decision and can therefore become generative constraints in their own right.

Temporal constraints require separate attention. Some capabilities can be expanded rapidly; institutional trust, professional expertise, ecological regeneration, language acquisition, community relations, and scientific infrastructure can require longer periods. A policy can therefore appear feasible at one horizon and destructive at another. Conversely, long-horizon benefits can be irrelevant to an urgent humanitarian crisis if near-term survival conditions are unmet. Domain inquiry should state the operative temporal scales rather than treating a single optimization horizon as natural.

Constraints are also partly endogenous. Institutions can create credential barriers; platforms can create switching costs; organizations can deskill workers through repeated automation; aid arrangements can create maintenance dependency; ecological degradation can narrow future feasible sets; successful public infrastructure can expand later administrative capacity. GRE therefore distinguishes a constraint that is inherited from one that is generated or reinforced by the arrangement being studied. This distinction connects domain analysis to Chapter 15: the current feasible set is historically produced, and present action can change the transformation rules governing future feasibility.

Constraint analysis should finally identify adaptation and substitution. A constraint can be binding under one institutional arrangement and relaxed under another. Lack of local expertise can be addressed through training, migration, shared infrastructure, remote collaboration, or organizational redesign, each with different dependencies and value consequences. Scarce public capacity can be addressed through contracting, digitization, decentralization, shared services, or long-horizon state-capacity investment. GRE does not prescribe one response through the category of constraint itself. It asks how alternative responses redistribute capabilities, dependencies, values, and future options.

Proposition 19.6 (Constraint-dynamics condition). *A domain constraint should be analyzed together with the relations that reproduce, relax, relocate, or transform it when those dynamics materially affect the future feasible set of the domain.*

The proposition keeps the category of constraint compatible with both realistic boundary recognition and generative analysis. Some constraints may remain effectively fixed within the horizon of a study; others are central objects of intervention. Domain translation should make that difference visible.

19.1.6 Transfer Scope and Domain Remainders

The preceding subsections establish the information needed to determine how far a general GRE concept can travel. Transfer is best treated as graded rather than binary.

A concept can be reused with little modification, adapted to domain parameters, decomposed into several local concepts, replaced by a domain-specific construct for the study at hand, or withheld when the correspondence is too weak. Each outcome can be legitimate. The objective is analytical fidelity rather than maximal preservation of the general framework.

Five transfer modes are especially useful. *Direct reuse* occurs when the general concept and domain object preserve sufficiently similar analytical roles and mechanisms. *Parameterized adaptation* preserves the concept while specifying domain-specific magnitudes, thresholds, institutions, or time scales. *Conceptual reinterpretation* preserves part of the relational structure while changing the domain semantics. *Decomposition or local substitution* replaces one broad concept with several domain concepts that better fit the evidence. *Withdrawal* records that the general concept contributes insufficiently to the inquiry or creates distortion. These modes should be understood as positions on a research process rather than a hierarchy in which direct reuse is always preferable.

Transfer requires attention to several characteristic errors. *Semantic drift* occurs when a concept gradually expands to include cases that lack the structure that originally gave it meaning. *Mechanism substitution* occurs when the same outcome is produced through a different process but is treated as evidence for the original mechanism. *Metric substitution* occurs when a readily observed indicator replaces the underlying object of interest. *Normative importation* occurs when the values embedded in one domain's institutions or measures are carried into another without justification. *Scale mismatch* occurs when a relation valid at one level is applied to another level whose aggregation or internal structure changes the mechanism. *Temporal mismatch* occurs when a short-horizon correspondence is used to support a long-horizon generative claim. *Institutional omission* occurs when formal similarity hides the institutional arrangements through which the mechanism actually operates.

The concept of a domain remainder protects inquiry against these errors. Section 18.17 introduced a domain-translation remainder for the transfer of AI architecture into substantive domains. Chapter 19 uses a more general version.

Definition 19.7 (Domain remainder). A *domain remainder* is a domain-relevant object, relation, value, constraint, history, mechanism, or evidential practice whose analytical significance is materially reduced, distorted, or absent when the domain is represented through the GRE concepts transferred into it.

A remainder is not automatically an error in GRE. Some remainders can fall outside the economic problem being investigated; some can be incorporated through domain-specific auxiliary concepts; some can indicate a boundary where GRE should defer to specialized theory. A remainder becomes programme-relevant when its omission recurrently changes explanation, evaluation, intervention, or comparison. At that point, the domain is supplying evidence that the general architecture may need extension, decomposition, or contraction.

The record of remainders also prevents successful operationalization from becoming false theoretical closure. A labor study can operationalize bargaining power through wage responses while leaving recognition, migration status, care obligations, or organizational voice outside the model. An education study can operationalize learning through test performance while leaving curiosity or independent problem formation weakly represented. An ecological study can operationalize restoration through selected indicators while leaving cultural relations or uncertain species inter-

actions outside the representation. The study can remain useful if those boundaries are explicit and the interpretation stays within them.

Proposition 19.8 (Transfer-warrant condition). *A GRE concept has stronger warrant for domain transfer when its domain object, relational mechanism, value implications, constraint structure, relevant scale, and evidential indicators can be specified coherently, and when material domain remainders are recorded as limits or sources of revision rather than absorbed through unconstrained reinterpretation.*

Proposition 19.8 supplies the central discipline of the section. It does not require exact structural identity. Translation can involve reinterpretation. It requires that the reinterpretation remain traceable enough for another researcher to see which part of the general concept has been preserved, which part has changed, and what evidence could weaken the resulting claim.

19.1.7 Comparative Domain Learning

Comparison becomes informative after domain translation has made local meanings explicit. Cross-domain learning should therefore begin with domain-specific maps rather than a universal coding imposed before the domains are understood. The purpose is to identify recurrent mechanisms, meaningful contrasts, and counterexamples while preserving differences in subject structure, institutional mediation, value, constraint, scale, and evidence.

A first form of comparison concerns *structural correspondence*. Two domains can contain relations with similar conversion structures even where their institutional forms differ. Gatekeeping can condition access to a platform audience, research funding, public service, migration status, or educational opportunity through different mechanisms. Comparison can ask whether each case contains control over an interface through which another subject reaches a valued resource or institutional position. The correspondence is strongest where the positions, conversion logic, and downstream consequences can be specified; the common label is secondary.

A second form concerns *mechanism contrast*. The same observed outcome can arise through different mechanisms. Reduced participation can follow exclusionary rules, lack of capability, high transaction costs, distrust, inaccessible infrastructure, language barriers, algorithmic ranking, legal status, or ecological displacement. Comparing mechanisms prevents outcome similarity from becoming theoretical equivalence. It also matters for intervention, because a policy effective against one mechanism can fail against another.

A third form concerns *boundary conditions*. A concept can work well in one domain and fail when a key condition changes. Trust built through repeated local interaction can operate differently from trust mediated by anonymous platforms. Exit can discipline a competitive market while providing little protection in a public monopoly or essential infrastructure. Monetary incentives can expand supply in one setting while weakening intrinsic, professional, or communal relations in another. Identifying the condition under which the relation changes supplies more useful theory than assigning a single cross-domain coefficient to heterogeneous cases.

A fourth form concerns *counterexample learning*. A domain that lacks a predicted relation can reveal that the general concept contains an unstated assumption. A successful commons can challenge a model that expects resource sharing to collapse under a specified incentive structure. A workplace that preserves skill formation under

extensive automation can identify institutional mechanisms preventing the capability erosion expected elsewhere. A development programme that combines external infrastructure with increasing local autonomy can reveal conditions under which dependence is transitional rather than self-reinforcing. Counterexamples can therefore refine mechanisms without requiring wholesale rejection of the framework.

Comparison should also preserve asymmetric evidential quality. One domain can possess administrative microdata and experimental variation; another can depend on historical reconstruction, participatory evidence, or ecological observation. Cross-domain synthesis should not manufacture symmetry by reducing every domain to the variables available in the most data-rich case. Nor should qualitative similarity erase differences in measurement precision. The appropriate comparison can concern mechanism plausibility, process sequence, institutional form, value conflict, or temporal pattern rather than a common scalar effect size.

The cumulative output of comparison is therefore a hierarchy of claims rather than a single unified model. Some findings remain local. Some become recurring domain mechanisms. Some support middle-range propositions that travel under stated conditions. Some reveal candidate structural invariants worthy of later formal investigation. A still smaller subset might eventually support a more general Generative Relational Theory. Chapter 19 remains deliberately below that final level. Its task is to produce disciplined comparative evidence from which stronger generalization could later be considered.

Proposition 19.9 (Comparative-correspondence condition). *Cross-domain recurrence provides stronger evidence for a GRE mechanism when the compared domains independently support compatible object roles, relational conversion structures, boundary conditions, and downstream consequences, while domain-specific remainders and counterexamples remain visible in the comparison.*

This condition favors comparison that can contract claims as readily as expand them. It also prepares the logic of Section 450, where the chapter returns to domain-specific findings, failed transfers, and possible revisions of GRE.

19.1.8 Framework Revisability through Domain Inquiry

Domain translation closes by specifying how applied findings return to the research programme. Revisability is substantive rather than ceremonial. A framework that announces openness while preserving every concept through ad hoc reinterpretation is difficult to correct. GRE therefore requires identifiable revision operations through which domain evidence can change its categories, mechanisms, scope, methods, and normative interfaces.

Several revision operations can be distinguished. *Contraction* narrows a concept or claim to a smaller domain or set of conditions. *Extension* adds a domain mechanism or object that the earlier framework did not represent. *Decomposition* divides a concept that proved too coarse into analytically distinct forms. *Recomposition* connects concepts that domain evidence shows to be systematically coupled. *Boundary revision* changes the relevant spatial, temporal, organizational, or subject boundary of inquiry. *Method revision* changes the evidential or analytical procedures used to identify a mechanism. *Normative-interface revision* changes how descriptive findings are connected to value, justice, law, professional standards, or governance. *Withdrawal* retires a category whose repeated use creates more distortion than explanatory value.

These revisions should preserve provenance. When a domain forces a change, the record should identify the prior formulation, the domain evidence or conceptual problem that exposed its limitation, the revised formulation, and the consequences for earlier comparisons. Versioned concepts can be less elegant than timeless definitions, yet they better match a research programme concerned with historically changing economic reality and its own changing knowledge conditions. Revision provenance also allows later researchers to determine whether apparent disagreement reflects evidence, domain difference, or use of different versions of the concept.

Negative findings deserve explicit preservation. A failed attempt to identify generative return in a policy, a power mechanism that disappears after controlling for institutional mediation, a value metric that becomes unstable across populations, or a domain where GRE adds little beyond established theory can each improve the programme. Publication and research incentives often privilege positive findings and theoretical extension. GRE's cumulative architecture should also retain contractions, null results, unsuccessful transfers, and boundary cases because these help prevent the framework from expanding through selective memory.

Revisability applies to the domain list itself. Chapter 19 examines selected domains because they expose important combinations of relational and generative problems; the selection does not define the permanent limits of GRE. Health, finance, housing, urban systems, agriculture, energy, security, family economies, international trade, industrial organization, and other fields can require dedicated treatment. Future domain inquiry can also show that some present categories should be divided, merged, or reorganized. The chapter provides a translation method that can travel beyond its own table of contents.

The relation to future GRT should remain similarly disciplined. Cross-domain recurrence can reveal candidate relational structures whose significance extends beyond economics. Such recurrence is a research prompt, not an ontological conclusion. A candidate general structure requires evidence that its meaning and mechanism survive domain change, that counterexamples have been considered, and that the abstraction does not erase precisely the domain differences responsible for its effects. GRE can therefore contribute to a future GRT through accumulated domain evidence while retaining its own economic specificity.

Proposition 19.10 (Domain-feedback condition). *A domain application contributes cumulatively to GRE when its findings can modify the programme's scope, concepts, mechanisms, evidential practices, or normative interfaces through traceable revision, including contraction or withdrawal where those responses better fit the domain evidence.*

Proposition 19.10 establishes the reciprocal character of Chapter 19. The domains that follow are neither illustrative appendices nor independent essays. Each provides a site in which GRE concepts can be used, tested, specified, and corrected. The next section begins with education because learning makes several generative processes unusually visible at once: relations can alter capabilities, curiosity can redirect future inquiry, institutions can shape access and recognition, infrastructures can widen or narrow participation, and artificial intelligence can expand immediate performance while changing the conditions of independent learning. Education therefore provides a demanding first test of the translation architecture developed here.

19.2 Education

Education provides the first substantive domain test of the translation method developed in Section 19.1. Its role is to examine how economic resources, institutions, relations, and technologies participate in the generation of learning while preserving the domain-specific objects that make education analytically distinct. The section has four objectives: to specify learning as a relational and temporally extended process; to identify the infrastructures through which educational access and participation become possible; to distinguish immediate task performance from the formation of capabilities, curiosity, judgment, and participation; and to develop a concept of generative educational return suitable for long-horizon evaluation. The method is relational and multiscale. It follows the learner across interactions with teachers, peers, texts, tools, families, institutions, communities, and artificial systems, while treating educational outcomes as trajectories whose significance can extend beyond the moment of instruction.

Economic analysis has long treated education as consequential for productivity, earnings, and the accumulation of human capital (Becker 1964). Capability-oriented approaches broaden the evaluative field by asking which substantive opportunities persons acquire through social arrangements (Sen 1999). GRE can use both lines of inquiry while adding a distinct question: through which relations are future capacities to learn, judge, inquire, participate, and contribute generated, reproduced, distributed, or weakened? This question makes the educational process itself economically relevant. A school place, textbook, network connection, teacher hour, credential, scholarship, laboratory, language resource, or AI tutor can provide access to an educational good, yet the longer-horizon effect depends on how that resource is converted into durable and revisable capability.

Education is therefore represented here as a relational field rather than as a sequence of isolated inputs and test outcomes. Learners occupy positions within families, classrooms, peer groups, institutions, language systems, credential structures, digital infrastructures, labor markets, and knowledge communities. Teachers and mentors carry expertise together with authority, care, evaluative responsibility, and access to practices that learners may not yet be able to enter independently. Institutions allocate time, recognition, infrastructure, credentials, and pathways. Communities preserve practices and standards through participation. Artificial systems increasingly mediate explanation, feedback, search, practice, translation, generation, and evaluation. Each relation can change what the learner can do later and which relations become available next.

Table 19.2 summarizes the principal educational dimensions used in the section. The columns separate immediate observables from the longer-horizon question because apparent educational success at one temporal scale can coexist with weakened capacity at another. The table is a diagnostic scaffold rather than a universal assessment instrument; educational purposes, ages, disciplines, institutions, and cultural settings can require different indicators and weightings.

19.2.1 Relational Architecture of Learning

Learning is a process in which a learner's later capacities, interpretations, dispositions, or possible forms of participation are altered through interaction with some

Table 19.2: Diagnostic dimensions for generative educational analysis.

Educational dimension	Immediate observable	Long-horizon generative question
Access	Enrollment, attendance, connectivity, materials, assistance	Whether access remains usable across language, disability, cost, location, and institutional change
Performance	Task completion, grades, speed, accuracy, produced artifacts	Whether performance reflects capabilities that remain available across changed tasks and support conditions
Capability formation	Demonstrated methods, conceptual understanding, practice, transfer	Whether learners can regenerate, adapt, combine, and extend capabilities in later situations
Curiosity	Question asking, exploration, persistence, topic choice	Whether educational relations enlarge the learner’s capacity to notice, form, and pursue worthwhile problems
Judgment	Selection, critique, comparison, justification, revision	Whether learners can orient among abundant alternatives and evaluate quality, relevance, evidence, and form
Participation	Dialogue, collaboration, apprenticeship, peer contribution	Whether learners acquire consequential positions in communities of knowledge and practice
Institutional reproduction	Teacher development, curriculum renewal, archives, laboratories, mentoring pathways	Whether the educational system can continue forming future cohorts and revising its own practices
Future option space	Further study, mobility across fields, civic and professional participation	Whether present education expands later feasible paths while preserving the ability to redirect them

educational environment. The environment can include persons, texts, artifacts, institutions, practices, symbols, tools, and material conditions. The relational emphasis matters because the same informational content can have different educational effects depending on prior knowledge, language, trust, timing, feedback, social position, opportunity for practice, and the later relations through which the content can be used.

Definition 19.11 (Educational generative relation). *An educational generative relation is a historically situated relation through which participation, instruction, practice, feedback, observation, interpretation, or collaboration changes a learner’s later capacity to understand, inquire, judge, act, learn further, or enter relevant communities of practice.*

Definition 19.11 makes several distinctions important. First, an educational relation is indexed to a learner and a later capability trajectory. A lecture, tutoring session, laboratory, conversation, simulation, or assessment can be educationally generative for one learner and weakly generative for another because the conversion conditions differ. Second, the relation can generate capabilities that were not the explicit instructional target. A collaborative project can generate coordination skill, disciplinary language, confidence, peer trust, or knowledge of institutional norms in addition to the stated curriculum. Third, educational effect can appear with delay. A concept encountered today can become useful only after a later problem supplies the

context in which its significance becomes visible.

This representation aligns with traditions that treat reflective thought as developing through inquiry and problematic situations (Dewey 1910). It also connects with situated accounts of learning in which changing participation in social practice is part of what learning means (Lave and Wenger 1991; Wenger 1998). GRE uses these insights for a specific economic purpose: educational relations generate capacities that alter later access, contribution, mobility, bargaining, research, institutional participation, and further learning. The economic consequence is therefore mediated through a relational history rather than exhausted by a contemporaneous educational output.

The learner–teacher relation illustrates this point. A teacher can supply information, but the relation can also provide diagnosis of misunderstanding, selection of examples, calibrated challenge, recognition, standards, encouragement, disciplinary modeling, and access to communities or opportunities. These functions can be distributed across several people and tools. Their generative effect depends partly on responsiveness: feedback becomes useful when it is connected to the learner’s current structure of understanding and to a path through which revision is possible. A technically correct answer supplied without such connection can improve immediate performance while contributing little to the learner’s capacity to reconstruct the reasoning later.

Peer relations provide a different mechanism. Learners can explain concepts to one another, expose incompatible interpretations, model alternative strategies, normalize question asking, distribute motivation, and create opportunities for collaborative problem solving. Peer environments can also stabilize exclusion, misinformation, status hierarchy, or reluctance to expose uncertainty. The educational object is therefore the structure of participation rather than the presence of peers alone. A study of collaborative learning should ask which interactions occur, who can enter them, whose contributions receive recognition, and how participation changes later capability.

Family and community relations can supply language, expectations, practical knowledge, time, emotional support, cultural interpretation, financial resources, and access to networks. These relations can interact with formal institutions in ways that make nominally equal provision produce unequal trajectories. A learner with quiet space, stable connectivity, knowledgeable support, and familiarity with institutional expectations encounters a different conversion environment from a learner receiving the same formal curriculum under unstable material conditions. Educational inequality can therefore persist through relational and infrastructural differences even where a measured instructional input is similar.

The same logic applies to assessment. Assessment can provide information about present performance, but it also changes incentives, attention, self-understanding, and institutional pathways. A test can direct study toward a valued body of knowledge, make progress visible, and support diagnostic feedback. It can also narrow attention if its categories become the effective definition of learning. GRE therefore treats assessment as an intervention in the learning relation as well as a measurement device. The relevant question is how evaluation changes what learners and institutions subsequently generate.

Proposition 19.12 (Learning-relation condition). *An educational arrangement has stronger generative warrant when the relations producing observable performance can also be traced to later capabilities for interpretation, inquiry, transfer, revision, and*

participation under conditions that differ meaningfully from the original instructional setting.

Proposition 19.12 does not require independent performance in every case. Human learning has always depended on tools, institutions, other persons, and accumulated culture. The condition asks whether the relation enlarges a learner's later feasible repertoire and whether dependence on the original support is understood rather than hidden inside the outcome measure.

19.2.2 Educational Infrastructure and Access

Educational relations require infrastructures that make participation materially, institutionally, symbolically, and temporally possible. Buildings, transportation, electricity, networks, libraries, laboratories, devices, textbooks, accessibility technologies, language resources, funding systems, teacher labor, administrative systems, credential arrangements, and public institutions can each determine whether an educational opportunity is practically reachable. Infrastructure therefore belongs inside the educational mechanism rather than serving only as background context.

Definition 19.13 (Educational infrastructure). *Educational infrastructure* denotes the material, institutional, informational, linguistic, technological, and relational arrangements that make sustained access to learning relations possible and support their reproduction across learners and cohorts.

The definition extends beyond physical provision. A university can possess buildings and courses while remaining inaccessible to a learner who cannot afford time away from work, navigate admissions, obtain required documentation, study in the instructional language, or access disability accommodations. An online course can remove geographic distance while depending on broadband, devices, payment systems, platform accounts, digital literacy, and a stable place to study. Educational access is therefore relational: a resource counts as available only through a path that the learner can actually traverse.

This point connects with the distinction developed earlier in the book between resources and capability. A library collection, scholarship, tutoring service, or AI system can increase the available resource set while conversion conditions determine what a learner can do with it. Capability-oriented analysis helps make that distinction visible (Sen 1999). GRE adds the temporal question of whether access itself generates later access. A scholarship can support one period of study while also creating credentials, networks, language competence, research experience, or confidence that expand future opportunities. Conversely, an access programme can remain externally dependent if participation collapses when a temporary platform, subsidy, donor, or technical service disappears.

Infrastructure also distributes educational attention. Teacher time, advising capacity, laboratory access, quiet study space, library support, and high-quality feedback are scarce even where digital content is abundant. Institutions allocate these resources through schedules, admissions, class size, tracking, fees, geographic distribution, recommendation systems, and informal norms. The resulting patterns can shape which learners receive intensive relational support and which rely mainly on standardized provision. Educational inequality can therefore migrate from scarcity of information to scarcity of attention, mentorship, trusted evaluation, and opportunities for consequential participation.

Language is a particularly important infrastructure because it mediates both access and conceptual formation. Translation technologies can widen participation across linguistic boundaries, yet educational inclusion requires more than sentence-level conversion. Disciplines carry specialized vocabularies, genres, inferential conventions, historical references, and tacit standards for what counts as a good question or explanation. Learners need routes into these practices while retaining access to the conceptual resources of their own languages. A multilingual educational order can therefore be evaluated by whether translation increases participation without collapsing distinct semantic and cultural resources into a single dominant representational system.

Credential infrastructure introduces another mediation. Credentials can reduce uncertainty for employers, professional bodies, governments, and other institutions by signaling completion of an educational pathway. They also condition access to later study, occupations, migration pathways, status, and professional authority. The generative value of a credential therefore depends partly on the capabilities it represents and partly on the institutional relations that recognize it. Credential expansion can widen access to valued positions while simultaneously creating new thresholds when the credential becomes a prerequisite for activities formerly open through other paths. Domain analysis should distinguish capability formation from credential acquisition while examining how each affects later feasible relations.

Public and private infrastructures can be complementary. Public schooling, libraries, scholarship systems, universities, community institutions, firms, households, philanthropic organizations, platforms, and informal networks can each carry part of the educational field. Their interaction changes resilience. A highly centralized infrastructure can achieve scale and standards while creating common points of failure; a fragmented infrastructure can preserve diversity while generating duplication and uneven quality. GRE does not identify one institutional form as universally preferable. It asks how the configuration affects access, capability formation, dependency, revision, and the reproduction of educational relations over time.

Proposition 19.14 (Educational-access conversion condition). *Educational access is more generatively consequential when material and institutional provision can be converted into sustained participation, usable learning relations, and later capabilities, and when the infrastructures carrying that conversion remain sufficiently maintainable, revisable, and accessible across the relevant learner population.*

The proposition separates formal availability from usable access while keeping infrastructure inside the causal account. It also supplies an empirical agenda: studies can examine where the conversion chain breaks and which institutional changes repair or reproduce that break.

19.2.3 Capability Formation and Regeneration

Capability formation is the central temporal problem of education. Educational systems frequently evaluate what a learner can demonstrate at a particular moment. GRE adds a second temporal layer by asking which capabilities remain available, combine with later experience, transfer across contexts, and support the acquisition of further capabilities. A capability that permits one successful performance can have limited generative reach; a capability that changes how the learner encounters subsequent problems can reshape an extended trajectory.

Educational capability is multidimensional. It can include factual and conceptual knowledge, procedural skill, representational competence, language, attention, memory strategies, experimental technique, mathematical reasoning, interpretive ability, practical judgment, social coordination, self-regulation, and familiarity with institutional practices. The relevant bundle depends on educational purpose. GRE therefore avoids reducing capability formation to a single latent quantity. The analytical task is to identify which capabilities matter for the later transformations under study and how their formation is evidenced.

Transfer supplies one important test. A learner can reproduce a procedure under familiar cues while struggling when the surface form of the problem changes. Another learner can understand why the procedure works and adapt it to a new setting. Both performances can be valuable, yet they imply different future option spaces. Transfer is therefore relevant because it reveals something about the structure of the acquired capability. It should still be interpreted cautiously: distant transfer can require additional knowledge, and failure to transfer can reflect a boundary of context rather than absence of learning.

Regeneration adds another dimension. A learner can forget a formula yet retain enough conceptual structure to reconstruct it, locate the relevant source, recognize a correct derivation, or relearn it rapidly. A researcher can lose access to a software package yet retain the methodological understanding needed to choose an alternative. A multilingual learner can use one language to recover a concept whose vocabulary in another language has faded. These cases suggest that educational resilience can reside in the capacity to regenerate competence, not only in continuous possession of every component of knowledge.

The distinction is especially important for foundational education. Early conceptual structures, language practices, numeracy, reading, and habits of inquiry can serve as generative infrastructure for later learning. Their value can therefore exceed the immediate tasks through which they are assessed. Conversely, an educational system can produce high short-run performance through intensive scaffolding while leaving learners dependent on the original format. The appropriate balance between guidance and independent reconstruction varies by developmental stage and subject; GRE's contribution is to keep the trajectory visible.

Capability formation also depends on opportunities to exercise capability consequentially. Knowledge that is never used can remain fragile, while participation in authentic or increasingly demanding practices can connect concepts to judgment and responsibility. Situated-learning traditions emphasize changing participation and identity within communities of practice (Lave and Wenger 1991; Wenger 1998). Within GRE, such participation is one mechanism through which education converts symbolic instruction into relational capability: learners gain access to tasks, standards, language, collaborators, and institutional positions that make knowledge operational.

The economic meaning of capability should also remain broader than labor-market productivity. Education can influence civic participation, health navigation, family care, cultural creation, scientific inquiry, entrepreneurship, public reasoning, and the capacity to understand or contest institutions. Some of these effects later appear in income or productivity; others remain valuable through different relational and normative channels. Human-capital analysis captures an important subset of educational return (Becker 1964); generative analysis asks how educational capability propagates through a wider network of later relations.

Proposition 19.15 (Capability-regeneration condition). *Educational capability has greater long-horizon generative significance when learners can retain, reconstruct, adapt, combine, and further develop the relevant competence across changing tasks, tools, institutions, and collaborative settings.*

Proposition 19.15 makes regeneration an evaluative dimension rather than a demand for total self-sufficiency. Collective capability can be highly generative when participants know how to locate complementary expertise, evaluate assistance, and reorganize collaboration as conditions change.

19.2.4 Curiosity and Problem Formation

Curiosity matters to education because learning trajectories depend partly on which absences, anomalies, possibilities, and unresolved structures become salient enough to pursue. Psychological research has connected curiosity with novelty, complexity, uncertainty, and conflict (Berlyne 1954), and the information-gap account emphasizes motivation generated by perceived gaps in knowledge (Loewenstein 1994). Work on interest development further suggests that sustained epistemic orientation can develop through stages rather than appearing only as a fixed individual preference (Hidi and Renninger 2006). GRE treats these traditions as evidence that curiosity can be relationally conditioned and historically formed.

A generative account distinguishes curiosity from indiscriminate novelty seeking. Educationally consequential curiosity involves a capacity to encounter a situation as containing a question worth pursuing. Such recognition depends on prior knowledge: a beginner can fail to notice an anomaly because the background structure needed to perceive it is absent, while an expert can overlook a possibility because disciplinary routines make the familiar structure too stable. Education therefore shapes both the field of possible questions and the sensitivity through which a learner notices openings within that field.

Problem formation extends this argument. Many educational tasks present a problem whose boundaries, objective, data, and acceptable form of answer have already been specified. Such tasks can efficiently develop technique. Later inquiry often requires additional operations: deciding what is puzzling, choosing a scale, defining the object, identifying missing information, deciding which values matter, and revising the question when the initial formulation proves inadequate. The problem-finding tradition in creativity research provides one established line of inquiry into this distinction (Getzels and Csikszentmihalyi 1976). GRE interprets problem formation as a generative capability because it changes which future transformations can even become objects of action or research.

Educational institutions influence curiosity through time allocation, curriculum structure, evaluation, disciplinary boundaries, teacher response, peer norms, and access to resources. A curriculum can provide the background knowledge without which curiosity remains shallow; it can also leave room for learners to connect that knowledge to self-generated questions. Assessment can reward careful inquiry or make exploration costly when only predetermined outputs count. Teachers can model uncertainty and question formation or present disciplinary knowledge mainly as completed answers. The relevant institutional question concerns how the arrangement distributes opportunities to encounter, formulate, and pursue problems.

Curiosity also has a relational safety dimension. Learners may possess questions

they do not voice because the social cost of appearing ignorant, challenging authority, exposing an unconventional interest, or crossing a disciplinary boundary is high. A learning environment that permits uncertainty to be articulated can therefore generate informational value for both learner and teacher. This does not imply that every question receives equal instructional time or epistemic status. Educational institutions still require selection, standards, and sequencing. The generative issue is whether the process of selection helps learners understand why some questions become fruitful and how rejected questions might be reformulated.

Abundant information changes the structure of curiosity. Search engines and generative systems can answer many factual questions immediately, lowering the cost of satisfying a local information gap. That can support exploration because a learner can follow chains of inquiry quickly. It can also shorten the interval during which a learner constructs hypotheses, tolerates uncertainty, or notices deeper questions behind the first answer. The educational design question is therefore temporal: when does rapid assistance enlarge the inquiry trajectory, and when does it close a productive gap before the learner has generated structure around it?

Proposition 19.16 (Curiosity-formation condition). *An educational environment is more supportive of generative curiosity when it develops enough knowledge and interpretive structure for learners to perceive consequential gaps, provides socially and materially feasible routes for pursuing them, and preserves opportunities to reformulate problems rather than treating question selection as external to learning.*

The proposition treats curiosity as partly educable while preserving individual and contextual variation. Its empirical indicators can include question formation, persistence, topic selection, exploratory behavior, willingness to revise a question, and later self-directed inquiry, with interpretation adapted to age, culture, discipline, and educational purpose.

19.2.5 Aesthetic Judgment and Educational Orientation

Educational orientation becomes increasingly important when learners face many possible problems, representations, explanations, designs, proofs, arguments, and cultural forms. Some choices can be made through explicit criteria such as accuracy, cost, validity, or conformity to a specification. Other choices depend partly on judgments of elegance, coherence, proportion, depth, surprise, expressive adequacy, or the felt promise of a line of inquiry. Aesthetic judgment enters education at this boundary between available alternatives and the orientation that selects among them.

The term *aesthetic* is used here broadly and cautiously. Classical philosophical accounts distinguish judgments of taste from straightforward judgments of utility or conceptual determination (Kant 1987). Dewey's account places aesthetic experience within temporally developing interaction between organism and environment rather than restricting it to detached contemplation of fine art (Dewey 1934). Empirical models of aesthetic appreciation likewise distinguish perceptual and cognitive processes while treating aesthetic emotion and judgment as related but separable outcomes (Leder et al. 2004). GRE does not attempt to unify these traditions. Their relevance is that aesthetic judgment can carry forms of orientation that are incompletely represented by instrumental optimization alone.

In mathematics, science, engineering, writing, design, history, and philosophy,

learners often encounter judgments that some formulation is elegant, illuminating, awkward, forced, fertile, shallow, balanced, or revealing. Such judgments can be difficult to translate into a complete rule. They can still guide attention. A teacher may choose an example because it exposes the structure of a concept with unusual economy; a mathematician may prefer a proof whose construction reveals why a result is true; a historian may find one archive arrangement more capable of making a suppressed relation visible; a designer may recognize that a solution technically satisfies constraints while lacking coherence. Education transmits these orientations partly through examples, comparison, critique, imitation, making, and participation in disciplinary communities.

Aesthetic judgment should therefore be distinguished from arbitrary preference. It can be informed by expertise, history, cultural formation, disciplinary norms, and repeated encounter with exemplars. It can also reproduce exclusionary conventions or inherited hierarchies. Educational cultivation requires both exposure and reflexivity: learners need opportunities to develop sensitivity to form while also examining whose standards are being transmitted, which histories produced them, and which alternatives they suppress or reveal. The appropriate aim is a revisable capacity for judgment rather than conformity to one canon.

Aesthetic orientation also interacts with curiosity. A learner can be drawn toward a problem before being able to articulate its significance fully. The attraction can arise from perceived symmetry, tension, incompleteness, elegance, strangeness, or expressive potential. Such orientation can become epistemically productive when later inquiry supplies reasons, evidence, and conceptual structure. It can also mislead. GRE therefore treats aesthetic judgment as one component in a plural orientation architecture, operating alongside evidential, ethical, practical, disciplinary, and institutional considerations.

This issue becomes sharper under symbolic abundance. Artificial systems can rapidly generate candidate explanations, examples, images, proofs, code, essay structures, and research questions. Selection then carries more of the educational burden. A learner able to request ten plausible alternatives still needs some basis for recognizing which one deserves further work, which is merely fluent, which expresses the underlying structure, and which opens a richer line of inquiry. Aesthetic judgment can contribute to that selection while remaining subject to verification and critique.

Educational practice can cultivate such judgment through comparison rather than only prescription. Learners can examine multiple solutions to the same problem, compare explanations of different granularity, revise artifacts after critique, reconstruct why an expert prefers one representation, or defend competing interpretations. These activities make judgment partially inspectable without pretending that every relevant dimension can be reduced to a scoring rubric. Historical study can further show how standards of elegance, importance, rigor, or expressive adequacy change over time, helping learners separate inherited convention from necessary structure.

Proposition 19.17 (Educational-orientation condition). *Educational judgment becomes more generatively useful when learners encounter plural exemplars, practice comparison and revision, connect aesthetic orientation with domain evidence and purpose, and acquire enough historical and critical perspective to treat standards of quality as discussable and revisable rather than merely imitated.*

Proposition 19.17 places aesthetic judgment within education without making it a universal decision criterion. Its role is strongest where explicit optimization leaves

several admissible possibilities and where the capacity to perceive form, promise, or expressive adequacy changes which possibilities receive further attention.

19.2.6 Knowledge Communities and Participation

Education occurs within communities that preserve, contest, and reproduce knowledge practices. Disciplines, professions, laboratories, schools, workshops, artistic traditions, online groups, civic organizations, and informal communities each contain roles, standards, vocabularies, exemplars, tools, histories, and expectations. Learning can therefore involve movement into a position from which a person is able to participate meaningfully in a shared practice. Situated-learning and communities-of-practice traditions make this participatory dimension explicit (Lave and Wenger 1991; Wenger 1998).

Participation changes the object of educational evaluation. A learner can know a body of propositions while lacking access to the relations through which that knowledge becomes consequential. Scientific knowledge becomes research capability partly through access to laboratories, collaborators, methods, critique, publication, and problem-selection practices. Legal knowledge becomes professional capability through institutions, procedures, clients, colleagues, responsibility, and interpretive practice. Craft knowledge becomes productive through tools, material experience, standards, and communities able to recognize quality. Educational return therefore depends partly on whether learners can enter the relational structures in which their capabilities acquire use and further develop.

Entry is often graduated. Novices can begin with bounded tasks, observation, simulation, supervised practice, or peripheral participation and later acquire broader responsibility. These trajectories matter economically because they are mechanisms for reproducing expertise. If institutions automate or remove low-level tasks, they can increase current efficiency while reducing traditional entry pathways. Alternative pathways can be created, but their effectiveness should be examined rather than assumed. A community that depends on experienced contributors must also reproduce the relations through which inexperienced participants become capable contributors.

Recognition is another mechanism. Communities decide, formally or informally, whose contribution counts as competent, original, trustworthy, or worthy of further responsibility. Credentials carry part of this function, but peer recognition, recommendation, reputation, mentorship, and demonstrated practice can matter as well. Such mechanisms can support quality while also preserving hierarchy or exclusion. GRE therefore examines recognition as a conversion interface between capability and participation. A learner may possess relevant capability yet remain outside consequential practice if the recognition path is blocked.

Knowledge communities also preserve memory. Texts, archives, datasets, instruments, recorded lectures, code, oral traditions, institutional routines, and experienced members carry knowledge across cohorts. Educational systems depend on this memory while also revising it. Preservation without interpretation can produce inert accumulation; revision without preservation can remove the possibility of recovering abandoned alternatives. Generative education therefore benefits from infrastructures that allow later learners to encounter both stabilized knowledge and enough provenance to understand how it became stabilized.

Community plurality has further value. Different schools, disciplines, languages, institutions, and traditions can preserve distinct representations and standards. Some plurality can create barriers to communication, duplication, or uneven quality. It can also preserve alternative problem framings, methods, and forms of judgment that become valuable when dominant approaches encounter limits. Educational integration should therefore distinguish interoperability from homogenization. Shared standards can enable mobility while plural communities maintain different ways of seeing and generating problems.

AI systems change participation because they can become intermediaries between learners and communities. A learner can receive an explanation, code review, translation, or simulated dialogue without direct access to an expert community. This can widen entry, especially where mentors are scarce. It can also create a parallel educational layer in which the learner interacts mainly with synthesized representations of disciplinary practice. The long-horizon question is whether such mediation eventually expands the learner's ability to enter human and mixed knowledge communities or becomes a substitute for participation in the relations where standards, responsibility, and collective judgment are formed.

Proposition 19.18 (Knowledge-community reproduction condition). *An educational knowledge community is more generatively sustainable when it enables new participants to acquire increasingly consequential roles, preserves and revises the memory required for competent practice, and maintains recognition and critique processes through which capability can be converted into responsible participation.*

The proposition provides a bridge to Section 440 on research and knowledge institutions. Education supplies many of the entry trajectories through which future researchers, professionals, teachers, and public contributors are formed; knowledge institutions in turn shape the environments into which those learners can enter.

19.2.7 AI-Assisted Learning Relations

Artificial intelligence changes education by altering the cost, speed, availability, and personalization of several activities involved in learning. A learner can request explanations at different levels, generate practice problems, translate unfamiliar language, obtain feedback on drafts or code, simulate dialogue, compare interpretations, explore examples, and receive assistance at times when a teacher is unavailable. These capabilities can widen educational access and increase the density of feedback. Their generative effect depends on how artificial assistance enters the learning relation and how resulting performance is converted into later capability.

Section 18.17.1 introduced the distinction between assisted performance and regenerative capability. Education requires that distinction to be made operational. Suppose a learner completes a proof, program, essay, calculation, translation, or design with AI assistance. At least four educational states are possible. The learner may merely possess the completed artifact. The learner may understand enough to explain and verify the artifact. The learner may acquire a method that transfers to related tasks. The learner may additionally become able to identify new problems, choose among methods, and recognize when the artificial system is likely to fail. These states can coexist in different combinations and should not be inferred from the quality of the artifact alone.

The relevant variable is therefore the structure of assistance. An artificial system

can act as answer supplier, hint generator, critic, translator, simulator, collaborator, question generator, tutor, search interface, or evaluation aid. The same system can occupy several roles within one session. Educational design can change the sequence in which those roles appear. A learner might first attempt a problem, then request a hint, compare two approaches, explain the chosen solution, test it on a new case, and finally inspect an AI-generated alternative. Another arrangement may provide a polished answer immediately. Both can be useful under different purposes, yet they create different opportunities for capability formation.

Verification becomes an educational object in its own right. When artificial outputs are fluent and plentiful, learners require enough domain knowledge to evaluate claims, identify missing assumptions, check sources, test code, reproduce calculations, or recognize uncertainty. Early learners face a circular problem: assistance is most valuable where knowledge is weak, while weak knowledge also limits verification. Educational institutions can respond by designing graduated verification practices, maintaining trusted reference resources, using teacher or peer review where stakes are high, and teaching learners to distinguish tasks for which independent checking is feasible from tasks requiring external expertise.

Dependence should be analyzed by type. Tool dependence is ubiquitous in advanced practice: mathematicians use notation and software, scientists use instruments, writers use dictionaries and archives, engineers use simulation, and institutions rely on communication networks. Educational concern arises when dependence becomes opaque, difficult to substitute, or capable of displacing the processes through which learners would otherwise acquire judgment. A learner can productively depend on an AI system while retaining knowledge of when to seek alternative sources, how to inspect the system's output, and how to continue learning if the interface changes. Such dependence differs from a relation in which the system supplies both the candidate answer and the effective standard by which the learner judges it.

AI can also affect teachers and institutions. Automated explanation and feedback may release teacher time for diagnosis, dialogue, mentoring, conflict mediation, and complex evaluation. It can also shift curriculum, assessment, monitoring, and instructional authority toward platform providers or standardized technical systems. The resulting effects depend on governance: who configures the system, which data it uses, how errors are reviewed, whether teachers can override recommendations, how student data are handled, and whether institutions retain the capability to change providers or practices. Educational technology is therefore part of institutional power and infrastructure, not merely an individual learning tool.

Assessment becomes especially sensitive. Where AI can produce high-quality artifacts, assessment tasks designed mainly to observe final products can lose diagnostic validity. Institutions can respond through oral examination, process records, supervised work, authentic projects, iterative critique, portfolios, or tasks that require contextual judgment. These responses should be aligned with the capability being assessed. The objective is not to recreate artificial scarcity of assistance; it is to obtain evidence about the learner's relation to the capability under relevant conditions.

The availability of AI also changes curriculum. Some procedural tasks can become easier to delegate, increasing the relative value of conceptual understanding, verification, problem formation, judgment, communication, and the capacity to work with artificial systems. Yet foundational knowledge can remain necessary precisely because it supports verification and higher-order judgment. Curriculum revision therefore

requires domain-specific evidence about which capabilities remain prerequisites for later competence and which can be safely externalized without weakening the generative pathway.

Definition 19.19 (Assistance-to-capability conversion). *Assistance-to-capability conversion* is the process through which externally supplied educational support—including artificial assistance—becomes a learner’s durable or regenerable capacity for understanding, verification, transfer, judgment, inquiry, or participation beyond the immediate supported performance.

Proposition 19.20 (AI-assisted learning conversion condition). *AI-assisted learning has stronger educational generativity when the assistance architecture increases useful access and performance while also creating observable pathways through which learners acquire verification, transfer, problem formation, judgment, and the capacity to continue learning across changes in tools and support.*

Definition 19.19 and Proposition 19.20 provide a more precise object for evaluation than a simple comparison between AI use and non-use. Studies can ask which kinds of assistance produce conversion for which learners, tasks, disciplines, and time horizons, and where assistance remains mainly an external performance extension.

19.2.8 Generative Educational Return

The concept of return provides the final synthesis because education consumes scarce resources while producing effects that unfold across long periods and several domains. Conventional economic return can include earnings, employment, productivity, fiscal effects, and other measurable consequences. These remain important. GRE adds a generative layer concerned with what educational relations make possible later: further learning, inquiry, judgment, contribution, institutional participation, knowledge reproduction, social coordination, and the formation of new educational capacity.

Definition 19.21 (Generative educational return). *Generative educational return* is the set of later capabilities, relations, institutional capacities, knowledge-community contributions, and option-space expansions produced through an educational arrangement, including the capacity of learners and institutions to reproduce, revise, and extend learning processes for subsequent situations and cohorts.

This definition deliberately preserves plurality. Educational return need not collapse into one monetary or utility measure. Earnings can capture economically important consequences, credentials can capture institutional recognition, test performance can capture selected competencies, and participation measures can capture access to communities or institutions. Each metric represents a different part of the educational field. Section 19.1 requires the remainder left by each representation to remain visible.

Generative return can operate at several scales. At the individual scale, education can expand capability, judgment, confidence, mobility, and future learning. At the relational scale, it can generate networks, mentoring relations, shared language, and collaborative competence. At the organizational scale, it can create professional capacity, institutional memory, leadership, and the ability to train others. At the societal scale, it can contribute to research, public reasoning, cultural production, administrative capacity, technological adaptation, and the reproduction of institutions. These returns can reinforce one another, but they can also diverge. A programme can in-

crease individual labor-market return while weakening local institutional capacity if graduates systematically exit; another can produce modest private return while generating valuable public or community capacity.

Return is also historically contingent. A capability valuable under one technological or institutional arrangement can decline in direct market value while remaining important as a prerequisite for judgment or adaptation. Conversely, a formerly specialized capability can become broadly useful when infrastructure changes. Educational evaluation should therefore distinguish present demand from longer-horizon generative reach. Training learners narrowly for a current task can be efficient when the environment is stable and the task itself provides future pathways. Under rapid change, broader regenerative capabilities can carry option value because they support reorientation.

Distribution matters because aggregate educational return can coexist with unequal access to the relations that generate it. High-performing institutions can concentrate networks, recognition, and infrastructure among learners who already possess advantageous conversion conditions. Expansion of information access can reduce one inequality while leaving mentorship, time, language, or credential recognition highly unequal. Generative analysis should therefore track who receives which form of return and which later relations become reachable as a consequence.

There is also an intergenerational dimension. Educational systems reproduce teachers, researchers, professionals, caregivers, institutional leaders, and citizens who later maintain or transform the systems that formed them. A system can therefore consume inherited educational capital while appearing productive for a period. If mentoring capacity, teacher formation, foundational instruction, archives, or institutional memory erode, current cohorts may continue to perform while later cohorts encounter a thinner generative environment. The long-horizon return of education includes whether the educational field itself remains capable of regeneration.

This perspective changes how efficiency is interpreted. Reducing instructional cost can be generative when saved resources widen access, improve feedback, support teachers, or fund new educational pathways. The same cost reduction can have weaker long-horizon return when it removes relations that were carrying tacit knowledge, recognition, curiosity, or entry into practice. Efficiency therefore requires specification of the valued educational object and temporal horizon. Cost per credential, cost per test-score gain, and cost per durable capability are different analytical quantities.

The domain remainder also remains important. Education contains experiences and values that GRE may represent only partially: childhood development, identity, care, cultural transmission, play, embodied formation, moral development, and forms of learning whose significance is difficult to assign to an economic return. Their presence should constrain the scope of GRE rather than disappear through expansive terminology. Education is an economic domain insofar as scarce resources, institutions, access, capabilities, labor, infrastructures, and future possibilities are involved; it is simultaneously more than an economic domain.

Proposition 19.22 (Generative educational return condition). *An educational arrangement has stronger long-horizon generative return when its immediate learning and access effects are accompanied by durable or regenerable capability, curiosity and problem formation, revisable judgment, consequential participation in knowledge communities, and institutional capacity to reproduce and adapt educational relations*

across later cohorts and changing conditions.

Proposition 19.22 synthesizes the section without prescribing a single curriculum, pedagogy, or institutional form. Different educational purposes can legitimately emphasize different components. The proposition instead identifies dimensions that become visible when education is evaluated as a generative relational process rather than only as a contemporaneous service or stock of acquired skill.

Education also supplies the first feedback from domain inquiry to GRE. The domain sharpens the distinction between access and conversion, shows that dependence can be educationally productive when it changes later capability, and demonstrates that judgment and curiosity can function as generated capacities rather than exogenous preferences. It also reveals a domain remainder: learning contains developmental, cultural, affective, and pedagogical structures that an economic framework should not presume to absorb. These findings support the reciprocal translation method of Section 19.1. The next section turns to research and knowledge institutions, where many of the same generative questions reappear at a different scale: learners become researchers and professionals, educational participation becomes knowledge production, and the reproduction of inquiry becomes an institutional object in its own right.

19.3 Research and Knowledge Institutions

Research and knowledge institutions provide a second substantive domain test of the translation discipline developed in Section 19.1. Chapter 17 examined knowledge as an economic object and analyzed epistemic scarcity, institutions, infrastructure, preservation, participation, commons, and artificial intelligence at a general level. The present section has a narrower domain role. It asks how those concepts change when the relevant practice is organized inquiry: activity in which persons and collectives formulate questions, construct or obtain evidence, develop representations, expose claims to criticism, preserve records, allocate recognition, and maintain the material and institutional conditions for further investigation. The section has four objectives: to examine funding as an upstream selection and temporal-protection mechanism; to specify the scientific relations and infrastructures through which inquiry becomes collectively possible; to distinguish openness and preservation as different conditions of cumulative knowledge; and to evaluate AI-assisted research through its effects on verification, capability, participation, and long-horizon knowledge generation. The method is relational, institutional, and historical. Research outputs are treated as events within longer trajectories of inquiry rather than as self-contained informational products.

Research is economically distinctive because its future uses are frequently uncertain at the time resources are committed. The information economics of invention has long emphasized uncertainty, non-rivalry, and appropriation problems in knowledge production (Bush 1945). These properties help explain why research is organized through heterogeneous mixtures of public finance, universities, laboratories, firms, philanthropy, mission agencies, professional associations, journals, repositories, and collaborative networks. GRE adds a generative question to this institutional literature: which arrangements preserve and enlarge the future capacity to ask consequential questions, investigate them with adequate resources and criticism, retain

Table 19.3: Diagnostic dimensions for generative analysis of research and knowledge institutions.

Research dimension	Immediate observable	Long-horizon generative question
Funding	Awards, budgets, project starts, portfolio shares	Whether resources protect plural questions, appropriate time horizons, and future entry into inquiry
Scientific relations	Collaboration, review, critique, replication, mentoring, credit	Whether distributed inquiry preserves criticism, trust, learning, and contestable recognition
Epistemic infrastructure	Laboratories, instruments, compute, data, repositories, standards, libraries	Whether recurrent access, maintenance, interoperability, and substitutability support later inquiry
Research communities	Membership, training, conferences, disciplinary participation, mobility	Whether communities reproduce capability while remaining permeable to new participants and problems
Open knowledge	Accessible papers, data, code, protocols, licenses	Whether materials are practically inspectable, reusable, interpretable, and governable across different users
Preservation	Archives, provenance, version histories, retained software and data	Whether later researchers can reconstruct, challenge, and re-epistemize inherited work
AI-assisted research	Search, generation, coding, modeling, analysis, writing, review support	Whether assistance increases inquiry capacity while preserving verification, provenance, responsibility, and exit
Knowledge-generating order	Publications, trained researchers, durable institutions, accumulated resources	Whether the research system can continue generating credible questions, methods, evidence, and communities under change

their traces, and allow later communities to reinterpret what earlier communities produced?

The distinction between a research output and a research-generating system is therefore central. A paper, dataset, model, patent, instrument, archive, or trained researcher can be valuable as an immediate product. Each can also alter later opportunity by changing what questions become feasible, which relations become available, which methods can be reproduced, and which communities can participate. Conversely, a system can produce many outputs while weakening the conditions of later inquiry through excessive agenda concentration, fragile infrastructure, loss of tacit capability, inaccessible records, narrowing of participation, or dependence on epistemic tools that cannot be adequately verified or replaced.

Table 19.3 summarizes the diagnostic dimensions used in the section. The distinction between immediate observables and long-horizon generative questions prevents output volume, citation visibility, short-run novelty, or computational speed from functioning as substitutes for the wider reproduction of research capacity. The table is an analytical scaffold rather than a universal evaluation system. Fields differ in capital intensity, time scale, evidential practice, collaboration structure, publication culture, ethical constraint, and dependence on shared infrastructure.

Definition 19.23 (Research-generative capacity). *Research-generative capacity* is the

historically situated capacity of a research configuration to formulate consequential questions, mobilize and coordinate appropriate inquiry, expose claims to criticism, preserve reconstructible traces, regenerate relevant human and institutional capabilities, and create conditions under which later inquiry can proceed or revise the inherited problem space.

Definition 19.23 is intentionally broader than productivity. A productive laboratory can generate many publications while depending on a narrow skill base that cannot be reproduced. A repository can accumulate large quantities of material while providing weak metadata or unstable access. A funding system can support technically excellent projects while concentrating opportunity in a way that reduces entry for emerging questions or communities. Research-generative capacity concerns the reproduction and transformation of the system of inquiry itself.

19.3.1 Research Funding and Agenda Formation

Research funding is an upstream generative relation because resource allocation changes which questions can be investigated, at what scale, for how long, by whom, and with which infrastructures. Money is one component of this relation. Funding can also confer time, legitimacy, access to facilities, ability to recruit, institutional bargaining power, data access, geographic mobility, and entry into collaborative networks. The same nominal award can therefore have different generative effects across fields and organizations because the complementary conditions differ.

The first analytical distinction is between *financing an activity* and *forming a research agenda*. A grant programme does both whenever eligibility rules, thematic calls, review criteria, allowable costs, reporting categories, and renewal expectations influence which questions become practically investigable. These mechanisms need not determine research content directly. Researchers can reinterpret programmes, combine funds, pursue adjacent questions, or generate unexpected findings. Yet the feasible set of projects is still shaped by whether a funding system supports long time horizons, expensive infrastructure, replication, exploratory work, negative results, field access, maintenance, risky methods, cross-disciplinary collaboration, or work whose benefits are difficult to appropriate.

A generative analysis therefore treats funding as a portfolio architecture. Different projects can require different temporal and epistemic protection. Some questions can be decomposed into short projects with measurable milestones. Others require patient accumulation, long observational windows, uncertain instrumentation, language acquisition, trust building, or repeated failure before the relevant object becomes tractable. Bush's account of public support for scientific research remains historically important because it recognized that inquiry with uncertain downstream uses can require institutional protection from immediate commercial appropriation pressures (Bush 1945). GRE does not infer a single optimal division between public and private funding from that argument. It instead asks which combinations of funding mechanisms preserve useful heterogeneity in questions, methods, horizons, and institutional positions.

Agenda formation also has a relational distribution. Researchers propose questions, reviewers evaluate them, institutions provide endorsements and overhead structures, funders define programmes, governments establish missions, firms seek strategic returns, communities articulate needs, and infrastructures impose feasibility

ity constraints. Power enters when some positions can recurrently determine which questions receive resources or recognition while affected or epistemically relevant positions have weak capacity to enter agenda formation. Chapter 16 provides the more general analysis of such conversion mechanisms. In the research domain, the practical task is to identify how funding asymmetry becomes agenda influence rather than assuming that every resource inequality constitutes epistemic power.

Funding dependence requires similar care. Dependence on a major funder can provide stability that enables difficult research. Vulnerability increases when a research unit's core capability, staff continuity, data access, or infrastructure cannot be maintained after a plausible funding change and when substitutes are weak. Conversely, fragmented short grants can reduce dependence on any single sponsor while generating other fragilities through administrative load, discontinuity, and the repeated loss of research time. The relevant object is therefore the configuration of duration, concentration, conditionality, substitutability, overhead, and renewal.

Proposition 19.24 (Funding-generativity condition). *Research funding becomes generatively consequential when its allocation rules, temporal structure, and complementary resource relations materially alter the diversity, feasibility, continuity, or later reproductibility of inquiry beyond the immediate projects financed.*

Proposition 19.24 separates expenditure from generative effect. A portfolio can spend heavily without building future capability, while a smaller intervention can have persistent consequences when it creates a durable instrument, dataset, training pathway, network, archive, or new line of inquiry. Evaluation should therefore trace both project outputs and the later relations produced by funding: who can continue, what can be reused, which capacities remain, and which previously inaccessible questions become investigable.

19.3.2 Scientific Relations and Distributed Inquiry

Research is rarely an activity of isolated knowers. Even apparently individual work relies on prior literature, languages, instruments, standards, data, software, reviewers, editors, institutions, and communities capable of interpreting the result. Scientific knowledge is therefore generated through distributed relations that combine cooperation and criticism. Longino's social account of scientific knowledge is relevant here because it emphasizes the role of critical interaction and the conditions under which criticism can transform inquiry (Longino 1990). GRE uses this insight to examine the economic and institutional conditions that make such interaction possible.

Several relations deserve separate treatment. Collaboration combines complementary expertise, access, labor, equipment, or field positions. Peer review allocates criticism and certification. Replication and reanalysis test whether claims survive different investigators, samples, instruments, or implementations. Mentoring and apprenticeship transmit tacit practices that are difficult to preserve in publications alone. Competition can motivate speed, differentiation, and discovery while also interacting with secrecy, priority disputes, duplication, or strategic presentation. Credit connects contribution to reputation, employment, future funding, and authority. None of these relations has a single generative effect independent of its institutional configuration.

Scientific collaboration can be especially generative when it combines capabilities that no participant possesses alone. Research networks can support innovation through repeated relations across organizational boundaries (Powell et al. 1996). Yet

complementarity can coexist with asymmetry. A group controlling a unique instrument, dataset, field site, model, or computational platform can occupy a structurally advantaged position. Junior researchers can depend on senior researchers for access, authorship, recommendation, or continuation. International collaboration can distribute resources unevenly while still producing valuable joint inquiry. A relational analysis therefore asks how contribution, decision authority, credit, access to records, capability formation, and future participation are distributed within the collaboration.

Criticism is likewise a resource-intensive relation. Effective criticism requires time, expertise, access to the relevant materials, and institutional conditions in which disagreement is possible. Open criticism can be nominally available while practical participation remains concentrated among actors with strong language, methodological, computational, or reputational resources. Conversely, criticism can become performative or strategically excessive when evaluation systems reward visible dispute without providing time for careful reconstruction. The relevant generative function is not disagreement itself but the capacity of a research relation to expose claims to informed challenge and to permit revision when warranted.

Trust also belongs inside the scientific relation. Complex inquiry depends on extensive reliance because researchers cannot independently reproduce every measurement, proof, calibration, dataset, or software dependency. Trust can reduce the cost of cooperation and permit specialization, yet it remains epistemically productive only when connected to provenance, accountability, and possibilities for verification or challenge. Quantification and formal procedures can support trust in institutions, but they can also relocate judgment into the categories and processes by which evidence is standardized (Porter 1995). A generative research system therefore requires neither universal distrust nor unconditional deference. It requires a structured distribution of reliance and contestability appropriate to consequence and feasibility.

Definition 19.25 (Scientific generative relation). A *scientific generative relation* is a historically situated relation of collaboration, criticism, verification, mentoring, comparison, recognition, or shared investigation through which the later capacity of participants or communities to inquire is materially changed.

This definition makes capability formation part of scientific organization. A collaboration that produces a high-value result while leaving one party unable to interpret, reproduce, or continue the relevant work can have a different long-horizon structure from a collaboration that also generates distributed capability. The distinction is especially important when equipment, data, compute, or specialized methods are concentrated.

Proposition 19.26 (Distributed-inquiry condition). *The generative quality of distributed research depends on the configuration of complementary capability, criticism, trust, recognition, and continued participation; collaboration volume alone does not establish that the relations of inquiry reproduce the capacities on which later research depends.*

19.3.3 Epistemic Infrastructure and Research Capacity

Research depends on infrastructures that persist across particular projects. Laboratories, telescopes, field stations, sample collections, libraries, archives, repositories, networks, computational systems, persistent identifiers, standards, metadata services,

statistical software, reference databases, and shared instruments can all serve recurrent inquiry. Chapter 17 defined shared epistemic infrastructure in general terms. The research-domain translation adds a stronger relation to evidential production: research infrastructure does not merely provide access to information; it can shape what can be observed, measured, simulated, compared, reproduced, and preserved.

Infrastructure has a layered structure. A computational analysis can depend on electrical supply, hardware, cloud or cluster access, operating systems, software libraries, code, data formats, authentication services, documentation, and human expertise. A biological experiment can depend on laboratory space, instruments, reagents, sample governance, calibration routines, safety systems, technical staff, and supply chains. Historical research can depend on preservation, cataloguing, language expertise, legal access, digitization, and provenance. Concentrating attention on the most visible instrument can therefore conceal the complementary relations that make the instrument scientifically usable.

The infrastructural perspective also changes the interpretation of access. Nominal access to a repository does not guarantee that its contents are discoverable, interoperable, or interpretable. Access to compute can remain weakly useful without data rights, software competence, or suitable workflows. An open instrument facility can be practically inaccessible when scheduling, travel, training, or sample-preparation requirements exclude some participants. Frischmann's infrastructure analysis is relevant because infrastructures can generate social value through heterogeneous downstream uses that cannot be completely specified in advance (Frischmann 2012). Research infrastructure is generative partly because future investigators can combine it with questions that were not known when the infrastructure was created.

Maintenance is therefore part of knowledge generation. Calibration, metadata correction, software updates, documentation, data stewardship, equipment repair, cybersecurity, archiving, migration, user support, and standards governance frequently produce few visible research outputs of their own. Yet their absence can degrade the reliability and future usability of the entire epistemic system. A publication-oriented evaluation regime can consequently undervalue activities that preserve the conditions under which publication remains possible.

Infrastructure also creates dependency profiles. A unique facility or platform can enable research that would otherwise be impossible, while interruption or rule change can alter a field's feasible question space. The governance issue is not solved by demanding duplication of every expensive infrastructure. Redundancy can be socially wasteful when fixed costs are large. The relevant questions concern continuity planning, transparent allocation, portability where feasible, interoperable standards, preservation of local interpretive capability, and procedures through which affected research communities can contest consequential changes.

Proposition 19.27 (Research-infrastructure generativity). *Research infrastructure becomes generatively consequential when recurrent access to maintained material, computational, informational, or organizational resources changes the feasible range, reliability, reproducibility, or future recombining ability of inquiry for multiple participants.*

The proposition directs evaluation toward the downstream option space created by infrastructure. A facility that is lightly used today can still be generative when it preserves rare capability or enables future response to unforeseen problems. A heavily used platform can be less generatively robust when access, standards, or records are fragile. Utilization is relevant, but it is not a sufficient measure of infrastructural

value.

19.3.4 Research Communities and Capability Reproduction

Research communities provide the relational environments in which methods, questions, standards, tacit skills, languages, reputations, and problem histories are reproduced. Their economic significance extends beyond networking. A research community can lower the cost of finding collaborators, transmit standards, provide criticism, coordinate specialization, preserve collective memory, and create paths through which newcomers become capable participants. Accounts of situated learning and communities of practice are useful because they treat learning partly as changing participation in shared practice (Lave and Wenger 1991; Wenger 1998). In research, such participation can include seminar discussion, laboratory work, field practice, code review, archival interpretation, conference exchange, peer review, and informal problem solving.

Community boundaries have a dual function. Some boundary formation is necessary because meaningful criticism requires shared competence, concepts, evidential standards, and histories. A completely undifferentiated research field would make it difficult to establish who can assess a specialized claim or how a new result relates to accumulated practice. Yet strong boundaries can also produce exclusion, intellectual closure, or difficulty recognizing questions that do not fit established categories. Domain analysis therefore needs both internal reproduction and permeability.

Entry into a research community is rarely determined by knowledge alone. Credentials, institutional affiliation, language, geography, funding, conference access, supervisory relations, publication history, citizenship or visa status, and access to equipment can all shape participation. These conditions become economically consequential when they determine who can accumulate research capital and whose questions become visible. Participation is especially important for early-career researchers, researchers working outside highly resourced institutions, and groups whose knowledge is relevant to a problem but whose institutional position does not translate easily into conventional scientific recognition.

Community reproduction also depends on intergenerational transfer. Senior researchers carry histories of failed methods, abandoned hypotheses, instrumental quirks, field relationships, and interpretive cautions that may be incompletely recorded. New researchers bring different questions, methods, social experiences, and technical capabilities. A generative community requires processes through which accumulated knowledge can be transmitted without turning historical inheritance into closure. Mentoring, archives, methodological training, open seminars, replication, and cross-generational collaboration can support such transfer when they also permit revision.

Recognition structures mediate this reproduction. Publications, citations, prizes, appointments, invitations, grants, and authorship positions influence attention and future opportunity. These signals can help coordinate a large research system under limited attention, but they can also become targets of strategic adaptation. Research on rankings and reactivity more generally shows how public measures can reorganize behavior when actors adjust to the categories by which they are evaluated (Espeland and Sauder 2007). GRE therefore treats research recognition as an allocation mechanism whose generative consequences depend on what forms of contribution it

renders visible or invisible.

Proposition 19.28 (Research-community reproduction condition). *A research community reproduces generative capacity when it transmits relevant capabilities and problem histories while maintaining credible pathways for criticism, entry, mobility, and revision of the community's own categories and standards.*

This condition excludes both pure openness and pure closure as universal prescriptions. Some research requires specialized training or controlled environments. Some communities can benefit from more porous boundaries. The relevant question is whether boundary conditions correspond to the epistemic functions they protect and whether they remain revisable when they suppress relevant participation or inquiry.

19.3.5 Open Knowledge and Reuse

Openness changes the circulation and possible recombination of research, but it should be specified as a multidimensional institutional profile rather than a binary property. UNESCO's Recommendation on Open Science frames openness in terms that include scientific knowledge, infrastructures, engagement, collaboration, and diversity of knowledge systems (UNESCO 2021). The FAIR principles likewise show that data reuse depends on findability, accessibility, interoperability, and reusability rather than on public release alone (Wilkinson et al. 2016). GRE uses these approaches to distinguish formal availability from practical generative access.

Open research can involve several layers: access to publications; availability of data, code, models, and protocols; inspectability of analytical procedures; licensing conditions that permit reuse; interoperable formats; metadata and provenance; participation in infrastructure or governance; and the capacity to reproduce or reinterpret the work. These layers can diverge. A paper can be freely readable while its data remain unavailable. Data can be downloadable while their meaning is opaque. Code can be public while depending on proprietary services. A model can be inspectable while computational cost prevents meaningful replication. Open access is therefore one relation within a wider reuse architecture.

The generative value of openness arises partly from unplanned downstream use. Researchers can recombine datasets, compare methods, translate findings into new domains, identify errors, develop educational resources, or formulate questions not anticipated by the original project. Knowledge commons scholarship is useful precisely because it examines access, governance, enclosure, preservation, and collective action without reducing knowledge to a natural-resource commons (Hess and Ostrom 2007). Commons-based peer production provides another example of distributed contribution under arrangements different from both conventional firms and simple spot markets (Benkler 2002).

Openness nevertheless carries costs and responsibilities. Data can include sensitive information; communities can have legitimate claims over culturally or politically consequential knowledge; maintaining repositories requires labor and finance; documentation takes time; openness can permit actors with stronger computational or commercial capacity to appropriate shared resources more effectively than the communities that generated them. The GRE concept of generative exploitation is relevant when appropriation weakens the conditions under which contributors or shared infrastructures can continue generating value. Openness therefore needs governance rather than being treated as the absence of governance.

Reproducibility and openness also intersect without becoming identical. Open materials can facilitate replication or reanalysis, and coordinated efforts to improve reproducibility can increase methodological transparency (Nosek et al. 2015; Open Science Collaboration 2015). Yet some research cannot be reproduced in a strict sense because historical events, field conditions, unique specimens, or costly experiments cannot simply be rerun. In such cases, provenance, methodological transparency, retained materials, and alternative forms of verification become more important. Generative access should be indexed to what later investigators need in order to scrutinize and build upon the work.

Definition 19.29 (Generative research openness). *Generative research openness is a governed configuration of access, provenance, interpretability, interoperability, reuse permission, and practical capability that enables relevant participants to inspect, challenge, recombine, or extend research while sustaining the conditions needed for continued knowledge generation.*

Proposition 19.30 (Openness-reuse condition). *The long-horizon generative effect of research openness depends on the conversion of formal availability into practical interpretability and reuse, together with governance of maintenance, responsibility, legitimate restrictions, and asymmetric appropriation.*

19.3.6 Preservation and Re-Epistemization

Research accumulates historically only when traces remain available for later reconstruction. Preservation therefore differs from storage. A retained file that cannot be opened, interpreted, situated, or connected to its provenance can survive materially while losing much of its epistemic function. Chapter 17 introduced *re-epistemization* to describe the possibility that inherited traces can become epistemically usable again for later communities. The research domain makes this requirement especially concrete because later verification and reinterpretation frequently depend on relations among publications, data, code, instruments, metadata, field notes, samples, software environments, decisions, and tacit procedures.

Archives are consequently active selection systems rather than neutral containers. Archival scholarship has emphasized how record creation, appraisal, description, and preservation participate in the construction of social memory (Schwartz and Cook 2002). Historical analysis likewise shows that silences can enter at multiple stages through which events become recorded and narratively available (Trouillot 1995). In research institutions, analogous selection occurs when only successful analyses are retained, failed experiments are discarded, software versions disappear, instruments are decommissioned without calibration histories, or datasets survive without the contextual records required to interpret them.

Negative and null results illustrate the generative importance of preservation. Publication bias can make statistically significant findings more likely to become visible than null results (Franco et al. 2014). The resulting record changes the evidence available to later researchers and can encourage repeated exploration of paths already attempted but weakly documented. Preserving unsuccessful methods, boundary conditions, and reasons for abandonment can therefore reduce unnecessary repetition and help later researchers reinterpret earlier decisions under new techniques or theories.

Digital preservation adds dependency on formats, software, services, and plat-

forms. A computational result can become difficult to reconstruct when package versions change, proprietary APIs disappear, code lacks documentation, or training data cannot be traced. The preservation object should therefore include dependency structure rather than only terminal outputs. For some domains, containers, virtual environments, emulation, persistent identifiers, checksums, or migration plans can help. For others, preservation requires institutional memory and descriptive documentation more than exact technical replay.

Preservation also requires selection because preserving everything at equal resolution is rarely feasible. A generative criterion asks which traces have high option value for future reconstruction, contestation, reinterpretation, or reuse. The answer can differ from present prestige. An apparently minor dataset, correspondence archive, specimen collection, unsuccessful prototype, or local observation can acquire later significance when new questions emerge. Preservation policy therefore involves uncertainty about future epistemic value.

Proposition 19.31 (Research-preservation condition). *Research preservation supports long-horizon generativity when retained traces preserve sufficient provenance, context, dependency information, and accessibility for later communities to reconstruct, challenge, reinterpret, or recombine inherited inquiry under changed questions and methods.*

This proposition implies that preservation and openness should be coordinated but remain analytically separate. An archive can preserve restricted material that later becomes accessible under lawful or ethical conditions. An openly released resource can disappear quickly without preservation. Research institutions therefore need both contemporaneous access arrangements and intertemporal memory architectures.

19.3.7 AI-Assisted Research Relations

Artificial intelligence is entering research through literature retrieval, translation, summarization, coding, data cleaning, pattern detection, image analysis, simulation support, hypothesis generation, drafting, visualization, experimental planning, and other activities. Chapter 18 analyzed artificial productive capacity and radical capability asymmetry at a broader economic level. The research-domain problem is more specific: how does AI change the relational architecture through which questions are formed, evidence is produced, claims are verified, capabilities are learned, and responsibility is assigned?

A useful first distinction is between *research acceleration* and *research-generative transformation*. AI can reduce the time required for search, coding, translation, drafting, or routine analysis without materially changing the institution's ability to formulate better questions or evaluate the generated result. In other cases, lowered computational or linguistic barriers can permit researchers to enter methods or literatures that were previously inaccessible. The direction cannot be inferred from tool use alone. Experimental evidence outside research settings already indicates that generative AI can change task productivity and that effects can differ by worker experience or task structure (Noy and Zhang 2023; Brynjolfsson et al. 2025). Research institutions need a more domain-specific evaluation because scientific consequence depends heavily on verification, provenance, methodological fit, and cumulative reliability.

AI assistance can redistribute epistemic labor. A researcher may delegate code generation while retaining model design and validation; use a system for literature search while independently reading decisive sources; generate candidate hypotheses while subjecting them to disciplinary and empirical screening; or rely on an AI-mediated analytical pipeline whose intermediate decisions are difficult to inspect. These arrangements differ in where judgment, verification, and responsibility reside. The relevant unit of analysis is therefore the human–AI–institution configuration rather than the model output in isolation.

Provenance becomes particularly important when generated text, code, data transformations, or synthetic materials enter the research record. A result can be reproducible only if later researchers can determine what was done, which inputs were used, which system or version materially affected the process, and where human choices entered. Documentation practices developed for datasets and model reporting provide useful analogies because they make provenance and intended use explicit (Geburu et al. 2021). The appropriate disclosure level can vary by consequence and field, but the general generative function is to preserve reconstructibility.

AI assistance can also alter capability formation. Repeated delegation of routine coding or writing may free researchers to concentrate on higher-level design and judgment. It can also reduce opportunities through which novices acquire tacit understanding of methods, failure modes, or evidential structure. The educational distinction developed in Section 19.2 therefore reappears inside research institutions: assisted performance should be distinguished from assistance-to-capability conversion. A research group can become more productive today while becoming less able to verify or reconstruct its own pipeline after a tool, vendor, model, or interface changes.

Epistemic asymmetry can increase when only some institutions can afford frontier models, proprietary databases, large-scale compute, or specialized AI engineering. Open models and shared infrastructure can reduce some access barriers while leaving others around hardware, data, evaluation, security, or expertise. AI-mediated research capacity should therefore be decomposed into a stack rather than represented as a binary possession. Access, capability, control, dependence, and power remain separate analytical questions.

The credibility of AI-generated research material also depends on the surrounding verification architecture. Large language models can produce fluent outputs whose surface form exceeds their evidential reliability, making provenance and independent checking especially important in consequential settings (Bender et al. 2021). This does not establish that AI-assisted research is intrinsically unreliable. It establishes that fluency, speed, or quantity cannot substitute for domain-appropriate evidential relations.

Definition 19.32 (AI-assisted research configuration). An *AI-assisted research configuration* is a historically situated arrangement of researchers, artificial systems, data, compute, institutional rules, verification practices, records, and decision rights through which one or more research functions are performed or transformed.

Proposition 19.33 (AI research-generativity condition). *AI assistance strengthens research-generative capacity when gains in feasible inquiry are accompanied by adequate verification, provenance, responsibility, capability regeneration, infrastructural continuity, and contestability relative to the consequences of the research function involved.*

The condition is deliberately relational. A low-risk exploratory use can require

much lighter controls than an AI-mediated process that determines a clinical inference, safety-critical design, public classification, or expensive experimental programme. Research governance should therefore scale with function and consequence rather than applying one uniform rule to all uses of artificial systems.

19.3.8 Long-Horizon Knowledge Generation

The preceding analysis permits research institutions to be evaluated as long-horizon generative systems. Funding selects and protects some inquiries. Scientific relations distribute cooperation, criticism, trust, and recognition. Infrastructure determines what can be observed, computed, stored, and shared. Communities reproduce methods and problem histories. Openness affects inspection and reuse. Preservation determines whether later communities can reconstruct inherited work. AI changes the cost and distribution of epistemic functions. These dimensions interact, so improvement in one can be offset by deterioration in another.

A research system can therefore experience several forms of generative imbalance. Strong funding with weak preservation can produce discoveries whose evidential paths later become difficult to reconstruct. Excellent infrastructure with narrow access can concentrate research capability. Open outputs with unstable maintenance can create temporary abundance without durable reuse. Highly productive AI-assisted laboratories can become dependent on opaque or non-portable workflows. Large research communities can reproduce established standards while leaving little institutional space for questions that require different categories, methods, or temporal horizons.

Long-horizon evaluation should consequently track trajectories rather than snapshots. Relevant trajectories include diversity of research questions; entry and continuation of researchers; concentration of critical infrastructure; availability of patient funding; maintenance capacity; openness and reuse; preservation quality; distribution of verification capability; mobility across fields; and the ability of institutions to revise evaluative categories when they cease to correspond to useful inquiry. No single trajectory should be assumed sufficient. A research order can tolerate concentration in some expensive infrastructures when governance, access, and complementary capability remain distributed. It can tolerate temporary closure in sensitive projects when preservation and later review are credible. It can specialize strongly when pathways for cross-field learning and revision remain available.

Definition 19.34 (Generative research order). A *generative research order* is a historically evolving configuration of funding, scientific relations, institutions, infrastructures, communities, openness, preservation, and epistemic technologies that sustains the capacity to generate, test, preserve, contest, and extend knowledge while retaining credible pathways for new participants, questions, methods, and institutional revision.

Definition 19.34 is not a claim that maximal pluralism, maximal openness, or maximal decentralization is universally desirable. Research involves tradeoffs among specialization, cost, security, privacy, speed, coordination, quality control, and duplication. Some facilities require scale. Some data require restriction. Some questions benefit from coordinated missions. The generative criterion concerns whether such arrangements preserve future inquiry and revisability relative to their purpose and constraints.

This perspective also changes how research returns are evaluated. Conventional indicators such as publication, citation, patenting, trained personnel, technological transfer, or economic spillovers remain relevant. GRE adds relational and intertemporal returns: new research communities, reusable infrastructures, preserved datasets, methods that lower future entry costs, new languages for formulating problems, strengthened critical capability, durable public knowledge, and institutional learning that permits a research system to adapt. These returns can be difficult to attribute to a single project, which is precisely why evaluation at the institutional and system level is required.

The concept of future option space developed earlier in the book is especially important here. Research is generative when it does more than solve a present problem: it can alter which future problems become visible and tractable. This effect is inherently uncertain. A method can migrate into another discipline; an archive can become relevant to a later question; a theoretical distinction can reorganize an empirical field; a failed experiment can identify a boundary condition; an instrument can enable observations not imagined at the time of construction. Research policy that values only currently specified uses risks excluding part of the generative function that makes research economically distinctive.

Proposition 19.35 (Long-horizon research-generativity condition). *A research and knowledge system exhibits stronger long-horizon generativity when its institutional configuration preserves and renews the capacities for question formation, credible investigation, criticism, preservation, reuse, capability formation, and revision across plausible changes in funding, technology, personnel, and problem structure.*

The proposition supplies the section's synthesis while preserving domain remainder. Research fields differ in what counts as evidence, acceptable uncertainty, replicability, preservation, authorship, responsible disclosure, and useful temporal horizon. A universal research metric would therefore reproduce the translation failure identified in Section 19.1. The task is to carry the generative questions into each research setting while allowing domain-specific practice to revise the categories through which GRE describes knowledge production.

The section also establishes the bridge to the next domain analysis. Research institutions are workplaces and organizations as well as epistemic systems. Their funding, authority, membership, labor, care, coordination, and automation relations cannot be fully understood through the epistemic function alone. The next section therefore moves from the specialized organization of inquiry to the broader problem of work and organizations, where contribution, membership, coordination, relational labor, automation, and participation become the principal domain objects.

19.4 Work and Organizations

Work and organizations provide a third substantive domain test of the translation discipline developed in Section 19.1. Chapter 18 examined labor under expanding artificial capability and distinguished task performance, employment, income, contribution, and participation. The present section broadens the object. Its role is to examine organizations as relational infrastructures through which work is authorized, coordinated, recognized, maintained, governed, and reproduced across time. The domain therefore includes firms, public agencies, cooperatives, nonprofit organizations, pro-

professional bodies, laboratories, associations, platform-mediated work arrangements, and other organized configurations in which persons and increasingly artificial systems participate in recurrent activity. The section has four objectives: to specify the relations bundled inside employment and organizational membership; to analyze coordination, contribution, and care as partially distinct organizational functions; to examine automation as organizational reconfiguration rather than task substitution alone; and to identify the conditions under which organizations regenerate capability, participation, institutional memory, and revisability. The method is relational and historical. Organizational outcomes are interpreted through the configuration of membership, authority, resources, information, recognition, responsibility, and time that makes recurrent collective action possible.

Organizations are economically distinctive because they stabilize relations that cannot be reconstructed anew for every transaction. Coase's account of the firm classically connected organization to the costs of using the price mechanism, while later work has emphasized network forms of coordination that cannot be reduced to either spot markets or simple hierarchy (Coase 1937; Powell 1990). GRE retains these insights while shifting attention toward the generative consequences of organizational form. A rule that lowers present coordination cost can also alter learning, bargaining power, membership continuity, trust, institutional memory, or the capacity to reorganize later. Conversely, an arrangement that appears locally redundant can preserve slack, mentoring, verification, or relational continuity that becomes valuable when the environment changes.

The relevant object is therefore wider than a labor contract. Work is organized through schedules, roles, permissions, reporting relations, tools, spaces, professional norms, evaluation systems, social protections, informal expectations, and histories of cooperation. Membership can provide access to some of these relations while withholding others. Contribution can be consequential without being well represented by output metrics. Care and maintenance can sustain the organization while remaining weakly visible in formal accounting. Automation can change task allocation while simultaneously redistributing monitoring, discretion, responsibility, and organizational knowledge. Participation can continue outside paid employment through ownership, governance, professional association, volunteering, cooperative membership, commons production, or other institutional forms.

Table 19.4 summarizes the analytical dimensions developed in the section. The table separates immediate organizational observables from longer-horizon generative questions. It is not a universal scorecard. Organizational purposes, legal forms, technological conditions, occupational structures, and normative obligations differ substantially across domains. The diagnostic function is to prevent one observable—such as headcount, output per worker, compensation, or automation rate—from standing in for the organization of work as a whole.

Definition 19.36 (Work–organizational configuration). A *work–organizational configuration* is a historically situated arrangement of persons, roles, artificial systems, resources, rules, authority, information, infrastructures, evaluative practices, and temporal commitments through which recurrent work is coordinated and through which claims to income, standing, responsibility, recognition, and participation are distributed.

Definition 19.36 treats the organization as more than a legal boundary or production function. Legal entities remain important because contracts, asset partitioning,

Table 19.4: Diagnostic dimensions for generative analysis of work and organizations.

Organizational dimension	Immediate observable	Long-horizon generative question
Labor relations	Contract type, pay, hours, authority, security, bargaining arrangements	Whether livelihood, discretion, learning, and voice remain viable under changing work organization
Membership	Entry, status, role, benefits, access, representation, exit	Whether organizational standing can be gained, maintained, contested, and transferred across changing roles
Coordination	Reporting lines, teams, routines, meetings, workflow, standards	Whether coordination preserves distributed knowledge, accountable authority, and adaptive recombination
Contribution	Outputs, credited tasks, evaluation, promotion, reward	Whether enabling, maintenance, epistemic, care-related, and collective contributions remain visible enough for recognition and learning
Care and relational labor	Mentoring, support, onboarding, trust maintenance, continuity, conflict repair	Whether relational conditions required for sustained cooperation are reproduced rather than consumed as unpriced background
Automation	Automated operations, algorithmic management, AI assistance, monitoring	Whether technical substitution or augmentation changes authority, skill, dependency, responsibility, and exit options in governable ways
Participation beyond employment	Governance rights, ownership, volunteering, association, commons participation, civic contribution	Whether consequential participation remains available when paid employment is absent, intermittent, or weakly connected to organizational standing
Organizational generativity	Capability renewal, institutional memory, succession, innovation, adaptation, retention	Whether the organization can reproduce and revise the relations through which future contribution remains possible

liability, governance, and ownership operate through formal organizational structures (Hansmann and Kraakman 2000). Yet actual work can cross several legal boundaries through contractors, suppliers, platforms, professional networks, franchises, research consortia, open-source communities, or public-private arrangements. A relational analysis therefore follows the work configuration wherever recurrent coordination, dependency, responsibility, and contribution are materially organized.

19.4.1 Employment Relations and Work Organization

Employment is a historically important organizational relation because it bundles several claims and obligations that could, in principle, be organized separately. The employee typically receives some combination of income, predictable access to work, legal protections, social insurance, organizational resources, role recognition, training, internal mobility, and membership in workplace institutions. The organization receives labor time, task performance, compliance with legitimate instructions, availability within specified periods, and participation in coordinated production. The ex-

act bundle varies across jurisdictions, occupations, sectors, and historical periods.

A generative analysis therefore separates the wage relation from the wider organization of work. Two positions with similar pay can differ substantially in discretion, predictability, learning, voice, occupational mobility, exposure to monitoring, ability to refuse unsafe tasks, or access to organizational knowledge. Conversely, a highly autonomous contractor can have substantial discretion while lacking continuity of income or institutional standing. The relevant comparison depends on which relational functions matter to the inquiry.

The distinction is especially important because labor markets can reorganize by unbundling employment. Outsourcing can separate organizational membership from the performance of recurrent work. Platform mediation can separate customer access from conventional managerial supervision while creating other forms of ranking, allocation, and control. Temporary work can provide repeated contribution with weak continuity. Professional partnerships, cooperatives, or member-owned organizations can combine work with governance claims. The economic consequence of such arrangements cannot be inferred from contractual label alone.

Authority is one component of the relation. Coase's classic formulation treated the firm partly through the substitution of internal direction for repeated market contracting (Coase 1937). GRE extends the problem by asking what the authority relation does to later capability and participation. Direction can coordinate complex interdependence and protect collective standards. It can also narrow discretion, suppress local knowledge, or create dependency when workers have weak exit or voice. The same formal hierarchy can therefore support very different generative trajectories depending on how information, contestation, training, and responsibility are organized.

Employment also provides temporal structure. Stable work can support planning, skill accumulation, social relationships, and projects that require continuity. It can also lock persons into roles with weak learning or limited exit. Flexibility can permit experimentation and multiple affiliations while transferring uncertainty onto workers. A generative analysis therefore avoids treating either stability or flexibility as intrinsically superior. The relevant question is how the distribution of temporal risk interacts with livelihood, capability formation, bargaining position, and future opportunity.

Proposition 19.37 (Employment-bundle condition). *Changes in employment status or contract form are analytically incomplete measures of work transformation when income, authority, security, capability formation, organizational access, voice, and social protection move differently across the same reorganization.*

Proposition 19.37 complements the task–employment distinction developed in Chapter 18. A task can persist while the employment bundle changes, and employment can persist while the internal organization of work changes substantially. Empirical analysis should therefore specify which components are being transformed rather than treating employment as a single undifferentiated variable.

19.4.2 Organizational Membership and Standing

Organizational membership concerns the relation through which a participant acquires recognized standing within an organized configuration. Standing can include access to information, voice in decisions, eligibility for benefits, professional identity,

claims on shared resources, participation in internal learning, representation, protection under procedures, and continuity across projects. Employment often carries such standing, yet the two relations are not identical. Owners, partners, volunteers, students, members of professional associations, elected representatives, cooperative members, and long-term contractors can hold organizational standing without occupying the same employment relation.

Membership is rarely binary in practice. Organizations contain graded positions. A temporary worker may enter operational routines while remaining outside strategic information. A contractor can possess specialized authority over a technical subsystem but lack access to internal promotion. A volunteer can hold strong community legitimacy with little formal decision power. A junior employee can belong legally while having weak practical voice. A member of a cooperative can possess voting rights while participating only intermittently in daily production. The relevant object is therefore a bundle of membership claims and recognitions rather than a single yes-or-no status.

Definition 19.38 (Organizational membership relation). An *organizational membership relation* is a recurrently recognized relation through which a person or collective receives a specified configuration of access, obligations, protections, decision rights, identity, representation, and continuity within an organization or organized practice.

The definition deliberately leaves artificial systems outside automatic membership attribution. An AI system can occupy a recurrent operational role, hold permissions, generate outputs, or mediate decisions. Those facts establish organizational integration, not by themselves legal, moral, or social membership. Chapter 18 separates collective capability from subjecthood and standing. The same restraint applies here: institutions may create technical roles for artificial systems without implying that the systems receive the same membership status as human participants.

Membership matters generatively because it changes what can be learned and contributed. Internal access to meetings, documentation, mentoring, informal networks, decision rationales, and historical memory can create capabilities that are difficult to acquire from isolated task execution. Exclusion from those relations can leave a participant productive in the short run while limiting later mobility and organizational understanding. This problem becomes especially important where firms rely heavily on contingent labor while concentrating learning and advancement opportunities among a smaller core.

Membership also creates obligations on the organization. Organizations can provide procedures for contesting evaluation, reporting harm, appealing decisions, accessing accommodations, negotiating role changes, or participating in governance. Such procedures vary widely and can be weak in practice. Their generative significance lies in making membership revisable without requiring immediate exit from the organization whenever conflict occurs.

Proposition 19.39 (Membership-access condition). *Where organizational learning, information, protection, and decision participation are distributed through membership status, differences in membership standing can generate capability and bargaining asymmetries even among participants performing closely related work.*

The proposition draws attention to organizational boundaries as mechanisms of future inequality. Current pay differences are only one channel. Access to relationships, learning, reputation, and decision processes can compound over time and shape which participants later become able to direct, innovate, negotiate, or exit.

19.4.3 Coordination and Distributed Authority

Organizations coordinate interdependent activity under conditions of partial information, specialized knowledge, limited attention, and changing environments. Hierarchy is one coordination mechanism, markets another, and network forms can organize reciprocal exchange and learning across organizational boundaries (Powell 1990). Actual organizations often combine these modes. A firm can use hierarchy for safety-critical decisions, internal markets for resource allocation, peer coordination for professional work, and external networks for innovation or supply.

GRE treats coordination as the organization of relations among distributed capabilities. The relevant problem is not simply whether a decision is centralized. It is whether the configuration allows the information and judgment required for a decision to reach positions with authority to act, while preserving accountability and the capacity to revise errors. Centralization can be useful where rapid integration or clear responsibility is needed. Decentralization can be useful where knowledge is local and adaptation must occur near the point of action. Both can fail when authority and information become misaligned.

Coordination also has an attentional dimension. Organizations generate more information than any participant can process. Reporting systems, dashboards, meetings, rankings, escalation rules, and managerial layers therefore allocate scarce attention. Simon's analysis of information-rich environments is relevant because abundance of information can make attention the limiting resource (Simon 1971). Organizational design consequently affects which signals receive notice and which remain structurally invisible.

Coordination routines can become capabilities in their own right. A team that learns how to hand off complex work, preserve context, challenge decisions, recover from error, and integrate specialized contributions can outperform a collection of individually capable participants. This relational capability is historically accumulated. It can be lost when reorganization removes experienced intermediaries, documentation, slack, or shared interpretive practices even if formal roles remain filled.

Authority is distributed through more than managerial titles. Technical standards, software permissions, workflow systems, budget controls, procurement rules, professional credentials, scheduling tools, and algorithmic systems can all determine what actions are possible. The analysis of power in Chapter 16 therefore applies directly: authority becomes consequential through conversion mechanisms that connect formal or technical positions to repeated control over others' feasible actions.

Proposition 19.40 (Coordination-alignment condition). *An organizational coordination arrangement is more generatively robust when decision authority, relevant information, capability, responsibility, and pathways for contestation remain sufficiently aligned for the organization to act and to revise action under changing conditions.*

This proposition does not prescribe a fixed degree of hierarchy. It identifies a relational alignment problem. A tightly centralized emergency organization can satisfy the condition when local signals travel quickly and centralized decisions remain accountable. A decentralized professional network can satisfy it when local autonomy is matched by clear interfaces and shared standards. The appropriate form depends on task, risk, scale, history, and institutional purpose.

19.4.4 Contribution, Recognition, and Attribution

Organizations have to decide what counts as contribution. Formal accounting often privileges outputs that can be assigned to a person, team, project, or cost center. Yet recurrent collective work depends on enabling contributions that are difficult to isolate: maintaining infrastructure, documenting decisions, mentoring new members, reviewing others' work, coordinating across boundaries, preventing errors, preserving relationships, absorbing uncertainty, and carrying institutional memory. A generative analysis makes these functions visible because their absence can reduce future organizational capacity even when short-run output remains high.

Contribution is therefore multidimensional. A participant can contribute directly to a final product, enable another participant's work, maintain a shared resource, provide judgment at a critical decision point, accept responsibility for a consequential action, preserve continuity with clients or communities, or create a method that lowers future coordination cost. These contribution types can overlap while remaining different in their evidential traces and reward structures.

Evaluation systems translate these heterogeneous contributions into organizational consequences. Performance reviews, promotion criteria, bonus systems, authorship conventions, project metrics, rankings, and informal reputation allocate recognition and future opportunity. The translation is necessarily selective. Some functions are easier to measure than others, and the act of measurement can change behavior. GRE therefore treats contribution evaluation as an interface rather than a transparent observation of value.

Definition 19.41 (Contribution–recognition interface). *A contribution–recognition interface is the institutional arrangement through which heterogeneous contributions are identified, represented, evaluated, attributed, and converted into organizational consequences such as pay, status, authority, opportunity, responsibility, or continued access.*

Definition 19.41 allows attribution to remain partial. A collective achievement can depend on many contributions without requiring that all be converted into one scalar measure. The interface can preserve several forms of recognition: financial reward, authorship, promotion, peer recognition, governance voice, workload adjustment, or documented responsibility. These forms need not be commensurable.

A weak interface can generate cumulative distortion. If visible individual output is rewarded while mentoring and maintenance are ignored, capable participants may rationally reduce activities that reproduce the organization. If error prevention is invisible because successful prevention produces no incident, high-reliability work can be undervalued. If contribution is attributed only to formal role holders, contractors or support staff can become structurally absent from the organizational narrative despite being causally important.

Proposition 19.42 (Contribution–representation condition). *Where organizational rewards and future opportunities depend on formal representations of contribution, persistent omission of enabling, maintenance, relational, or collective contributions can weaken the capacities on which later organizational performance depends.*

The proposition does not imply that every contribution must be measured continuously. Measurement itself has costs and can distort practice. The requirement is diagnostic: organizations should identify which important contributions remain systematically invisible and whether that invisibility changes behavior, capability repro-

duction, responsibility, or fairness in ways material to the organization's purpose.

19.4.5 Care, Maintenance, and Relational Labor

Care and relational labor expose a limit of organizational models centered exclusively on discrete output. Some work has value partly because a relation is sustained through attention, responsiveness, trust, presence, continuity, or responsibility. Care economics has long emphasized that socially necessary caring activity is often organized through households, markets, public institutions, and unpaid relations in ways that ordinary production accounts capture imperfectly (Folbre 1994; Folbre 2001). Similar relational functions also occur inside organizations through mentoring, supervision, onboarding, conflict repair, accommodation, pastoral support, community engagement, and the maintenance of trust with clients, patients, students, users, or collaborators.

The economic significance of this labor is partly temporal. A supportive interaction can solve an immediate problem, yet repeated reliable support can also create a relation in which future communication becomes easier, uncertainty lower, and participation more sustainable. Conversely, organizations can consume accumulated trust faster than they regenerate it. A period of intense restructuring can remain productive because experienced workers continue to coordinate informally; later failure can appear sudden when the underlying relational reserve has already been depleted.

Maintenance work has a related structure. Equipment, software, archives, facilities, procedures, standards, and documentation require recurrent attention. Maintenance is often less visible than innovation because its success appears as continuity. Yet organizational generativity depends on preserved infrastructures and know-how. The distinction between preservation and re-epistemization developed in Section 19.3 therefore has an organizational analogue: retained records or routines become useful only when participants can understand, repair, and adapt them.

Relational labor should not be romanticized. Expectations of care can be distributed unequally and can become an unrecognized burden. Informal mentoring or emotional support can be demanded from some members without corresponding time, authority, recognition, or compensation. A generative analysis therefore asks both whether relational work occurs and how its costs, recognition, and decision power are distributed.

Artificial systems can assist some relational functions through scheduling, translation, information retrieval, triage, documentation, or routine communication. Technical assistance can reduce administrative burden and increase availability. It can also fragment continuity or move interaction into interfaces that are poorly suited to trust, responsibility, or exceptional circumstances. The relevant question is which components of the wider relation are being automated and which relational functions remain dependent on human or community continuity.

Proposition 19.43 (Relational-maintenance condition). *Where sustained cooperation depends on trust, continuity, mentoring, care, maintenance, or repair; organizational evaluation that treats these functions as costless background can erode the relational and infrastructural conditions required for later contribution.*

The proposition gives a generative interpretation to work that may appear indirect from a narrow output perspective. Its scope remains contextual. Some organizations depend heavily on continuity and care; others rely more on standardized interfaces.

The task is to identify the relational conditions actually required for the organization's function and to observe whether they are being regenerated.

19.4.6 Automation and Organizational Reconfiguration

Automation changes organizations through more than substitution of machine execution for human tasks. It can alter workflow, span of control, information asymmetry, evaluation, training, job boundaries, responsibility, bargaining positions, and the location of expertise. Chapter 18 developed the task-level and human–AI analysis. The present subsection translates that architecture into organizational design.

A first distinction concerns execution and control. An organization can automate task execution while leaving managerial authority largely unchanged. It can also retain human execution while using algorithms to allocate tasks, set pace, rank workers, evaluate performance, or trigger discipline. Research on algorithmic management documents how computational systems can become mechanisms of direction, evaluation, and control in workplace settings (Kellogg et al. 2020). The organizational consequence therefore depends on which function is automated and how that function connects to authority.

A second distinction concerns capability. Automation can remove routine burdens and allow workers to engage in more complex activity. It can also externalize knowledge into systems that reduce opportunities for practice. The task framework of Acemoglu and Restrepo is useful because automation can displace labor from some tasks while new tasks reinstate labor demand elsewhere (Acemoglu and Restrepo 2019). GRE adds the question of capability trajectory: whether workers and organizations remain able to understand, verify, repair, contest, and redesign the automated process.

A third distinction concerns organizational memory. When expertise is embedded in software, models, workflows, or vendor platforms, knowledge can become more reproducible across locations. Yet dependency can deepen if the organization loses the human capacity to reconstruct or replace the system. A technically efficient configuration can therefore become fragile when maintenance, vendor access, data provenance, model behavior, or institutional memory are concentrated outside the organization.

Automation can also redistribute responsibility. An AI system can generate recommendations while a human remains formally accountable. A worker can become responsible for monitoring a process without having authority to change it. Managers can rely on automated scoring while lacking access to its assumptions. Such mismatches between responsibility, knowledge, and control are organizational problems even when the technical system performs well on average.

Proposition 19.44 (Automation-reconfiguration condition). *The organizational effect of automation depends on the joint reconfiguration of execution, authority, verification, skill formation, responsibility, dependency, and exit options; an automation rate by itself does not identify the resulting work order.*

The proposition also explains why similar technologies can produce different workplaces. One organization can use artificial assistance to expand worker discretion and learning. Another can use the same underlying capability to centralize control, intensify monitoring, or reduce opportunities for skill development. Technical possibility constrains the field, while organizational choices and institutions shape which

configuration becomes durable.

19.4.7 Participation beyond Paid Employment

Paid employment has historically carried several functions at once: access to income, social insurance, routine, organizational membership, recognition, networks, learning, bargaining institutions, and opportunities to contribute. Chapter 18 argued that these functions can become analytically separable when artificial capability reduces the quantity of human labor required for some forms of production. The organizational domain adds a practical question: through which institutions can consequential participation occur when employment is intermittent, reduced, or absent?

Participation beyond employment already exists in many economic settings. Co-operative members can exercise governance rights. Volunteers can sustain nonprofit and community organizations. Professional associations can maintain standards and shared knowledge. Open-source contributors can create common technical infrastructures. Citizens can participate in public institutions. Family and community members perform care and coordination outside wage relations. Owners can influence organizations without being employees. These forms differ in purpose, access, responsibility, and normative standing; they should not be collapsed into one replacement for employment.

The capability perspective developed earlier in the book is useful because participation requires more than formal permission. Time, income security, accessibility, language, digital infrastructure, mobility, care support, skills, and recognition can determine whether a nominal participation opportunity is practically usable (Sen 1999). Organizations can therefore widen participation by changing entry conditions, role design, governance procedures, accessibility, and the resources required to contribute.

Participation also needs boundaries. An organization cannot include every affected person in every operational decision. Decision procedures have costs, and specialized work can require expertise or confidentiality. The generative question is whether important affected positions have credible routes to representation, contestation, contribution, or review at the points where their participation is materially relevant.

Forms of participation beyond employment can also create new exclusions. Volunteer-dependent institutions can privilege persons with sufficient free time or independent income. Commons production can depend on hidden maintenance work. Cooperative governance can become formally democratic while practically dominated by highly active members. Participation therefore requires the same relational scrutiny applied to employment: who can enter, who can remain, whose contribution becomes legible, and whose exit is costly?

Proposition 19.45 (Participation-plurality condition). *A work order becomes less dependent on paid employment as the exclusive route to consequential organizational participation when institutions provide multiple viable forms of contribution, standing, learning, voice, and recognition whose practical accessibility does not presuppose employment itself.*

The proposition does not predict or prescribe the decline of employment. Paid work can remain an important and desirable form of participation. The analytical point is that employment need not carry every participatory function, especially

where technological or institutional change weakens its universality.

19.4.8 Organizational Generativity and Capability Reproduction

The preceding dimensions permit work organizations to be evaluated as generative systems. Labor relations distribute livelihood, authority, and temporal risk. Membership distributes standing and access. Coordination combines distributed knowledge and authority. Contribution interfaces shape recognition and future opportunity. Care and maintenance reproduce relational and infrastructural conditions. Automation reorganizes execution, control, capability, and responsibility. Participation arrangements determine who can remain consequential inside or alongside the organization. These dimensions interact, so high present productivity can coexist with declining organizational capacity.

An organization can become less generative in several ways. It can rely on a shrinking group of experts without reproducing their knowledge. It can automate routine work while eliminating the practice through which novices previously learned. It can reward visible outputs while exhausting mentoring and maintenance. It can centralize decision rights faster than it improves information flows. It can preserve records while losing the interpretive capability needed to use them. It can retain members while weakening their voice or future mobility. It can expand rapidly while becoming dependent on a small number of external infrastructures that it cannot replace.

The reverse is also possible. Redundant capability can provide resilience. Mentoring can turn present work into future capability. Documentation can transform individual knowledge into organizational memory. Cross-functional relations can permit recombination when tasks change. Internal mobility can preserve membership while roles evolve. Exit and contestation procedures can reveal failure without requiring complete organizational breakdown. Shared ownership or governance can align some participants with longer time horizons, although their effects depend on actual institutional design rather than legal form alone.

Definition 19.46 (Organizational generativity). *Organizational generativity* is the historically evolving capacity of an organized work configuration to reproduce and revise the relations, capabilities, memberships, infrastructures, memories, and participation pathways through which consequential collective action can continue under changing tasks, technologies, personnel, and external conditions.

Definition 19.46 distinguishes generativity from growth, profitability, innovation rate, or organizational survival. A stable organization can remain generative if it renews capability and preserves revisability. A rapidly growing organization can become less generative if its expansion destroys learning, trust, maintenance, or institutional memory. An organization can also dissolve after successfully generating capabilities and institutions that continue elsewhere. The relevant object is the reproduction and transformation of relational capacity, not the indefinite persistence of one legal entity.

Organizational generativity has at least three temporal layers. The first concerns *operational continuation*: whether work can be carried out now. The second concerns *capability reproduction*: whether participants, routines, and infrastructures required for later work are being renewed. The third concerns *reorganizational capacity*: whether the organization can alter roles, authority, technology, membership, and coordination when the current configuration becomes inadequate. These layers can

diverge. Organizations often remain operational after capability reproduction has weakened, because accumulated expertise and trust provide a temporary reserve.

This temporal structure also clarifies the role of slack and redundancy. Spare capacity can appear inefficient in a static comparison, yet some redundancy enables training, verification, experimentation, handover, resilience, and response to unusual conditions. GRE does not infer that more slack is always better. Excessive redundancy can consume resources that would support other valuable activities. The generative question is whether current efficiency removes the capacities needed for learning, maintenance, recovery, and reconfiguration at the relevant risk horizon.

Institutional memory is another generative resource. Documents, code, procedures, archives, role histories, and narratives can preserve traces of past decisions. Their value depends on accessibility and interpretation. A large repository does not guarantee usable memory when provenance is weak or staff cannot reconstruct why a procedure exists. Organizational memory therefore requires both preserved artifacts and communities capable of re-epistemizing them, paralleling the preservation analysis of Section 19.3.

Generativity also depends on relations with environments beyond the organization. Labor markets, educational institutions, professional communities, suppliers, regulators, public infrastructure, families, and local communities can provide capabilities the organization itself does not generate. A firm that appears highly productive can rely on public education, unpaid care, transport infrastructure, open knowledge, and ecological systems that remain outside its accounts. Organizational analysis should therefore avoid attributing every enabling condition to the organization that captures the final output.

Proposition 19.47 (Organizational-generativity condition). *A work organization exhibits stronger long-horizon generativity when its current mode of coordination reproduces the capabilities, relational maintenance, institutional memory, participation pathways, and revisability required for future collective action across plausible changes in tasks, technologies, membership, and external conditions.*

Proposition 19.47 is intentionally domain-sensitive. Organizations differ in mission, scale, risk, legal form, labor intensity, capital intensity, public responsibility, and temporal horizon. The proposition therefore supplies a diagnostic direction rather than a universal organizational design. Empirical inquiry must identify which capabilities and relations are actually constitutive of the organization under study and which external conditions it relies upon.

The section also produces a domain remainder for GRE. Organizations show that access, contribution, value, and capability are mediated through membership and authority structures whose boundaries are institutionally maintained. These structures cannot always be represented adequately by dyadic exchange or by treating organizations as unitary actors. Internal relations among members, roles, technologies, and governance positions can be economically causal. Domain translation therefore feeds back into GRE by requiring organization-sensitive representations of economic subjects and by keeping internal distribution and capability reproduction visible when organizations appear as actors in wider markets or institutions.

The next section moves from work organizations to development and humanitarian practice. That domain places resource transfer, institutional mediation, local relational structures, dependency, capability formation, participation, and historical context inside settings where the organizations providing assistance and the com-

munities receiving or co-producing it often occupy sharply different positions. The distinction developed here between contribution, membership, authority, and generativity will therefore remain important when assistance crosses organizational and jurisdictional boundaries.

19.5 Development and Humanitarian Practice

Development and humanitarian practice provide a demanding domain test for Generative Relational Economics because assistance is rarely a simple transfer between two already independent positions. Resources move through organizations, infrastructures, legal categories, political authorities, local institutions, households, informal networks, ecological conditions, and histories of prior intervention. Humanitarian practice adds further temporal compression: protection, food, shelter, health, mobility, and basic continuity may require action before institutional relations can be extensively redesigned. Development practice more often operates over longer horizons in which capability formation, institutional change, participation, and locally sustained reproduction become central. The two domains overlap, yet their temporal structures and immediate obligations can differ materially. The role of this section is therefore to specify an assistance-centered GRE architecture that can accommodate both urgent response and longer-horizon transformation without collapsing one into the other.

The section has four objectives. First, it distinguishes resource transfer from the relational and institutional processes through which transferred resources become usable capabilities. Second, it examines mediation, local relational structures, dependency, participation, and history as constitutive parts of assistance rather than contextual additions. Third, it identifies the temporal interface between immediate protection and long-horizon capability regeneration. Fourth, it develops a concept of *generative assistance* for arrangements that support present needs while strengthening the situated capacity to interpret, organize, maintain, adapt, and eventually reconfigure the conditions of collective life. The method remains relational, historical, and domain-sensitive. Development and humanitarian arrangements vary across conflict, displacement, public-health emergencies, ecological shocks, poverty, infrastructure failure, institutional transition, and ordinary long-term development; the framework therefore supplies diagnostic distinctions rather than a universal programme of intervention.

Classical development analysis already provides several reasons to resist identifying resources with achieved well-being. Sen's entitlement analysis of famine showed that aggregate food availability and individual command over food can diverge, while the capability approach later emphasized the distinction between commodities, resources, functionings, and substantive freedoms (Sen 1981; Sen 1985; Sen 1999). Human development approaches similarly shifted attention beyond aggregate production toward the expansion of people's capabilities and opportunities (United Nations Development Programme 1990; Robeyns 2005). GRE retains these distinctions while adding a stronger emphasis on the relational pathways through which resources, capabilities, institutions, participation, and future generative capacity are jointly produced.

Assistance also operates through embedded relations. Local institutions shape ac-

cess, legitimacy, trust, allocation, information, and dispute resolution; external organizations enter already structured fields of authority and reciprocity rather than socially empty spaces. Institutional rules can stabilize cooperation and resource governance, but their effects depend on locally situated practices, histories, and power relations (Granovetter 1985; Ostrom 1990; Ostrom 2005; North 1990). For this reason, the analytical unit used here is an *assistance configuration*: a historically situated arrangement connecting needs, resources, institutions, infrastructures, local relations, external organizations, decision rights, knowledge, and temporal commitments.

Table 19.5 summarizes the principal dimensions developed in the section. The table separates immediate observables from longer-horizon generative questions. It should not be read as a scoring system. Under acute humanitarian conditions, immediate survival and protection can justifiably dominate other objectives. Under longer-horizon development conditions, institutional continuity, capability formation, participation, and local maintenance may receive greater analytical weight. The relevant judgment is therefore indexed to the situation, risk horizon, and obligations of the actors involved.

Definition 19.48 (Assistance configuration). An *assistance configuration* is a historically situated arrangement of affected persons and communities, public and non-public institutions, external organizations, resources, infrastructures, knowledge practices, decision rights, rules, dependencies, and temporal commitments through which developmental or humanitarian support is identified, transferred, mediated, used, maintained, contested, and revised.

Definition 19.48 keeps the unit of analysis wider than a project, grant, shipment, or programme. A food transfer, cash payment, clinic, school, water system, legal service, or technical-assistance programme can be economically consequential through its immediate material effects. Its longer-horizon consequences depend on the surrounding configuration: who controls access, which local institutions are strengthened or bypassed, what maintenance is required, what knowledge is retained, which dependencies are created, and whether affected participants can influence later revision. The same nominal intervention can therefore enter different generative trajectories in different relational settings.

19.5.1 Resource Transfer and Conversion

Resource transfer is often the most visible component of assistance. Development finance, cash transfers, food, medical supplies, shelter materials, tools, infrastructure, technical expertise, information systems, and public services can all alter feasible action. Yet the transfer itself is only one stage in a larger conversion process. Resources must become accessible, usable, maintainable, socially legitimate, and compatible with the conditions under which people can convert them into functionings and capabilities. The capability literature makes this distinction explicit: equal resource bundles can yield unequal substantive opportunities because personal, social, institutional, and environmental conversion conditions differ (Sen 1985; Sen 1992; Robeyns 2005).

GRE extends this insight by treating conversion conditions as relationally produced and historically variable. A cash transfer requires functioning markets, accepted payment media, security, information, and practical access. A water system requires maintenance capacity, institutional responsibility, energy or mechanical inputs,

Table 19.5: Diagnostic dimensions for generative analysis of development and humanitarian assistance.

Assistance dimension	Immediate observable	Long-horizon generative question
Resource transfer	Cash, food, shelter, equipment, services, finance, infrastructure	Whether resources can be converted into context-relevant capabilities without destroying necessary local relations or access pathways
Institutional mediation	Eligibility rules, implementing agencies, procurement, coordination, reporting, legal categories	Whether mediation remains legible, contestable, adaptive, and capable of connecting external support to situated needs
Local relational structures	Households, associations, informal networks, public bodies, customary institutions, markets	Whether assistance recognizes and strengthens viable local relations while identifying exclusion, domination, or fragility within them
Dependency	Recurrent external finance, imported expertise, platform reliance, logistical dependence	Whether essential functions can remain supported while dependency becomes visible, governable, diversified, or reversible where appropriate
Capability formation	Skills, organizational capacity, maintenance, learning, public capability, technical competence	Whether present assistance increases the capacity to generate, maintain, and revise future responses
Participation	Consultation, representation, co-design, local decision rights, complaint and appeal channels	Whether affected persons and institutions acquire consequential standing in problem formation, allocation, evaluation, and revision
Historical pathways	Prior interventions, conflict history, displacement, institutional change, ecological transformation	Whether present design accounts for inherited relations, accumulated commitments, path dependence, and historical memory
Generative assistance	Transition plans, local maintenance, institutional learning, diversified capacities, adaptive governance	Whether assistance protects present life while widening the locally grounded capacity for future collective action and reorganization

spare parts, knowledge, and a governance arrangement for allocation. A training programme requires time, language access, institutional recognition, opportunities for practice, and pathways through which the acquired capability can become consequential. An imported technical system can raise present capacity while generating maintenance dependence if replacement parts, expertise, or digital infrastructure remain externally controlled.

The conversion pathway is therefore economically significant in its own right. It includes the relations through which a resource becomes usable, the losses that occur during mediation, and the capacities required to sustain the resulting function. These relations can distribute benefits unevenly. A resource that is formally universal can be practically inaccessible to persons without documentation, mobility, digital access,

language proficiency, social standing, or recognized household status. The relevant question is not solely how much was transferred, but how transfer interacted with differentiated conversion positions.

Definition 19.49 (Assistance conversion pathway). *An assistance conversion pathway is the set of relational, institutional, infrastructural, personal, and environmental conditions through which transferred resources become, or fail to become, context-relevant functionings, capabilities, services, or durable collective capacities.*

Definition 19.49 permits analysis at several scales. At the household scale, conversion may concern access to food, shelter, income, mobility, care, or education. At the organizational scale, it may concern whether equipment and finance can be maintained and incorporated into recurrent practice. At the public scale, it may concern whether an infrastructure investment becomes a functioning service system. At each scale, the transfer can succeed materially in the short run while leaving fragile conversion conditions.

Humanitarian urgency changes the acceptable temporal balance. When survival or protection is at stake, immediate transfer may justifiably proceed before a complete long-horizon institutional architecture can be established. A generative perspective does not require postponing urgent action until every local relation has been mapped. It requires preserving awareness of which capacities are being temporarily substituted, which dependencies are being created, and which conversion conditions will need later attention. Temporal compression changes sequencing; it does not erase the conversion problem.

Proposition 19.50 (Transfer–conversion condition). *Within development and humanitarian practice, an increase in transferred resources produces stronger generative effects when the relevant conversion pathways remain accessible, maintainable, context-sensitive, and capable of supporting later action beyond the immediate transfer episode.*

Proposition 19.50 is deliberately conditional. In some emergencies, short-lived resources are valuable precisely because they meet a temporary need. Durability is therefore not a universal criterion for every transfer. The proposition applies when the intended objective includes capability persistence, service continuity, or institutional reproduction beyond the immediate episode.

19.5.2 Institutional Mediation and Assistance Architecture

Assistance is almost always mediated. Governments, municipalities, international organizations, nongovernmental organizations, community groups, contractors, financial institutions, health providers, schools, digital platforms, donors, and informal networks can all participate in deciding who is eligible, what counts as need, how resources are procured, how information is collected, and how outcomes are evaluated. Institutional mediation therefore shapes the practical meaning of assistance before resources reach an intended recipient.

Mediation performs necessary functions. Large-scale response requires coordination, standards, logistics, accountability, specialized knowledge, legal authority, and mechanisms for allocating scarce resources. Yet each additional layer can also transform information, incentives, timing, and decision rights. Reporting categories can improve comparability while suppressing local distinctions. Procurement rules can improve financial accountability while excluding smaller local suppliers. Centralized eligibility criteria can improve administrative consistency while missing households

whose needs do not fit standardized categories. Institutional design therefore mediates both resource flow and epistemic visibility.

This problem is especially important when external institutions enter settings with different administrative, linguistic, legal, or social classifications. The categories used by an assistance organization may not correspond to locally meaningful relations. Household, disability, livelihood, community, vulnerability, displacement, or ownership can have institutionally specific meanings. Translation is therefore partly conceptual and partly distributive: classification determines who becomes legible to the assistance system and which claims can be recognized.

Institutional mediation can also redistribute authority. An externally funded programme can strengthen a public agency by providing resources and systems through it, or weaken public capability by creating parallel delivery structures that attract skilled personnel and bypass existing institutions. A humanitarian organization may appropriately establish temporary parallel mechanisms when public institutions are absent, inaccessible, discriminatory, or directly implicated in harm. The generative question is situational: which mediation structure can meet present obligations while preserving or creating feasible pathways for accountable future provision?

North's emphasis on institutions as structured rules and incentives and Ostrom's work on institutionally diverse governance arrangements both suggest that formal organizational design interacts with historically embedded practices rather than operating independently of them (North 1990; Ostrom 2005). GRE adds a temporal concern: mediation should be examined not only for current delivery performance, but for the institutional capacities and dependencies it generates.

Proposition 19.51 (Institutional-mediation condition). *Assistance mediation is more generatively robust when the institutions that classify need, allocate resources, coordinate delivery, and evaluate outcomes remain sufficiently legible, contestable, and revisable to incorporate situated information and to transfer or redistribute functions as conditions change.*

The proposition does not privilege decentralization or local administration in every case. Centralized logistics can be indispensable under large-scale emergencies; national institutions can protect rights that local authorities deny; external monitoring can expose local capture; and specialized international capacity can supply functions that do not exist locally. Generative analysis therefore asks which functions require which scale and how authority among scales can be revised when evidence changes.

19.5.3 Local Relational Structures and Situated Capacity

Development and humanitarian programmes enter local relational structures that already coordinate care, livelihood, information, reciprocity, dispute resolution, access, and collective action. Families, neighborhood associations, religious institutions, customary authorities, cooperatives, informal credit networks, local businesses, municipal offices, professional groups, and other recurrent relations can provide capabilities long before an external intervention begins. They can also reproduce exclusion, unequal power, discrimination, violence, or rigid hierarchy. A relational approach therefore avoids treating local structure as either a romantic source of authenticity or an obstacle to modernization.

Embeddedness matters because assistance changes incentives and relations among participants (Granovetter 1985). Selecting one organization as an imple-

menting partner can alter its standing relative to others. Paying participants in one activity can change expectations around previously reciprocal work. Establishing a new distribution point can shift mobility patterns and commercial activity. Requiring formal documentation can privilege persons already recognized by administrative institutions. The intervention participates in local structure even when its design treats that structure as external context.

Ostrom's work on commons governance is useful here because it demonstrates that durable collective arrangements can emerge through locally specific combinations of boundaries, rules, monitoring, sanctions, conflict resolution, and nested organization (Ostrom 1990). The lesson for GRE is not that every local institution should be preserved. It is that local relational capacity is often institutionally organized and cannot be inferred from the presence or absence of formal state or market mechanisms alone.

Definition 19.52 (Situating relational capacity). *Situated relational capacity* is the historically formed ability of persons and institutions within a place or community to coordinate, interpret needs, mobilize resources, maintain services, resolve disputes, transmit knowledge, and reorganize collective activity through locally available relations and infrastructures.

Situated relational capacity can be unevenly distributed. A community may possess strong coordination capacity while systematically excluding a minority. A household network may provide effective care while placing disproportionate burdens on women or particular kin. A customary institution may resolve disputes efficiently while limiting appeal. The analytical object is therefore the capacity and its internal distribution, authority structure, and revisability.

External assistance can interact with situated capacity in several ways. It can complement it by supplying resources or expertise that local relations cannot generate. It can extend it by connecting local institutions to wider infrastructures. It can substitute for it temporarily during acute disruption. It can transform it by introducing new rules or technologies. It can also displace it when externally controlled systems become the principal route through which resources, recognition, or decisions flow. These effects are often mixed and may differ across groups.

Proposition 19.53 (Situating-capacity condition). *Assistance is more likely to support durable local generativity when it identifies the situated relations through which essential functions are already produced, distinguishes enabling relations from exclusionary or harmful ones, and designs external support in ways that preserve feasible local capacities for maintenance, learning, and reorganization.*

The proposition requires empirical investigation rather than a default preference for existing arrangements. Locality does not by itself confer legitimacy. What matters is whether the relevant relations are capable, inclusive enough for the purpose at hand, accountable to affected persons, and open to correction when they generate harm.

19.5.4 Dependency and Assistance Relations

Dependency is structurally unavoidable in many forms of social and economic life. Persons depend on care, institutions depend on infrastructure, communities depend on trade and public systems, and organizations depend on specialized knowledge and networks. Humanitarian crises often intensify dependency because ordinary ac-

cess routes have been destroyed or suspended. GRE therefore treats dependency as a typed relation rather than a general pathology. The relevant questions concern what is depended upon, for which functions, with what substitutes, under what power relations, and with what possibilities for contestation, diversification, or exit.

Development history also cautions against interpreting dependency only at the level of individual projects. Structuralist and dependency-oriented traditions drew attention to unequal international production and exchange relations that can shape national development possibilities (Prebisch 1950). GRE does not assume one universal macroeconomic dependency model, but it retains the insight that assistance relations can be embedded within wider asymmetries of finance, trade, technology, legal authority, knowledge, and institutional recognition.

At the project level, assistance can create dependency when a recurrent function becomes tied to a resource, technology, supplier, funding stream, expertise base, or administrative system that local actors cannot maintain or replace. Such dependency can be entirely acceptable when the external relation is stable, accountable, and normatively appropriate. International vaccine production, advanced medical equipment, satellite communications, or specialized disaster logistics may reasonably remain translocal. The analytical issue is whether the dependence is understood and governed.

Dependency becomes more consequential when it combines high importance, low substitutability, weak visibility, and asymmetric control. A clinic dependent on one imported reagent differs from a clinic with several procurement routes. A cash-transfer programme dependent on one proprietary identity platform differs from one with interoperable alternatives. A local organization dependent on annual project grants differs from one with diversified finance and predictable institutional support. These differences concern reversibility and bargaining position rather than an abstract ideal of self-sufficiency.

Care ethics also provides a useful corrective to autonomy-centered descriptions of dependency. Human life is constituted through relations of care and support, so dependence cannot simply be eliminated without eliminating valuable relations themselves (Kittay 1999; Tronto 1993; Held 2006). The development question is consequently closer to whether dependencies are sustaining, visible, reciprocal where appropriate, and institutionally governed than whether dependency exists at all.

Proposition 19.54 (Dependency-revisability condition). *An assistance configuration manages dependency more generatively when critical dependencies are identifiable, their control structures and substitutes are understood, and affected institutions possess feasible pathways to renegotiate, diversify, internalize, or deliberately retain them as circumstances change.*

This condition is especially relevant during transitions out of emergency provision. Abrupt withdrawal can convert a previously protective dependency into a service failure. A generative transition therefore requires attention to which functions can be localized, which require continuing external provision, which can be shared across scales, and which should be retired because the underlying need has changed.

19.5.5 Capability Formation and Local Regeneration

Capability formation concerns the development of durable capacities to act, choose, maintain, interpret, coordinate, and learn. Within development practice, this

includes individual skills and health, organizational competence, public administrative capacity, technical maintenance, research and data capability, legal capacity, collective coordination, and the ability to generate new solutions. The capability approach supplies an important normative foundation by focusing attention on substantive opportunities rather than resources alone (Sen 1999; Alkire 2002). GRE adds the question of how capabilities are reproduced relationally over time.

Training is one pathway, but capability formation is broader than training. A short course can transfer information without creating practice opportunities, institutional roles, equipment access, mentorship, authority, or career pathways through which knowledge becomes usable. Conversely, participation in recurrent work can develop capability through situated learning even when no formal training programme exists. Capability therefore depends on relations among knowledge, practice, infrastructure, recognition, time, and institutional opportunity.

Public capability is particularly important. A development programme can improve services through externally funded personnel while leaving the public institution unable to recruit, pay, retain, or supervise comparable staff after the programme ends. The immediate output can be excellent while the capability trajectory remains fragile. The same pattern can appear in humanitarian response when emergency systems perform functions that ordinary public services cannot currently provide. This may be necessary; generative analysis keeps the later institutional handover problem visible without making handover an immediate precondition for emergency action.

Capability formation also has a regenerative dimension. Communities and institutions face turnover, demographic change, migration, technological change, ecological shocks, and political disruption. Durable capability therefore requires mechanisms for teaching newcomers, preserving memory, maintaining equipment, updating procedures, financing recurring costs, and revising roles. A single cohort of trained experts does not by itself constitute regenerative capacity.

Proposition 19.55 (Capability-regeneration condition). *Developmental assistance contributes more strongly to long-horizon capability when acquired skills and institutional capacities are connected to recurrent practice, maintenance resources, knowledge transmission, role continuity, and mechanisms for adaptation across personnel and environmental change.*

The proposition is again conditional on the objective. Humanitarian action may appropriately supply capabilities directly when local formation would take too long to protect life. Yet even temporary substitution benefits from documenting which functions have been externally supplied and what transition options exist if the crisis persists.

19.5.6 Participation and Decision Standing

Participation is frequently invoked in development practice, but the term can refer to materially different relations. People may provide information, attend consultations, select among predetermined options, co-design programmes, govern resources, hold formal decision rights, evaluate outcomes, or possess appeal and veto mechanisms. These arrangements distribute decision standing differently. Treating them as a single participatory category can conceal whether affected persons can actually influence the assistance configuration.

Development scholarship has long connected substantive development with par-

ticipation and public agency (Drèze and Sen 2002; Sen 1999). GRE extends this by distinguishing participation in *problem formation, resource allocation, implementation, evaluation, and revision*. A programme can be participatory at one stage and highly centralized at another. It can also involve some groups while rendering others invisible through eligibility rules, meeting formats, language, mobility requirements, or local power hierarchies.

Participation has epistemic as well as normative significance. Affected persons often possess situated knowledge about needs, informal institutions, seasonal variation, local risks, household strategies, and prior interventions. External organizations can possess comparative knowledge, technical expertise, logistical capacity, and broader information. Effective participation can therefore combine heterogeneous knowledge rather than merely transfer authority from one side to another. The problem is institutional: which forms of knowledge enter which decisions, and how disagreements are recorded and revisited.

The urgency of humanitarian response again changes the feasible design. Immediate life-saving action can require centralized decisions under severe time pressure. Even then, decision standing can appear through accessible feedback, complaint mechanisms, rapid local consultation, transparent criteria, and later revision. Participation is therefore scalable and temporally differentiated rather than an all-or-nothing procedural requirement.

Definition 19.56 (Assistance decision standing). *Assistance decision standing* is the institutionally recognized capacity of affected persons, communities, or representative bodies to introduce information, formulate or contest problems, influence allocation or implementation, evaluate consequences, and participate in revision of an assistance configuration.

Decision standing can be distributed across several institutions. Community bodies may control local implementation while national authorities set legal rules and external donors set financial conditions. The distribution itself becomes an object of analysis. The issue is not whether one actor possesses complete control, but whether consequential decisions have identifiable loci and whether affected positions can enter those loci through meaningful channels.

Proposition 19.57 (Participation-standing condition). *Participation contributes more strongly to generative assistance when affected persons possess consequential and appropriately scaled decision standing across the stages where situated knowledge, allocation, accountability, and revision materially influence outcomes.*

This proposition avoids equating participation with consensus. Development and humanitarian settings can contain genuine conflicts of interest and value. Decision standing ensures that claims and knowledge can enter the process; it does not guarantee agreement or remove the need for legal rights, expertise, or protective constraints.

19.5.7 Historical Pathways and Institutional Memory

Assistance occurs within history. Present needs can reflect previous conflicts, displacement, extractive relations, infrastructure decisions, land regimes, trade structures, colonial administration, prior aid programmes, ecological change, public investment, demographic shifts, and repeated emergencies. Historical context therefore does more than explain background conditions. It shapes current trust, institutional capacity, entitlement, political legitimacy, expectations, and the practical mean-

ing of external intervention.

Path dependence can appear at several levels. Infrastructure constrains where services can be delivered. Administrative categories determine who is documented. Earlier programme designs create organizations and professional roles that later interventions inherit. Repeated short-term funding can shape local organizations toward donor reporting cycles. Prior exclusion can make formally equal procedures appear untrustworthy. Earlier failures can also produce valuable learning if their records and interpretations remain available.

Historical analysis matters particularly where development intervention changes the structures through which future intervention will occur. A programme can create a new ministry unit, database, procurement standard, local association, funding expectation, professional class, or infrastructure dependency. These become part of the starting conditions for later programmes. Development practice is therefore reflexive: intervention modifies the field that future intervention will diagnose.

Norgaard's co-evolutionary account of development emphasizes that social, economic, technological, and environmental systems change together rather than along a single universal path (Norgaard 1994). GRE adopts a compatible historical discipline while retaining ontological caution. The relevant point is analytical: the capacities and constraints observed at time t can be products of prior relational transformations, so cross-sectional comparison alone may misidentify causes or feasible alternatives.

Institutional memory is consequently valuable. Programme records, local archives, oral histories, monitoring data, financial records, technical documentation, community memory, and professional experience can all contribute to reconstructing why present arrangements exist. Their preservation is insufficient when future actors cannot interpret them. The re-epistemization problem developed in Section 19.3 applies here as well: stored records become useful historical knowledge only through institutions capable of reconstructing provenance, context, and relevance.

Proposition 19.58 (Historical-path condition). *Development and humanitarian analysis becomes more generatively adequate when present assistance design incorporates the historical pathways through which current needs, institutions, dependencies, expectations, and capacities were produced, especially where the proposed intervention will alter the starting conditions of future action.*

Historical sensitivity does not imply historical determinism. A path can constrain without uniquely determining the future. The purpose of reconstruction is to identify inherited capacities, liabilities, commitments, and possible points of revision so that intervention does not treat historically generated structures as natural or fixed.

19.5.8 Generative Assistance and Transition Capacity

The preceding dimensions can now be integrated into a concept of generative assistance. Immediate relief, resource transfer, infrastructure, institutional mediation, local relations, dependency, capability formation, participation, and history are analytically distinct but practically coupled. An intervention that performs well on one dimension can weaken another. Rapid delivery can bypass local institutions; participatory procedures can delay urgent action; local procurement can strengthen local economic relations while reducing access to scarce specialized goods; standardized systems can improve coordination while reducing contextual fit. Generative assistance therefore requires situated balancing rather than a fixed hierarchy of design

principles.

The temporal relation between humanitarian protection and development is central. Humanitarian practice may substitute for damaged capabilities, centralize logistics, or rely on external expertise in order to protect life under acute conditions. Development practice more often asks how capabilities, institutions, livelihoods, and public systems can be reproduced over time. In protracted crises, these temporalities coexist. Emergency provision can persist for years; displaced populations can develop new institutions; temporary digital or logistical systems can become durable infrastructures. The analytical task is to make these temporal layers explicit rather than assuming a clean transition from relief to development.

Transition capacity concerns the ability to change the mode of assistance without causing avoidable loss of protection or capability. A programme may need to move from direct external delivery toward public provision, local organizational control, market-based access, cooperative management, or another configuration. The appropriate direction varies by context. What matters is whether the functions currently being provided are identified, whether alternative providers have the necessary capability, whether financing and maintenance can continue, and whether affected persons retain decision standing during the transition.

Definition 19.59 (Generative assistance). *Generative assistance* is development or humanitarian support whose design and evolution address present needs while preserving or strengthening the situated capacities, relational infrastructures, institutional learning, decision standing, and transition pathways through which affected persons and institutions can generate, maintain, and revise future forms of collective action.

Definition 19.59 is compatible with temporary external substitution. An emergency field hospital can be generative even when it is fully externally operated if it protects life, records the functions being substituted, coordinates with surrounding institutions where feasible, and preserves viable pathways for later transition. Conversely, a programme labeled “capacity building” can be weakly generative if it provides training without roles, maintenance, finance, or decision authority through which capability can persist.

Generative assistance also requires attention to exit. Exit can mean programme closure, transfer to another institution, transition to ordinary public services, incorporation into local markets, merger with community governance, or continued long-term support under a more stable arrangement. Premature exit can destroy capabilities that have become dependent on the intervention. Indefinite continuation can also freeze an arrangement whose original rationale has disappeared. The relevant criterion is whether the assistance configuration remains appropriate to current conditions and whether change can occur without avoidable generative loss.

The distinction between substitution and regeneration helps organize this problem. *Substitution* supplies a function that affected persons or institutions cannot presently provide. *Regeneration* strengthens the relations and capacities through which that function, or a contextually appropriate successor, can later be generated. Both can be legitimate. Substitution is often indispensable in acute crisis; regeneration becomes increasingly important when duration lengthens or when the objective includes sustainable local capability. A well-designed assistance configuration can contain both simultaneously.

Generative assistance is also multi-scalar. Local capability can depend on national finance, regional infrastructure, international supply chains, transnational knowl-

edge, or global public goods. Localizing every function would therefore be neither feasible nor necessarily desirable. The stronger criterion is whether the scale at which a function is organized is compatible with accountability, reliability, access, and the capacity to adapt. Some capabilities should remain distributed across scales, provided their dependencies are visible and governable.

Proposition 19.60 (Generative-assistance condition). *An assistance configuration is more strongly generative when it can protect or improve present conditions while preserving the capacity to revise its own resource pathways, institutional mediation, dependencies, capability arrangements, participation structures, and scale of provision as historical conditions change.*

Proposition 19.60 makes revisability part of assistance quality. It does not imply that every intervention should maximize future option value at the expense of present welfare. In emergencies, some options can appropriately be closed to secure protection; in development, durable commitment can be necessary for infrastructure and institution building. The relevant question is whether such commitments remain proportionate to their objectives and whether the capacities required for later evaluation and revision are preserved.

The domain analysis also generates a remainder for GRE. Development and humanitarian practice reveal that generativity cannot be identified with local self-sufficiency, decentralization, or continuous participation. Acute protection can require external substitution and centralized coordination. Long-horizon development can require durable translocal dependencies. Participation can be constrained by urgency while remaining important for later correction. The framework therefore needs a temporally indexed account of assistance in which resource conversion, dependency, capability, participation, and institutional scale can legitimately change across phases.

The next section, *Welfare and Social Protection*, extends the analysis into welfare and social protection. That domain shares the concerns with transfer, access, capability, care, and participation developed here, yet differs in an important respect: social protection is often constituted as a continuing public or institutional entitlement rather than as externally bounded assistance. The distinction will allow Chapter 19 to compare temporary and recurrent support architectures without treating either as the universal model of economic security.

19.6 Welfare and Social Protection

Welfare and social protection provide a sixth substantive domain test of the translation discipline developed in Section 19.1. The domain shares with development and humanitarian practice the problems of transfer, access, care, capability, dependency, and participation developed in Section 19.5, yet its institutional architecture is often different. Social protection is commonly organized through continuing entitlements, contributory arrangements, tax-financed provision, public services, regulated insurance, care systems, or other recurrent institutions that remain in force across ordinary life rather than only during externally bounded programmes or acute crises. The role of the present section is therefore to examine how durable welfare institutions stabilize life conditions, mediate access to resources and services, organize care and dependency, and shape the capacity of persons and communities to participate in economic and social life over time. Its objectives are to distinguish income security

from wider capability security; to analyze entitlement and administrative access as relational processes; to integrate care and public services into the welfare architecture; to examine continuity, trust, and capability regeneration; and to identify conditions under which social protection can remain generative as demographic, technological, fiscal, labor-market, and ecological conditions change. The method is relational, institutional, and temporal. Welfare outcomes are interpreted through the relations that connect persons, households, public institutions, providers, infrastructures, legal statuses, financing arrangements, and histories of use.

The term *welfare* has several disciplinary meanings. In welfare economics it has often named an evaluative problem concerning economic well-being and the comparison or aggregation of outcomes, with major historical formulations extending from Pigou to the compensation-principle tradition and later critiques of narrow utility-based evaluation (Pigou 1920; Hicks 1939; Kaldor 1939; Sen 1985). The present section uses the term primarily in an institutional sense: the arrangements through which societies protect or support income, care, health, education, housing-related security, disability support, unemployment protection, pensions, family support, and other conditions of ordinary life. This institutional meaning does not settle the normative metric by which such arrangements should be judged. Capability, recognition, care, security, participation, and distribution can remain partially distinct evaluative objects.

A GRE analysis accordingly begins from the proposition that welfare provision is more than a transfer of money. Income can stabilize consumption and widen feasible action, but practical security also depends on whether a person can convert nominal entitlement into usable resources, reach services, maintain care relations, preserve housing and documentation, navigate administrative procedures, remain socially recognized, and recover or regenerate capabilities after interruption. Sen's capability approach is especially relevant because it distinguishes resources from the substantive opportunities that persons are actually able to realize and emphasizes the role of social and personal conversion conditions (Sen 1985; Sen 1992; Sen 1999; Robeyns 2005). GRE adds a historical and relational emphasis: the institutions that secure present capability also shape later dependency, trust, participation, administrative knowledge, and the range of futures available to households and public systems.

Table 19.6 summarizes the principal dimensions developed in this section. The table is diagnostic rather than a universal welfare ranking. Social-protection systems differ in legal form, fiscal capacity, demographic structure, household organization, labor-market institutions, political settlement, service infrastructure, and historical trajectory. The purpose is to prevent a single observable—such as transfer size, coverage rate, replacement ratio, expenditure, or service volume—from standing in for the whole protection relation.

Definition 19.61 (Social-protection configuration). A *social-protection configuration* is a historically situated arrangement of persons, households, public and private institutions, entitlements, financing mechanisms, care relations, services, administrative rules, infrastructures, and temporal commitments through which risks, dependencies, needs, and claims to security are recognized and acted upon.

Definition 19.61 treats the welfare state, social insurance scheme, pension system, disability-support arrangement, care system, or benefit programme as more than a payment mechanism. Protection is realized through a chain of relations. Eligibility must be defined; persons must become legible to the institution; claims must be sub-

Table 19.6: Diagnostic dimensions for generative analysis of welfare and social protection.

Protection dimension	Immediate observable	Long-horizon generative question
Income security	Benefit level, replacement rate, duration, regularity, eligibility	Whether income protection stabilizes feasible action across shocks without creating avoidable discontinuities or administrative traps
Entitlement and access	Legal eligibility, enrollment, documentation, take-up, appeals, payment and service channels	Whether nominal rights are practically reachable, intelligible, contestable, and portable across changing life conditions
Care and social reproduction	Care availability, caregiver time, paid and unpaid provision, respite, dependency support	Whether caring relations and dependency work can be sustained without systematically exhausting caregivers or excluding dependents
Public services	Health, education, housing, transport, childcare, digital and administrative infrastructure	Whether service systems provide durable capability infrastructure rather than episodic access alone
Relational continuity	Case continuity, provider stability, trust, administrative memory, handover, portability	Whether persons can remain protected across institutional transitions without repeated loss of history, recognition, or access
Capability protection	Prevention, recovery, rehabilitation, adaptation, learning, re-entry pathways	Whether protection preserves and regenerates substantive capabilities after unemployment, illness, disability, care interruption, displacement, or technological change
Participation and governance	Voice, representation, co-design, grievance, appeal, public reasoning	Whether affected persons can contest classifications and contribute to the revision of protection institutions
Generative social protection	Institutional learning, fiscal durability, adaptability, interoperability, transition capacity	Whether the protection order can reproduce and revise the relations through which future security and participation remain possible

mitted or activated; records must be interpreted; resources or services must reach the claimant; and the resulting support must be usable within the claimant's actual social and material environment. Failure at any point can separate formal provision from realized security.

19.6.1 Income Security and Temporal Stabilization

Income security is one of the most visible functions of social protection. Unemployment benefits, pensions, disability benefits, family allowances, sickness benefits, minimum-income schemes, and related transfers can stabilize consumption when earnings are absent, volatile, or insufficient. Their importance is partly temporal. A household facing an abrupt loss of income can be forced into debt, asset sales, housing loss, interrupted education, delayed medical care, or other changes whose

consequences persist after income later recovers. Protection can therefore alter trajectories by reducing the need for costly short-horizon responses.

The relevant object is wider than benefit amount. Timing, predictability, duration, indexation, conditionality, interaction with earnings, household composition, taxation, and the treatment of irregular income can all shape realized security. A transfer that arrives after a critical payment deadline can have a different effect from the same transfer delivered predictably before the deadline. A nominally adequate benefit can provide weak security when eligibility is frequently reassessed, payments are administratively unstable, or small earnings trigger abrupt withdrawal. Conversely, a lower transfer combined with secure housing, healthcare, childcare, and transport can support a wider effective capability set than cash alone.

Income security also interacts with market dependence. Polanyi's historical analysis emphasized that the institutional organization of market society changes the degree to which livelihoods are exposed to market participation and social dislocation (Polanyi 1944). GRE does not infer that protection should eliminate market relations. It asks how the balance among earnings, transfers, services, household support, community relations, and public provision affects the ability to act without catastrophic exposure to one failed relation.

Temporal stabilization is therefore analytically important. Social protection can preserve time for job search, caregiving, recovery, retraining, family reorganization, or migration decisions that would otherwise be compressed by immediate subsistence pressure. At the same time, poorly designed duration rules can create abrupt cliffs or repeated uncertainty. The generative question concerns the shape of the pathway through insecurity rather than the static level of resources at one date.

Proposition 19.62 (Income-stabilization condition). *Income protection is more strongly generative when its level, timing, duration, and interaction with other resources reduce destructive short-horizon adaptation while preserving viable pathways into later work, care, participation, recovery, or retirement appropriate to the claimant's circumstances.*

Proposition 19.62 does not imply that labor-market re-entry is the universal endpoint of income protection. Retirement, long-term disability, caregiving, education, or other life conditions can make continued wage employment irrelevant or inappropriate. The condition is broader: protection should stabilize substantive action without defining every recipient through an assumed return to paid work.

19.6.2 Entitlement, Access, and Administrative Reach

A legal entitlement becomes protective only when it can be reached and used. Social protection therefore has an administrative geography. Persons interact with offices, digital portals, identification systems, payment providers, medical assessors, schools, employers, insurers, courts, municipalities, caseworkers, family members, and other intermediaries. Each interface can enable or obstruct access. Distance, documentation, language, disability, digital literacy, unstable housing, migration status, caregiving obligations, or lack of institutional knowledge can make formally universal rules practically unequal.

This distinction parallels the capability approach's separation of resources from their conversion into substantive opportunity (Sen 1999; Robeyns 2005). In welfare institutions, conversion begins even before a benefit is received. A person must first

know that an entitlement exists, understand the relevant classification, satisfy or contest documentation requirements, complete procedures, and remain connected to payment or service channels. Administrative design is therefore part of distributive design.

Definition 19.63 (Entitlement–access pathway). An *entitlement–access pathway* is the sequence of legal, informational, documentary, administrative, infrastructural, and relational conditions through which a formal welfare claim becomes a practically usable transfer, service, protection, or recognized status.

The pathway concept makes several distinctions visible. *Eligibility* concerns whether rules recognize a claim. *Enrollment* concerns whether the claimant enters the system. *Take-up* concerns whether an eligible person actually receives or uses the provision. *Continuity* concerns whether access persists when circumstances change. *Contestability* concerns whether errors or disputed classifications can be challenged. These moments are related but not identical.

Administrative simplification can improve access, but simplification has tradeoffs. Automatic enrollment can reduce burdens while increasing dependence on data quality and institutional interoperability. Means testing can target scarce resources while creating reporting burdens and income volatility. Digital access can reduce travel while excluding persons with weak connectivity, limited devices, low literacy, or accessibility needs. Human casework can provide contextual interpretation while producing variation and discretion. GRE therefore treats administrative form as a design problem involving capability, legibility, discretion, privacy, error correction, and continuity.

Classification is especially consequential. Welfare systems categorize persons as unemployed, disabled, dependent, retired, eligible, resident, caregiver, student, low-income, or otherwise situated. Such categories can be necessary for administration, yet they also mediate recognition and access. A category can fit imperfectly, lag behind changing conditions, or create incentives to remain legible in a status that no longer captures the person's situation. Fraser and Honneth's debate over redistribution and recognition helps clarify why material provision and social standing can interact without collapsing into one evaluative dimension (Fraser and Honneth 2003).

Proposition 19.64 (Entitlement–reach condition). A *social-protection entitlement provides stronger practical protection when eligible persons can identify, activate, maintain, and contest the claim through administrative pathways whose informational, documentary, temporal, technological, and relational demands are proportionate to the protection at stake.*

This condition directs empirical attention toward the full pathway between rule and realized protection. A high statutory benefit can coexist with weak generative value when take-up is low, procedures are fragile, appeals are inaccessible, or transitions between statuses repeatedly interrupt support.

19.6.3 Care, Dependency, and Social Reproduction

Care places dependency at the center of welfare analysis. Infancy, illness, disability, aging, injury, pregnancy, recovery, and other conditions can create periods in which persons depend on others for bodily, emotional, practical, or administrative support. Dependency also extends to ordinary social reproduction: households and communities continually perform work that sustains persons across the life course. Kittay and

Fineman have emphasized that dependency is a normal feature of human life rather than an exceptional deviation from an otherwise autonomous subject, while feminist economics has shown how care and social reproduction are unequally distributed and often weakly represented in conventional economic accounts (Kittay 1999; Fineman 2004; Folbre 1994; Power 2004).

A welfare system therefore protects at least two positions: persons requiring care and persons providing it. These positions can overlap over a life course and sometimes simultaneously. Support focused only on the recipient can externalize costs to caregivers through unpaid time, foregone income, exhaustion, interrupted education, reduced retirement contributions, or constrained mobility. Support focused only on formal paid care can neglect relational continuity, family preference, community knowledge, or culturally specific forms of support. The analytical task is to represent the care configuration rather than assume one provider form.

Care is also relationally qualitative. Tronto and Held emphasize care as a practice and relation involving attentiveness, responsibility, responsiveness, and interdependence rather than a fungible service quantity alone (Tronto 1993; Held 2006). This does not imply that intimate care should remain unpaid or private. It means that hours of service cannot by themselves represent continuity, trust, knowledge of the person, emotional safety, or the capacity to respond to changing needs.

Paid care markets and public care systems add further relations. Wages, staffing ratios, scheduling, training, immigration rules, professional status, funding models, and organizational design can shape both care quality and caregiver sustainability. England's analysis of care work helps show why care can be systematically undervalued even when it is socially indispensable (England 2005). A generative welfare analysis asks whether the care system reproduces its own human and relational capacity or consumes it faster than it can be renewed.

Definition 19.65 (Relational protection). *Relational protection* is the preservation or regeneration of dependable caring, supportive, administrative, and social relations whose continuity is materially significant to a person's security, capability, or participation and whose value cannot be represented adequately by transfer volume alone.

Relational protection can be provided through families, public services, nonprofit organizations, cooperatives, community institutions, professional care systems, or mixed arrangements. The relevant criterion is neither privatization nor public provision by definition. It is whether the arrangement protects dependents and caregivers while keeping responsibility, resource requirements, continuity, and routes of revision visible.

Proposition 19.66 (Care-reproduction condition). *A social-protection system is more generatively adequate when its organization of dependency protects persons requiring care while also reproducing the time, income, capability, health, recognition, and relational continuity required by those who provide care.*

The proposition makes caregiver exhaustion an institutional outcome rather than a private remainder. It also prevents the existence of family care from being interpreted as evidence that public or collective support is unnecessary. Informal capacity can itself depend on income security, leave, respite, housing, transport, health services, and other forms of social provision.

19.6.4 Public Services and Capability Infrastructure

Cash transfers and insurance operate within a wider landscape of public and collectively organized services. Healthcare, education, childcare, housing support, transport, disability access, legal aid, employment services, digital connectivity, water, sanitation, and administrative infrastructure can function as capability-enabling systems. Their economic significance lies partly in the fact that individuals cannot readily reproduce them through isolated purchasing power, especially where network effects, professional specialization, high fixed costs, collective standards, or spatial coordination are involved.

Public services therefore alter the conversion of income into capability. A household with modest income but reliable healthcare, education, childcare, transport, and housing security can face a different feasible set from a household with higher income that must privately reconstruct each service under volatile prices and fragmented access. Sen's broader account of development as substantive freedom emphasizes the role of social opportunities and public institutions in shaping what people are effectively able to do (Sen 1999). GRE extends the point by treating service infrastructures as historically reproduced relational capacities.

The infrastructure perspective changes evaluation. Service volume is important, yet continuity, geographical reach, interoperability, maintenance, staffing, institutional memory, accessibility, and adaptability also matter. A hospital building without personnel, a digital portal without accessible authentication, a school without stable teaching capability, or a transport subsidy without usable routes can provide nominal resources while weakly expanding capability.

Public services also distribute dependence. Universal systems can pool risks and reduce household exposure to market prices, while centralized systems can create vulnerability to common failure. Decentralized provision can improve contextual responsiveness while producing territorial inequality. Mixed systems can widen provider choice while increasing coordination burdens. No single institutional form follows directly from GRE. The relevant inquiry concerns which dependencies are created, how visible they are, what backup relations exist, and whether users can obtain continuity when one provider or administrative channel fails.

Proposition 19.67 (Capability-infrastructure condition). *Public and collectively organized services provide stronger long-horizon protection when their financing, staffing, maintenance, accessibility, and interoperability preserve the capability-enabling functions on which persons depend across ordinary use, crisis, and institutional transition.*

This proposition shifts attention from service existence to service reproducibility. Deferred maintenance, workforce depletion, fragmented records, or unstable financing can leave current provision intact while weakening future capability infrastructure. Generative evaluation therefore includes the condition of the service system itself.

19.6.5 Relational Continuity and Institutional Trust

Social protection is frequently experienced through repeated relations rather than isolated transactions. A person with a chronic illness may interact with health providers, disability assessors, pharmacies, care workers, transport services, insurers, municipal offices, and family members over many years. A worker moving

between employment and unemployment may cross several benefit, tax, training, and pension institutions. Families can interact with childcare, schools, housing systems, and income-support agencies across successive life stages. Continuity across these relations can become a protection resource in its own right.

Relational continuity has several components. *Record continuity* concerns whether relevant history follows the person. *interpretive continuity* concerns whether institutions can understand the meaning of that history. *provider continuity* concerns whether recurring human or organizational relationships can persist where they matter. *status continuity* concerns whether entitlement changes are coordinated rather than creating gaps. *procedural continuity* concerns whether a person can predict how claims will be handled and where responsibility lies.

Continuity can reduce repeated administrative burden and prevent loss of knowledge. It can also create lock-in when a person becomes dependent on one provider, caseworker, locality, or classification. Protection therefore requires continuity with portability and contestability. A record should be able to move where appropriate; a person should be able to change provider or jurisdiction without losing essential history; and institutional memory should not become a mechanism for permanently fixing a contested interpretation of the person.

Trust is related but distinct. Repeated reliable treatment can make institutions more usable because persons become willing to disclose information, seek help early, comply with necessary procedures, or rely on future support. Repeated error, humiliation, opaque surveillance, arbitrary reassessment, or abrupt withdrawal can produce the opposite effect. Trust should not be treated as a demand for passive acceptance. A robust protection relation can include distrust, appeal, audit, and contestation while remaining institutionally reliable.

Administrative memory has a generative role here. Records can preserve prior decisions and reduce repeated proof, but preserved data require provenance, contextual interpretation, correction procedures, and limits on inappropriate reuse. The re-epistemization problem developed for knowledge institutions in Section 19.3 reappears inside welfare administration: stored information becomes protective knowledge only when institutions can reconstruct what it means, why it was collected, how reliable it is, and whether it remains relevant.

Proposition 19.68 (Continuity–portability condition). *Relational continuity contributes more strongly to social protection when relevant histories, entitlements, care relations, and service connections can persist across ordinary transitions while remaining portable, correctable, and contestable when the existing relation becomes inadequate.*

The proposition avoids equating continuity with institutional immobility. Protection can require stable relations, yet long-horizon security also requires the capacity to leave, transfer, revise, or recombine them without disproportionate loss.

19.6.6 Capability Protection and Regeneration

Social protection is often discussed as a buffer against loss. A generative perspective adds the question of what happens after protection has prevented immediate deterioration. Unemployment can erode skills, professional networks, confidence, and occupational identity. Illness can interrupt education or work routines. Disability can require new technologies, environments, or social arrangements. Care respon-

sibilities can alter time, mobility, and earnings for years. Housing loss can disrupt schooling, healthcare, employment, and community relations simultaneously. Protection therefore concerns both preservation and regeneration of capability.

Capability preservation aims to prevent avoidable erosion. Income support can keep housing and nutrition stable; health insurance can prevent treatable conditions from worsening; leave can preserve employment relations during care or illness; accessible transport can maintain participation. Capability regeneration concerns the rebuilding or reconfiguration of feasible action after conditions have changed. Rehabilitation, retraining, assistive technology, childcare, re-entry programmes, recognition of prior learning, debt restructuring, and adapted workplaces can all contribute when they fit the person's actual circumstances.

The distinction between achieved functioning and capability is important here (Sen 1992; Robeyns 2005). A programme can produce a target functioning in the short term while narrowing later options. Conversely, a person can temporarily reduce work or study while preserving the capacity to resume later. The relevant evaluation therefore cannot be limited to immediate activity levels.

Capability protection also depends on heterogeneity. Equal transfers can have unequal effects because persons face different health conditions, care responsibilities, spatial constraints, discrimination, accessibility requirements, or household relations. Nussbaum's work further emphasizes that capability-oriented political evaluation can require attention to thresholds below which central opportunities are seriously compromised (Nussbaum 2000). GRE does not adopt a universal list of capabilities for every domain, but it retains the methodological lesson that protection thresholds may be multidimensional and cannot always be inferred from income alone.

Regeneration can also be collective. A neighborhood childcare system, disability-access network, employment service, public-health capacity, mutual-aid institution, or social-insurance administration can lose capabilities during austerity, demographic change, disaster, or technological reorganization. Protecting individual capability while allowing the institutions that enable it to decay creates delayed vulnerability. Welfare analysis therefore needs both person-level and institutional capability accounts.

Proposition 19.69 (Capability-regeneration condition). *Social protection is more strongly generative when it prevents avoidable capability erosion and provides credible pathways for persons and enabling institutions to rebuild, adapt, or reconfigure capabilities after changes in health, work, care, technology, household structure, or other material conditions.*

The proposition allows different trajectories. Regeneration may mean return to an earlier activity, development of a new capability, adaptation of the environment, permanent support, or transfer of responsibility to a more appropriate institution. The analytical requirement is that protection does not equate recovery with restoration of one predefined prior state.

19.6.7 Participation and Welfare Governance

Welfare institutions classify needs, allocate resources, define evidence, determine eligibility, regulate providers, establish contribution rules, and decide how errors are corrected. These are governance functions. Participation matters because persons affected by the rules often possess information that centralized designers cannot fully

observe: the practical cost of documentation, the interaction of benefits, the effects of reassessment, local service gaps, care burdens, accessibility failures, or ways in which a category misrepresents lived conditions.

Participation can occur through elections, unions, beneficiary associations, disability organizations, pensioner organizations, parent groups, public consultation, service-user councils, grievance systems, administrative appeals, litigation, participatory budgeting, co-production, professional representation, or other institutions. These mechanisms do different work. Some aggregate preferences; some protect rights; some reveal implementation failures; some provide local knowledge; some enable direct governance. A generative analysis should therefore identify the function of participation rather than treat its presence as a binary variable.

Participation is also unevenly costly. Persons with severe illness, disability, unstable housing, care burdens, low income, limited language access, or precarious legal status may have the least time and capacity to participate precisely where institutional decisions matter most. Requiring extensive participation can therefore reproduce exclusion. Representation, accessible procedures, compensation for participation, advocacy support, delegated voice, and strong appeal rights can sometimes provide more realistic routes to decision standing than continuous direct involvement.

Recognition matters alongside distribution. A welfare institution can provide material resources while communicating stigma, distrust, or inferiority through its procedures. Conversely, respectful treatment cannot substitute for adequate material provision. The redistribution–recognition distinction is therefore useful as an analytical separation even where the two dimensions interact (Fraser and Honneth 2003). GRE adds a third concern: whether affected persons retain pathways to influence how the institution learns and changes.

Proposition 19.70 (Welfare-governance participation condition). *Participation contributes more strongly to generative social protection when affected persons have practicable routes to representation, explanation, contestation, and institutional learning at the points where classifications, service designs, or eligibility rules materially shape their security and capability.*

The condition does not require that every welfare decision be co-produced. Technical standards, fiscal constraints, emergency decisions, privacy duties, and conflicts among legitimate claims can require differentiated authority. The generative requirement is that institutional learning and correction do not depend solely on internal administrative signals.

19.6.8 Generative Social Protection

The preceding dimensions can now be integrated into a concept of generative social protection. Income security stabilizes time and feasible action. Entitlement pathways determine whether formal claims become usable protection. Care systems organize dependency and social reproduction. Public services provide shared capability infrastructure. Relational continuity preserves histories and connections across transitions. Capability protection limits erosion and supports adaptation. Participation creates channels through which institutions can learn from those affected by their classifications and procedures. These dimensions are coupled, and improvement in one can be offset by deterioration in another.

A welfare system can therefore be generous in expenditure while weak in gener-

ativity. High transfers can coexist with inaccessible administration, fragmented services, exhausted caregivers, unstable eligibility, or weak capability regeneration. A low-expenditure system can also appear fiscally efficient while shifting costs into unpaid care, household debt, deteriorating health, delayed maintenance, or exclusion from participation. Generative analysis does not provide a single optimal expenditure ratio. It asks whether the protection configuration reproduces the relations and infrastructures through which future security remains possible.

Definition 19.71 (Generative social protection). *Generative social protection* is a recurrent institutional arrangement that secures present life conditions while preserving or strengthening the income stability, accessible entitlements, caring relations, public-service infrastructures, capabilities, institutional trust, participation pathways, and adaptive capacities through which persons and communities can remain secure and consequential under changing conditions.

Definition 19.71 places recurrent welfare institutions inside the broader GRE concern with future-generating capacity. It does not imply that every protection instrument should directly generate new productive capability. Pensions can appropriately support retirement; disability benefits can appropriately secure life without requiring labor-market activation; care systems can protect dependency without treating independence as the universal objective. Generativity here concerns the continued capacity for valued life, relation, participation, and institutional adaptation, not a demand for economic productivity from recipients.

This distinction is important because social protection can otherwise become subordinated to labor-market activation. Employment can be one pathway to income, participation, social relation, and capability, yet Section 19.4 has already separated employment from contribution, membership, and participation. Welfare institutions should therefore be able to protect persons whose valuable activities occur outside paid work or whose conditions make paid work unavailable, inappropriate, or secondary.

Generative social protection also has an institutional reproduction problem. Long-lived systems require financing, administrative capability, professional workforces, data and payment infrastructures, political legitimacy, legal continuity, maintenance, and the capacity to revise rules as populations and risks change. Aging, migration, family transformation, automation, climate-related shocks, new forms of employment, and changes in disease burden can alter both contribution bases and protection needs. A durable system is therefore not one whose rules never change. It is one that can change without repeatedly exposing protected persons to avoidable insecurity.

Interdependence across generations is especially visible. Pensions, childcare, education, healthcare, disability support, and long-term care connect people occupying different life stages through taxation, contributions, unpaid care, public services, and institutional commitments. These relations can be politically contested because costs and benefits occur at different times and are represented through different institutions. A generative approach keeps both present claims and the reproduction of future provision visible without assuming that one generation's interest can be reduced to a single scalar balance.

The relation between universal and targeted provision also remains domain-specific. Universal arrangements can reduce classification burden, stigma, and gaps while requiring broad financing. Targeted arrangements can concentrate resources while creating more complex eligibility and administrative interfaces. Contributory

arrangements can link claims to work histories while excluding persons with interrupted or informal employment. Mixed systems can combine these logics. GRE does not infer a universal institutional form from generativity. It asks which combination of relations secures access, continuity, capability, recognition, and revisability under the relevant conditions.

Social protection also reveals a domain remainder for GRE. Dependency cannot be treated only as a relation to be reduced. Some dependencies are constitutive of secure life: persons depend on caregivers, public health, pension institutions, disability supports, transport systems, and administrative infrastructures. The analytical task is to distinguish supportive, revisable, and accountable dependencies from critical dependencies that expose persons to opaque control or catastrophic failure. Welfare analysis therefore strengthens the framework's distinction between dependency intensity and dependency quality.

A second remainder concerns maintenance. Generative language can overemphasize novelty if it is interpreted too narrowly. Welfare institutions show that maintaining a stable payment, preserving a care relation, keeping a clinic staffed, repairing a service infrastructure, or continuing a pension entitlement can itself be generatively important because continuity preserves the conditions from which later action remains possible. Generation and maintenance are therefore complementary temporal functions rather than competing categories.

Proposition 19.72 (Generative-social-protection condition). *A social-protection order exhibits stronger long-horizon generativity when it can secure present protection while reproducing and revising the entitlement pathways, care relations, capability infrastructures, institutional capacities, and participation mechanisms required to respond to changing risks without avoidable loss of continuity, dignity, or substantive freedom.*

Proposition 19.72 remains diagnostic rather than a complete normative ranking. Fiscal feasibility, intergenerational distribution, migration, household diversity, provider structure, political legitimacy, and competing public purposes require empirical and normative analysis within particular systems. The proposition identifies the relations that should remain visible when those judgments are made.

The transition to the next domain follows directly from this result. Welfare institutions protect persons partly through recurrent public and household arrangements, yet many forms of security and capability also depend on community organizations, associations, shared resources, informal cooperation, and commons governance whose boundaries are neither identical to the household nor reducible to the state or market. Section 19.7 therefore turns to *Communities and Commons*, where collective maintenance, membership, reciprocity, shared resources, and local governance become the principal analytical objects.

19.7 Communities and Commons

Communities and commons provide a seventh substantive domain test of the translation discipline developed in Section 19.1. The domain is analytically important because many resources, capacities, and forms of security are generated through relations that are neither adequately described as household provision, market exchange, firm organization, nor public entitlement. Neighborhood associations, irrigation systems, fisheries, forests, community facilities, cooperatives, mutual-aid arrangements,

open-source projects, shared knowledge repositories, cultural associations, and digitally mediated communities can organize access, maintenance, contribution, rule formation, and collective learning through heterogeneous institutional forms. The role of the present section is to examine how shared resources and community relations become governable, reproducible, and generative over time. Its objectives are to distinguish commons from open access and generic publicness; to analyze membership, reciprocity, trust, and collective rule formation as relational structures; to examine local circulation and stewardship capacity; and to identify conditions under which a community can reproduce shared resources together with the capabilities required to govern them. The method is relational, institutional, and historical. It treats community boundaries, resource characteristics, rights, obligations, reputational structures, maintenance practices, and rule-revision processes as empirical objects whose configuration varies across domains.

Commons scholarship provides an important starting point because it demonstrates that shared-resource governance can take forms more diverse than a simple opposition between privatization and centralized state control. Ostrom's comparative work on common-pool resources emphasized the empirical study of self-organized institutions, rule systems, monitoring, sanctions, conflict-resolution arrangements, and nested governance rather than assuming one universal institutional solution (Ostrom 1990; Ostrom 2005; Ostrom 2010). Schlager and Ostrom further distinguish bundles of rights and positions, showing that access, withdrawal, management, exclusion, and alienation can be distributed among different participants rather than residing in a single undifferentiated ownership relation (Schlager and Ostrom 1992). These insights fit closely with GRE's treatment of economic architecture as relationally differentiated and historically generated.

At the same time, *community* and *commons* should remain analytically distinct. A community can exist without governing a shared resource, and a commons can be governed by participants whose social relations are limited, conflictual, geographically dispersed, or technologically mediated. A shared resource can also be governed through public, private, cooperative, customary, hybrid, or polycentric arrangements. The present analysis therefore avoids treating community cohesion as a precondition of commons governance or commons governance as evidence of social harmony. The central object is the configuration through which participants, resources, rights, rules, maintenance practices, and histories become connected.

Table 19.7 summarizes the principal dimensions developed in this section. The table is diagnostic. It does not imply that every commons should maximize local closure, reciprocity, trust, or self-governance. Large-scale infrastructures, ecological systems, digital commons, knowledge resources, and translocal communities can require external expertise, public law, market interfaces, technical standards, or governance across several institutional levels. The relevant question is how these relations affect the reproduction of the shared resource and the collective capacity to revise its governance.

Definition 19.73 (Community–commons configuration). A *community–commons configuration* is a historically situated arrangement of participants, shared resources, membership relations, rights, obligations, rules, contribution practices, monitoring and maintenance capacities, external interfaces, and collective histories through which access, use, care, and revision are organized.

Definition 19.73 makes two analytical commitments. First, the community and the

Table 19.7: Diagnostic dimensions for generative analysis of communities and commons.

Community–commons dimension	Immediate observable	Long-horizon generative question
Shared-resource boundaries	Resource units, access conditions, users, spatial or digital boundaries, exclusion rules	Whether resource and participant boundaries are sufficiently legible for use, maintenance, accountability, and revision without erasing relevant external effects
Community membership	Membership criteria, roles, standing, entry, exit, representation, recognition	Whether membership relations support contribution and voice while remaining revisable as participants and conditions change
Reciprocal provision	Mutual aid, contribution, exchange, volunteering, time, gifts, shared labor	Whether reciprocal relations reproduce support without becoming opaque obligation, exclusion, or systematically unequal burden
Relational trust	Reputation, monitoring, reliability, repeated interaction, conflict history	Whether trust reduces coordination costs while remaining compatible with verification, contestation, and institutional learning
Collective rules	Rule formation, monitoring, sanctions, dispute resolution, nested governance	Whether rules correspond to resource conditions, remain intelligible to participants, and can be revised through legitimate processes
Local value circulation	Local exchange, reuse, maintenance, procurement, mutual provision, knowledge recirculation	Whether locally retained and recirculated value strengthens community capability without producing avoidable closure or exclusion
Stewardship capacity	Maintenance knowledge, monitoring, repair, ecological or technical competence, succession	Whether the community can reproduce the practical and institutional capabilities required to sustain the shared resource
Community generativity	Collective learning, rule revision, newcomer incorporation, resource regeneration, future option creation	Whether the community–commons configuration can reproduce shared resources and collective agency while adapting to changing conditions

resource are co-specified rather than assumed in advance: the relevant participants depend partly on who uses, maintains, depends upon, governs, or is affected by the resource. Second, governance is treated as an ongoing process. A commons can persist materially while its governing capability erodes, and a community can remain socially recognizable while losing the resource, infrastructure, or institutional memory that once sustained collective action.

19.7.1 Shared-Resource Boundary Architecture

Commons analysis begins with the object that is shared, yet the category of shared resource is heterogeneous. A pasture, groundwater basin, fishery, neighborhood garden, community hall, code repository, dataset, archive, language resource, or collectively maintained digital infrastructure differs in subtractability, replenishment, spatiality, replicability, congestion, exclusion cost, observability, and dependence on maintenance. Knowledge commons are especially instructive because copying a digital object can differ materially from withdrawing a fish or unit of irrigation water, while access, preservation, curation, enclosure, provenance, and institutional sustainability remain consequential (Hess and Ostrom 2007). GRE therefore treats resource properties as part of the relational configuration rather than assuming that the institutional logic of one commons can be transferred directly to another.

A second distinction concerns open access. A resource available to anyone without an effective rule system is not analytically equivalent to a commons governed through specified rights, responsibilities, and procedures. The influential tragedy model associates unrestricted appropriation from a finite shared resource with depletion under particular incentive conditions (Hardin 1968). Later institutional research shows that communities can sometimes construct durable rule systems that alter those conditions (Ostrom 1990). The relevant comparison therefore concerns specific resource and governance configurations, not a categorical opposition between shared ownership and private control.

Boundaries perform several functions. They can identify who may access a resource, who may withdraw from it, who carries maintenance obligations, whose actions are monitored, who can participate in rule revision, and which effects fall outside the governing group. Boundary clarity can support accountability, but boundaries can also exclude affected persons, newcomers, mobile populations, downstream users, future generations, or ecological systems that are weakly represented within the current membership. A boundary can therefore be operationally clear while normatively incomplete.

Resource boundaries can also change. Urban redevelopment can alter a neighborhood commons; climate change can shift ecological ranges; migration can transform membership; digital replication can expand access far beyond the founding community; commercialization can create new users; and technological infrastructure can relocate control to platform providers or maintainers. A generative account therefore treats boundaries as revisable institutional achievements rather than timeless facts.

Proposition 19.74 (Commons-boundary correspondence condition). *A shared-resource arrangement is more likely to remain generative when its resource boundaries, participant boundaries, rights, obligations, and external effects are specified with sufficient correspondence to the resource's actual ecological, technical, social, or informational conditions and remain revisable as those conditions change.*

Proposition 19.74 is a diagnostic condition rather than a prescription for closed membership. Some resources benefit from broad access, porous participation, or public guarantees. The proposition asks whether the governance boundary makes relevant relations visible enough for maintenance, responsibility, and revision.

19.7.2 Community Membership Relations

Community analysis requires a similarly careful treatment of membership. Membership can be based on residence, kinship, citizenship, profession, practice, shared identity, contribution, property, use, affiliation, technical participation, or self-identification. These bases can overlap, and their consequences can differ. A resident may be affected by a neighborhood decision without belonging to the association that makes it. A software contributor may have technical standing without legal ownership. A customary user may depend on a natural resource without formal title. A diaspora member may contribute resources while living outside the locality. Community membership is therefore better analyzed as a bundle of relations than as a binary status.

The relevant dimensions include access, contribution, voice, recognition, obligation, representation, protection, exit, and the ability to challenge rules. Different members can occupy different positions across these dimensions. Some may use a resource without participating in governance; others may carry maintenance responsibilities; some may hold historical authority; others may be newcomers whose practical dependence is high but whose standing is weak. Schlager and Ostrom's analysis of differentiated rights positions provides one institutional vocabulary for describing such variation (Schlager and Ostrom 1992).

Membership also has a temporal dimension. Communities reproduce themselves through entry, learning, socialization, succession, inheritance, migration, conversion of informal participants into recognized members, and sometimes the departure of members whose knowledge or labor had been central. The capacity to incorporate newcomers can be as important as the preservation of established relations. Excessively rigid boundaries can protect current coordination while narrowing future renewal; completely unstructured entry can make obligations and accountability difficult to sustain. The balance depends on the resource and community involved.

Recognition matters because formal membership alone may not generate practical standing. Informal hierarchies, language, gender, age, caste, class, expertise, digital literacy, or historical reputation can affect who is heard and whose contributions are legible. GRE therefore distinguishes membership from consequential participation. A community can formally include a person while structurally marginalizing that person's capacity to affect shared decisions.

Definition 19.75 (Community standing profile). A *community standing profile* is the differentiated set of access, contribution, voice, recognition, obligation, protection, representation, and exit relations through which a participant is positioned within a community-commons configuration.

Proposition 19.76 (Membership-renewal condition). *Community membership contributes more strongly to long-horizon generativity when entry, standing, contribution, voice, succession, and exit can be revised in ways that preserve institutional memory while allowing changing participants and dependencies to become consequential within governance.*

The condition does not imply equal authority in every decision. Technical competence, custodial responsibility, legal duty, and differentiated exposure can justify differentiated roles. The generative concern is whether role differentiation remains intelligible, contestable, and capable of renewal.

19.7.3 Reciprocal Provision within Communities

Communities often allocate resources and labor through reciprocal practices that differ from spot exchange and centralized redistribution. Reciprocal provision can include mutual aid, rotating care, shared repair, reciprocal access, gifting, volunteer labor, exchange of knowledge, emergency support, and expectations of future assistance. Polanyi treats reciprocity as one institutional pattern through which economic life can be organized, while Mauss's analysis of gifts emphasizes that giving, receiving, and reciprocating can be embedded in wider legal, moral, political, and status relations (Polanyi 1957; Mauss 1990). These traditions caution against interpreting reciprocal relations as informal versions of market exchange.

Reciprocity can lower coordination costs and expand available support where contracts are incomplete or formal provision is absent. It can also carry obligations whose distribution is difficult to observe. A household that repeatedly provides care may receive social recognition while bearing a persistent time burden. A volunteer may gain belonging while supplying labor that substitutes for underfunded public provision. A community may sustain members during crisis while expecting conformity or future service. GRE therefore analyzes reciprocity through both flow and position: what circulates, who contributes, who receives, how obligations accumulate, and how the relation affects future capability.

Reciprocity also need not be dyadic or immediate. Contributions can circulate through a group, across generations, or through institutions that preserve generalized expectations of mutual support. A person may contribute to a shared facility without receiving a direct equivalent return; later users may benefit from earlier maintenance; older members may transmit knowledge to newcomers; and current members may preserve ecological resources for future participants. Such arrangements are better represented as relational circulation than as balanced bilateral exchange.

The relevant diagnostic question is therefore whether reciprocal provision remains supportive and revisable. Reciprocity can strengthen belonging and collective capability when participants can contribute in heterogeneous forms, receive support when needed, and renegotiate expectations as capacities change. It can become extractive when obligations are opaque, socially coercive, unequally distributed, or difficult to exit.

Proposition 19.77 (Reciprocal-provision condition). *Reciprocal provision contributes more strongly to community generativity when contributions and support can circulate across heterogeneous forms and time horizons while burdens, expectations, and asymmetries remain sufficiently visible for recognition, renegotiation, and protection against persistent extraction.*

This proposition leaves room for asymmetry. A child, ill person, older adult, new member, or temporarily vulnerable household may appropriately receive substantially more than they provide at a particular time. Generative reciprocity concerns the sustainability and legitimacy of the relational arrangement, not equivalence in each exchange.

19.7.4 Relational Trust in Community Governance

Repeated interaction can generate expectations about reliability, contribution, rule compliance, competence, and care. Trust can therefore reduce the need to verify every action and make cooperation possible under incomplete information. Ostrom's behavioral account of collective action emphasizes the interaction among reciprocity, reputation, and trust in enabling cooperation under social-dilemma conditions (Ostrom 1998). Arrow similarly identifies trust and related social virtues as economically consequential where complete contracting is unavailable (Arrow 1972).

Trust is nevertheless more specific than generalized social harmony. A participant can trust another person's technical competence while distrusting their distributive judgment. Members can trust a maintenance committee to repair infrastructure while insisting on transparent accounts. A community can rely on a long-standing leader while retaining procedures for succession and challenge. GRE therefore treats trust as typed and relation-specific. The question is who trusts whom, regarding which action, under which information conditions, and with what possibilities for verification and correction.

High trust can be productive, but it can also obscure concentration of authority when verification practices weaken. Informal groups sometimes rely heavily on a small number of highly trusted participants who carry passwords, financial knowledge, institutional memory, or external relationships. Such arrangements can function efficiently until departure, conflict, illness, or misconduct reveals the absence of redundancy. Trust and resilience therefore need not move together.

Monitoring should likewise be understood relationally. Monitoring can express suspicion, but it can also distribute information, support learning, protect contributors from free-riding, and make rule revision evidence-based. Ostrom's empirical work emphasizes monitoring and graduated sanctions as features of many enduring common-pool-resource institutions (Ostrom 1990). The generative objective is not maximal surveillance. It is a proportionate information architecture that supports accountability without destroying the relations on which cooperation depends.

Definition 19.78 (Relational trust capacity). *Relational trust capacity* is the situated ability of participants to rely on one another or on community institutions for specified actions while retaining practicable means of verification, correction, succession, and learning when expectations fail.

Proposition 19.79 (Trust–verification complementarity condition). *Community trust contributes more strongly to durable collective action when relation-specific reliance is supported by proportionate verification, transparent responsibility, conflict-resolution pathways, and succession arrangements that allow cooperation to survive error, disagreement, and participant turnover.*

The proposition treats trust and verification as potentially complementary institutional capacities. Verification can preserve trust by localizing disagreement and distinguishing error from opportunism; trust can make verification less costly by reducing the need for constant control.

19.7.5 Collective Rule Formation for Commons

Shared resources require rules because access, use, contribution, maintenance, exclusion, conflict, and external effects rarely coordinate themselves. Rules may be formal

or customary, written or tacit, centrally legislated or locally generated, and they may operate at several levels simultaneously. Ostrom's institutional analysis emphasizes rules-in-use and the action situations through which participants interact, while polycentric governance highlights arrangements in which several decision centers operate with partial autonomy and mutual adjustment (Ostrom 2005; Ostrom 2010).

For GRE, the critical issue is the relation between rules and generative capacity. A rule can solve a present coordination problem while narrowing future adaptation. A fixed quota can preserve a resource under one ecological condition but become inappropriate after environmental change. A contribution requirement can distribute maintenance fairly among current users yet exclude people with limited time or mobility. A digital governance rule can protect code quality while concentrating authority in maintainers whose succession is weak. Rule quality therefore includes the capacity for justified revision.

Collective rule formation also depends on who can propose, interpret, monitor, enforce, and revise rules. Formal voting rights provide one form of participation, but practical agenda control can remain concentrated among persons with time, expertise, confidence, language access, or institutional memory. The community standing profile introduced in Definition 19.75 therefore interacts directly with governance.

Conflict is a normal feature of this domain. Participants can disagree about resource use, contribution burdens, membership, conservation, distribution, cultural meaning, or relations with external institutions. Conflict-resolution mechanisms can prevent disagreement from becoming institutional rupture when they provide accessible forums, credible procedures, and opportunities for learning. Their design is especially important where exit is costly because participants depend on the resource or locality.

Polycentric arrangements can provide additional adaptability. Local groups can govern operational details while municipalities, courts, federations, technical bodies, or ecological authorities provide wider coordination and safeguards. Such nesting can distribute knowledge and authority across scales. It can also create confusion when jurisdictions overlap or accountability is unclear. Polycentricity therefore requires empirical analysis of interfaces rather than an assumption that more centers of authority necessarily improve governance.

Proposition 19.80 (Rule-revision correspondence condition). *Collective rules support commons generativity when their content, monitoring, enforcement, conflict-resolution, and revision procedures remain sufficiently responsive to changing resource conditions, participant relations, external effects, and governance scales.*

Proposition 19.80 places institutional learning inside commons governance. Durable governance is compatible with stable rules, but stability is generative when it remains capable of warranted revision rather than depending on institutional immobility.

19.7.6 Local Value Circulation in Communities

Communities and commons generate forms of value that can circulate through local relations before, alongside, or beyond monetary exchange. Shared maintenance can preserve infrastructure; local procurement can retain income and knowledge; mutual aid can redistribute time and care; cultural activity can reproduce meaning and belonging; reuse and repair can extend material life; and community institutions can

recirculate surpluses into common facilities. These processes connect directly with Chapter 14's account of heterogeneous value generation, transmission, conversion, capture, return, dissipation, and regeneration.

Local circulation should not be romanticized as intrinsically superior to wider exchange. Communities may lack capital, expertise, scale, diversity, or resources that are available through external networks. Local procurement can strengthen capabilities in one setting and preserve inefficient or exclusionary arrangements in another. External trade can widen opportunity while also extracting value or increasing dependency. The analytical task is to trace how value moves across the boundary and what capabilities those flows reproduce.

A useful distinction concerns retention and recirculation. Value can be generated locally but captured elsewhere through ownership, debt, platform fees, rents, intellectual-property arrangements, or procurement structures. Conversely, externally generated value can enter a community and be converted into locally governed capability through investment, training, maintenance, or shared infrastructure. The spatial origin of value therefore does not determine its generative effect.

Community currencies, time banks, cooperative surpluses, mutual-credit systems, and informal reciprocal networks illustrate attempts to structure circulation through specific relational logics. Their significance depends on acceptance, convertibility, governance, accounting, participation, and interfaces with taxation, regulation, and wider monetary systems. GRE can analyze these arrangements without presuming that alternative media of exchange necessarily produce alternative power structures.

Knowledge provides another circulation mechanism. Repair practices, ecological knowledge, historical memory, caregiving techniques, software expertise, and organizational know-how can move through apprenticeship, documentation, storytelling, public archives, peer learning, or digital repositories. Such circulation is generative when it expands the number and diversity of persons able to maintain or revise common resources rather than concentrating indispensable knowledge in a few individuals.

Proposition 19.81 (Local-circulation regeneration condition). *Local value circulation contributes more strongly to community generativity when monetary, material, epistemic, social, and cultural flows reproduce shared capabilities, maintenance infrastructures, and participation pathways while preserving beneficial interfaces with wider economic and institutional networks.*

The condition focuses on regeneration rather than localization as an end in itself. A translocal network can be highly generative when knowledge and resources circulate back into local capability; a locally closed system can be fragile when it lacks redundancy or external learning.

19.7.7 Collective Stewardship Capacity

Commons persist through stewardship. Stewardship includes monitoring resource conditions, performing maintenance, resolving routine problems, retaining records, transmitting practical knowledge, coordinating labor, managing finances, negotiating external relationships, and adapting rules. These activities are often less visible than moments of allocation or conflict, yet they determine whether a resource remains usable across time.

The concept of stewardship capacity connects maintenance to collective capability. A community can possess a valuable resource while lacking the technical, institutional, financial, or relational capacity to care for it. A donated facility can deteriorate when repair knowledge is absent. A digital commons can depend on a few maintainers whose unpaid labor is unsustainable. A forest can be legally protected while local monitoring is weak. A cooperative can own assets while succession mechanisms fail. Asset possession and stewardship capacity are therefore distinct.

Stewardship also has a distributional structure. Maintenance work may fall disproportionately on persons whose contributions are weakly recognized: elders preserving institutional memory, women providing social coordination, volunteers performing administrative work, technically skilled contributors maintaining digital systems, or residents undertaking routine care of shared spaces. Section 19.4's distinction between contribution and recognition therefore applies directly. A commons can consume stewardship capacity faster than it regenerates it.

Succession is especially important. Collective capability weakens when practical knowledge, legitimacy, passwords, external contacts, or conflict histories remain concentrated in a small cohort. Documentation can support succession, but tacit knowledge often requires participation and apprenticeship. Communities therefore need both records and relational pathways through which newcomers can learn by contributing.

External support can strengthen stewardship when it supplies expertise, finance, legal recognition, insurance, data, or infrastructure that local participants cannot efficiently reproduce. It can also create critical dependency when the community loses the ability to diagnose needs, select providers, verify work, or continue operation after support ends. The dependency analysis developed in Sections 19.5 and 19.6 therefore extends into commons governance.

Definition 19.82 (Collective stewardship capacity). *Collective stewardship capacity* is the distributed practical, epistemic, institutional, financial, and relational ability through which a community can monitor, maintain, repair, regenerate, and revise a shared resource and its governance across participant and environmental change.

Proposition 19.83 (Stewardship-reproduction condition). *A commons becomes more robustly generative when the capabilities required for monitoring, maintenance, repair, coordination, governance, and succession are themselves reproduced across participants rather than remaining concentrated in irreplaceable persons or external providers.*

The proposition does not require universal competence. Specialized roles can be efficient and appropriate. The diagnostic issue is whether specialization remains connected to redundancy, succession, transparency, and the community's capacity to commission, evaluate, and replace specialized functions when necessary.

19.7.8 Community Generativity and Commons Reproduction

The preceding dimensions can now be integrated into a concept of community generativity. Shared-resource boundaries determine who and what enter the governance configuration. Membership relations distribute standing. Reciprocity organizes forms of mutual provision. Trust enables reliance under incomplete information. Rules coordinate use and provide mechanisms for revision. Local circulation shapes how value and knowledge are retained, converted, and returned. Stewardship ca-

capacity maintains both the resource and the competence required to govern it. These relations interact over time and can reinforce or undermine one another.

A community can be cohesive while weakly generative. Strong internal identity can coexist with exclusion of newcomers, concentration of authority, depleted resources, exhausted volunteers, or rules that cannot respond to changing conditions. A commons can also be well conserved while participation capacity contracts. Conversely, visible conflict does not necessarily indicate institutional failure when conflict is processed through legitimate procedures that generate learning and revised rules. Generativity therefore concerns the reproduction of collective action capacity, not the absence of disagreement.

The relevant temporal unit is longer than one successful cooperation episode. Communities encounter demographic turnover, ecological change, technological disruption, migration, commercialization, political intervention, infrastructure failure, and shifts in cultural meaning. A generative community can absorb some of these changes by revising membership relations, rules, resource practices, and external interfaces while preserving enough continuity for collective memory and responsibility to remain meaningful.

Commons-based peer production provides a useful extension beyond locality. Benkler's analysis of distributed peer production shows that large-scale productive collaboration can be coordinated through mechanisms that differ from both price-mediated markets and managerial hierarchy (Benkler 2002). Digital communities can therefore exhibit generative features without geographic proximity. Their shared resources, however, depend on technical infrastructure, licenses, repositories, maintainers, standards, and platform interfaces whose governance can become concentrated. The community-commons framework applies only when these concrete relations are specified.

The domain also produces a significant remainder for GRE. Collective capacity can exist at a level that is not reducible to the sum of individual capabilities. A group may collectively monitor a watershed, maintain a codebase, preserve a language archive, operate a mutual-aid network, or negotiate with external institutions even though no single member can perform the entire function. The relevant capacity emerges from role differentiation, communication, trust, shared memory, rules, and infrastructure. GRE should therefore preserve collective capacity as a relationally realized property of a configuration rather than translating it immediately into individual human capital.

A second remainder concerns commons reproduction itself. Generativity is sometimes described in terms of creating new possibilities, yet commons show that preserving a shared condition can be the activity that keeps possibility open. Maintaining soil fertility, repairing irrigation channels, sustaining an archive, updating software dependencies, preserving a communal space, or renewing a governance procedure can reproduce the substrate from which later innovation becomes possible. Maintenance, regeneration, and novelty therefore occupy different but interacting temporal positions within generative analysis.

Definition 19.84 (Community generativity). *Community generativity* is the historically situated capacity of a community-commons configuration to reproduce and revise shared resources, membership relations, cooperative practices, governance institutions, stewardship capabilities, and external interfaces in ways that preserve or enlarge the conditions for future collective action.

Proposition 19.85 (Community-generativity condition). *A community-commons configuration exhibits stronger long-horizon generativity when it can sustain shared resources while renewing membership, reciprocal support, trustworthy coordination, rule-revision capacity, value recirculation, stewardship competence, and practicable interfaces with wider institutions under changing conditions.*

Proposition 19.85 remains a framework for inquiry rather than a universal ranking of communities. Community closure can sometimes protect vulnerable practices; openness can sometimes expand learning and resilience; public intervention can either strengthen or weaken local governance; market exchange can create resources or intensify extraction; and digital infrastructure can widen participation while concentrating technical control. Empirical analysis must determine how these relations operate in a particular case.

The section also clarifies the relation between communities and the domains that follow. Community governance increasingly occurs through digital platforms that mediate communication, visibility, transactions, reputation, data, and access to shared infrastructures. Such platforms can enable community formation while simultaneously relocating coordination and gatekeeping power outside the community. Section 19.8 therefore turns to *Platforms and Digital Economies*, where mediation, attention, data, network structure, algorithmic coordination, and dependency become the principal analytical objects.

19.8 Platforms and Digital Economies

Platforms and digital economies provide an eighth substantive domain test of the translation discipline developed in Section 19.1. The domain is analytically important because digital platforms can organize transactions, communication, search, discovery, reputation, identity, payment, labor, content circulation, software distribution, and access to infrastructures through a shared technical and institutional interface. A platform can thereby occupy a position that is simultaneously economic, informational, infrastructural, and governmental. The role of the present section is to examine how such mediation redistributes visibility, data, coordination capacity, bargaining position, dependency, and the practical ability to participate in digital economic relations. Its objectives are to distinguish platform mediation from ordinary market exchange; to analyze attention and data as relationally generated economic objects; to specify network effects without treating scale as automatically beneficial; to examine gatekeeping and algorithmic coordination as institutional mechanisms; to differentiate several forms of platform dependency; and to identify conditions under which a platform ecosystem reproduces or contracts the generative capacities of its participants. The method is relational, institutional, and historical. It treats platform rules, technical interfaces, ranking systems, data practices, participant positions, interoperability, switching conditions, and governance arrangements as empirically variable components of a larger configuration.

Platform economics provides an important point of departure because platforms can coordinate participation across several sides whose decisions are interdependent. Rochet and Tirole's analysis of two-sided markets emphasizes cross-side effects and the significance of price structure for attracting and balancing participant groups (Rochet and Tirole 2003). Digital-economics research further shows how digital technolo-

gies can reduce search, replication, transportation, tracking, and verification costs, thereby altering the organization of economic activity (Goldfarb and Tucker 2019). Contemporary platform analysis adds a broader infrastructural perspective in which platforms provide hardware or software foundations for interaction while accumulating data and benefiting from network dynamics (Srnicsek 2016). GRE draws on these literatures while asking a distinct question: how does platform mediation change the distribution and regeneration of economic capabilities among the heterogeneous positions that depend upon the platform?

The category *platform* should remain analytically bounded. Not every digital service is a platform, and not every platform performs the same functions. Some platforms primarily match buyers and sellers; others coordinate labor, host applications, distribute media, mediate social connection, manage payments, provide cloud infrastructure, organize search, or combine several of these roles. A platform can also operate simultaneously as a market organizer, rule maker, data collector, ranking institution, technical infrastructure, and participant in the market it organizes. The relevant GRE object is therefore not a generic technology but the configuration through which participant positions become connected, observed, ranked, governed, and made economically consequential.

Table 19.8 summarizes the principal dimensions developed in this section. The table is diagnostic. It does not assume that platform scale, data accumulation, algorithmic coordination, interoperability, or decentralization is intrinsically desirable. Each feature can support some generative processes while constraining others. The analytical task is to identify which capabilities are created, who can exercise them, which dependencies become critical, which forms of exit remain practicable, and whether the platform ecosystem can revise its own coordination architecture without destroying the conditions for continued participation.

Definition 19.86 (Platform-mediated economic configuration). A *platform-mediated economic configuration* is a historically situated arrangement of participant positions, technical interfaces, rules, standards, data flows, ranking and matching mechanisms, payment or exchange pathways, governance procedures, complementary services, and external institutions through which economically consequential interaction is organized.

Definition 19.86 treats a platform as a relational configuration rather than a neutral container. Participants encounter different interfaces, permissions, risks, information, and dependence according to their position. A consumer, merchant, driver, developer, advertiser, moderator, creator, cloud customer, or third-party service provider can therefore inhabit different economic relations even when all are described as “users.” The configuration also extends beyond the platform firm itself because payment systems, app stores, identity providers, public regulation, telecommunications infrastructure, device ecosystems, and complementary businesses can condition the practical operation of the platform relation.

19.8.1 Platform Mediation Architecture

Platform mediation concerns the organization of relations among participants who might otherwise search, transact, communicate, coordinate, or establish trust through different institutional arrangements. A platform can reduce search and transaction frictions by standardizing interfaces, pooling information, verifying

Table 19.8: Diagnostic dimensions for generative analysis of platforms and digital economies.

Platform dimension	Immediate observable	Long-horizon generative question
Mediation architecture	Participant sides, interfaces, pricing, rules, technical standards, transaction pathways	Whether mediation expands coordination while preserving participant capacity to understand, contest, and reorganize the relation
Attention and visibility	Ranking, recommendation, search position, notifications, advertising exposure, discoverability	Whether scarce attention is allocated in ways that sustain plural discovery and participant orientation rather than producing opaque visibility dependence
Data relations	Collection, inference, storage, portability, access, recombination, model training, behavioral feedback	Whether data generation and reuse remain legible, appropriately governed, and capable of returning value or capability to the relations that generate them
Network structure	Same-side and cross-side effects, installed base, compatibility, complements, participation density	Whether network growth enlarges useful interaction without converting scale into irreversible participation dependence or exclusion
Gatekeeping	Admission, moderation, verification, app approval, API access, payment access, deplatforming, rule enforcement	Whether access control is predictable, proportionate, contestable, and compatible with viable routes of entry, correction, and appeal
Algorithmic coordination	Matching, pricing, recommendation, scheduling, moderation, evaluation, fraud detection	Whether computational coordination remains accountable, reviewable, and connected to institutional responsibility and participant learning
Platform dependency	Switching costs, reputation portability, data portability, identity, social graph, market access, technical lock-in	Whether dependence is visible, substitutable where appropriate, and compatible with practical exit, interoperability, and renegotiation
Platform generativity	Ecosystem innovation, complement creation, capability formation, participant entry, governance revision	Whether the platform reproduces an ecosystem in which participants can generate new activities and institutions rather than merely remain users of a fixed architecture

identity, processing payments, providing reputation signals, or coordinating logistics. These functions can make previously costly interactions feasible. Digital technologies can be especially consequential where the marginal cost of replication and transmission is low and where tracking or verification can be embedded in software (Goldfarb and Tucker 2019).

Mediation nevertheless does more than reduce friction. The platform chooses or implements categories through which participants become legible to one another. It can determine what counts as a product, a worker, a review, an eligible transaction, a violation, a successful completion, a relevant search result, or a monetizable inter-

action. Interface design therefore participates in economic ordering. A standardized listing format can expand comparability while suppressing qualities that do not fit the template. A reputation score can lower uncertainty while compressing heterogeneous histories into a scalar representation. A payment architecture can enable exchange while also defining settlement timing, fees, reversals, and access conditions.

Multi-sided platform analysis is useful because it emphasizes that the value of participation on one side can depend on participation on another (Rochet and Tirole 2003). GRE extends this point beyond price structure. Cross-side relations can also concern visibility, labor supply, creator audiences, software complements, moderation capacity, advertising demand, data generation, and institutional legitimacy. A platform can subsidize one participant group because that group increases value elsewhere in the ecosystem. The resulting distribution of monetary payment may therefore differ substantially from the distribution of generated value.

Mediation can also become constitutive rather than merely connective. When a platform provides the identity, reputation, discovery, transaction history, technical standards, and audience through which an activity becomes economically viable, leaving the platform can mean losing more than a sales channel. The participant may lose accumulated recognition, interoperable tools, relationships, learning, or access to a market that has itself reorganized around the platform. Platform mediation can thus alter the field in which alternatives exist.

Proposition 19.87 (Platform-mediation correspondence condition). *A platform-mediated configuration becomes more generatively enabling when reductions in coordination friction are accompanied by sufficient legibility of rules, participant positions, value flows, and revision procedures for affected participants to understand and adapt the relation.*

Proposition 19.87 does not require every participant to understand the platform's full technical stack. The relevant requirement is functional correspondence: participants should have enough access to the rules and consequences governing their position to plan, contest, learn, and revise their participation where those functions materially affect their economic trajectory.

19.8.2 Attention Allocation and Visibility

Digital platforms frequently operate in environments where informational supply is abundant relative to the attention available to receive it. Simon's formulation remains foundational: information abundance consumes scarce recipient attention (Simon 1971). On a platform, this scarcity becomes institutionalized through ranking, recommendation, search, subscription, notification, advertising, trending systems, and other mechanisms that allocate visibility among competing objects and participants.

Visibility is economically consequential because discoverability can affect sales, employment opportunities, reputation, political reach, collaboration, social connection, and access to later opportunities. Attention allocation therefore becomes an allocation of possible relations. A creator who is technically permitted to publish but practically undiscoverable occupies a different platform position from a creator repeatedly surfaced to relevant audiences. A merchant listed in a marketplace but systematically placed below sponsored or vertically integrated alternatives can face a similar distinction between formal access and effective reach.

Attention on platforms is also recursively generated. Visibility produces interaction; interaction can generate behavioral data; those data can influence future ranking; ranking can produce further visibility. This feedback can amplify early advantage, path dependence, or strategic adaptation. Participants may optimize titles, timing, format, pricing, posting frequency, or interaction style toward inferred ranking criteria. The platform thereby shapes not only who is seen but what kinds of activity are produced in anticipation of being seen.

The allocation problem is qualitative as well as quantitative. Sustained attention, deliberative attention, trust-based attention, curiosity, entertainment-oriented attention, and emergency attention have different generative consequences. A system that maximizes short interaction episodes can generate large measured engagement while weakening slower forms of discovery, verification, or community formation. GRE therefore treats attention metrics as representations of a wider orientation process rather than as complete measures of value.

Definition 19.88 (Platform visibility relation). A *platform visibility relation* is the position-specific relation through which a platform's ranking, recommendation, search, notification, advertising, or interface mechanisms affect the probability, timing, and context in which one participant, object, or activity becomes perceptible to another.

Proposition 19.89 (Visibility-generativity condition). *Attention allocation is more supportive of platform generativity when participants can achieve meaningful discoverability through plural pathways and when ranking dependence remains sufficiently legible and revisable to avoid converting visibility into an opaque single-channel bottleneck.*

Plural pathways do not imply equal visibility or random ranking. Relevance, quality, safety, user preference, and resource constraints can justify differentiation. The diagnostic issue is whether the architecture sustains meaningful possibilities for entry, discovery, experimentation, and correction across heterogeneous participants rather than allowing one opaque ranking relation to become the decisive condition of economic existence.

19.8.3 Data Generation and Relational Capture

Platforms generate and accumulate data through transactions, searches, clicks, locations, communications, ratings, content creation, device use, payment histories, social relations, operational processes, and inferred attributes. Large-scale digital data can increase the granularity and timeliness with which economic behavior is observed (Einav and Levin 2014). Data can support fraud detection, personalization, logistics, recommendation, pricing, scientific inquiry, public administration, product improvement, safety, and new services. The analytical problem is therefore wider than a simple opposition between data collection and privacy.

Data are frequently relationally generated. A review concerns a reviewer, an object, a transaction, a platform category, and a temporal context. A mobility trace can reflect a person's movement together with device infrastructure, mapping systems, transport networks, and platform prompts. A purchase history records a relation among buyer, seller, product classification, payment system, and platform architecture. Treating such data as if they originated entirely from one isolated individual or entirely from the platform can obscure the relational conditions of their production.

Relational generation does not by itself settle ownership, privacy, access, or compensation. It instead identifies the questions that require institutional specification. Who can access the record? Who can combine it with other data? Which inferences may be drawn? Which uses remain within the context in which the data were generated? Nissenbaum's contextual-integrity framework is relevant because it evaluates information flows through actors, information types, contexts, and transmission principles rather than through secrecy alone (Nissenbaum 2010). GRE retains the broader lesson that technically possible reuse can transform the relation under which information was originally generated.

Data accumulation can also produce asymmetric learning. The platform may observe aggregate behavior across many participants while any individual participant sees only a narrow local history. This asymmetry can improve system coordination while also concentrating strategic knowledge. A marketplace may infer demand elasticity across categories; a labor platform may estimate supply responsiveness; an advertising platform may learn audience behavior; a cloud provider may observe changing service demand. The economic significance of data therefore includes not only the data object but also the capability to combine, interpret, and operationalize it.

Definition 19.90 (Relational data capture). *Relational data capture* is the process through which information generated through platform-mediated interactions becomes selectively recorded, classified, retained, combined, inferred upon, and made available for subsequent economic or institutional use.

Proposition 19.91 (Data-return correspondence condition). *Relational data capture becomes more generatively balanced when material data uses are sufficiently legible and governed, and when the capabilities generated through data accumulation can return to participating relations through improved services, portability, access, learning, accountability, or other context-appropriate forms rather than remaining exclusively concentrated at the capture interface.*

The proposition does not establish a universal entitlement to raw data, model parameters, or equal economic returns. Security, privacy, trade secrecy, collective rights, and legitimate organizational specialization can limit disclosure. The principle concerns correspondence between relational generation and the distribution of capabilities enabled by that generation.

19.8.4 Network Effects and Participation Structure

Network effects arise when the value or usefulness of a system depends partly on the number or composition of other participants. Systems competition research shows how compatibility and installed bases can influence adoption and competition when network effects are present (Katz and Shapiro 1994). Platform settings can contain same-side effects, cross-side effects, congestion, complement effects, reputational effects, and negative externalities simultaneously. A larger network can therefore increase value for some participant positions while reducing it for others.

Network growth can generate substantial economic possibilities. More buyers can attract sellers; more developers can enlarge a software ecosystem; more participants can improve matching; more contributors can enrich a knowledge resource; more users can support specialized communities that would be unsustainable at smaller scale. These effects can make platforms generative by enabling interactions that were previously too sparse or costly.

The same dynamics can produce path dependence. Participants may join because others have joined, complementary investments may become platform-specific, and external institutions may adapt to the dominant standard. Once a network becomes central to social or economic coordination, alternatives can face a bootstrap problem: an entrant requires participants to become valuable, yet participants hesitate to join until the entrant is already valuable. The issue is therefore not size alone but the relation among network value, compatibility, switching, multihoming, and interoperability.

Network effects can also change the meaning of exclusion. Being excluded from a small optional service differs from being excluded from a platform that has become a dominant route to employment, customers, software distribution, social communication, or professional visibility. As a platform becomes infrastructural, access decisions can acquire consequences beyond ordinary firm–customer relations. This does not automatically transform a private platform into a public institution, but it does change the analytical importance of its participation architecture.

Proposition 19.92 (Network-participation condition). *Network effects are more compatible with long-horizon generativity when scale enlarges useful relations without making participation in one platform architecture the uniquely practicable route to essential complementary capabilities, audiences, or economic opportunities.*

The condition can be supported through several institutional forms, including interoperability, data portability, multihoming, open standards, public alternatives, competitive entry, federated structures, or contractual safeguards. Their adequacy depends on the domain. GRE therefore treats network structure as an empirical configuration rather than prescribing one universal institutional solution.

19.8.5 Gatekeeping and Access Control

Platforms govern entry and continued participation through terms of service, identity verification, content rules, payment policies, app review, merchant standards, developer permissions, moderation, security controls, reputation thresholds, technical requirements, and contractual access to interfaces. These mechanisms can protect users, maintain quality, reduce fraud, preserve system integrity, or satisfy legal obligations. They can also determine who is able to reach a market, audience, infrastructure, or community.

Gatekeeping should therefore be disaggregated. Admission gatekeeping determines who may enter. Functional gatekeeping determines what an admitted participant may do. Visibility gatekeeping affects discoverability. Transactional gatekeeping controls payment or settlement. Technical gatekeeping governs APIs, standards, interoperability, or device access. Governance gatekeeping affects who may contest rules or participate in their revision. A participant can be formally admitted while being constrained at several of these other layers.

The asymmetry is especially consequential where rules change frequently or where enforcement is difficult to contest. Platforms often need discretion because abuse evolves and ex ante rules cannot anticipate every case. Yet discretionary enforcement can create uncertainty when livelihoods, communities, archives, or reputations depend upon continued access. A generative analysis therefore asks whether enforcement is proportionate to the stakes, whether reasons are intelligible where disclosure is compatible with security, and whether correction or appeal

mechanisms exist for consequential errors.

Gatekeeping can also occur indirectly through technical design. An application may be technically compatible but commercially impracticable because of fees; a seller may retain an account but lose access to a critical advertising format; a developer may retain API access under terms that make its business model unsustainable. Access analysis should therefore include effective capability, not only nominal permission.

Definition 19.93 (Platform gatekeeping position). *A platform gatekeeping position is a relational position from which an actor or automated process can materially condition another participant's entry, visibility, functionality, transaction capacity, technical interoperability, or continued participation in a platform-mediated economic configuration.*

Proposition 19.94 (Gatekeeping-contestability condition). *Platform gatekeeping is more compatible with generative participation when consequential access decisions are governed through sufficiently intelligible criteria, proportionate procedures, correction pathways, and context-appropriate forms of contestation or external review.*

This condition does not imply that every moderation, fraud, security, or ranking decision requires individualized adjudication. Procedural intensity can vary with scale, urgency, reversibility, and stakes. The principle concerns correspondence between the consequence of gatekeeping and the institutional capacity to detect and correct consequential error or abuse.

19.8.6 Algorithmic Coordination and Rule Execution

Digital platforms frequently coordinate activity through computational systems that match, rank, recommend, price, schedule, detect fraud, moderate content, evaluate performance, allocate tasks, or trigger sanctions. Such systems can process volumes and speeds of interaction that would be difficult to coordinate manually. They can also produce more consistent execution of some rules. The economic significance lies in the fact that algorithmic coordination is often woven directly into the operational architecture through which participants act.

Algorithmic systems nevertheless do not eliminate institutional judgment. Choices concerning objectives, training data, features, loss functions, thresholds, exception handling, appeals, monitoring, and update procedures remain institutionally consequential even when individual decisions are automated. Burrell's differentiated account of opacity is useful here because secrecy, technical-literacy barriers, and opacity arising from model complexity are distinct problems (Burrell 2016). A platform can therefore disclose that an algorithm is used while leaving participants unable to understand which aspects of their conduct materially affect outcomes.

Algorithmic coordination can also generate behavioral adaptation. Workers may reorganize activity around predicted performance metrics; sellers may adapt listings to recommendation systems; creators may adjust content to engagement signals; drivers may respond to dynamic pricing; users may alter communication to moderation systems. Kellogg, Valentine, and Christin show how algorithmic systems can become mechanisms of organizational control in work settings (Kellogg et al. 2020). In platform economies, similar mechanisms can extend across organizational boundaries to participants who are formally independent but operationally coordinated through the platform.

Accountability therefore concerns more than explaining one output. It includes identifying responsibility for system objectives, monitoring distributional effects, maintaining records of material changes, providing review where stakes justify it, and retaining institutional capacity to intervene when automated coordination produces systematic harm. Work on accountable algorithms emphasizes the need for technical and institutional mechanisms that can make computationally mediated decisions subject to meaningful scrutiny (Kroll et al. 2017).

Definition 19.95 (Algorithmic coordination regime). An *algorithmic coordination regime* is the combination of computational models, data inputs, objective functions, thresholds, update procedures, interface rules, human oversight, exception processes, and accountability institutions through which platform-mediated actions are ordered or evaluated.

Proposition 19.96 (Algorithmic-revisability condition). *Algorithmic coordination is more compatible with platform generativity when material automated rules remain monitorable, institutionally attributable, and revisable in response to error, strategic adaptation, distributional change, or transformed platform conditions.*

Revisability does not require exposing security-sensitive code or making every model interpretable in the same way. It requires that the platform retain practical capacity to diagnose consequential failures and alter the coordination regime rather than treating algorithmic outputs as self-authorizing facts.

19.8.7 Platform Dependency and Exit Capacity

Platform participation can generate several forms of dependency. Economic dependency arises when a large share of income, customers, or suppliers is accessible through one platform. Social dependency arises when relationships or communities are concentrated there. Reputational dependency occurs when accumulated ratings or histories are difficult to transfer. Data dependency arises when records, analytics, or models are platform-specific. Technical dependency can arise from proprietary standards, APIs, software environments, or complementary investments. Identity dependency can emerge where authentication or account status is used across multiple services. These dependencies can overlap and reinforce one another.

Dependency is not intrinsically undesirable. Stable infrastructure can enable investment precisely because participants can rely on it. A software developer may build efficiently on a platform API; a seller may benefit from a trusted marketplace; a worker may prefer a platform that reliably matches demand; a community may depend on communication infrastructure. The generative issue is whether dependency remains visible, governable, and revisable, especially when the dependent participant cannot readily reproduce the relation elsewhere.

Exit is therefore more complex than account deletion. A participant may technically be free to leave while losing reputation, customer relationships, transaction history, social graph, purchased complements, learned workflows, or data required to continue the activity. Portability can reduce some switching costs, but data portability alone may be insufficient when the receiving ecosystem lacks compatible participants, standards, reputation mechanisms, or complementary services. Interoperability and multihoming can matter because they preserve relations across boundaries rather than merely transferring static records.

Dependency also changes through time. Early-stage participants may voluntarily

accept platform-specific investment because expected returns are high. Later rule changes can alter the value of that investment after alternatives have weakened. A historical analysis should therefore track how dependency was generated, which commitments became irreversible, how rule-making power changed, and whether new exit or renegotiation mechanisms developed alongside increasing reliance.

Definition 19.97 (Platform dependency profile). *A platform dependency profile is the position-specific configuration of economic, social, reputational, informational, technical, identity, and infrastructural dependencies through which continued participation in a platform conditions an actor's present activity and future alternatives.*

Proposition 19.98 (Exit-capacity condition). *Platform dependency becomes less generatively constraining when participants retain practicable combinations of portability, interoperability, multihoming, substitution, renegotiation, or institutional protection sufficient to preserve meaningful alternatives under material rule or access changes.*

Meaningful exit does not imply costless exit. Long-term relationships and specialized infrastructures often create legitimate switching costs. The relevant distinction is between costs arising from productive specialization and dependency that becomes critical because alternatives, records, relationships, or essential capabilities are institutionally blocked from movement.

19.8.8 Platform Generativity and Ecosystem Reproduction

The preceding dimensions can now be integrated into an account of platform generativity. Platform mediation can lower coordination costs and make new interactions possible. Attention allocation determines which possibilities become visible. Data capture can support learning and adaptation while concentrating information. Network effects can enlarge useful interaction while producing path dependence. Gate-keeping protects and structures participation while controlling access. Algorithmic coordination can increase operational capacity while embedding rule execution in computational systems. Dependency can stabilize investment while narrowing future alternatives. These mechanisms form an ecosystem whose long-horizon effects cannot be inferred from platform growth or current user numbers alone.

Platforms can be strongly generative. They can enable new businesses, creator communities, distributed work, software ecosystems, scientific collaboration, mutual aid, educational access, financial participation, cultural production, and forms of coordination that would otherwise be infeasible. Complementors can create innovations the platform operator did not design. Participants can discover one another, combine capabilities, establish reputation, and reuse shared infrastructures. Network scale can sustain specialized activities whose audiences or counterparties are geographically dispersed.

Generativity can nevertheless become asymmetric. The platform may retain broad capability to observe, redesign, price, rank, and recombine activity while complementors become increasingly specialized to its architecture. Participants can generate value, data, social relations, content, software, or reputation whose continuation depends upon access controlled elsewhere. Platform growth can therefore coexist with declining generative autonomy among some participant groups. The relevant GRE question is how ecosystem-level generativity is distributed and regenerated.

A platform ecosystem also has to reproduce its own institutional capability. Rapid growth can outpace moderation, dispute resolution, security, privacy protection,

developer support, public accountability, or internal learning. Technical reliability alone is insufficient where the platform has become a consequential coordinator of economic and social relations. Governance capacity, historical memory, monitoring, appeals, succession, standards revision, and external institutional interfaces become part of platform reproduction.

The domain produces a significant remainder for GRE concerning the relation between infrastructure and rule-making. In many conventional economic settings, infrastructure and governance can be analytically separated with relative ease. Platform architectures often merge them: the interface through which an interaction occurs can itself execute the rule governing that interaction. A ranking system can simultaneously provide information and allocate visibility; an API can simultaneously enable innovation and delimit permissible innovation; a payment interface can simultaneously facilitate exchange and enforce exclusion. GRE should therefore preserve the analytical category of *executable institutional architecture*: rules can be materially embedded in technical systems without becoming merely technical facts.

A second remainder concerns scale. Scale can increase generativity through matching density, complement diversity, shared infrastructure, and lower average cost. It can also concentrate gatekeeping and create dependence. Scale should therefore be treated as a relational amplifier whose effect depends on governance, interoperability, value circulation, and the distribution of capability across participant positions.

Definition 19.99 (Platform generativity). *Platform generativity* is the historically situated capacity of a platform-mediated economic configuration to enable participants and complementors to generate, combine, and revise economic activities, relations, capabilities, and institutions while reproducing the technical and governance capacities required for continued ecosystem participation and adaptation.

Proposition 19.100 (Platform-generativity condition). *A platform ecosystem exhibits stronger long-horizon generativity when mediation, visibility, data use, network structure, gatekeeping, algorithmic coordination, and dependency are organized so that ecosystem growth reproduces participant capabilities, plural entry pathways, revisable governance, and practicable alternatives rather than concentrating the capacity to generate future relations exclusively at the platform interface.*

Proposition 19.100 is a diagnostic proposition rather than a claim that one ownership form, business model, or regulatory architecture is universally preferable. Open protocols can generate coordination problems; integrated platforms can reduce fragmentation; centralized moderation can protect vulnerable participants; decentralization can redistribute both agency and risk; interoperability can expand alternatives while creating security or privacy challenges. Domain analysis must identify the specific mechanisms through which these institutional forms affect participant capabilities and future options.

The section also clarifies the relation between platform economies and the public-institutional domain that follows. Platforms increasingly mediate access to communication, payment, mobility, employment, information, and other activities with public significance, while public institutions themselves increasingly depend on digital infrastructures, identity systems, cloud services, data architectures, and algorithmic tools. The analytical boundary between private coordination and public infrastructure can therefore become consequential without disappearing. Section 19.9 turns to *Public Institutions and Infrastructure*, where public mandates, access, institutional capacity, learning, trust, and adaptive governance become the principal objects of

analysis.

19.9 Public Institutions and Infrastructure

Public institutions and infrastructure provide a ninth substantive domain test of the translation discipline developed in Section 19.1. The domain is analytically distinctive because public institutions combine authorized purposes, coercive and allocative powers, service obligations, infrastructures, administrative procedures, records, professional roles, and accountability relations that are not adequately described by ordinary exchange or organizational membership alone. Roads, water systems, schools, hospitals, courts, registries, payment systems, statistical systems, emergency services, digital identity arrangements, regulatory bodies, and administrative agencies can each become part of the relational conditions through which economic participation is made possible. The role of the present section is to examine these arrangements as public relational infrastructure. Its objectives are to specify the architecture of public mandates; distinguish infrastructure from isolated assets; analyze administrative access pathways; decompose public institutional capacity; develop institutional learning as a recursive capability; treat public trust as a typed and revisable relation; specify adaptive governance without equating adaptation with unconstrained flexibility; and identify conditions under which public institutions enlarge rather than contract long-horizon generative possibilities. The method is relational, institutional, and historical. It treats mandates, service relations, material and digital infrastructures, professional capabilities, administrative classifications, data systems, maintenance practices, review procedures, and accountability arrangements as components of a changing public configuration.

Institutional economics provides one point of departure because institutions structure interaction through rules, incentives, and expectations that develop historically (North 1990). Institutional analysis also emphasizes that rules operate through action situations involving participants, positions, information, community attributes, and patterns of interaction rather than through formal texts alone (Ostrom 2005). Public-governance research adds a practical concern with monitoring, evidence, evaluation, implementation feedback, and the capacity to revise policy during and after implementation (OECD 2020c; OECD 2020b). GRE draws on these traditions while asking a further question: what public relations and infrastructures must be maintained, regenerated, and revised so that heterogeneous subjects retain practical capacities to act, participate, contest, and generate future arrangements?

The category *public institution* should remain bounded. A public institution is not simply any organization that produces a socially useful output, and public infrastructure is not limited to publicly owned physical capital. Public functions can be delivered through ministries, municipalities, public corporations, courts, schools, hospitals, regulated utilities, contracted organizations, digital systems, professional bodies, or hybrid arrangements. Ownership, financing, mandate, operation, and accountability can therefore be distributed across different actors. The relevant GRE object is the public configuration through which authority, obligation, access, infrastructure, information, maintenance, and revision become connected.

Table 19.9 summarizes the principal dimensions developed in this section. The table is diagnostic rather than prescriptive. Centralization, decentralization, digiti-

Table 19.9: Diagnostic dimensions for generative analysis of public institutions and infrastructure.

Public dimension	Immediate observable	Long-horizon generative question
Mandate architecture	Statutory purpose, delegated powers, duties, beneficiaries, constraints, accountability channels	Whether authority remains connected to intelligible purposes, bounded responsibility, and revisable public justification
Relational infrastructure	Physical systems, digital systems, administrative processes, records, standards, maintenance, interoperability	Whether infrastructure sustains repeated public relations and remains maintainable, repairable, and adaptable across institutional change
Administrative access	Eligibility, documentation, geography, language, interfaces, waiting time, digital access, appeal	Whether formal public provision becomes practically reachable across heterogeneous positions and life conditions
Public capacity	Personnel, expertise, fiscal resources, information, procurement, coordination, legal authority, maintenance capability	Whether public capability can be reproduced, transferred, and mobilized rather than temporarily assembled and subsequently lost
Institutional learning	Monitoring, data, evaluation, feedback, review, memory, experimentation, revision routines	Whether evidence can alter models, practices, resource allocation, and rules while preserving records of failure and uncertainty
Public trust	Reliability, procedural fairness, competence, transparency, contestability, respectful treatment, expectation of continuity	Whether trust is grounded in observable trustworthiness and compatible with scrutiny, disagreement, and correction
Adaptive governance	Revision triggers, delegated discretion, emergency procedures, experimentation, review, reversibility, legal safeguards	Whether institutions can respond to changing conditions without converting flexibility into opaque discretion or unstable commitments
Public generativity	Maintenance, capability reproduction, institutional renewal, infrastructure investment, future-option preservation	Whether public arrangements enlarge the capacity of later participants to maintain, revise, and create viable collective possibilities

zation, outsourcing, standardization, discretion, and institutional stability can each support some public purposes while impairing others. The analytical task is to identify which public capabilities are required, whose access depends on them, how failures propagate, where accountability is located, and whether the institutional configuration can learn and change without repeatedly destroying the continuity on which public life depends.

Definition 19.101 (Public institutional configuration). *A public institutional configuration is a historically situated arrangement of mandates, authorized powers, obligations, organizations, infrastructures, administrative procedures, professional roles, data and record systems, fiscal resources, service relations, and accountability pathways through which public purposes are interpreted and enacted.*

Definition 19.101 keeps the unit of analysis wider than a single agency. A transport authority can depend on tax rules, procurement systems, engineering professions, land-use institutions, data infrastructure, courts, contractors, standards bodies, and municipal coordination. A health service can depend on professional training, supply chains, records, licensing, public finance, digital systems, laboratories, and local care networks. Public capacity can therefore be distributed even when responsibility appears concentrated in one named institution.

19.9.1 Public Mandate Architecture

Public mandates define authorized fields of action and responsibility. They can specify purposes, duties, powers, beneficiaries, territorial scope, procedural constraints, reporting obligations, and relationships to other institutions. A mandate can arise through constitutions, statutes, regulation, delegated authority, judicial interpretation, administrative practice, or combinations of these sources. Its economic significance lies partly in the fact that it stabilizes expectations concerning who may act, who must provide, who can compel, who can appeal, and which resources can be mobilized for public purposes.

Mandates are rarely reducible to one objective. A public transport institution can be expected to provide mobility, safety, accessibility, fiscal discipline, geographic coverage, environmental compatibility, and continuity during disruption. A public university can face educational, research, access, workforce, regional, cultural, and public-service expectations. A regulator can be asked to support competition, safety, innovation, consumer protection, systemic resilience, and procedural fairness. The analytical problem is therefore not simply whether an institution follows its mandate, but how plural purposes are interpreted when they cannot be maximized simultaneously.

A mandate also allocates responsibility. Authority without responsibility can create a gap in which decisions materially alter feasible action while accountability remains diffuse. Responsibility without corresponding authority or resources can generate a different gap: an institution is publicly charged with an outcome while lacking the powers, information, personnel, or infrastructure needed to affect it. GRE therefore treats mandate, authority, capability, and accountability as related but distinct dimensions.

Proposition 19.102 (Mandate–responsibility condition). *A public mandate contributes to generative institutional order only to the extent that authorized purposes, decision powers, resource capacities, affected positions, and accountability pathways can be related with sufficient clarity to support action, review, and revision.*

Proposition 19.102 does not require that every public action have one uniquely identifiable decision maker. Complex systems often require distributed responsibility. It requires instead that distribution itself remain legible enough for affected subjects, professionals, oversight bodies, and collaborating institutions to understand where decisions can be made, challenged, corrected, or escalated.

Mandate architecture also has a temporal dimension. Public institutions inherit obligations and infrastructures from earlier periods while operating under changing demographic, technological, ecological, fiscal, and social conditions. A mandate written for one institutional environment may acquire new implications when digital systems mediate access, private contractors operate critical services, or new dependencies appear. Revision is therefore part of mandate architecture. Stable public purpose can coexist with changing means, categories, and organizational forms.

This point distinguishes mandate stability from institutional rigidity. Durable commitments can protect people against arbitrary change, while periodic reinterpretation can keep public responsibility aligned with changing conditions. A generative public institution requires both capacities: the ability to honor commitments across time and the ability to revise how those commitments are realized when inherited arrangements become inadequate.

19.9.2 Relational Public Infrastructure

Infrastructure is often described through durable physical assets. Roads, bridges, water networks, energy systems, ports, schools, hospitals, and communication networks are important examples, but a relational analysis requires a wider scope. Administrative registries, identification systems, standards, payment rails, statistical systems, interoperable records, legal procedures, emergency protocols, professional classifications, and public data infrastructures can also enable recurrent economic relations. Their significance lies in making repeated forms of action feasible across participants who do not need to renegotiate every underlying condition for each transaction or service encounter.

Definition 19.103 (Relational public infrastructure). *Relational public infrastructure* is a maintained configuration of material, digital, legal, administrative, informational, and organizational arrangements that enables recurrent public relations or collectively consequential activities across time.

The definition emphasizes maintenance. An infrastructure that exists nominally but cannot be repaired, staffed, updated, supplied, secured, or institutionally supported can lose much of its relational function. Maintenance therefore includes more than physical repair. Digital systems require software support, security updates, data stewardship, interface revision, and preservation of institutional knowledge. Administrative systems require trained personnel, records, procedural continuity, and coordination across organizational boundaries. Standards require revision and compatible implementation. Public infrastructure is consequently a process of continued reproduction as well as an accumulated asset.

Infrastructure also distributes capability. A reliable transit network can expand feasible employment and educational relations; accessible public records can reduce information asymmetry; interoperable payment or identity systems can lower administrative barriers; public laboratories or statistical systems can enlarge the capacity of many organizations to act. Infrastructure can therefore generate capabilities that no individual participant could feasibly reproduce alone. Conversely, infrastructural failure can simultaneously contract many downstream relations.

Proposition 19.104 (Infrastructure–continuity condition). *The generative contribution of public infrastructure depends on the continuity of the relations it enables, including maintenance, repair, interoperability, institutional memory, and the capacity*

to adapt the infrastructure without severing critical access or accumulated capability.

This condition gives lifecycle analysis a central role. Construction is only one moment in infrastructural generation. Deferred maintenance can transform an apparently successful investment into a later constraint. Replacement can destroy compatibility or institutional memory if migration paths are weak. Digitization can increase speed while creating dependence on technical vendors, identity systems, network access, cybersecurity capacity, or specialized expertise. A generative analysis therefore follows infrastructure through operation, degradation, repair, upgrading, succession, and retirement.

Relational infrastructure also reveals why public and private boundaries can be analytically insufficient. A privately operated system can become infrastructurally public in consequence if access to employment, communication, payment, identity, mobility, or essential services becomes widely dependent on it. This does not by itself determine ownership or governance. It indicates that the public consequences of infrastructural dependence may require forms of accountability, continuity planning, interoperability, or public capacity even where operation remains outside direct public ownership.

19.9.3 Administrative Access Pathways

Public provision becomes effective through access pathways. Legal eligibility or universal statutory coverage can be an important condition while remaining insufficient for practical access. People may need to discover a service, understand eligibility, assemble documents, travel to an office, use a digital interface, communicate in an accepted language, wait through administrative queues, satisfy identity requirements, or navigate review and appeal. Each step can become a conversion condition between formal provision and realized capability.

Definition 19.105 (Administrative access pathway). *An administrative access pathway is the sequence of informational, documentary, spatial, temporal, linguistic, technological, procedural, and relational conditions through which a subject converts formal public eligibility or availability into usable public provision, recognition, protection, or participation.*

Administrative pathways are relational because the same formal rule can produce different practical burdens across positions. A digital process can reduce travel and waiting for some participants while increasing difficulty for people with weak connectivity, inaccessible devices, limited digital literacy, language barriers, disability, unstable documentation, or dependence on intermediaries. A face-to-face process can support contextual interpretation while imposing geographic or temporal burdens. Universal design therefore cannot be inferred from one interface alone.

Access is also affected by classification. Administrative systems sort people, organizations, places, events, incomes, risks, disabilities, occupations, family relations, and other conditions into categories that determine eligibility or procedure. Classification can make large-scale administration possible, but it can also create mismatch where lived conditions do not map cleanly onto administrative categories. Correction and appeal are therefore part of access architecture rather than merely exceptional remedies.

Proposition 19.106 (Access-realization condition). *Formal public provision becomes generatively meaningful only when relevant subjects can convert eligibility or avail-*

ability into practical use through pathways whose informational, procedural, temporal, spatial, technological, and representational burdens remain compatible with heterogeneous capacities and with practicable routes of correction.

Proposition 19.106 connects public access to the capability framework used elsewhere in GRE. The object of evaluation is not frictionlessness. Some procedures are necessary for verification, safety, accountability, or fair allocation. The question is whether procedural burdens are proportionate to their public function and whether they create patterned exclusion, dependence on opaque intermediaries, or avoidable loss of standing.

Administrative reach also matters geographically and institutionally. National rules can depend on local offices, schools, clinics, courts, postal systems, banks, identity providers, network coverage, or community organizations. Public access can therefore fail at interfaces among institutions even where each institution performs its own narrow function. Relational diagnosis follows the complete pathway rather than attributing failure only to the final service provider.

19.9.4 Public Institutional Capacity

Public capacity is often discussed as the ability of a state or agency to implement decisions. GRE decomposes this capacity because implementation can depend on heterogeneous resources that do not substitute freely for one another. Fiscal resources cannot automatically replace engineering expertise; legal authority cannot replace information; data cannot replace field relationships; contractors cannot automatically replace institutional memory; digital systems cannot replace accountable judgment in every case. Capacity is therefore typed and relational.

Definition 19.107 (Public institutional capacity). *Public institutional capacity* is the configuration-specific ability to interpret public mandates, mobilize resources, maintain infrastructures, coordinate actors, generate and use information, exercise authorized judgment, provide continuity, respond to disruption, and reproduce the professional and organizational capabilities required for later public action.

The final component is crucial. An institution can temporarily deliver through extraordinary effort, external consultants, emergency transfers, or concentrated expertise while weakening its future capacity. Repeated dependence on a small number of individuals can create succession risk. Outsourcing can extend capability where external specialization is valuable, while also hollowing internal capacity if knowledge, records, system access, or contract-management competence do not remain available. Public capacity must therefore be evaluated dynamically.

Professional capability is part of this architecture. Engineers, teachers, clinicians, statisticians, procurement specialists, case workers, inspectors, lawyers, archivists, emergency planners, software engineers, and other public professionals often carry tacit knowledge that is only partially codified. Recruitment, training, mentoring, professional autonomy, documentation, career pathways, and succession are consequently public-capacity mechanisms rather than merely human-resource concerns.

Proposition 19.108 (Capacity-reproduction condition). *A public institution possesses durable capacity only where the capabilities required for recurrent mandate fulfillment can be maintained, regenerated, transferred, coordinated, and mobilized across personnel turnover, technological change, organizational restructuring, and periods of disruption.*

This proposition distinguishes output continuity from capacity continuity. An institution can maintain outputs for a period by consuming reserves of expertise, deferred maintenance, staff commitment, or external support. Such performance may conceal declining generative capacity. Conversely, temporary output reductions can accompany investments in systems, training, maintenance, or reorganization that improve future capability. Evaluation therefore requires a temporal horizon longer than immediate throughput.

Data and digital capability increasingly enter public capacity as well. Public-sector data can support service delivery, policy design, organizational management, and innovation when governance arrangements permit responsible use across institutional boundaries (Ooijen et al. 2019). Integrated data systems can also create new coordination possibilities while increasing the importance of safeguards, institutional responsibility, and the governance of reuse (World Bank 2021). Data capacity should therefore include stewardship, interpretation, interoperability, documentation, security, and public accountability rather than collection volume alone.

19.9.5 Institutional Learning Architecture

Public institutions act under uncertainty and incomplete knowledge. Policies and infrastructures interact with changing populations, technologies, organizations, ecological conditions, and other institutions. Institutional learning therefore concerns the capacity to convert experience into revised understanding and action while preserving enough memory to distinguish learning from recurrent improvisation.

Monitoring, research, administrative data, evaluation, audit, professional experience, public complaints, judicial review, incident investigation, and community knowledge can each provide evidence. Evidence-informed policy frameworks emphasize that statistics, research, evaluation, and other forms of evidence can inform formulation, implementation, and revision (OECD 2020a). Policy evaluation can also support accountability and organizational learning where findings are connected to decision processes rather than produced as detached reports (OECD 2020b).

Information accumulation is nevertheless different from institutional learning. An institution can collect extensive data while leaving its categories, causal assumptions, procedures, incentives, or resource allocation unchanged. Learning requires some capacity to revise a model of the problem, a rule, an implementation pathway, a coordination relation, or an evaluative criterion when warranted by evidence. It also requires preservation of uncertainty and failed approaches so that later personnel do not repeatedly reconstruct the same mistakes without institutional memory.

Proposition 19.109 (Institutional-learning condition). *A public institution exhibits learning where evidence and experience can alter relevant models, classifications, procedures, resource allocations, coordination relations, or rules through documented and reviewable processes that preserve the provenance of the change and the uncertainty that remains.*

Learning also has organizational costs. Continuous revision can destabilize service delivery, exhaust personnel, fragment records, or make public expectations difficult to maintain. Institutional learning therefore requires selection of revision depth and timing. Operational adjustment, program redesign, regulatory amendment, infrastructural replacement, and mandate revision are different levels of change and should not be conflated.

This produces a role for institutional memory. Archives, version histories, evaluation records, longitudinal data, professional narratives, maintenance logs, legal precedents, incident reports, and documentation of abandoned alternatives allow later actors to reconstruct why a public arrangement exists. Such memory supports both continuity and critique. Without it, inherited arrangements can appear natural because their historical reasons are inaccessible, or repeatedly modified systems can lose the evidence required to understand cumulative consequences.

19.9.6 Public Trust Relations

Public trust concerns expectations about institutions whose actions can affect rights, services, resources, risks, classifications, and future opportunities. It should not be represented as a single scalar attitude toward government. A person can trust an emergency service to respond reliably while distrusting a data-sharing arrangement; trust professional competence while contesting distributive priorities; or regard a procedure as fair while disagreeing with its outcome. The relevant relations are typed and institution-specific.

Definition 19.110 (Public trust relation). A *public trust relation* is a historically situated expectation that a public institution, role, or procedure will act with sufficient reliability, competence, procedural integrity, bounded authority, and responsiveness for a subject to accept some degree of vulnerability, reliance, or delegated judgment.

The definition treats trust as relational reliance rather than unconditional approval. Public institutions often require people to disclose information, accept classifications, wait for decisions, rely on infrastructure, comply with rules, or defer temporarily to professional judgment. Such reliance creates vulnerability. Trustworthiness therefore depends partly on whether institutions can explain, review, correct, and account for the exercise of authority.

Procedural-justice research is relevant because perceived fairness, respectful treatment, and legitimacy can affect voluntary acceptance of legal authority beyond immediate outcome favorability or deterrence (Tyler 2006). GRE extends this insight by emphasizing the temporal reproduction of trust relations. Reliability over repeated encounters, continuity across personnel changes, correction after error, and preservation of accessible appeal pathways can matter as much as one favorable interaction.

Proposition 19.111 (Trust–legitimacy condition). *Public trust contributes to generative governance when reliance is grounded in observable institutional trustworthiness, including competence, procedural integrity, bounded authority, continuity, intelligible justification, and practicable correction, while leaving room for scrutiny, disagreement, and contestation.*

This proposition avoids making trust maximization an objective. Distrust can sometimes reveal misconduct, exclusion, historical injury, conflicting values, or reasonable uncertainty. A public institution that seeks trust by reducing transparency or discouraging contestation can weaken the very relations on which legitimate reliance depends. The generative object is therefore a trustworthy and revisable relation rather than an undifferentiated level of confidence.

Trust can also be distributed unequally. Groups with different historical experiences may encounter the same institution through different expectations and risks. Aggregate trust measures can consequently conceal patterned relational differences. A generative analysis asks which public encounters produce reliability or vulnerabil-

ity, whose errors are corrected, whose knowledge is recognized, and how historical memory conditions present willingness to rely.

19.9.7 Adaptive Governance Architecture

Adaptive governance concerns the institutional capacity to revise action as conditions, evidence, or consequences change. It differs from continuous flexibility. Public institutions also carry legal commitments, rights, procedural expectations, budgets, infrastructures, and long-term investments that can be damaged by arbitrary or excessively frequent change. Adaptation therefore requires an architecture that specifies when revision is possible, who can authorize it, what evidence can trigger it, which commitments remain protected, and how changes can later be reviewed.

Monitoring and feedback are central because implementation itself can produce information about whether a policy or service is functioning as expected. Public-governance frameworks accordingly treat monitoring and evaluation as inputs to adjustment and resource allocation across the policy cycle (OECD 2020c). GRE places this feedback within a wider architecture of reversibility, path dependence, and generative capacity. A change that improves an immediate indicator can still reduce later adaptability if it destroys internal expertise, closes alternative infrastructures, eliminates local variation required for learning, or creates hard-to-reverse dependencies.

Adaptive governance can therefore be layered. Operational adaptation adjusts implementation within an established rule. Programmatic adaptation revises instruments or resource allocation. Institutional adaptation changes organizational relations, delegated authority, or administrative categories. Constitutional or mandate-level adaptation changes the purposes or boundaries of public authority itself. Each layer requires different evidence, participation, authorization, and safeguards.

Proposition 19.112 (Adaptive-governance condition). *Public adaptation is generatively credible where revision authority, evidential triggers, affected positions, temporal horizons, reversibility conditions, accountability pathways, and protected commitments are specified with enough clarity to permit responsive change without converting discretion into unbounded or historically opaque power.*

The condition also applies to emergency governance. Compressed time can justify delegated discretion or temporary procedures where ordinary processes cannot respond quickly enough. Yet emergency capacity is itself infrastructural. Clear activation conditions, records, review, sunset or transition mechanisms, and preserved institutional memory can reduce the risk that temporary arrangements become unexamined permanent structures.

Digital and algorithmic systems add another layer. Automated triage, risk scoring, resource scheduling, anomaly detection, document processing, and decision support can increase administrative capacity. They can also embed categories, thresholds, model assumptions, vendor dependencies, and data practices into executable public processes. Adaptive governance therefore requires the capacity to inspect, override, audit, update, and if necessary replace such systems without losing the public service relation they mediate.

19.9.8 Long-Horizon Public Generativity

Public institutions act partly on behalf of people who are not present in the immediate administrative encounter. Infrastructure, education systems, archives, environmental regulation, public-health capability, statistical systems, fiscal institutions, research capacity, and legal orders can shape possibilities over decades. Long-horizon public analysis therefore asks whether present arrangements preserve the material, institutional, epistemic, and relational capacities through which later subjects can continue collective action.

Definition 19.113 (Public generativity). *Public generativity* is the capacity of a public institutional configuration to maintain and regenerate the infrastructures, capabilities, records, relationships, accountability pathways, and revisable commitments through which present and future participants can address shared conditions and create further viable public possibilities.

Public generativity includes maintenance because future possibility depends on inherited substrates. A functioning water network, archive, statistical series, court record, school system, professional corps, emergency protocol, or public standard can be valuable partly because later actors do not need to rebuild the entire relational basis for action. Maintenance is therefore generative when it preserves capacities from which future revision remains possible.

Generativity also includes investment in new capacity. New infrastructure, institutional forms, data systems, professional capabilities, and coordination arrangements can open possibilities that were previously infeasible. Such investment nevertheless creates path dependence. Infrastructure can lock in spatial patterns; digital systems can create vendor or data dependencies; organizational reforms can eliminate skills or local knowledge; fiscal commitments can constrain later allocation. Long-horizon evaluation must therefore include both opportunity creation and the reversibility or adaptability of the resulting structure.

Proposition 19.114 (Public-generativity condition). *A public institutional configuration is generatively stronger where it can meet recurrent public obligations while reproducing public capability, maintaining critical infrastructures, preserving institutional memory, supporting practical access and contestation, learning from consequences, and retaining sufficient revisability for future participants to respond to conditions that present institutions cannot fully anticipate.*

This condition is deliberately broader than administrative efficiency. Efficiency can be important where public purposes and relevant costs are well specified, but a narrowly efficient arrangement can become fragile if it eliminates redundancy, maintenance capacity, professional learning, local knowledge, or alternative pathways required under disruption. Generativity therefore treats some reserve capacity, institutional memory, and option preservation as potentially productive even when they appear underutilized in ordinary periods.

The domain also returns several remainders to GRE. First, public mandate makes *authorized obligation* analytically important: some relations persist because institutions are required to maintain them across fluctuations in profitability or immediate demand. Second, infrastructure makes maintenance and lifecycle succession central components of generation. Third, administrative access shows how universal formal rules can produce heterogeneous practical pathways. Fourth, public trust demonstrates that reliance can be both necessary and contestable, with trustworthiness tak-

ing analytical priority over trust maximization. Fifth, adaptive governance shows that revisability itself requires institutional design; flexibility without records, boundaries, and accountability can reduce rather than increase future generative capacity.

Section 19.10 extends the domain analysis beyond territorially bounded public arrangements. Migration and transnational relations complicate mandate, access, legal standing, infrastructure, and capability because relevant subjects and relationships can cross jurisdictions while public authority remains institutionally segmented. The present section therefore provides the public-institutional baseline from which those transnational discontinuities can be examined.

19.10 Migration and Transnational Relations

Migration and transnational relations provide a further domain test of the translation discipline developed in Section 19.1. The domain is analytically distinctive because movement, residence, legal status, family relations, labor-market participation, care, money, knowledge, and institutional standing can be distributed across several jurisdictions at once. A person can live in one territory, hold citizenship in another, support relatives elsewhere, work through a transnational organization, participate in multiple communities, and remain dependent on legal or administrative decisions taken at several scales. The role of the present section is therefore to analyze migration as a reconfiguration of relations across space and jurisdiction rather than as movement between self-contained national containers. Its objectives are to distinguish mobility capability from realized movement; examine borders as mediating institutions; analyze legal status as differentiated institutional standing; reconstruct remittance relations and household conversion; treat transnational families as distributed care and obligation configurations; examine knowledge and skill circulation; identify multi-jurisdictional dependencies; and specify conditions of transnational generativity. The method is relational, historical, institutional, and multiscale. It treats migration trajectories as configurations of persons, households, organizations, infrastructures, jurisdictions, documents, rights, obligations, networks, and temporal commitments whose relations can persist, weaken, or transform across distance.

Migration scholarship offers several compatible starting points without yielding one complete explanatory theory. Massey and colleagues survey mechanisms operating at multiple analytical levels and distinguish theories concerning the initiation and persistence of international migration (D. S. Massey et al. 1993). De Haas develops an aspirations–capabilities framework in which mobility depends on both the aspiration and the practical capability to move, while the freedom to remain can also form part of migratory agency (Haas 2021). Transnational scholarship further shows that social fields, belonging, and institutional relations can cross state boundaries and remain consequential simultaneously in more than one national setting (Levitt and Glick Schiller 2004). GRE builds on these insights while asking a domain-specific question: how do cross-border relations alter the capacities, dependencies, values, recognition pathways, and future possibilities of heterogeneous subjects situated within partially overlapping institutional orders?

The category *migration* should remain analytically bounded. Tourism, commuting, forced displacement, seasonal labor, student mobility, family migration, asylum, return migration, circular migration, and permanent settlement can involve very dif-

ferent legal positions, temporalities, risks, and institutional relations. The present section therefore avoids treating migration status as a single binary variable. It also avoids assuming that movement itself is the relevant outcome. Remaining in place, returning, maintaining transnational ties, or sustaining mobility options can each be economically consequential depending on the inquiry.

Table 19.10 summarizes the principal dimensions developed in this section. The table is diagnostic rather than prescriptive. Increased mobility can enlarge capability in some configurations while producing insecurity or care disruption in others. Stronger borders can stabilize some public obligations while creating costly discontinuities for persons whose livelihoods or family relations cross jurisdictions. Remittances can support household capability while also creating exposure to distant labor markets. Transnational networks can circulate knowledge while concentrating opportunity among already connected groups. The analytical task is therefore to identify which relations are created, interrupted, or redistributed through mobility and institutional segmentation.

Definition 19.115 (Transnational economic configuration). A *transnational economic configuration* is a historically situated arrangement in which economically consequential relations among persons, households, organizations, infrastructures, institutions, and communities extend across more than one jurisdiction or territorial setting and are mediated by distinct legal, administrative, monetary, social, and logistical conditions.

Definition 19.115 keeps the unit of analysis wider than a migrant individual. A migration trajectory can be generated jointly by household decisions, labor demand, recruiters, education systems, transport infrastructures, border rules, professional recognition, family obligations, housing markets, digital communication, and monetary transfer systems. The relevant economic effects can therefore appear in several connected places at once.

19.10.1 Mobility Capability and Spatial Choice

Mobility is an economically relevant capability because access to work, education, care, safety, family relations, public services, and communities can depend on the ability to change location or to remain where valued relations already exist. The capability to move should nevertheless be distinguished from realized movement. De Haas's aspirations–capabilities framework is useful here because it treats migration as shaped by both aspirations and practical capabilities and explicitly allows staying to be part of mobility freedom (Haas 2021). GRE translates this insight into a broader relational account: mobility capability concerns the feasible set of spatial trajectories that a subject can enter while retaining sufficient access to the relations required for life and participation.

Mobility capability is multidimensional. Financial resources can pay for transport and relocation, yet money alone does not establish mobility where visas, documentation, health conditions, care obligations, discrimination, language, housing, transport access, or security constraints remain binding. Conversely, legal permission to move may have little practical value where employment, housing, childcare, or recognition pathways are absent. Spatial choice therefore depends on conversion conditions in the same sense developed for resources elsewhere in GRE.

The ability to remain can be equally consequential. Environmental degradation,

Table 19.10: Diagnostic dimensions for generative analysis of migration and transnational relations.

Transnational dimension	Immediate observable	Long-horizon generative question
Mobility capability	Ability to move, remain, return, circulate, or reunify; costs; documentation; transport; safety	Whether spatial choice expands without making residence, return, or immobility involuntary through preventable constraints
Border mediation	Admission, exit, inspection, visa rules, recognition, waiting, detention, transit, territorial reach	Whether passage regimes allocate risk, delay, and standing transparently and preserve review, correction, and lawful transition pathways
Legal status	Citizenship, residence, work authorization, asylum status, family status, portability, eligibility, documentation	Whether institutional standing remains sufficiently secure and intelligible for people to plan, work, care, learn, contest, and change position
Remittance relations	Transfer frequency, channels, costs, exchange, household use, savings, investment, emergency support	Whether cross-border transfers become usable capability without creating hidden obligations, concentration, or fragile single-source dependence
Transnational families	Care, co-residence, separation, communication, reunification, inheritance, schooling, elder support	Whether family relations can reproduce care, recognition, and decision capacity across distance without systematically externalizing burdens
Knowledge and skill circulation	Credentials, professional networks, return, remote collaboration, mentoring, investment, institutional ties	Whether mobility circulates capability and organizational learning rather than producing irreversible capability loss in particular places
Multi-jurisdictional dependency	Employer sponsorship, documentation, remittance income, intermediaries, platforms, consular or welfare access	Whether consequential dependencies are visible, diversified where feasible, contestable, and compatible with realistic exit or transition options
Transnational generativity	Relational continuity, cross-border capability, institutional bridges, option preservation, collective renewal	Whether transnational arrangements expand the capacity to generate viable futures across connected places without exhausting one side of the relation

conflict, eviction, loss of livelihood, exclusion from services, or family separation can make apparent immobility involuntary. A person who remains because movement is impossible occupies a different relational position from a person who remains because valued relations can be sustained locally. Similarly, migration can be undertaken under constrained choice where the feasible alternatives are severely narrowed. Generative analysis therefore avoids inferring freedom directly from movement or non-movement.

Definition 19.116 (Mobility capability). *Mobility capability* is the practically realizable capacity of a subject or household to choose among relevant spatial trajectories, including movement, residence, return, circulation, and family reunification, under the legal, material, social, infrastructural, and temporal conditions that make those trajectories feasible.

Proposition 19.117 (Mobility-capability condition). *Observed movement provides an incomplete indicator of migratory agency where the practical possibilities of moving, remaining, returning, or reuniting differ substantially across subjects or where spatial choices are generated under severe legal, material, relational, or temporal constraint.*

Mobility capability is also temporally structured. A visa may permit entry for six months but provide little basis for long-horizon planning. A student migration pathway can expand education while delaying family reunification. A seasonal labor arrangement can support income generation while repeatedly interrupting local participation. A residence permit can gradually become more secure or can remain contingent on one employer. The generative question therefore concerns trajectories of mobility and standing rather than one-time passage alone.

19.10.2 Border Mediation and Passage Regimes

Borders are institutions that mediate passage, classification, jurisdiction, and the applicability of rights and obligations. Their economic effects arise through more than geographical separation. A border can change whether credentials are recognized, which taxes apply, whether a contract is enforceable, whether family members can reunify, which social protections are accessible, whether capital or goods can move, and which authority can review an administrative decision. Borders therefore operate as transformation interfaces between institutional orders.

Passage regimes include visas, permits, inspections, sponsorship systems, transit rules, admissibility criteria, recognition procedures, waiting periods, detention powers, appeal mechanisms, and documentation requirements. Each mechanism can redistribute time, uncertainty, cost, and bargaining power. A nominally open route can remain practically inaccessible where processing delays exceed a person's financial or legal capacity to wait. A formally temporary rule can become structurally consequential when repeated renewals keep employment, housing, or family planning under persistent uncertainty.

The relevant boundary can also differ from the territorial border. Airline authorization, employer sponsorship, university admission, professional licensing, insurance eligibility, digital identity verification, banking requirements, and platform rules can become preconditions for practical cross-border movement. Border mediation is therefore distributed across public and private organizations even where sovereign authority remains legally central.

Definition 19.118 (Passage regime). A *passage regime* is the configuration of legal rules, administrative procedures, infrastructures, classifications, organizational intermediaries, documentation requirements, and review mechanisms through which movement across a jurisdictional boundary is enabled, delayed, conditioned, transformed, or refused.

Proposition 19.119 (Passage-regime condition). *The generative significance of a border depends partly on how its passage regime distributes delay, uncertainty, documentation burdens, recognition, review, and transition pathways across subject positions,*

rather than only on the formal openness or closure of the territorial boundary.

This formulation does not presume that lower border friction is always preferable. Public-health emergencies, security concerns, legal obligations, labor standards, or capacity constraints can justify forms of regulated passage. The GRE question concerns the relation among purpose, authority, proportionality, practical access, correction, and downstream capability. A passage regime can be restrictive yet intelligible and reviewable, or formally permissive yet practically arbitrary and exclusionary.

19.10.3 Legal Status and Institutional Standing

Legal status is a major conversion interface in migration because it conditions whether resources, skills, relationships, and opportunities can be translated into practical economic participation. Citizenship, permanent residence, temporary residence, work authorization, student status, asylum status, family status, undocumented presence, and other categories can carry different bundles of rights, obligations, time horizons, and institutional pathways. These categories are legally specific and should not be collapsed into one continuum, yet they share an analytical feature: they alter institutional standing.

Status can affect employment, occupational mobility, welfare access, education, housing, finance, healthcare, family reunification, political participation, portability, and the ability to contest decisions. Anderson's analysis of immigration control and precarious labor illustrates how immigration rules can help shape labor-market positions and institutionalized uncertainty rather than merely regulate the quantity of workers crossing a border (Anderson 2010). GRE generalizes the mechanism cautiously: legal categories can become relational properties that change bargaining positions, feasible exits, and dependence on employers, sponsors, intermediaries, or authorities.

Status security also has a temporal dimension. A short permit tied to one employer can make long-term investments, training, housing, or family formation risky. A pathway to more secure residence can produce a different trajectory even where initial labor-market conditions are similar. Legal standing therefore matters through both present rights and expected transitions among categories.

Definition 19.120 (Transnational institutional standing). *Transnational institutional standing* is the configuration of legally and administratively recognized positions through which a person or household can reside, work, study, receive services, maintain family relations, hold assets, contest decisions, and transition among jurisdictions or status categories.

Proposition 19.121 (Status-conversion condition). *The economic value of income, skills, credentials, networks, and mobility options depends partly on the legal and administrative standing through which those resources can be converted into work, residence, care, participation, and future security.*

Status can also become fragmented. A person may possess work authorization without family-reunification rights, residence without political participation, professional credentials without local recognition, or social-insurance contributions without full portability. Analysis therefore benefits from decomposing status into function-specific standing rather than assuming that one legal category fully determines economic position.

19.10.4 Remittance Relations and Household Conversion

Remittances connect migration to household and community economies across distance. The World Bank describes remittances as funds sent from a migrant's country of work back to a home country (World Bank 2024). For GRE, the analytical object extends beyond the transfer itself. A remittance relation includes the sender's labor conditions, transfer infrastructure, exchange rates, fees, household expectations, decision rights, uses of funds, care obligations, and the capacities generated or constrained on both sides of the transfer.

The household perspective is important because labor migration often involves strategies distributed across family members rather than isolated individual wage maximization. The new economics of labor migration foregrounds household-level risk, income, and strategic considerations in migration decisions (Stark and Bloom 1985). GRE adds a relational emphasis on conversion and reciprocity. The same remittance amount can finance consumption, debt repayment, healthcare, schooling, housing, business investment, community obligations, emergency support, or savings, with different effects on capability and dependency.

Remittance relations can also reshape power within households. A sender can acquire greater decision influence; a recipient can become dependent on one distant income stream; care work may shift toward non-migrating relatives; expectations to remit can constrain the migrant's own savings or integration. Monetary flow therefore interacts with non-monetary obligations and cannot be interpreted as a simple one-directional benefit.

Definition 19.122 (Remittance-conversion relation). *A remittance-conversion relation is the cross-border configuration through which earnings or other monetary claims are transferred, converted, allocated, and incorporated into household or community capabilities, obligations, investments, and dependencies.*

Proposition 19.123 (Remittance-conversion condition). *The generative effect of remittances depends on the stability and conditions of the income source, transfer costs and reliability, household decision relations, local conversion opportunities, exposure to shocks, and the extent to which transferred resources support capabilities that can persist beyond the current remittance stream.*

This condition also preserves heterogeneity. Recurrent remittances can provide valuable insurance or intergenerational support without needing to disappear in order to count as generative. The relevant concern is whether the relation remains sustainable, recognizable, and compatible with the capabilities of both sender and recipient rather than whether dependence on cross-border support reaches zero.

19.10.5 Transnational Families and Care Relations

Migration frequently reorganizes family relations across distance. Transnational-family research documents households and kinship networks whose members, obligations, identities, and flows of money, information, and care extend across national boundaries (Bryceson and Vuorela 2002). A family can therefore remain a consequential relational unit even where co-residence is absent and legal statuses differ among members.

Care is central because spatial separation reallocates time, presence, emotional labor, supervision, financial support, and responsibility. Childcare can shift toward

grandparents or other relatives. Elder care can be coordinated remotely and financed through remittances. A migrant worker can provide income while receiving emotional, logistical, or property support from family members elsewhere. Reunification policies can alter these arrangements again. The relevant economic configuration includes both paid and unpaid relations.

Distance changes what kinds of care can be transmitted. Money and communication can cross borders more easily than physical presence. Digital connectivity can sustain frequent contact while leaving practical care needs unresolved. Travel rights and cost can therefore become part of care infrastructure. A family relation that appears financially stable can remain fragile where illness, bereavement, child-care emergencies, or legal status make physical reunion difficult.

Proposition 19.124 (Transnational-care condition). *A transnational family arrangement is generatively stronger where care, income, decision authority, communication, mobility, and reunification possibilities are distributed in ways that preserve the capabilities of both mobile and non-mobile members and avoid systematically transferring unrecoverable burdens to less visible positions.*

The proposition does not imply one preferred family geography. Co-residence, circular migration, long-distance family relations, return, and distributed households can each be viable under different conditions. The analytical task is to reconstruct who provides which forms of support, whose opportunities are deferred, how decisions are made, and what happens when the arrangement encounters illness, unemployment, status change, or aging.

19.10.6 Knowledge, Skill, and Institutional Circulation

Migration redistributes knowledge and skill, yet one-directional loss is only one possible trajectory. Education, professional experience, entrepreneurial practice, research collaboration, mentoring, investment, remote work, return migration, and diaspora networks can circulate capability across regions. Saxenian's study of high-skilled transnational communities in India and China provides a well-known example in which professional networks and repeated cross-border engagement contributed to forms of technical and institutional circulation that complicate a simple brain-drain model (Saxenian 2005).

GRE treats this process as relational rather than automatically beneficial. Knowledge circulation depends on institutional interfaces. Credentials must be recognized; professional networks must remain accessible; firms or universities must be able to collaborate; financing, intellectual property, language, and digital infrastructure can condition transfer; local organizations require absorptive and interpretive capacity. A returning professional does not carry an institution in isolation, and a diaspora network does not automatically generate local upgrading.

The relevant unit can also be collective. A region can lose experienced workers while gaining transnational access to markets, capital, research, or organizational knowledge. Another region can gain workers while relying on training systems financed elsewhere. The distributional incidence therefore spans multiple places and time horizons.

Definition 19.125 (Transnational capability circulation). *Transnational capability circulation* is the recurrent cross-border movement and relational transmission of knowledge, skills, professional practices, organizational routines, networks, cre-

dentials, capital, and institutional learning through which capabilities can be lost, reproduced, recombined, or regenerated across connected places.

Proposition 19.126 (Capability-circulation condition). *Cross-border movement becomes capability circulation where receiving, origin, and transnational institutions can translate mobile knowledge and skill into reproducible local or distributed capability rather than relying primarily on the continued presence of particular individuals.*

This distinction makes institutional reproduction central. Mentoring, professional associations, research partnerships, return pathways, remote collaboration, curriculum change, standards, investment, and organizational learning can convert individual mobility into wider capability. Where such interfaces are absent, highly skilled movement can remain concentrated in personal careers with limited collective transmission.

19.10.7 Transnational Dependency and Multi-Jurisdictional Exposure

Migration creates dependencies that cross institutional boundaries. A worker can depend on an employer for income and immigration sponsorship. A household can depend on remittances generated in a distant labor market. A student can depend on a university for legal residence. A refugee can depend on documentation and recognition across several agencies. A family can depend on airlines, consulates, communication platforms, transfer services, and border procedures to maintain ordinary relations. These dependencies are neither uniformly harmful nor reducible to market exchange.

The transnational setting adds a specific problem of jurisdictional segmentation. A relation can be governed by one legal order while its consequences occur in another. Labor standards, social insurance, family law, taxation, pensions, healthcare, credential recognition, and dispute resolution may fail to align. A person can therefore occupy overlapping but incomplete institutional memberships. Levitt and Glick Schiller's transnational social-field perspective is useful precisely because it resists equating social embeddedness with one national boundary (Levitt and Glick Schiller 2004).

Dependency can also propagate through chains. An employer's closure can terminate income, status, housing, and family-remittance capacity at once. A banking restriction can disrupt household consumption in another country. A policy change can make previously viable care or study arrangements impossible. Such chains make redundancy and transition options economically significant.

Definition 19.127 (Multi-jurisdictional dependency profile). *A multi-jurisdictional dependency profile records the consequential resources, permissions, infrastructures, intermediaries, and institutional recognitions on which a transnational subject or household relies, together with their jurisdictional location, substitutability, transition pathways, and potential for cascading failure.*

Proposition 19.128 (Transnational-dependency condition). *A transnational configuration is more resilient where consequential dependencies are sufficiently visible, legally and institutionally intelligible, substitutable or diversifiable where feasible, and connected to realistic correction, portability, or transition pathways across jurisdictions.*

The condition does not make self-sufficiency the objective. Transnational life often

depends productively on durable interdependence. The relevant distinction concerns whether dependence supports capability and relation continuity or creates opaque and difficult-to-exit control positions whose failure can cascade across several domains of life.

19.10.8 Transnational Generativity and Relational Continuity

Migration and transnational relations reshape the economic meaning of locality. A household, organization, community, or region can be generated partly through relations that extend beyond its territory: remittances, professional networks, family care, trade, digital communication, institutional recognition, investment, education, and political or civic ties. Massey's relational account of place developed earlier in the book is compatible with this domain because places can be constituted through intersecting relations whose spatial reach exceeds administrative boundaries (D. B. Massey 1994). The migration domain adds that the persons sustaining those relations may themselves move while the relation remains persistent.

Definition 19.129 (Transnational generativity). *Transnational generativity* is the capacity of cross-border relational configurations to sustain and regenerate capabilities, care, knowledge, institutional bridges, livelihood options, recognition, and collective possibilities across connected places while retaining sufficient mobility, continuity, and revisability for participants whose positions change over time.

Transnational generativity can take several forms. Migration can diversify household income, expand education, connect firms to new markets, create professional networks, preserve family relations across political disruption, or enable return and circulation. It can also produce losses: care deficits, regional skill depletion, status insecurity, extractive recruitment, fragmented social protection, or dependence on distant labor markets. Generative evaluation therefore requires incidence across origin, destination, transit, and transnational positions rather than one aggregate measure.

The temporal horizon is especially important. Short-run migration gains can co-exist with long-run institutional depletion if training systems repeatedly lose experienced personnel without replacement. Conversely, apparent short-run loss can later support circulation if migrants create durable professional and organizational bridges. A remittance-supported household can become more capable through education and asset formation, or more exposed if local opportunities contract around one external income source. The direction of effect is therefore historically contingent and should be reconstructed rather than presumed.

Proposition 19.130 (Transnational-generativity condition). *A transnational economic configuration is generatively stronger where mobility and residence remain meaningfully selectable, legal standing supports practical participation, cross-border transfers are convertible into durable capability, care burdens remain visible, knowledge can circulate through reproducible institutions, critical dependencies have transposition pathways, and connected places retain sufficient capacity to generate future alternatives of their own.*

The migration domain returns several remainders to GRE. First, jurisdiction is not only a spatial boundary; it is a distribution of rule applicability, recognition, and authorized standing. Second, capability can be spatially distributed: a household's feasible action may depend on a member located elsewhere. Third, social reproduction can occur transnationally through combinations of money, care, information, travel,

and delegated presence. Fourth, institutional membership can be partial and overlapping, making portability and recognition central conversion problems. Fifth, a relation can remain economically constitutive despite physical separation, so co-location cannot serve as a general proxy for relational intensity.

The domain also strengthens the book's account of economic spacetime. Migration trajectories connect places through historical sequences of movement, settlement, return, family formation, credential acquisition, status change, and institutional learning. These histories alter later options for both mobile and non-mobile participants. The transnational configuration is therefore neither a set of isolated locations nor a timeless network. It is a history-bearing arrangement whose borders, memberships, and capabilities can change together.

Section 19.11 extends the domain analysis to ecology. Ecological relations further destabilize any assumption that economically relevant boundaries coincide with political jurisdictions because watersheds, atmospheric processes, species, energy flows, extraction chains, and climate effects can cross territories independently of human legal categories. Migration and transnational relations therefore provide a direct bridge between the institutional segmentation of space and the materially interconnected ecological domain that follows.

19.11 Ecology

Ecology provides a demanding domain test for Generative Relational Economics because economically consequential relations extend beyond human organizations, legal jurisdictions, and market transactions. Production and consumption depend on material and energy flows, living systems, soils, water, atmospheric processes, species interactions, waste-assimilation capacities, and ecological histories whose dynamics are only partially governed by human institutions. The role of the present section is to specify how GRE can analyze these relations while preserving the methodological discipline established in Section 19.1. Its objectives are to reconstruct human–ecological relational architecture; identify material–energy flows and their transformation; distinguish stewardship from ownership and control; translate commons analysis into ecological settings; represent intergenerational incidence; specify biophysical constraints and threshold-sensitive dynamics; clarify regenerative ecological capacity; and define ecological generativity without presuming a complete theory of ecological value or non-human moral standing. The method is relational, historical, multiscale, and biophysically constrained. It treats economic activity as situated within ecological configurations whose constituent processes can persist, regenerate, reorganize, or become irreversibly transformed across time.

Ecological economics offers several established points of contact. Costanza characterizes ecological economics broadly through relations between ecological and economic systems (Costanza 1989). Georgescu-Roegen emphasizes the thermodynamic irreversibility of economic processes (Georgescu-Roegen 1971), while Daly develops operational sustainability principles that connect renewable-resource use to regeneration and waste emission to assimilative capacity (Daly 1990). Social–ecological scholarship further emphasizes coupled resource, governance, user, and institutional structures (Ostrom 2009); Holling distinguishes resilience from simple stability (Holling 1973); and Earth-system research identifies interacting processes

whose alteration can increase risks to the conditions supporting human development (Steffen et al. 2015). GRE does not replace these literatures. Its domain-specific task is to ask how ecological dependencies, constraints, values, institutions, representations, and regenerative capacities alter the generation and distribution of future economic possibilities.

Ecological analysis also exposes a recurring problem of scale. A household can experience clean water as a local service while its availability depends on an upstream watershed. A city can externalize waste while relying on distant ecosystems for food, energy, and materials. A firm can improve resource efficiency at one production site while aggregate throughput or supply-chain extraction increases elsewhere. A government can regulate within a jurisdiction while ecological processes cross its boundaries. The relevant economic configuration therefore cannot be identified solely with the location where prices, ownership, or administrative decisions are observed.

Table 19.11 summarizes the eight diagnostic dimensions developed in this section. The table is analytical rather than prescriptive. Regeneration can be desirable in one ecological system while active transformation is appropriate in another; resilience can preserve valued ecological function or stabilize a degraded regime; and stewardship arrangements can support ecological continuity while also excluding legitimate human claims. The GRE task is therefore to identify the relations, constraints, affected positions, time horizons, and conversion mechanisms through which ecological conditions become economically consequential.

Definition 19.131 (Ecological–economic configuration). An *ecological–economic configuration* is a historically situated arrangement of human and non-human organisms, ecological processes, material and energy flows, infrastructures, institutions, technologies, territories, rules, and value relations whose interactions jointly condition economic possibilities and ecological reproduction.

Definition 19.131 keeps the analytical unit wider than a resource stock or environmental externality. A forest, river, fishery, agricultural landscape, coastal zone, or urban ecosystem can participate in economic processes through multiple relations at once: livelihood, habitat, flood protection, cultural meaning, carbon storage, recreation, extraction, transport, identity, and future option value. The resulting configuration may contain subjects with different forms of agency and standing, including humans, organizations, collectives, and non-human entities represented institutionally in different ways. The definition therefore identifies ecological affectedness without deciding in advance how moral standing, legal personality, or political representation should be assigned.

19.11.1 Human–Ecological Relational Architecture

Economic life is constituted through ecological dependence even when that dependence is institutionally or cognitively distant. Food systems depend on soils, water, pollination, climate, nutrients, organisms, and energy. Urban systems depend on water catchments, energy networks, material supply chains, waste sinks, and atmospheric conditions. Health, housing, transport, and production are similarly embedded in ecological relations that can remain invisible when analysis begins from prices or ownership alone. Costanza and colleagues' ecosystem-services analysis provides one influential vocabulary for making some of these dependencies economically legible (Costanza, d'Arge, et al. 1997). GRE uses such representations cautiously because

Table 19.11: Diagnostic dimensions for generative analysis of ecological relations.

Ecological dimension	Immediate observable	Long-horizon generative question
Human–ecological relations	Dependence on water, soil, climate, species, ecosystems, landscape, and ecological services	Whether economic arrangements make ecological dependencies visible and preserve the relations required for viable future activity
Material–energy flows	Extraction, throughput, energy conversion, waste, emissions, recycling, dissipation	Whether flow architectures reduce destructive throughput while respecting thermodynamic, spatial, and temporal constraints
Stewardship	Monitoring, maintenance, restoration, rule enforcement, care, ecological knowledge	Whether responsibility and capability for ecological maintenance are durable, accountable, transferable, and matched to relevant scales
Ecological commons	Shared resource systems, access rules, property-right bundles, collective monitoring, conflict resolution	Whether governance aligns use, maintenance, exclusion, participation, and ecological reproduction without assuming one property form
Future inheritance	Long-lived infrastructure, depletion, contamination, restoration, inherited institutions, delayed effects	Whether present decisions preserve intelligible options and regenerative capacity for later participants whose preferences cannot be fully represented now
Biophysical constraints	Regeneration rates, assimilative capacity, thresholds, irreversibilities, ecological limits, critical dependencies	Whether constraints are treated as dynamic conditions of feasible action rather than external afterthoughts to economic allocation
Regenerative capacity	Recovery, succession, habitat repair, soil renewal, biodiversity, adaptive capacity, institutional support	Whether ecological systems and stewardship institutions retain capacity to renew function after disturbance and changing conditions
Ecological generativity	Future ecological options, viable livelihoods, knowledge, stewardship capacity, relational continuity	Whether coupled ecological–economic configurations reproduce the conditions from which diverse future forms of life and economic activity can emerge

valuation can reveal dependence while still leaving ecological relations, heterogeneous meanings, and non-monetized forms of importance incompletely represented.

A human–ecological relation can involve several analytically different positions. Humans may depend on ecological processes, alter them, monitor them, restore them, represent them in institutions, derive livelihoods from them, or bear harms when they deteriorate. Non-human organisms and ecological systems can be affected by economic activity without possessing the same kinds of agency, legal standing, or representational capacity as human participants. Section 19.11 therefore carries forward the heterogeneous-subject discipline developed in Chapter 18: affectedness, agency,

representation, stewardship, and standing should be distinguished rather than collapsed.

Ecological dependence can also be spatially remote. Consumers can be connected to distant extraction, land-use change, fisheries, water use, and emissions through supply chains. The ecological incidence of an economic activity can therefore differ from the geographical location of production or consumption. Such displacement matters for responsibility because actors who benefit from an activity, actors who control it, and ecological systems that bear its effects can occupy different positions in the configuration.

Proposition 19.132 (Ecological-relational specification condition). *An economic analysis of ecological conditions is generatively informative only where consequential dependencies, affected ecological processes, mediating institutions, and relevant spatial and temporal scales are specified sufficiently to identify how ecological change alters feasible action and future capability.*

The proposition does not require complete ecological knowledge. It requires that uncertainty remain part of the configuration rather than disappearing behind an aggregate environmental indicator. Where ecological causal pathways are uncertain, governance can still distinguish high-dependence systems, plausible irreversible harms, monitoring gaps, and options whose preservation has value under uncertainty.

19.11.2 Material–Energy Flow Architecture

Economic processes transform matter and energy. Extraction, transport, manufacture, use, repair, recycling, decomposition, and disposal rearrange material stocks and generate dissipative flows. Georgescu-Roegen’s thermodynamic treatment is important because it resists describing the economy as a reversible circulation detached from physical transformation (Georgescu-Roegen 1971). GRE translates this insight into relational terms: a flow has a source, transformation pathway, infrastructure, temporal profile, destination, ecological incidence, and set of agents who control or depend on different stages.

Material circularity can reduce some extraction and waste, yet circularity is itself constrained by energy requirements, material degradation, contamination, geography, product design, collection systems, and economic incentives. Korhonen and colleagues emphasize several physical and systemic limitations of circular-economy claims (Korhonen et al. 2018). A generative analysis therefore asks which loops can be closed or slowed, which flows remain dissipative, who bears the costs of recovery, and whether lower per-unit throughput is offset by greater aggregate scale.

Energy requires similar care. An energy transition changes more than the source of electricity. It can reconfigure mining, land use, grids, storage, transport, labor, geopolitical dependency, local revenues, technical knowledge, and waste streams. The ecological-economic object is therefore the transformation pathway rather than one technology viewed in isolation.

Definition 19.133 (Ecological flow pathway). *An ecological flow pathway is the temporally ordered sequence through which material, energy, organisms, or residuals are extracted, transformed, transported, used, recirculated, dissipated, assimilated, or accumulated across ecological and institutional settings.*

Proposition 19.134 (Flow-incidence condition). *A material or energy intervention should be evaluated across its relevant flow pathway because local efficiency, recycling, or substitution can shift ecological burdens across stages, places, subjects, or time without reducing the configuration's total dependency or long-horizon ecological exposure.*

This condition places lifecycle reasoning within GRE's broader incidence analysis. It also helps distinguish an intervention that genuinely changes an ecological dependency from one that merely relocates it beyond the visible boundary of a firm, jurisdiction, or accounting period.

19.11.3 Ecological Stewardship Relations

Stewardship concerns the relations through which ecological conditions are observed, maintained, restored, governed, and transmitted. It can be performed by public agencies, communities, Indigenous institutions, landholders, firms, scientists, volunteers, or combinations of these positions. Stewardship is therefore neither equivalent to ownership nor confined to conservation organizations. A proprietor can lack the knowledge or incentive required for stewardship, while a community with limited formal ownership can maintain extensive ecological knowledge and practical responsibility.

The distinction matters because ecological systems often require recurrent maintenance rather than one-time protection. Fire regimes, invasive species, soil fertility, irrigation structures, habitat connectivity, fisheries, urban green infrastructure, and watershed conditions can depend on monitoring and adaptive intervention. Stewardship capacity therefore combines knowledge, time, labor, authority, legitimacy, resources, coordination, and institutional memory.

Responsibility should also remain differentiated. Control over a damaging activity, benefit from that activity, historical contribution, capacity to repair, proximity to harm, legal duty, and stewardship knowledge can point toward different actors. A relational approach can map these positions without presuming that one responsibility principle resolves every ecological case.

Definition 19.135 (Ecological stewardship capacity). *Ecological stewardship capacity is the relationally organized capability to observe, interpret, maintain, restore, and revise human interaction with an ecological configuration through sufficiently durable knowledge, authority, resources, participation, and institutional memory.*

Proposition 19.136 (Stewardship-reproduction condition). *Ecological stewardship is long-horizon generative where the knowledge, authority, resources, monitoring practices, and succession pathways required for maintenance can be reproduced across personnel, institutional, and environmental change.*

This proposition connects ecology with the book's broader emphasis on maintenance as a generative activity. Ecological stewardship can be highly generative even when its immediate observable is continuity rather than novelty. Preserving soil function, a breeding habitat, a floodplain, or a monitoring institution can maintain the substrate from which later possibilities remain available.

19.11.4 Ecological Commons Governance

Ecological systems often contain resources or processes that are jointly used, difficult to partition, mobile, interconnected, or costly to exclude from. Commons scholarship therefore provides an important domain interface. Ostrom's work demonstrates the empirical diversity of governance arrangements for common-pool resources (Ostrom 1990), while later social-ecological analysis situates resource systems, resource units, governance systems, users, interactions, and outcomes within coupled configurations (Ostrom 2009). Schlager and Ostrom further distinguish bundles of property rights rather than treating ownership as a single binary status (Schlager and Ostrom 1992).

The ecological domain extends the commons analysis developed in Section 19.7. A watershed can connect users who never meet. A migratory species can cross several jurisdictions. Atmospheric and ocean processes can exceed local governance boundaries. Ecological interdependence can therefore create commons problems whose participants, affected positions, and relevant scale are difficult to align within one community.

Governance must also reflect ecological heterogeneity. Rules suited to a stable irrigation system may not transfer to a migratory fishery or rapidly changing coastal ecosystem. Monitoring indicators, exclusion possibilities, seasonal variation, disturbance regimes, and uncertainty can differ substantially. Domain translation therefore requires correspondence between institutional boundaries and ecological processes rather than simply importing a familiar commons model.

Proposition 19.137 (Ecological-commons alignment condition). *Ecological commons governance is more capable of sustaining shared systems where rights, monitoring, rule revision, conflict-resolution pathways, and stewardship responsibilities correspond sufficiently to the ecological scale, temporal dynamics, and mobility of the resource or process being governed.*

The proposition does not imply that governance must occur at one scale. Polycentric arrangements can be appropriate where ecological processes and institutional capacities are distributed across nested levels (Ostrom 2010). The generative question concerns whether coordination among levels preserves learning and local knowledge while addressing cross-boundary effects that local actors cannot govern alone.

19.11.5 Intergenerational Ecological Relations

Ecological decisions frequently distribute consequences across generations. Soil degradation, species loss, groundwater depletion, persistent pollutants, long-lived infrastructure, climate change, and restoration investments can alter options for people who are absent from current decision processes. Intergenerational analysis is therefore not only a matter of discounting future outcomes. It concerns the transmission of ecological conditions, infrastructures, knowledge, institutions, liabilities, and option sets through time.

Future participants cannot fully specify their preferences to present institutions. Their circumstances and values will also differ from those presently known. This creates a representation problem analogous to other heterogeneous-subject settings in GRE: institutions must act under incomplete knowledge of later subjects while avoiding the assumption that present preferences exhaust future value.

Costanza and Daly's discussion of natural capital is relevant because it treats main-

tenance of ecological stocks as a sustainability problem under uncertainty and limited substitutability (Costanza and Daly 1992). GRE broadens the issue from stocks to relations. What is transmitted is not only an amount of “natural capital” but also ecological functioning, access, dependency patterns, restoration burden, monitoring knowledge, institutional capability, and the feasibility of later transformation.

Definition 19.138 (Intergenerational ecological inheritance). *Intergenerational ecological inheritance* is the historically accumulated configuration of ecological conditions, infrastructures, knowledge, institutions, dependencies, liabilities, and feasible restoration or transformation pathways transmitted to later participants through present ecological-economic decisions.

Proposition 19.139 (Intergenerational-option condition). *Long-horizon ecological governance is generatively stronger where present decisions preserve sufficiently diverse and intelligible future options, particularly where ecological losses may be difficult to reverse and future subjects cannot presently express the values they will attach to those options.*

Option preservation is not equivalent to freezing ecological systems in their present state. Ecologies change, climates shift, and some interventions deliberately transform landscapes. The condition concerns retaining the capability to learn, adapt, restore, or choose among future pathways rather than imposing irreversible closure where uncertainty is high.

19.11.6 Biophysical Constraint Architecture

Ecological constraints differ from ordinary institutional constraints because they can arise from material or biological processes whose operation does not depend on human recognition. Renewable resources have regeneration dynamics; sinks have assimilative capacities; materials degrade; organisms require habitat; hydrological systems impose spatial relations; and some ecological changes contain thresholds or long recovery times. Daly’s operational principles make this distinction explicit by relating resource use and waste to regenerative and assimilative capacities (Daly 1990).

Constraints are nevertheless relationally experienced. The same drought can affect households differently depending on water rights, infrastructure, wealth, crop choice, insurance, social protection, migration capability, and public capacity. A biophysical limit therefore enters economic life through institutional and technological conversion structures. GRE can recognize the physical constraint while still analyzing how its incidence is distributed and mediated.

Threshold-sensitive processes require particular caution. Holling’s resilience analysis distinguishes persistence under disturbance from stability around an equilibrium (Holling 1973). Planetary-boundary research similarly emphasizes interacting Earth-system processes and rising risk when key processes are substantially perturbed (Steffen et al. 2015). These frameworks should not be converted mechanically into one economic constraint vector. They instead show why some ecological relations may be nonlinear, multiscalar, and uncertain in ways that make reversibility, monitoring, and safety margins analytically important.

Definition 19.140 (Biophysical constraint profile). A *biophysical constraint profile* records the ecological regeneration rates, assimilative capacities, critical dependencies, threshold-sensitive processes, irreversibilities, spatial couplings, and uncertainty conditions that materially restrict or condition a specified economic

configuration.

Proposition 19.141 (Constraint-conversion condition). *Biophysical constraints become economically consequential through conversion structures that distribute exposure, adaptation capacity, scarcity, access, and loss across heterogeneous subjects; ecological analysis therefore requires both the physical constraint and the institutional architecture through which its effects are realized.*

This proposition keeps GRE from reducing ecological constraint either to a price signal or to an unmediated natural fact. Both levels matter. Physical dynamics can constrain feasible action, while social arrangements shape who encounters the constraint, when, and with which capacities to respond.

19.11.7 Regenerative Ecological Capacity

Regeneration concerns the capacity of ecological systems to renew functions, relations, populations, structures, or processes over time. Regeneration can involve biological reproduction, succession, soil formation, nutrient cycling, habitat restoration, hydrological recovery, or re-establishment of ecological relations after disturbance. It can also depend on human institutions that reduce pressure, restore habitat, monitor change, and sustain maintenance.

Regeneration should be distinguished from simple return to a previous state. Holling's account of resilience already cautions against equating ecological persistence with equilibrium stability (Holling 1973). Ecological systems can reorganize while retaining important functions, and restoration may seek a viable future configuration rather than exact historical replication. GRE therefore treats regeneration as a capacity concept indexed to specified ecological functions and values.

The same distinction applies to economies. A region dependent on a degraded ecosystem may need livelihood transformation alongside ecological restoration. Restoration that removes local access without viable alternatives can generate social conflict and weaken stewardship. Conversely, livelihood interventions that ignore ecological regeneration can stabilize income temporarily while eroding the material basis of future production. Regenerative analysis must therefore connect ecological and social capability rather than treating them as separate objectives.

Definition 19.142 (Regenerative ecological capacity). *Regenerative ecological capacity* is the historically conditioned capability of an ecological configuration, together with relevant stewardship institutions, to renew or reorganize specified ecological functions and relations after use, disturbance, or environmental change without exhausting the conditions required for continued renewal.

Proposition 19.143 (Regenerative-capacity condition). *An ecological-economic arrangement is more regenerative where rates and forms of use remain compatible with the renewal or adaptive reorganization of valued ecological functions, while stewardship institutions retain the knowledge and capability required to detect deterioration and revise practice.*

The proposition does not assume that every ecological function should be preserved indefinitely. It requires specification of what is being regenerated, for whom or for what affected systems it matters, which transformations remain acceptable, and how uncertainty enters the judgment. Regeneration remains a domain-specific evaluative object rather than a universal positive scalar.

19.11.8 Ecological Generativity

Ecological generativity integrates the preceding architecture without collapsing ecological value into economic productivity. Ecological systems generate and sustain conditions from which human and non-human life, livelihoods, knowledge, cultural relations, and future economic forms become possible. Economic institutions can support this capacity through maintenance, restraint, restoration, stewardship, monitoring, and adaptation, or they can narrow it through depletion, fragmentation, contamination, irreversible conversion, and the erosion of stewardship institutions.

Definition 19.144 (Ecological generativity). *Ecological generativity* is the capacity of an ecological-economic configuration to sustain and regenerate the ecological relations, material conditions, stewardship capabilities, institutional learning, and option structures from which diverse future forms of life and economic participation can continue to emerge and be revised.

Ecological generativity is wider than preservation and narrower than an assertion that every ecological change is undesirable. A dynamic landscape can be generative when ecological functions, adaptive capacity, and future options remain rich. A highly stable but degraded regime can be weakly generative if it supports few viable trajectories. Likewise, a technologically productive economy can be ecologically ungenerative where its throughput, pollution, or habitat effects progressively eliminate the conditions required for later activity.

Proposition 19.145 (Ecological-generativity condition). *An ecological-economic configuration is generatively stronger where material and energy flows remain compatible with relevant regenerative capacities, critical ecological dependencies are visible, stewardship capability is reproduced, commons governance corresponds to ecological scale, intergenerational options remain sufficiently open, threshold-sensitive risks are governed with appropriate caution, and affected ecological relations remain capable of informing institutional revision.*

The final clause requires representational care. Ecological entities and processes do not enter institutions in the same way as human citizens or organizations. Their effects can be represented through science, monitoring, stewardship practice, legal institutions, community knowledge, indicators, and other epistemic interfaces. Such representation remains partial. GRE should therefore distinguish ecological reality from the institutional representations through which decisions respond to it, consistent with the book's broader separation of relational and manifestation layers.

The ecology domain returns several remainders to GRE. First, some constraints operate independently of institutional recognition, which sharpens the distinction between socially constituted rules and biophysical conditions. Second, non-human affectedness can be economically consequential even where agency or standing remains disputed. Third, ecological relations can connect distant places and generations without direct interaction among affected participants. Fourth, regeneration can involve reorganization rather than restoration to an earlier state. Fifth, maintenance and restraint can be generative activities because they preserve the conditions for later possibility. Sixth, irreversible ecological transformation can narrow future option sets before its full economic value is representable in present institutions.

These remainders strengthen the book's account of relational sustainability developed in Chapter 16. Sustainability concerns more than persistence of an institution or resource stock. It requires attention to whether the relations that sustain capabil-

ity and future generation remain reproducible under changing ecological conditions. The ecological domain also adds a stronger physical meaning to the book's concept of generative spacetime: ecological histories accumulate through succession, extraction, contamination, restoration, climate processes, infrastructure, and institutional learning, and these histories alter the topology of feasible future action.

Section 19.12 turns to culture and symbolic economy. The transition is substantive rather than merely sequential. Ecological relations are mediated by classifications, narratives, aesthetic judgments, identities, sacred meanings, scientific representations, and symbols that shape what societies perceive as valuable, degraded, natural, repairable, or worthy of protection. Culture therefore enters ecological economy not only as an external preference but as part of the symbolic infrastructure through which ecological relations become visible, contestable, and actionable.

19.12 Culture and Symbolic Economy

Culture provides a distinctive test for Generative Relational Economics because many economically consequential objects acquire significance through interpretation, recognition, memory, convention, aesthetic judgment, and historically situated symbolic relations. Cultural activity includes markets for artworks, performances, media, design, publishing, heritage, and entertainment, yet its economic structure extends beyond traded cultural goods. Languages, narratives, classifications, reputations, rituals, archives, styles, institutions, shared references, and practices of interpretation can condition who is recognized, what receives attention, which histories remain legible, and which possible forms of collective life become imaginable. The role of the present section is therefore to translate GRE into cultural and symbolic economy without reducing culture either to preference over commodities or to an autonomous sphere detached from material institutions. Its objectives are to specify cultural relational architecture; distinguish symbolic production from symbolic realization; analyze attention and visibility; treat meaning as relational and historically revisable; locate aesthetic judgment within plural evaluative practices; identify cultural infrastructure and transmission capacity; examine AI-mediated symbolic abundance; and define cultural generativity as a long-horizon capacity for continued creation, reinterpretation, participation, and transmission.

Several established traditions provide partial points of contact. Cassirer analyzes language, myth, art, religion, and science as symbolic forms through which experience becomes articulated and intelligible (Cassirer 1955). Geertz's interpretive anthropology emphasizes culturally situated webs of meaning and the importance of contextual interpretation (Geertz 1973). Bourdieu shows that taste, classification, language, and symbolic power are socially structured and can participate in differentiation and reproduction (Bourdieu 1984; Bourdieu 1991). Cultural economics, including Throsby's account, distinguishes economic from cultural value and treats cultural capital as analytically consequential where heritage, artistic significance, and other forms of cultural value are incompletely represented by price (Throsby 2001). GRE does not combine these traditions into one theory. It uses them as disciplined interfaces for examining how symbolic relations enter access, allocation, recognition, value formation, institutional reproduction, and future generative capacity.

The culture domain also sharpens the distinction between an artifact and the rela-

tions through which it becomes culturally consequential. A text, image, song, performance, ritual, archive, style, or symbol can remain materially available while losing interpretive context, institutional recognition, linguistic accessibility, or the communities capable of making use of it. Conversely, a cultural form can remain generative after its original material carrier disappears where practices, techniques, stories, conventions, and capacities have been transmitted. Economic analysis therefore requires attention to both symbolic objects and the relations, institutions, and infrastructures through which they become legible, contestable, transmissible, and capable of further transformation.

Table 19.12 summarizes the eight diagnostic dimensions developed in this section. The table is analytical rather than evaluative. High visibility can accompany shallow engagement; strong preservation can support continuity or freeze one authorized interpretation; abundant production can widen participation or intensify dependence on concentrated infrastructures; and cultural continuity can coexist with substantial reinterpretation. GRE therefore treats cultural generativity as a relational capacity whose relevant values remain plural and historically situated.

Definition 19.146 (Cultural-symbolic configuration). A *cultural-symbolic configuration* is a historically situated arrangement of symbolic objects, practices, participants, interpretive communities, institutions, infrastructures, languages, conventions, memories, attention structures, and value relations through which cultural meanings are produced, recognized, circulated, contested, preserved, and transformed.

Definition 19.146 places markets inside a wider relational field. A commercial platform, museum, neighborhood festival, literary tradition, fan community, religious practice, language community, independent music scene, archive, design profession, or digital creator ecosystem can each organize symbolic production and recognition differently. Some configurations rely heavily on prices and intellectual-property arrangements; others rely on reputation, reciprocity, patronage, public funding, volunteer labor, ritual authority, community stewardship, or mixed arrangements. The GRE task is to identify the relevant relations without assuming that one institutional form exhausts cultural economy.

19.12.1 Cultural Relational Architecture

Culture is reproduced through relations among makers, interpreters, audiences, teachers, critics, curators, custodians, institutions, communities, infrastructures, and historically inherited symbolic forms. These positions need not be sharply separated. A participant can create, interpret, teach, preserve, finance, criticize, and transmit within the same cultural configuration. What matters analytically is the relation through which a practice or symbolic object becomes consequential.

This relational architecture helps explain why cultural participation cannot be inferred from consumption alone. Purchasing a book, streaming music, visiting a museum, contributing to an online community, learning a language, performing in a local ensemble, preserving an archive, and transmitting a family practice involve different forms of participation. Their economic requirements also differ. Money, time, education, linguistic capability, physical access, social recognition, technical infrastructure, institutional permission, and community standing can each condition participation. A low monetary price can coexist with high relational barriers, while a costly cultural object can circulate widely through institutions that subsidize or share

Table 19.12: Diagnostic dimensions for generative analysis of culture and symbolic economy.

Cultural dimension	Immediate observable	Long-horizon generative question
Cultural relations	Participation, interpretation, recognition, belonging, practice, shared reference	Whether cultural relations remain accessible, revisable, and capable of supporting plural participation across changing contexts
Symbolic production	Texts, images, performances, styles, classifications, narratives, reputational signals	Whether production is accompanied by pathways of attribution, interpretation, recognition, and further cultural transformation
Attention and visibility	Audience reach, curation, ranking, recommendation, prestige, institutional selection	Whether attention allocation preserves discovery, contestability, and exposure to heterogeneous cultural possibilities
Meaning	Interpretive context, language, memory, convention, narrative, historical reference	Whether symbolic objects retain enough context and interpretive plurality to remain intelligible and reinterpretable over time
Aesthetic judgment	Selection, taste, evaluation, criticism, orientation, artistic problem formation	Whether evaluative practices remain plural, cultivated, contestable, and capable of orienting creation beyond immediate popularity or price
Cultural infrastructure	Archives, libraries, venues, schools, rights, funding, preservation, platforms, community institutions	Whether infrastructures reproduce access, capability, preservation, transmission, and institutional memory across generations
AI-mediated culture	Synthetic artifacts, hybrid creation, model dependence, provenance, attribution, scalable variation	Whether expanded generative capacity preserves meaningful participation, provenance, attribution, interpretive capacity, and cultural diversity
Cultural generativity	New forms, reinterpretation, transmission, recombination, collective memory, future participation	Whether cultural configurations reproduce the capacities and relations from which diverse later cultural forms can emerge and be revised

access.

Cultural relations also distribute recognition. Bourdieu's analyses of taste and symbolic power are useful here because cultural classification can participate in social differentiation and institutional reproduction (Bourdieu 1984; Bourdieu 1991). GRE extends the question by asking how recognition changes later possibility. Recognition can open access to commissions, audiences, education, archives, funding, institutional standing, collaboration, and future attention. Misrecognition or invisibility can narrow those pathways even when productive capability remains present. Symbolic standing therefore functions as one conversion interface through which cultural relations acquire economic consequences.

Proposition 19.147 (Cultural-realization condition). *A cultural object or practice becomes economically and institutionally consequential through relations of access, interpretation, recognition, circulation, and uptake; production or material availability alone therefore provides an incomplete account of its realized cultural position.*

Proposition 19.147 does not imply that institutional recognition is required for cultural value. Informal, marginalized, emergent, or deliberately private practices can carry substantial meaning and generative importance. The proposition concerns realization within a specified cultural-economic field: an artifact can exist without entering the relations through which a particular institution, audience, or community can recognize, use, contest, or transmit it.

The relational architecture also includes exclusion and silence. Some cultural positions are absent because entry costs are high; others because classifications render them illegible; others because languages, archives, venues, rights, or transmission chains have been weakened. Such absence should not automatically be interpreted as lack of demand or cultural significance. It can be an outcome of the architecture through which participation and recognition are organized.

19.12.2 Symbolic Production and Recognition

Symbolic production concerns the generation and transformation of texts, images, performances, sounds, designs, classifications, names, narratives, reputational markers, and other forms through which meaning can be expressed or coordinated. These artifacts can enter markets directly, but they can also influence economic action indirectly by shaping identities, expectations, legitimacy, aspiration, trust, memory, or institutional classification. Cassirer's symbolic-form analysis provides one philosophical precedent for treating symbolic articulation as constitutive of intelligible experience rather than merely decorative representation (Cassirer 1955).

GRE distinguishes symbolic production from symbolic realization and symbolic value. Production describes the generation of a symbolic form. Realization concerns whether that form enters consequential relations of interpretation, recognition, circulation, or action. Value concerns the heterogeneous evaluations attached to the form or the relations it sustains. These layers can diverge substantially. A work can be expensive to produce and culturally marginal, cheap to produce and historically influential, commercially successful and critically contested, or institutionally prestigious while inaccessible to many communities.

Appadurai's account of commodities and the politics of value is relevant because objects can move through socially organized trajectories in which their value changes with context and classification (Appadurai 1986). Cultural-symbolic objects make this dependence especially visible. An archival document, ceremonial object, meme, recording, photograph, manuscript, digital artwork, or fashion item can acquire different meanings and valuations as it moves among private, commercial, institutional, sacred, educational, or political settings.

Definition 19.148 (Symbolic production relation). *A symbolic production relation is a relation through which one or more participants generate, select, transform, attribute, circulate, or institutionally recognize a symbolic form whose significance depends partly on the cultural configuration in which it is interpreted.*

Proposition 19.149 (Symbolic-recognition condition). *Expansion of symbolic production increases cultural possibility most reliably where channels of interpretation, at-*

tribution, recognition, and reuse also remain available; an increase in artifact volume alone can enlarge symbolic abundance while leaving realized cultural diversity weak.

The proposition becomes increasingly important where production costs fall. Cheap tools can enable more participants to create, translate, remix, visualize, publish, or perform. Yet the effective diversity of a cultural field also depends on which outputs become discoverable, which creators gain standing, which languages and styles remain legible, and whether communities retain capacity to interpret and transform the resulting material. Symbolic abundance therefore relocates scarcity toward attention, trust, context, recognition, and judgment, consistent with the epistemic analysis of Chapter 17.

19.12.3 Attention Allocation and Cultural Visibility

Culture requires attention because symbolic objects compete for finite perceptual, cognitive, institutional, and social capacity. Simon's analysis of information-rich environments identifies the basic scarcity relation: abundance of information consumes scarce recipient attention (Simon 1971). Cultural fields add further layers because attention is mediated by critics, curators, publishers, schools, festivals, galleries, broadcasters, platforms, recommendation systems, prestige institutions, peer communities, and interpersonal networks.

Attention allocation affects more than immediate audience size. Visibility can influence whether a creator obtains future commissions, whether a tradition attracts learners, whether an archive receives preservation resources, whether a style becomes imitable, whether a language retains public presence, and whether a cultural controversy enters institutional memory. Attention can therefore compound historically. Early visibility may create later visibility through reputation, recommendation, search ranking, citation, canon formation, platform feedback, or institutional collection.

At the same time, visibility should not be equated with cultural value. Outrage, novelty, celebrity, controversy, algorithmic amplification, or concentrated marketing can produce high attention without durable cultural significance. Conversely, culturally important practices can remain local, slow, difficult, specialized, private, or institutionally neglected. The relevant GRE object is therefore the allocation mechanism through which attention is distributed and converted into later opportunities.

Definition 19.150 (Cultural attention allocation). *Cultural attention allocation* is the configuration of curatorial, institutional, interpersonal, market, and algorithmic processes through which limited attention is distributed among competing or coexisting symbolic objects, practices, creators, and traditions.

Proposition 19.151 (Visibility-option condition). *Attention allocation is more generatively enabling where culturally relevant positions retain practicable routes to discovery, interpretation, and renewed visibility, and where temporary invisibility does not irreversibly eliminate the capacities required for later cultural participation.*

This proposition favors neither equal visibility nor permanent preservation of every cultural object. Attention is necessarily selective. The concern is whether selection becomes so concentrated, path-dependent, opaque, or infrastructure-dependent that alternative cultural trajectories become difficult to regenerate. Libraries, archives, public media, local venues, independent publishers, educational institutions, search systems, and community networks can matter partly because

they diversify the temporal structure of attention: material that is not prominent today can remain discoverable later.

19.12.4 Meaning, Interpretation, and Cultural Memory

Meaning is central to culture because symbolic forms do not carry a complete and invariant significance independently of language, convention, history, practice, and interpretive context. Geertz's interpretive account of culture is relevant precisely because it emphasizes contextual meaning rather than treating observable behavior as self-explanatory (Geertz 1973). GRE translates this insight economically by asking which infrastructures and relations preserve or alter the capacity to interpret symbolic objects across time.

A cultural artifact can survive materially while becoming semantically thin. A ritual can be recorded but detached from the community that understands its sequence. A manuscript can remain preserved while the relevant language becomes unreadable. A digital object can persist while software, metadata, provenance, or platform context disappears. A quotation can circulate while its original argumentative setting is lost. Cultural preservation therefore requires more than storage. It can require documentation, translation, custodial practice, education, commentary, institutional memory, and preservation of relations among objects.

Meaning can also change productively. Later communities reinterpret inherited works under new historical experiences, conceptual vocabularies, political conditions, artistic practices, and ethical judgments. Such reinterpretation need not imply that earlier meanings were false or disposable. Several meanings can coexist, conflict, or become historically layered. This is compatible with the book's broader treatment of re-epistemization in Chapter 17: preservation has generative value partly because later contexts can disclose questions and relations unavailable to earlier interpreters.

Definition 19.152 (Meaning-bearing cultural relation). *A meaning-bearing cultural relation is a historically situated relation among a symbolic object or practice, its interpretive contexts, participants, conventions, memories, and institutions through which significance becomes intelligible and capable of later reinterpretation.*

Proposition 19.153 (Interpretive-context condition). *Cultural preservation has greater long-horizon generative value where enough linguistic, historical, relational, and provenance context survives for later participants to reconstruct, contest, and reinterpret significance rather than merely encounter an isolated surviving artifact.*

The proposition is intentionally scoped. Complete preservation of context is impossible because contexts themselves evolve and expand. The practical objective is to preserve sufficient interpretive capacity for relevant future uses, while accepting that later meanings will remain partly contingent. This also limits claims of authenticity: provenance and historical continuity can be documented to varying degrees, yet they do not freeze one final interpretation of what an object means.

19.12.5 Aesthetic Judgment and Cultural Orientation

Cultural fields require selection among more possible forms than any participant can fully experience, produce, preserve, or support. Aesthetic judgment therefore has an allocative and orientational role in addition to its philosophical significance. It

can guide attention toward particular forms, direct artistic practice, influence institutional acquisition, shape education, affect patronage, and help creators decide which possibilities merit sustained development.

Aesthetic judgment should not be identified with price, popularity, prestige, technical complexity, or one universal criterion. Kant's account of aesthetic judgment remains an important classical reference for the distinctive structure of judgments of taste and their claims to communicability (Kant 1987). Dewey emphasizes aesthetic experience as developing through relations of perception, action, undergoing, and environment (Dewey 1934). Contemporary psychological work likewise treats aesthetic appreciation as a multi-stage process involving perception, classification, understanding, and evaluation (Leder et al. 2004). Bourdieu, meanwhile, demonstrates that taste is socially structured and implicated in distinction (Bourdieu 1984). Taken together, these literatures caution against both pure subjectivism and socially unconditioned universalism.

GRE treats aesthetic judgment as one heterogeneous orientation mechanism within cultural economy. It can help participants notice formal coherence, tension, novelty, historical resonance, craft, expressive force, or unexplored possibility. It can also reproduce exclusion where institutionalized taste is mistaken for neutral competence. The relevant economic question concerns how capacities for judgment are cultivated, whose judgments acquire conversion power, how criticism remains contestable, and whether alternative evaluative communities can survive.

Proposition 19.154 (Aesthetic-orientation condition). *Aesthetic judgment contributes to cultural generativity where evaluative capacities are cultivated through encounter, practice, history, criticism, and plural participation, while institutional arrangements leave room for contested judgments and emerging forms that lack established recognition.*

Problem formation is relevant here as well. Getzels and Csikszentmihalyi's work on artistic problem finding supports the distinction between solving a supplied problem and selecting or constructing the problem to be pursued (Getzels and Csikszentmihalyi 1976). Cultural generativity often depends on this upstream orientation: artists, designers, writers, performers, curators, and communities generate new questions about form, representation, memory, identity, and experience before any market can evaluate the resulting output. Aesthetic institutions can therefore be economically consequential partly because they shape the space of problems that receive sustained creative attention.

19.12.6 Cultural Infrastructure and Transmission Capacity

Cultural infrastructure includes the material, institutional, technical, legal, educational, linguistic, and relational arrangements through which cultural practice can continue. Venues, studios, archives, libraries, museums, schools, publishers, broadcasters, repositories, public spaces, platforms, funding mechanisms, professional associations, community organizations, preservation systems, and rights regimes can all form part of such infrastructure. Their importance lies less in institutional form than in the functions they make reproducible.

These functions include access, practice, training, documentation, preservation, criticism, commissioning, attribution, coordination, translation, discovery, repair, succession, and intergenerational transmission. An orchestra requires instruments

and a venue, yet it also requires musicianship, rehearsal practices, notation or memory, organizational coordination, audiences, and institutional continuity. A language requires speakers, but its long-horizon vitality can also depend on education, media, documentation, public use, digital support, and intergenerational transmission. An archive requires storage, but practical cultural access may depend on cataloguing, context, rights clearance, conservation expertise, translation, and discovery systems.

Definition 19.155 (Cultural transmission capacity). *Cultural transmission capacity* is the historically conditioned capability of a cultural-symbolic configuration to preserve, teach, reinterpret, perform, reproduce, translate, and transform cultural forms and practices across participants, institutions, media, and generations.

Proposition 19.156 (Infrastructure-transmission condition). *Cultural infrastructure is generatively stronger where it reproduces practical capacities for participation, interpretation, preservation, and transformation rather than preserving symbolic objects without the relations and skills required for their continued cultural use.*

This proposition clarifies the relation between preservation and change. Cultural transmission does not require exact replication. Traditions often survive through reinterpretation, hybridization, translation, improvisation, and new technical media. Preservation can become ungenerative where one authorized form is protected while living participation disappears. Conversely, continual novelty can become ungenerative where transmission chains, historical memory, or craft capability erode so extensively that future participants lose access to inherited possibility. Cultural infrastructure therefore mediates continuity and transformation rather than selecting one as universally preferable.

Cultural infrastructure also has a distributional structure. Major institutions can preserve rare expertise and collections while concentrating attention or access. Small organizations can support local experimentation while remaining financially fragile. Digital platforms can lower publication costs while creating new gatekeeping dependencies. Public funding can protect forms weakly represented by commercial demand while also shaping institutional priorities. GRE therefore asks how infrastructure distributes capability, dependency, recognition, and future option value across the cultural field.

19.12.7 AI-Mediated Cultural Production

Artificial intelligence changes cultural economy by expanding the speed, scale, and accessibility of symbolic generation, transformation, translation, imitation, recombination, and personalization. Chapter 18 analyzed this general condition as artificial symbolic productive capacity and symbolic abundance. The culture domain adds a different question: how does machine-mediated generation alter the relations through which cultural authorship, participation, authenticity, provenance, style, recognition, and meaning are organized?

AI-mediated cultural production can widen entry into some practices. Participants with limited technical skill can prototype images, music, text, video, or design; translation can connect linguistic communities; accessibility tools can convert media across modalities; and creators can explore more variants before committing to one form. These effects can expand expressive possibility. Their long-horizon value nevertheless depends on whether participants also develop or retain capacities for judgment, interpretation, attribution, editing, situated expression, and independent

cultural practice.

The same systems can intensify infrastructure dependence. Access to models, compute, training data, interfaces, moderation systems, distribution channels, and platform visibility can become conditions of cultural participation. A creator may gain output capacity while becoming dependent on a narrow model ecosystem, opaque ranking process, or unstable licensing and access arrangement. AI-generated abundance can also make provenance and attribution more consequential because audiences and institutions may need to distinguish origin, transformation history, authorized use, and synthetic modification. Contemporary provenance standards such as C2PA provide technical mechanisms for recording signed assertions and content history, while explicitly leaving truth and evaluative judgment to wider institutional processes (Coalition for Content Provenance and Authenticity 2026).

Definition 19.157 (AI-mediated cultural configuration). *An AI-mediated cultural configuration is a cultural-symbolic configuration in which artificial systems materially participate in generation, transformation, selection, translation, distribution, recommendation, attribution, preservation, or interpretation, together with the human and institutional relations that govern those operations.*

Proposition 19.158 (Synthetic-abundance cultural condition). *AI-mediated symbolic abundance expands cultural generativity where increased production and variation are accompanied by durable capacities for provenance, attribution, interpretation, judgment, participation, and independent or plural pathways of cultural distribution.*

The proposition does not establish a privileged boundary between human and machine creativity. Questions of consciousness, authorship, agency, and moral standing remain separate and can require legal, philosophical, or empirical analysis beyond the present chapter. The economic concern is relational: which participants control the infrastructure, whose prior cultural contributions become inputs, how recognition and income are distributed, which styles receive exposure, how communities can contest synthetic representation, and whether cultural capacities remain widely reproducible under changing technical conditions.

AI also intensifies the difference between authenticity and value. A documented human origin can matter greatly in one cultural setting and little in another. A synthetic work can be culturally meaningful despite artificial generation; a human-made work can be derivative or manipulative; and a technically authentic record can still be interpreted misleadingly. Provenance is therefore one informational layer within cultural judgment rather than a universal substitute for interpretation.

19.12.8 Cultural Generativity

Cultural generativity integrates the preceding architecture by asking whether a cultural-symbolic configuration reproduces the capacity for later creation, interpretation, participation, memory, judgment, and transformation. Throsby's distinction between economic and cultural value is especially relevant at this point because cultural continuity and future cultural possibility can matter even where immediate market returns are weak or indeterminate (Throsby 2001). GRE adds a temporal-relational emphasis: the analytical object is not only the value of an existing cultural asset but the configuration through which later cultural forms can continue to emerge.

Definition 19.159 (Cultural generativity). *Cultural generativity is the capacity of a*

cultural-symbolic configuration to reproduce and revise the relations, capabilities, infrastructures, memories, interpretive practices, attention pathways, and evaluative spaces from which diverse future cultural forms can emerge, circulate, acquire meaning, and be transformed.

Cultural generativity includes continuity and innovation without making either an unconditional objective. A language community can be generative through transmission and new expression. A musical tradition can remain generative through reinterpretation, improvisation, and encounter with other forms. An archive can be generative by preserving materials that later scholarship or communities reinterpret. A digital platform can be generative when it enables diverse participation, discoverability, attribution, and viable creator trajectories. A museum can be generative when collections, scholarship, education, and contestable interpretation support future cultural relations rather than only conserving objects.

Proposition 19.160 (Cultural-generativity condition). *A cultural-symbolic configuration is generatively stronger where symbolic production remains connected to interpretation and recognition, attention pathways permit renewed discovery, meanings remain historically reconstructible and contestable, aesthetic judgment is cultivated without premature closure, transmission infrastructures reproduce practical capability, and technological mediation preserves plural routes for attribution, participation, and future transformation.*

The proposition is intentionally multidimensional. High production can coexist with weak interpretation. Strong preservation can coexist with declining participation. Wide access can coexist with attention concentration. Diverse creators can coexist with homogeneous distribution. Rich historical memory can coexist with exclusionary institutional standing. No single metric therefore captures cultural generativity without substantial loss of structure.

The culture domain returns several remainders to GRE. First, symbolic objects can have economic effects through meaning and recognition even where their material characteristics remain unchanged. Second, attention is both scarce and historically cumulative, making cultural opportunity sensitive to selection architectures. Third, meaning belongs partly to relations among objects, interpreters, histories, and institutions rather than to detachable artifacts alone. Fourth, aesthetic judgment can orient generation before stable metrics exist, while remaining socially situated and contestable. Fifth, preservation can require maintenance of interpretive and practical capability rather than only retention of objects. Sixth, authenticity, provenance, attribution, and cultural value are distinct dimensions. Seventh, symbolic abundance can increase rather than eliminate scarcity by relocating it toward attention, trust, contextual interpretation, and orientation. Eighth, cultural continuity can depend on transformation because living traditions often reproduce themselves through reinterpretation rather than exact replication.

These remainders sharpen the broader GRE account of value developed in Chapter 14. Cultural value frequently passes through incomplete conversion interfaces: price can represent some dimensions while missing historical significance, communal meaning, identity, aesthetic experience, or future option value. The culture domain also strengthens the book's account of power because control over classification, visibility, language, archives, reputational signals, and distribution infrastructures can alter which symbolic forms acquire consequential standing. Finally, culture strengthens the account of generative spacetime because symbolic histories accumu-

late through transmission, forgetting, reinterpretation, canon formation, technological change, and institutional memory, thereby altering the space of forms that later participants can perceive as possible.

Section 19.13 turns from individual domains to comparative synthesis. The comparative task is not to search for one vocabulary that erases domain differences. It is to identify recurring relational mechanisms while preserving the remainders revealed by education, research, organizations, assistance, welfare, commons, platforms, public institutions, migration, ecology, and culture. Culture provides a final reminder before that comparison: successful translation requires more than shared words. Similar terms can carry different histories, meanings, evaluative stakes, and institutional effects across domains, and those differences can themselves be analytically generative.

19.13 Comparative Domain Synthesis

Sections 19.2–19.12 translated Generative Relational Economics into eleven domains whose objects, mechanisms, values, institutions, temporalities, and evidential practices differ substantially. The role of the present section is to compare those translations without converting their recurrence into a claim of theoretical identity. Its objective is to identify which GRE structures travel across domains, which require domain-specific reformulation, where transfer fails, and which remainders place pressure on GRE itself. The discussion therefore proceeds comparatively: it first records domain-specific analytical returns, then distinguishes recurring structures from domain-differentiated mechanisms, examines transfer failures and boundary conditions, derives domain-driven revisions of GRE, specifies the scope of warranted generalization, identifies contributions that may later inform a broader Generative Relational Theory (GRT), and closes by defining an open programme of further domain expansion.

Comparative synthesis is especially important for an open research programme because repeated vocabulary can create a false appearance of unity. Education, research, organizations, welfare, platforms, ecology, and culture all involve access, capability, dependency, value, maintenance, participation, and future possibility, yet these terms refer to different relations in each domain. Educational access concerns participation in learning relations and infrastructures; platform access can concern admission, visibility, technical functionality, or transaction; ecological access may concern rights of use, stewardship, or exposure to ecological conditions; cultural access can concern interpretive intelligibility as well as material availability. Similarity is therefore analytically useful only where the correspondence among subjects, relations, mechanisms, constraints, temporal scales, and values is made explicit.

The domain studies also reveal that the direction of correction runs both ways. GRE provides a shared vocabulary for examining relational configuration, heterogeneous value, generative capability, dependency, power, historical pathways, and future possibility. The domains in turn reveal where that vocabulary is too coarse. Welfare emphasizes continuity and recurrent protection; commons emphasize collective capacity and stewardship; platforms reveal executable institutional architecture; migration reveals multi-jurisdictional standing and portability; ecology introduces biophysical constraint and non-human affectedness; culture makes interpretive context

Table 19.13: Comparative domain returns and domain-specific remainders.

Domain	Recurrent GRE structure made concrete	Domain-specific remainder or revision pressure
Education	Capability formation, access, participation, generative return	Curiosity, problem formation, aesthetic orientation, and assistance-to-capability conversion
Research	Epistemic infrastructure, collective capability, preservation, openness	Research-agenda formation, reconstructibility, distributed verification, and re-epistemization
Work and organizations	Membership, contribution, coordination, capability reproduction	Differentiation among employment, membership, contribution, care, recognition, and participation
Development and humanitarian practice	Conversion, dependency, participation, transition capacity	Compressed humanitarian temporality, local relational capacity, and bounded external substitution
Welfare and social protection	Access, continuity, capability protection, public provision	Entitlement–access pathways, recurrent protection, supportive dependency, and maintenance as generative activity
Communities and commons	Shared resources, trust, rule formation, stewardship	Collective capacity irreducible to individual sums and reproduction of common governance relations
Platforms and digital economies	Mediation, visibility, dependency, access, governance	Executable institutional architecture, recoverable exit, data capture, and scale as a relational amplifier
Public institutions and infrastructure	Authority, access, learning, maintenance, revisability	Mandate-bound authority, reproducible public capacity, institutional trustworthiness, and long-horizon continuity
Migration and transnational relations	Capability, standing, conversion, dependency, circulation	Multi-jurisdictional standing, portability, distributed care, and mobility as a plural option structure
Ecology	Constraint, stewardship, commons, regeneration, intergenerational inheritance	Biophysical constraints, non-human affectedness, ecological scale, irreversibility, and regenerative function
Culture and symbolic economy	Value, attention, recognition, transmission, historical memory	Meaning, interpretation, aesthetic judgment, symbolic realization, and transmission of interpretive capacity

and symbolic recognition analytically unavoidable. Comparative synthesis therefore functions primarily as a revision mechanism whose findings remain open to further correction.

Table 19.13 summarizes the principal analytical return and domain-specific remainder identified across the eleven domains. The table is non-ranking and treats remainders as potentially shared across fields. It identifies the domain in which a particular issue became especially visible and therefore exerted distinctive pressure on GRE’s general architecture.

Definition 19.161 (Comparative domain synthesis). *A comparative domain synthesis* is a structured comparison of domain translations that identifies recurrent relational structures, domain-specific mechanisms, transfer boundary conditions, and revision pressures while preserving differences in subjects, values, constraints, temporalities, and evidential requirements.

Definition 19.161 makes comparison a method of controlled abstraction. The objective is controlled comparison across domain findings. A useful synthesis should preserve enough structure to explain why the same GRE term behaves differently across domains and enough commonality to permit learning across them.

19.13.1 Domain-Specific Analytical Returns

The domain studies return more to GRE than illustrations. Each domain exposes a mechanism that becomes difficult to see when economic analysis begins from exchange, allocation, or production alone. Education shows that access and assistance matter partly through their effects on later capability regeneration. Research insti-

tutions show that knowledge production depends on agenda formation, verification, preservation, and communities capable of reconstructing prior work. Work and organizations separate livelihood, membership, authority, recognition, care, and contribution. Development and humanitarian practice make conversion pathways and transition capacity central. Welfare reveals the importance of recurrent protection and institutional continuity. Commons expose collective stewardship capacities that can exist at the configuration level. Platforms reveal the fusion of infrastructure, rule execution, visibility, and data capture. Public institutions make mandate, administrative reach, trustworthiness, and capability reproduction unavoidable. Migration reveals distributed standing across jurisdictions. Ecology places biophysical constraint and regenerative function inside economic architecture. Culture makes symbolic realization, interpretation, and aesthetic orientation economically consequential.

These returns can be organized into three broad families. The first concerns *conversion*. Resources, rights, information, services, infrastructures, or formal permissions acquire practical effect only through relations that convert them into usable capability, participation, recognition, or protection. Educational assistance, welfare entitlement, remittance income, public services, platform membership, and cultural availability all exhibit this structure in different forms. Conversion therefore appears as a recurring GRE problem, while the conversion interface remains domain-specific.

The second family concerns *reproduction*. Many economic arrangements persist only when they reproduce the capacities that make later action possible. Research systems reproduce epistemic capability; organizations reproduce professional and coordinative capability; welfare systems reproduce conditions of secure participation; commons reproduce stewardship relations; public institutions reproduce administrative and maintenance capacity; ecological systems regenerate functions; cultural systems reproduce interpretive and transmission capacity. Reproduction is therefore broader than institutional survival. It concerns the renewal of relations, competences, infrastructures, memories, and option structures.

The third family concerns *representation and standing*. Several domains contain subjects or affected positions whose interests, contributions, or values are incompletely represented by market exchange or direct voice. Care work can be weakly represented in organizational metrics. Future generations are absent from present ecological decisions. Non-human entities can be affected without participating in institutional deliberation. Migrants can hold fragmented standing across jurisdictions. Cultural communities can depend on interpretation and recognition rather than ownership alone. These cases strengthen the GRE distinction among affectedness, agency, representation, standing, authority, and value.

Proposition 19.162 (Domain-return condition). *A domain translation contributes substantively to GRE where it identifies a relation, mechanism, constraint, value structure, temporal feature, or evidential requirement that changes how an existing GRE category should be specified, connected, or bounded.*

Proposition 19.162 keeps domain application epistemically productive. A case that merely substitutes domain nouns into an unchanged general schema supplies illustration but little theoretical feedback. A domain return occurs where the translation changes the architecture of analysis: for example, by separating entitlement from access, distinguishing account exit from recoverable exit, or adding biophysical constraints that cannot be rewritten as institutional rules.

19.13.2 Recurring Cross-Domain Structures

Despite substantial heterogeneity, several structures recur strongly enough to justify comparative attention. The most persistent are relational mediation, practical access, conversion, capability formation and regeneration, dependency, participation, maintenance, institutional memory, heterogeneous value, historical pathway dependence, and generativity. These structures recur because the domains studied here all contain arrangements in which present states alter later capacities and possibilities through relations among heterogeneous participants and infrastructures.

Recurring structure should be understood at an intermediate level of abstraction. Consider practical access. In education, access can require enrollment, time, language, infrastructure, pedagogical relations, and the ability to use assistance. In welfare, it can require entitlement, documentation, administrative reach, and service availability. In platforms, effective access can require visibility and technical functionality after formal admission. In migration, legal status and portability shape access across jurisdictions. The shared structure is that formal availability requires a conversion path before it becomes practically usable. The mechanisms inside that path remain different.

Dependency exhibits a similar pattern. Educational dependence on AI, organizational dependence on employers or infrastructures, humanitarian dependence on external providers, welfare dependence on public systems, platform dependence, migration-related dependence across jurisdictions, ecological dependence on regenerative systems, and cultural dependence on transmission infrastructures can all be analyzed relationally. The recurring questions concern criticality, substitutability, opacity, control, recoverability, and transition. Yet the normative meaning of dependence changes with the relation. Dependence on a reliable public healthcare system can be constitutive of secure life; dependence on a platform that controls reputation and customer access can create a different vulnerability. The cross-domain abstraction therefore concerns dependency structure and leaves the evaluative status of independence or interdependence to the specified relation.

Maintenance is another recurrent structure. Educational institutions maintain learning environments; research institutions maintain archives, instruments, and methods; organizations maintain coordination and care; welfare systems maintain continuity; commons depend on repair and stewardship; public infrastructures require recurrent upkeep; ecological systems involve stewardship of regenerative conditions; cultural systems require preservation and interpretive transmission. Across these cases, maintenance can preserve the substrate of future action. This finding expands the meaning of generativity: generation can include preservation and renewal of enabling conditions alongside the production of novelty.

Definition 19.163 (Cross-domain structural recurrence). *A cross-domain structural recurrence is a relational pattern that appears in several domains with sufficiently similar analytical roles to support comparison while retaining domain-specific subjects, mechanisms, values, temporal scales, and evidential indicators.*

Proposition 19.164 (Recurrence-with-correspondence condition). *A recurrent GRE concept supports cross-domain inference only where the relevant correspondence among relational role, mechanism, scope, and evidence is specified; lexical similarity alone provides insufficient warrant for transfer.*

This condition restrains the temptation to transform GRE into a vocabulary of uni-

versal metaphors. A term such as “trust” can refer to reliance on a research community, public institution, commons-governance process, platform mechanism, or cultural authority. Each relation can be compared, yet its empirical indicators and normative stakes differ. Comparative learning becomes warranted after those differences are identified.

19.13.3 Domain-Differentiated Mechanisms

Cross-domain recurrence coexists with mechanism differentiation. Similar outcomes can be produced through different causal and institutional pathways, and similar mechanisms can have different effects because domain structure changes their incidence. A monetary transfer can stabilize welfare, support a transnational household, finance humanitarian recovery, or contribute to education, yet its conversion depends on distinct institutional and relational arrangements. Visibility can determine cultural recognition, platform livelihood, research attention, or public legitimacy through very different selection systems. Regeneration can concern human capability, organizational competence, ecological function, institutional memory, or cultural interpretation.

The comparative task therefore requires typed mechanisms. A platform ranking system and a public administrative eligibility rule can both mediate access, but they differ in mandate, legal standing, accountability, technical execution, correction procedures, and consequences of error. A commons rule and an organizational policy can both allocate rights and obligations, but membership, exit, ownership, authority, and stewardship differ. A cultural archive and a research repository both preserve records, yet reconstructibility, interpretive context, provenance, epistemic verification, and community use are weighted differently.

Temporal structure also varies. Humanitarian response can require rapid substitution under acute threat; welfare protection is recurrent and often expected to provide continuity; ecological processes can unfold over long periods and include thresholds or irreversibilities; cultural transmission can remain dormant before later reinterpretation; migration trajectories can span several jurisdictions and generations; digital platform rules can change rapidly through software deployment. A common GRE vocabulary must therefore remain compatible with heterogeneous clocks, delays, horizons, and forms of path dependence.

Definition 19.165 (Domain-differentiated mechanism). A *domain-differentiated mechanism* is a process whose general relational function can be compared across domains while its operative components, institutional embedding, temporal scale, evidential indicators, or normative consequences require domain-specific specification.

Proposition 19.166 (Mechanism-typing condition). *Cross-domain synthesis remains analytically adequate where recurring mechanisms are typed by the domain-specific relations through which they operate and where changes in mechanism type are allowed to alter expected consequences.*

This proposition places a limit on aggressive abstraction. A model that replaces several mechanisms with one generic relation may gain formal simplicity while losing the features that explain why policy, governance, or value consequences differ. Comparative GRE therefore permits families of related mechanisms and treats universal mechanisms as claims requiring separate support.

19.13.4 Transfer Failures and Boundary Conditions

The domain studies reveal several forms of transfer failure. The first is *object mismatch*. A category defined for individual actors can fail when the relevant subject is a collective capability, ecological configuration, transnational family, or interpretive community. The second is *mechanism mismatch*. A concept can name a similar relation while the causal pathway differs materially. The third is *value mismatch*. Monetary, welfare, ecological, cultural, epistemic, and relational values can enter different conversion interfaces and may resist common scalarization. The fourth is *temporal mismatch*. A long-horizon criterion can be inappropriate as an immediate operational rule during acute humanitarian response, while a short-horizon efficiency criterion can be inadequate for ecology or capability reproduction. The fifth is *standing mismatch*. A framework built around direct agency can omit children, future generations, non-human affected positions, or people whose legal standing is fragmented across jurisdictions. The sixth is *evidential mismatch*. Indicators appropriate to one domain can fail to represent the object of another.

Transfer failure should therefore be recorded explicitly before any broader reformulation is attempted. A failed transfer can reveal a genuine boundary of the source concept. For example, market exit does not map cleanly onto citizenship, ecological stewardship, welfare entitlement, or cultural belonging. Price signals can matter in several domains without exhausting their relevant values. Ownership can matter for commons, cultural works, platforms, and ecological resources without supplying a complete account of stewardship, access, recognition, or authority. Productivity can matter in organizations and research while remaining distinct from organizational, epistemic, ecological, or cultural generativity.

Definition 19.167 (Domain transfer failure). A *domain transfer failure* occurs where applying a GRE concept across domains would erase or misrepresent a materially consequential difference in object, mechanism, value, standing, temporal structure, constraint, or evidence.

Proposition 19.168 (Transfer-boundary condition). A *domain transfer should be narrowed, reformulated, decomposed, or withdrawn where the transfer failure materially changes the interpretation of the relation or the practical conclusions that could be drawn from it*.

The proposition preserves a role for withdrawal established in Section 19.1. A research programme becomes more robust when it can identify where its own concepts should stop. Withdrawal can therefore function as evidence of boundary discipline within an open research programme. Some failed transfers can motivate new concepts; others indicate that a neighboring discipline already possesses a more appropriate vocabulary and should remain methodologically autonomous within the local analysis.

19.13.5 Domain-Driven Revision of GRE

The accumulated domain returns suggest several revisions to GRE's working architecture. These revisions refine the granularity of categories developed in earlier chapters where domain translation exposed excessive compression.

First, *access* should be treated as a family of conversion pathways. Formal availability, legal entitlement, admission, visibility, intelligibility, technical functionality,

and usable participation are different access positions. The relevant path should be specified as a structured sequence of access positions and conversion conditions.

Second, *capability* should include regenerative and collective forms. Education and research show that later capability can depend on learning and community reproduction; organizations and commons show that some capacities exist only through coordinated relations; public institutions show that capacity can be institutional and must survive succession; ecology shows that regenerative capability can belong to coupled ecological-institutional configurations. Capability analysis therefore benefits from identifying the bearer, relation, reproduction mechanism, and temporal horizon of the capability under study.

Third, *dependency* should remain typed and evaluatively open. Welfare, care, public infrastructure, ecology, and transnational families demonstrate that durable dependence can be enabling. Platforms, concentrated infrastructures, and status relations show how dependence can become a site of control or vulnerability. GRE should therefore characterize dependency through criticality, substitutability, opacity, control, recoverability, and transition capacity before attaching normative conclusions.

Fourth, *maintenance* belongs inside generativity. Repair, continuity, preservation, care, stewardship, and institutional memory can sustain the conditions from which future alternatives remain possible. This revision guards against identifying generativity with novelty, expansion, disruption, or measurable innovation alone.

Fifth, *standing and representation* require greater dimensionality. Economic subjecthood, affectedness, agency, membership, legal standing, voice, recognition, representation, responsibility, and moral standing can diverge. Migration, ecology, welfare, culture, and AI-mediated domains make these divergences especially visible. A GRE analysis should therefore state which standing dimension is relevant to each institutional relation.

Sixth, *infrastructure* should include rule-bearing and interpretive components. Platforms show that technical interfaces can execute institutional rules. Public institutions show that registries, procedures, standards, and records can function as infrastructure. Culture shows that language and interpretive capacity can condition the usability of preserved artifacts. Research shows that software, metadata, provenance, and methodological records can determine reconstructibility. Infrastructure is consequently material, technical, institutional, informational, and relational.

Seventh, *constraint* requires ontological and analytical typing. Some constraints are legal, institutional, technological, economic, or social; ecology adds biophysical constraints whose operation does not depend on institutional recognition. GRE can remain ontologically restrained while still distinguishing constraints whose causal status and reversibility differ.

Definition 19.169 (Domain-driven revision pressure). *A domain-driven revision pressure arises where repeated domain translation shows that an existing GRE category systematically compresses distinctions needed for explanation, evidence, value analysis, or practical judgment.*

Proposition 19.170 (Revision-through-recurrence condition). *A proposed GRE revision gains comparative warrant where the same analytical deficiency recurs across several domains or where one domain reveals a constraint whose omission would materially distort other plausible GRE applications.*

The second clause is important. A feature need not appear everywhere to justify

framework revision. Biophysical constraints are most visible in ecology, yet material and energy dependence can affect production, infrastructure, migration, public capacity, and welfare. Interpretive context is most explicit in culture, yet interpretation also matters for law, research, public administration, and AI-mediated knowledge. Domain synthesis therefore considers both frequency and structural significance.

19.13.6 Generalization Scope and Comparative Restraint

Generalization in GRE should be proportional to the stability of the correspondence being claimed. The completed domain set supports several intermediate-level statements: economic relations often depend on conversion pathways; capability can require regeneration; participation can diverge from formal membership; maintenance can preserve future possibility; institutional memory can be economically consequential; dependencies vary in criticality and recoverability; value remains heterogeneous; and present arrangements can reshape later option structures. These statements organize inquiry without establishing universal laws.

Comparative restraint is particularly important because the eleven domains constitute a selective set of economic fields designed for theoretical variation. They were selected to stress different parts of GRE and therefore provide theoretical variation rather than statistical representativeness. Important domains remain underdeveloped or absent, including finance, health systems, housing, agriculture, energy, family economy, security, urban systems, science-intensive industry, religion, sport, transport, law, and space economy. Within the domains studied, institutional and cultural variation is also much wider than a single chapter can represent.

The framework should therefore distinguish at least three levels of generalization. A *domain-local* statement is supported within a specified field and institutional setting. A *cross-domain* statement is supported where several translations exhibit a corresponding structure. A *programme-level* proposition identifies a research commitment or analytical question that GRE carries into future domains without assuming that its empirical answer is invariant.

Definition 19.171 (Comparative generalization scope). The *comparative generalization scope* of a GRE claim is the set of domains, mechanisms, temporal conditions, and evidential contexts for which the correspondence supporting that claim has been specified and remains materially stable.

Proposition 19.172 (Generalization-scope condition). *The strength of a cross-domain GRE claim should remain bounded by its comparative generalization scope, with untested domains treated as opportunities for further translation and independent evaluation.*

This formulation preserves ambition without premature closure. GRE can propose a coherent programme around relations, generation, heterogeneous value, historical pathways, and future possibility while allowing future domains to challenge its categories and reveal new remainders.

19.13.7 Contributions to Future Generative Relational Theory

The comparative returns of Chapter 19 also suggest contributions that may eventually matter beyond economics. Such contributions should be treated as provisional inputs

to future GRT whose general-theory status remains open. The book's task remains GRE, and its ontological commitments remain deliberately limited.

Several candidate inputs nevertheless recur. One is the distinction among entity, relation, configuration, and history-bearing pathway. Domain studies repeatedly show that the relevant analytical unit is often a history-bearing configuration with relations that exceed a point-like actor representation. A second is the need to distinguish generativity from output: generativity concerns the conditions under which later relations, capabilities, interpretations, institutions, or possibilities can emerge. A third is the importance of typed dependency and conversion interfaces. A fourth is the coexistence of maintenance, regeneration, and transformation within one temporal architecture. A fifth is the role of standing and representation where affected positions are heterogeneous. A sixth is the possibility that collective capability, institutional capacity, ecological regeneration, or cultural interpretation can be relational properties that cannot be assigned cleanly to isolated individuals.

The domains also suggest that any future GRT would need stronger treatment of scale. Community governance, platform ecosystems, public institutions, transnational relations, ecological processes, and culture all show that relations can be nested, overlapping, cross-boundary, or only partially aligned with formal jurisdictions. Scale therefore appears as a relational property that can emerge through coupling, nesting, overlap, and boundary formation.

A future GRT would also need to preserve ontological restraint. Ecological systems, artificial agents, institutions, communities, cultural forms, and persons can all be treated as relationally consequential without requiring the theory to assert one common ultimate ontology. The comparative domain results strengthen the usefulness of layered analysis precisely because they show that similar formal or relational structures can coexist with different ontological and normative questions.

Definition 19.173 (GRT-relevant comparative remainder). *A GRT-relevant comparative remainder is a recurrent structural issue revealed through GRE domain inquiry whose adequate treatment appears to require concepts more general than the economic domain while remaining insufficiently developed for incorporation as a settled general-theory commitment.*

Proposition 19.174 (General-theory deferral condition). *GRT-relevant comparative remainders should be recorded as open theoretical inputs until their meaning, scope, ontological status, and cross-domain correspondence have been independently developed beyond the economic cases that revealed them.*

This condition protects the division of labor between GRE and a possible future GRT. The present book can identify where broader theory may be needed while keeping its substantive claims anchored in economic and institutionally mediated relational analysis.

19.13.8 Domain Expansion and Comparative Research Programme

Comparative synthesis closes the first domain cycle of GRE, yet the domain architecture remains intentionally open. New domains should be selected partly for substantive importance and partly for the pressure they place on the framework. A useful expansion introduces subjects, constraints, value structures, temporal scales, institu-

tional forms, or evidential practices that materially test the existing architecture.

Future domain work can proceed through the translation procedure established in Section 19.1: specify local objects, relations, values, constraints, and histories; test direct reuse and adaptation; record remainders; compare with existing domains; and feed warranted revisions back into GRE. Comparative work should also revisit completed domains as technologies, institutions, ecological conditions, demographic structures, and cultural practices change. Domain synthesis is therefore iterative and remains open to later revision.

Several expansion directions appear especially informative. Finance could test expectations, liquidity, leverage, symbolic representation, and systemic dependency. Health could test care, bodily vulnerability, expertise, public infrastructure, uncertainty, and unequal capacity. Housing and urban systems could test spatial lock-in, infrastructure, neighborhood relations, land, mobility, and public authority. Agriculture and food systems could connect ecological regeneration with labor, technology, culture, and supply-chain dependency. Energy could test long-lived infrastructure, physical constraints, transition pathways, and geopolitical interdependence. Family economy could deepen care, intergenerational transfer, household decision relations, and social reproduction. Each domain may reproduce familiar GRE structures while also exposing new transfer failures.

Proposition 19.175 (Open-domain expansion condition). *A domain is especially informative for GRE expansion where its translation is likely to test the scope of existing concepts, reveal materially different mechanisms or constraints, or generate comparative remainders that can revise the programme's analytical architecture.*

The comparative synthesis therefore yields a disciplined middle position. GRE carries a revisable set of relational questions across domains while allowing each domain to determine how those questions should be specified, evidenced, and bounded. The recurring architecture becomes more credible where it survives translation with identifiable correspondence; the framework becomes more useful where failed transfers remain visible and capable of changing it.

Section 19.14 uses the resulting comparative architecture to state domain-derived requirements for economic-order analysis. Its task is narrower than constructing an economic-order theory or institutional design: it records which relational, capability, dependency, value, temporal, epistemic, and AI-mediated conditions the domain comparisons make difficult to omit. Chapter 20 alone undertakes the subsequent synthesis of those requirements into an order-level analytical architecture.

19.14 Domain-Derived Requirements for Economic-Order Analysis

The role of this section is to close the domain-inquiry chapter by stating what the comparative findings require a later economic-order analysis to keep visible. It does not construct an economic-order architecture, rank institutional systems, or specify a preferred design. Those tasks belong to Chapter 20. The present section instead records a bounded set of requirements that recur across the eleven domains while preserving the transfer failures, domain remainders, and scope limitations established in Section 19.13.

Table 19.14: Domain-derived requirements retained for economic-order analysis.

Requirement family	Comparative domain finding	Requirement carried into Chapter 20
Relational conversion	Formal resources, rights, and opportunities acquire practical effect through domain-specific relations and conversion pathways	Track the relations and infrastructures through which nominal provision becomes usable capability
Capability reproduction	Learning, care, maintenance, preservation, repair, and regeneration sustain later action	Examine how an order reproduces individual, collective, institutional, and ecological capacities
Dependency and standing	Dependence varies in criticality, substitutability, opacity, control, and recoverability; affectedness, agency, membership, and representation can diverge	Type dependencies and distinguish relevant forms of standing, participation, voice, and representation
Value and return	Heterogeneous values can circulate, convert, accumulate, dissipate, or fail to return to the substrates on which generation depends	Preserve value plurality and make return, depletion, and recirculation visible without presuming complete commensurability
Temporal and ecological constraint	Present arrangements reshape later option spaces, while some constraints and losses are slow, cumulative, or partly irreversible	Include path dependence, transition capacity, long-horizon effects, and biophysical conditions where materially relevant
Epistemic and AI mediation	Knowledge infrastructures and artificial systems can change capability, verification, coordination, authority, dependency, and participation	Track epistemic capacity, verification, AI infrastructure, delegation, and capability reproduction together
Revisability	Domain transfer repeatedly exposes error, remainder, and context-sensitive mechanisms	Preserve contestability, monitoring, evidential correction, and institutional revision where uncertainty is consequential

The distinction is methodologically important. Domain inquiry can show that access depends on conversion, that capability may require maintenance and regeneration, that dependencies differ in criticality and recoverability, that standing and participation can diverge, that value is heterogeneous, or that AI can redistribute both capability and epistemic authority. Such findings constrain what an adequate economic-order analysis should examine. They do not determine how markets, public institutions, communities, firms, households, platforms, or hybrid arrangements should be combined. The movement from comparative requirement to institutional architecture therefore requires an additional synthetic step.

Table 19.14 records the principal requirements generated by the comparative domain work. Its final column deliberately states analytical obligations rather than institutional solutions.

Definition 19.176 (Domain-derived economic-order requirement). A *domain-derived economic-order requirement* is a comparative finding whose recurrence or structural significance is sufficient to require explicit treatment in economic-order inquiry, while remaining insufficient by itself to determine a unique institutional design, normative ranking, or policy instrument.

Definition 19.176 preserves the boundary between Chapter 19 and Chapter 20. Comparative domain inquiry supplies warranted constraints on later synthesis. Economic-order synthesis must still determine how those constraints interact, which conflicts require adjudication, which mechanisms are empirically present, and which institutional responses are feasible or justified.

19.14.1 Relational and Conversion Requirements

Across education, welfare, platforms, migration, public institutions, research, and other domains, nominal access repeatedly diverges from practical access. Rights, resources, services, opportunities, and infrastructures matter through relations of information, recognition, documentation, mediation, time, language, technical functionality, institutional standing, and local support. The comparative result is therefore not a universal conversion function. It is a requirement to identify the conversion pathways through which an allocation or entitlement acquires practical effect.

The same discipline applies to relational position. A change in rules can alter visibility, membership, bargaining position, dependency, representation, or exit capacity without changing a measured resource stock. Economic-order analysis must consequently remain able to represent relational changes that materially affect what subjects can do, claim, contest, or become.

Proposition 19.177 (Relational-conversion requirement). *Where domain evidence shows that formal provision and realized capability are separated by consequential relational or infrastructural conditions, subsequent economic-order analysis should represent those conversion conditions explicitly rather than treating provision as equivalent to effective access.*

19.14.2 Capability, Maintenance, and Infrastructure Requirements

Domain inquiry also broadens the object of capability analysis. Capability can be individual, collective, institutional, or coupled across subjects and infrastructures. It can depend on education, care, repair, archives, professional communities, administrative memory, ecological regeneration, software maintenance, interpretive competence, or other recurrent supports. These findings require later economic-order analysis to examine the reproduction of capacity rather than only its current exercise.

Maintenance is especially important because it can preserve future possibility without appearing as novelty or expansion. The comparative domains therefore place maintenance, continuity, repair, preservation, and regeneration inside the economic-order problem whenever they sustain capacities on which later action depends. Chapter 20 will determine how these functions interact with allocation, institutions, investment, and governance; Chapter 19 only records their analytical necessity.

Proposition 19.178 (Capability-reproduction requirement). *Economic-order inquiry should include the relations and infrastructures through which materially relevant individual, collective, institutional, or ecological capabilities are maintained, regenerated, or depleted over time.*

19.14.3 Dependency, Standing, and Contestability Requirements

The domain studies resist both an ideal of complete independence and an undifferentiated celebration of interdependence. Dependence can be enabling, protective, productive, coercive, fragile, or difficult to exit. Its consequences depend on criticality, substitutability, opacity, control, reversibility, transition capacity, and the distribution of authority over the relation. Later synthesis therefore needs typed dependency

rather than a binary dependent-independent classification.

The domains also show that agency, affectedness, membership, legal standing, voice, recognition, representation, and responsibility can diverge. This is visible in migration, welfare, ecology, public institutions, platforms, culture, and AI-mediated relations. Economic-order analysis should therefore state which form of standing is relevant to a particular institution and how consequential decisions remain contestable by or on behalf of affected positions.

Proposition 19.179 (Dependency-and-standing requirement). *Where an economic relation materially conditions access, capability, exposure, or exit, later order analysis should characterize the dependency and the relevant forms of standing or representation through which the relation can be evaluated, contested, or revised.*

19.14.4 Value, Recirculation, and Plurality Requirements

The comparative domains repeatedly generate values that cannot be represented adequately by one metric without remainder. Income, capability, care, ecological functioning, knowledge, cultural meaning, trust, security, time, institutional capacity, and participation can enter different evidential and normative practices. The requirement carried forward is therefore one of visibility and disciplined translation: later synthesis should identify which values are being represented, converted, compared, or omitted, and should preserve relevant remainders where complete commensuration is unwarranted.

Domain inquiry also shows that generated value can fail to return to the relations and infrastructures that make continued generation possible. Research systems can deplete training and verification capacity; platforms can extract from communities while weakening exit or participation; ecological production can consume regenerative substrates; cultural production can depend on interpretive and archival infrastructures that remain under-supported. These observations motivate a recirculation requirement without predetermining a tax, ownership form, funding regime, or institutional formula.

Proposition 19.180 (Value-return requirement). *Economic-order analysis should make visible materially relevant processes of value generation, realization, capture, return, depletion, and regeneration while keeping heterogeneous value forms distinct where their commensuration lacks adequate warrant.*

19.14.5 Temporal and Ecological Requirements

Several domains expose the inadequacy of contemporaneous evaluation alone. Education, infrastructure, ecology, migration, public capacity, research, and culture can involve long formation times, path dependence, cumulative loss, delayed return, and asymmetric reversibility. Present arrangements can therefore alter not only current outcomes but also which future actions remain reachable and which capabilities can later be reconstructed.

Ecology adds a further discipline. Some constraints are biophysical rather than merely institutional, and some losses cannot be restored on the same timescale as a policy cycle or market adjustment. Economic-order analysis does not need to reduce all ecological relations to one master limit, but it should distinguish constraints whose

causal operation and reversibility differ materially from ordinary institutional variables.

Proposition 19.181 (Temporal-constraint requirement). *Where domain consequences are materially path-dependent, delayed, cumulative, or partly irreversible, economic-order inquiry should include the relevant temporal horizon, transition capacity, and constraint type rather than evaluating only contemporaneous states.*

19.14.6 Epistemic and AI Requirements

Research, education, public administration, platforms, culture, and AI-mediated practice show that an economic order also depends on epistemic capacities. Verification, preservation, interpretation, orientation, criticism, and reconstructibility can be infrastructures of later action. Their distribution affects who can understand systems, contest decisions, maintain institutions, and regenerate knowledge rather than merely consume outputs.

Artificial intelligence intensifies this requirement because performance gains can coexist with dependency, verification loss, concentrated infrastructure control, weakened participation, or stronger learning and capability formation. Domain evidence therefore does not support a single AI-order conclusion. It requires Chapter 20 to analyze AI as part of a coupled technical–institutional–epistemic configuration and to distinguish assisted performance from the reproduction of human and collective capability.

Proposition 19.182 (Epistemic-AI requirement). *Where artificial or epistemic infrastructures mediate consequential economic activity, economic-order analysis should examine capability reproduction, verification, access, dependency, delegation, participation, and institutional learning together rather than inferring order-level effects from output or productivity measures alone.*

19.14.7 Boundary Conditions for Economic-Order Synthesis

The requirements above do not form a completed theory of economic order. They are constraints on such a theory derived from comparative domain inquiry. They remain heterogeneous, can conflict, and can carry different empirical weights across historical settings. Chapter 20 must therefore perform work that Chapter 19 deliberately does not perform: integrate the requirements with the earlier architecture of allocation, value, generative spacetime, power, knowledge, and praxis; define the economic-order object; examine institutional and evaluative consequences; and preserve explicit scope conditions where the evidence does not support stronger generalization.

The boundary also runs in the reverse direction. Economic-order synthesis should not erase the domain remainders that generated these requirements. If an integrated model makes welfare access, ecological regeneration, cultural interpretation, migration standing, research verification, or platform dependency appear interchangeable merely because they share a higher-level category, the synthesis has become too coarse. The comparative domain record therefore remains a standing source of correction for Chapter 20.

Proposition 19.183 (Domain-to-order boundary condition). *Cross-domain recurrence may establish requirements for economic-order inquiry, but the construction,*

evaluation, and institutional interpretation of an economic-order architecture require a separate synthetic analysis that preserves domain-specific mechanisms, scope conditions, and unresolved remainders.

This condition closes Chapter 19. The chapter has translated GRE into heterogeneous domains, tested transfer, recorded failures and remainders, revised several working categories, and extracted comparative requirements that a later order-level analysis should not omit. Chapter 20 begins the distinct task of economic-order synthesis. It inherits the requirements established here as constraints and evidence, not as a preconstructed institutional architecture.

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Chapter 20

Generative Relational Economic Order

Economic-Order Synthesis and Chapter Scope

Chapter 20 develops the book's economic-order synthesis. The preceding chapters established Generative Relational Economics as a historically situated and revisable research programme, developed its ontological and epistemological discipline, clarified research and application praxis, and progressively constructed an economic architecture of allocation, heterogeneous value, generative spacetime, power, knowledge, artificial intelligence, and domain-specific inquiry. Chapter 19 then tested those constructions across eleven domains and returned a bounded set of domain-derived requirements for economic-order analysis. Those requirements constrain what later synthesis should keep visible, but they do not themselves constitute an economic-order architecture. The present chapter owns that additional synthetic task and takes the accumulated GRE architecture, together with the domain-derived requirements, as its object. Its task is to ask what becomes visible when economic order is analyzed as a history-bearing configuration of relations, institutions, infrastructures, capabilities, values, dependencies, and future possibilities rather than only as a distribution of resources or a choice among familiar institutional labels.

The chapter does not propose a closed institutional blueprint. A market economy, welfare state, cooperative system, public infrastructure regime, commons arrangement, platform ecology, or mixed economy can contain substantially different relational architectures even where the same formal category is used. Conversely, distinct institutional forms can sometimes perform overlapping functions. GRE therefore treats economic order as a design and research problem whose relevant questions concern the organization of access, conversion, participation, power, learning, maintenance, value return, and revision across heterogeneous subjects and temporal scales. The chapter seeks to identify conditions, diagnostics, and open design questions rather than a uniquely optimal constitutional form.

This orientation preserves the methodological result of Chapter 19: recurrence across domains does not establish theoretical identity, and comparative synthesis does not authorize unrestricted generalization. The present chapter therefore works

with the recurrent structures that survived domain translation while preserving the domain-specific remainders that qualify them. Access remains a conversion pathway rather than a binary entitlement; capability remains typed and potentially collective; dependency remains relational and heterogeneous; infrastructure includes material, institutional, informational, interpretive, and ecological supports; maintenance can be generative; standing and participation remain multidimensional; and value remains plural, historically mediated, and incompletely commensurable. These constraints shape the economic-order analysis that follows.

The chapter has four connected objectives. The first is synthetic. Section 20.1 reconstructs the GRE programme across historical conditions, relational architecture, allocation, value, spacetime, power, knowledge, artificial intelligence, and praxis. The objective is to show how these components constrain one another when brought into one economic-order frame. The second objective is evaluative and institutional. Subsequent sections develop generative economic evaluation, policy, institutions, relational infrastructure, participation, and value recirculation. These sections ask how present arrangements alter downstream relations, capacities, constraints, and option structures, and how institutions can learn while remaining contestable.

The third objective concerns conditions that complicate conventional economic-order reasoning. The chapter examines plural and incommensurable values, productive and symbolic abundance accompanied by new scarcities, and persistent capability asymmetry under advanced artificial intelligence. It then develops adaptive governance and open economic futures as problems of monitoring, feedback, reversibility, institutional learning, path creation, intergenerational possibility, and radical uncertainty. These topics extend the analyses of Chapters 14–18 into the economic-order level without presuming that their local concepts can be aggregated into one scalar objective.

The fourth objective is reflexive and chapter-scoped. A framework that analyzes revisability should expose the limits of the synthesis it is presently making. The closing sections therefore place validity boundaries around the economic-order claims developed here, state the research obligations generated by those claims, clarify the bounded interface between GRE's economic-order synthesis and possible future development of Generative Relational Theory, and close this chapter provisionally. They do not perform the book-level closure undertaken later in Chapters 21–25. The economic-order synthesis is consequently left open to empirical correction, comparative domain work, formal refinement, historical re-epistemization, and institutional experimentation without duplicating the later architecture of theoretical dialogue, programme construction, limits, and programme identity.

The internal sequence of the chapter is thus *economic-order synthesis, evaluation, policy, institutions, infrastructure, participation, recirculation, plural value, abundance and scarcity, capability asymmetry, adaptive governance, futures, scoped validity boundaries, economic-order research obligations, general-theory interface, provisional economic-order closure*. The sequence moves from analytical integration toward increasingly direct questions of economic order and then returns to reflexive limits. It is intentionally non-linear in one important sense: later sections can revise the interpretation of earlier ones. Economic-order synthesis is therefore treated as an iterative construction rather than the terminal deduction of a finished theory.

The term *generative relational economic order* will be defined formally enough for analytical use in Section 20.1. At the chapter level, it refers provisionally to an eco-

economic order examined through the relations and infrastructures that generate, distribute, maintain, constrain, regenerate, and revise capabilities and value-bearing possibilities through time. The adjective *generative* does not imply maximal novelty, perpetual growth, or unrestricted expansion. Maintenance, care, preservation, ecological regeneration, institutional continuity, and reduction of destructive dependence can all be generatively significant where they preserve or reopen consequential future possibilities. The adjective *relational* likewise does not deny entities or individual agency. It indicates that economically consequential capacities and values often depend on relations whose effects cannot be inferred from isolated actors alone.

Chapter 20 therefore provides economic synthesis while preserving the open-programme character established at the beginning of the book. Its standards are demanding in two directions. The analysis should be sufficiently integrated to say something substantive about economic order, yet sufficiently restrained to keep heterogeneity, uncertainty, contestation, and future revision visible. The chapter proceeds within that tension.

20.1 GRE Programme Synthesis

The role of this section is to construct the economic-order architecture that Chapter 19 deliberately left open. Section 19.14 supplied domain-derived requirements, not a completed order model; the present section integrates those requirements with the principal components of Generative Relational Economics before the chapter develops more specific approaches to evaluation, policy, institutions, infrastructure, participation, and governance. Its objective is synthesis rather than summary. The earlier chapters introduced concepts in response to distinct analytical problems; the present section asks how those concepts constrain one another when an economic order is treated as a history-bearing configuration. The discussion therefore proceeds through ten dimensions: historical formation, relational architecture, allocation and conversion, heterogeneous value, generative spacetime, power and justice, knowledge, artificial intelligence, research and application praxis, and the conditions of an open synthesis.

The method is reconstructive. Each dimension is restated only to the extent necessary for its economic-order role, and previously stabilized distinctions are preserved rather than redefined. The result is not a master variable or one composite welfare function. It is an architecture in which several kinds of relation must remain jointly visible because changes that appear beneficial in one dimension can alter capacities, dependencies, institutions, or future possibilities in another. Table 20.1 provides a compact map of these dimensions and their principal economic-order questions.

Definition 20.1 (Generative relational economic order). A *generative relational economic order* is a history-bearing configuration of economic subjects, relations, institutions, infrastructures, allocation and conversion pathways, value processes, dependencies, epistemic arrangements, and governance mechanisms considered with respect to how they generate, maintain, constrain, regenerate, and revise capabilities and future possibilities across heterogeneous subjects and temporal scales.

The definition is intentionally analytical rather than constitutional. It does not identify a specific property regime, market structure, welfare architecture, technology policy, or governance form as generative by definition. The same institutional label

Table 20.1: GRE programme dimensions and their economic-order roles.

Dimension	Principal analytical object	Economic-order question
Historical formation	Pathways, inherited institutions, classifications, infrastructures, and conditions of possibility	Which inherited relations make the present order possible, and which remain revisable?
Relational architecture	Subjects, positions, relations, configurations, constraints, and standing	Which relations constitute practical access, participation, dependence, and capability?
Allocation and conversion	Resources, rights, services, infrastructures, and conversion pathways	How do allocated objects become usable capabilities and downstream effects?
Heterogeneous value	Generation, realization, conversion, circulation, capture, return, and remainder	Which values are produced or displaced, and how are conflicts mediated under incomplete commensurability?
Generative spacetime	Sequence, delay, reachability, path dependence, irreversibility, and option structures	How do present arrangements reshape later possibilities and transition capacities?
Power and justice	Typed asymmetry, dependence, conversion mechanisms, standing, and governance	Which asymmetries become durable power, and through which mechanisms can they be contested or revised?
Knowledge	Epistemic infrastructure, attention, verification, preservation, and orientation	Which knowledge capacities and interpretive conditions does the order reproduce or erode?
Artificial intelligence	Capability stacks, infrastructure, ownership, access, delegation, and participation	How do artificial capabilities alter dependency, judgment, participation, and human or collective capability reproduction?
Praxis	Research, application, evidence, intervention, learning, and revision	How can inquiry and intervention remain mutually corrective under uncertainty?
Open synthesis	Coupled dimensions, domain remainders, uncertainty, and revision pathways	Which conclusions are warranted now, and which structures must remain open to correction?

can support different relational configurations, and the same generative function can sometimes be realized through different institutional forms. The definition therefore establishes an object of inquiry whose adequacy must be evaluated through mechanisms, histories, evidence, and domain-specific conditions.

20.1.1 Historical Formation and Problem Conditions

GRE begins historically because an economic order is never encountered as an institutionally empty present. Categories such as labor, property, firm, household, market, public service, currency, welfare, platform, profession, migration status, and infrastructure are historically constituted positions whose meanings and practical consequences depend on prior institutional development. Chapter 1 therefore treated the emergence of GRE itself as historically conditioned, while later chapters repeatedly showed that inherited classifications and infrastructures shape which relations can be perceived, measured, governed, or transformed.

At the economic-order level, historical analysis performs at least four functions. First, it identifies *conditions of possibility*: legal forms, technical systems, administrative capacities, knowledge infrastructures, cultural conventions, ecological inheritances, and political settlements without which present arrangements would operate differently. Second, it identifies *path dependence*: past investments and institutional choices can alter the cost, intelligibility, legitimacy, and feasibility of later alternatives. Third, it makes visible *historical burden*: present actors can inherit maintenance obligations, ecological damage, debt structures, exclusionary classifications, or depleted capabilities that are absent from contemporaneous flow measures. Fourth, it reveals *historical remainder*: some effects of earlier arrangements persist even after formal

rules change.

These functions matter because economic-order evaluation can be distorted by treating present distributions as if they arose from contemporaneous choice alone. A platform ecosystem may depend on accumulated user networks and data; a public institution on generations of professional knowledge and administrative memory; a research system on inherited laboratories, journals, languages, and disciplinary standards; a neighborhood on past infrastructure and land-use decisions; an ecological economy on soil, water, biodiversity, and prior extraction. The present order is therefore partly an inheritance relation.

History also places limits on institutional design. A proposed rule can be normatively attractive in abstraction yet weakly implementable where administrative capacity, trust, infrastructure, or professional competence is missing. Conversely, inherited institutions can make some reforms feasible precisely because prior generations invested in capacities that no current actor could reproduce quickly. GRE thus treats institutional feasibility as historically conditioned rather than as a static constraint set.

Proposition 20.2 (Historical-formation condition). *Economic-order analysis is historically adequate only where present institutions, distributions, capabilities, and dependencies are interpreted together with the inherited pathways and infrastructures that materially condition their reproduction and revision.*

The proposition does not require every economic inquiry to reconstruct a complete history. It requires historical depth proportional to the mechanism under study. Where inherited classification, infrastructure, ecological burden, institutional memory, or path dependence materially affects present options, those histories belong inside the economic object rather than outside it as background narrative.

20.1.2 Relational Economic Architecture

Chapter 12 developed economic architecture around subjects, relations, configurations, institutions, access, dependencies, and constraints. At the order level, this architecture prevents the economy from being represented solely as a collection of agents exchanging objects. Economic subjects occupy differentiated positions within households, firms, public institutions, platforms, communities, knowledge systems, ecological relations, and transnational structures. Their practical capacities depend partly on the relations through which resources, information, recognition, authority, care, mobility, and institutional standing are mediated.

A relational architecture does not dissolve individuals into structure. It asks which relations are constitutive of what individuals and collectives can practically do. A formal right can require administrative documentation; an educational opportunity can require time, language, support, and institutional access; a nominally open market can depend on visibility, reputation, interoperability, transport, or payment infrastructure; a scientific capability can depend on laboratories, peer communities, archives, and verification practices. The relevant unit is therefore frequently a configuration in which individual and collective capabilities are jointly produced.

This architecture also supports heterogeneous subjecthood. Persons, households, firms, communities, public institutions, artificial systems, ecological entities, and transnational networks occupy different kinds of economic position. Their agency, affectedness, representation, legal standing, moral standing, responsibility, and ca-

capacity for participation should not be collapsed into one subject variable. Chapter 18 made this especially explicit under human–AI coexistence, while Chapter 19 showed that the same distinction matters in welfare, commons, ecology, migration, culture, and public institutions.

The economic-order implication is that institutional design changes relational positions even when measured resource stocks remain constant. A rule can change voice, visibility, bargaining position, dependency, exit capacity, institutional membership, or recognition without transferring money. Conversely, a monetary transfer can leave the surrounding relation unchanged. GRE therefore requires order analysis to track the relational architecture through which distribution becomes capability and participation.

Proposition 20.3 (Relational-adequacy condition). *An economic-order description is relationally adequate only where it identifies the economically consequential relations through which subjects acquire or lose practical access, capability, standing, dependency, participation, and influence over subsequent institutional states.*

The condition is diagnostic rather than maximalist. Not every relation matters for every question. The analytical requirement is to include those relations whose omission would materially alter explanation, evaluation, or feasible intervention.

20.1.3 Allocation and Conversion

Allocation remains central to economics, but GRE broadens its analytical unit. Chapter 13 treated allocation as the distribution or assignment of resources, rights, services, opportunities, burdens, infrastructures, and access positions within a relational configuration. Chapter 19 then repeatedly showed that allocation and realized capability can diverge because allocated objects pass through conversion pathways.

Conversion depends on context. Income can become nutrition, mobility, housing security, learning, or care only through prices, infrastructure, household relations, time, knowledge, bodily condition, legal status, local institutions, and other mediating structures. A public service can exist formally while remaining inaccessible because of documentation, distance, language, interface design, waiting time, or administrative discretion. A digital platform can be formally open while ranking architecture limits visibility. A research grant can purchase equipment while failing to generate durable research capability if training, maintenance, institutional memory, or community remain weak.

Allocation also has downstream structural effects. Public investment in transport changes mobility relations and spatial accessibility; research funding shapes agendas and institutional capacity; welfare design alters risk-bearing and bargaining positions; infrastructure standards shape interoperability; platform rules alter market visibility; ecological allocation can shift burdens across places and generations. Allocation therefore acts on relations and future pathways as well as on current holdings.

This motivates a distinction among at least four analytical moments: *allocation*, concerning what is assigned; *access*, concerning whether the assigned object can be reached or claimed; *conversion*, concerning whether it can become a relevant capability or value realization; and *trajectory effect*, concerning how the resulting configuration alters later possibilities. These moments can be separated empirically even when they occur rapidly in practice.

Proposition 20.4 (Allocation–conversion condition). *Economic-order evaluation of an allocation should examine the pathways through which allocated resources, rights, services, infrastructures, or opportunities become practically accessible capabilities and should include material downstream changes in relations, constraints, and future options.*

The proposition does not displace distributional analysis. It extends it. Distribution remains ethically and economically important, while conversion analysis helps explain why formally similar allocations can produce different realized possibilities and why some inequalities persist despite nominally equal provision.

20.1.4 Heterogeneous Value Processes

Chapter 14 developed value as a heterogeneous process of generation, realization, conversion, circulation, capture, return, dissipation, regeneration, and transformation. At the economic-order level, this architecture prevents monetary valuation or aggregate utility from silently becoming the complete description of what an order produces and destroys. Monetary value remains indispensable for many economic questions, yet economic arrangements also affect capability, care, ecological functioning, knowledge, trust, cultural meaning, institutional capacity, time, security, and participation.

Value heterogeneity creates two distinct problems. The first is representational. Different values can be measured with different levels of precision and through different evidential practices. Some can be priced or monetized for specific purposes; others are better represented through multidimensional indicators, qualitative judgment, procedural safeguards, or domain-specific criteria. Representation should therefore remain purpose-indexed. A price, score, index, or utility representation can be useful without becoming an ontological claim that the represented values share one underlying substance.

The second problem is institutional mediation. Economic order must act despite incomplete commensurability. Budgets are finite, infrastructures occupy space, rules privilege some activities over others, and public decisions frequently require closure. GRE does not resolve this problem by refusing aggregation altogether. It asks which values are being translated, which remainders are lost, who has standing in the translation, how uncertainty is represented, and which decisions remain revisable. Procedural architecture becomes especially important where substantive values cannot be fully reduced to a common metric.

Value analysis also concerns circulation and return. Many activities depend on shared substrates that are only partially represented in transaction prices: educational systems, public institutions, ecological processes, scientific knowledge, cultural memory, community trust, care infrastructures, digital standards, and inherited technical systems. Chapter 19 introduced generative value return to ask whether value-generating activities help reproduce the capacities and relations on which their own continuation depends. At the order level, this becomes a problem of recurrent reinvestment and depletion.

Proposition 20.5 (Value-process visibility condition). *Economic-order analysis should keep visible the generation, realization, conversion, circulation, capture, return, and possible dissipation of materially relevant value forms, while preserving evaluative remainders where complete commensuration is unwarranted.*

The proposition leaves normative ranking open. Its purpose is to prevent institutional convenience, data availability, or market price from determining in advance which values count as economically consequential.

20.1.5 Generative Spacetime and Historical Trajectories

Chapter 15 added sequence, delay, accessibility, path dependence, reversibility, historical inheritance, and changing possibility spaces to GRE. These dimensions become decisive at the economic-order level because institutions rarely affect only contemporaneous outcomes. Infrastructure can last for decades; ecological change can be partly irreversible; education changes later capability; welfare institutions stabilize or destabilize life trajectories; platform networks accumulate; legal categories persist; research capacity requires long formation; cultural and institutional memory can disappear faster than it can later be rebuilt.

A static comparison can therefore miss the difference between two orders that produce similar present outputs while generating different future transition capacities. One order can achieve performance through concentrated infrastructure, brittle dependencies, or erosion of local capability; another can achieve similar performance while maintaining redundancy, learning, portable knowledge, and reversible institutional commitments. Their present-state descriptions may look similar while their future option structures differ materially.

The spacetime perspective also complicates efficiency. A faster process can impose downstream maintenance burdens; a cheaper institutional arrangement can externalize future rebuilding costs; a high-return investment can narrow technological pathways; protective regulation can preserve option space while slowing present deployment; redundancy can look inefficient under normal conditions while becoming valuable under disruption. These are not arguments against efficiency analysis. They indicate that the temporal boundary of the analysis matters.

GRE therefore treats economic order as a trajectory-generating configuration. Present institutions define neither one predetermined future nor an unconstrained option set. They alter probabilities, costs, dependencies, interpretive frames, infrastructures, and available transition pathways. Future possibilities are partly produced through the current order.

Proposition 20.6 (Spatiotemporal-adequacy condition). *Economic-order evaluation is spatiotemporally adequate only where materially relevant delay, path dependence, reversibility, inherited burden, transition capacity, and future-option effects are included at scales appropriate to the mechanism under study.*

This condition is deliberately scale-sensitive. Long-horizon analysis does not mean that every decision must be evaluated over the same temporal horizon. Acute humanitarian action, monetary operations, education, infrastructure, ecology, and institutional reform operate on different clocks. The requirement is to choose a horizon capable of representing the consequential effects of the mechanism rather than defaulting to one conventional period.

20.1.6 Power, Justice, and Governance

Chapter 16 distinguished asymmetry, dependence, control, power, injustice, and governance. This distinction remains essential for economic-order synthesis. Unequal

capability, resources, information, institutional access, or technical expertise do not automatically constitute power in the same form. Power emerges where an asymmetry is relationally converted into effective influence over another subject's feasible actions, standing, access, dependencies, or future possibilities, and where the conversion acquires sufficient persistence or efficacy.

The order-level question is therefore mechanistic. Property rights, labor contracts, platform interfaces, professional credentials, administrative procedures, standards, control of infrastructure, data access, financial structures, legal status, and epistemic authority can all mediate power. The same formal asymmetry can have different consequences depending on substitutability, exit, voice, counter-power, transparency, portability, institutional review, and the availability of alternative relations.

Justice enters because economic order distributes more than resources. It distributes exposure to dependency, capacity to convert resources into action, access to institutional correction, recognition, voice, responsibility, and influence over collective futures. Heterogeneous values make justice analysis especially difficult: a procedure can improve aggregate output while narrowing participation, preserve income while eroding standing, or expand formal access while increasing dependency on opaque infrastructure. GRE therefore treats justice as requiring plural evaluative dimensions and explicit mediation rather than automatic derivation from one outcome metric.

Governance is the institutional response to these asymmetries and conflicts, but governance itself can generate power. Monitoring, classification, eligibility rules, standards, algorithms, professional judgments, and emergency procedures can alter practical action spaces. Governance should therefore be analyzed through both its substantive objective and its relational mode of operation.

Proposition 20.7 (Power–governance visibility condition). *Economic-order analysis should identify the mechanisms through which asymmetries become effective power and should evaluate governance arrangements partly through their effects on standing, dependency, contestability, correction, and the capacity to revise consequential relations.*

The proposition does not imply that every asymmetry should be eliminated. Expertise, specialization, care, infrastructure, and institutional division of labor can create beneficial asymmetries. The economic-order problem is to distinguish productive differentiation from dependencies that become opaque, non-substitutable, non-contestable, or systematically depleting of others' generative capacities.

20.1.7 Knowledge and Epistemic Economy

Chapter 17 established knowledge as an economic and generative field rather than a frictionless informational input. Economic order depends on institutions that produce questions, evidence, methods, expertise, archives, standards, verification practices, interpretive communities, and orientation. These epistemic capacities shape both production and governance. An economy unable to identify emerging problems, preserve records, verify claims, or revise classifications can lose adaptive capacity even where current output remains high.

Knowledge also has distinctive economic properties. It can be copied while remaining costly to generate, abundant in symbolic form while scarce in verified or contextually usable form, and publicly accessible while practically inaccessible without language, training, tools, or institutional standing. Attention and orientation become

especially consequential under abundance. The order-level question is therefore not merely how much information exists but which epistemic pathways remain capable of producing credible judgment.

Epistemic infrastructure includes universities, schools, libraries, laboratories, archives, professional communities, statistical systems, standards bodies, public records, software, data systems, and informal practices of interpretation and verification. Their capacities depend on funding and material infrastructure, but also on norms of criticism, preservation, provenance, access, succession, and institutional memory. An economic order that consumes these capacities without reproducing them can experience epistemic depletion analogous to the depletion of physical or ecological infrastructure.

Knowledge also intersects with power. Control over classification, expertise, metrics, ranking, data, or verification can shape what becomes institutionally visible and which claims can enter decision processes. Epistemic inclusion therefore does not mean that every claim receives equal evidential weight. It means that the procedures by which knowledge is produced, challenged, corrected, and incorporated remain intelligible and appropriately contestable.

Proposition 20.8 (Epistemic-capacity condition). *A generative economic-order analysis should examine whether its institutions reproduce the capacities required for problem formation, evidence generation, verification, interpretation, preservation, criticism, and revision across the domains on which collective decisions depend.*

The proposition connects epistemic economy to economic resilience without reducing knowledge to instrumental productivity. Cultural, scientific, historical, civic, and practical knowledge can matter because they sustain the interpretive and institutional conditions through which a society recognizes and revises its own problems.

20.1.8 Artificial Intelligence and Capability Asymmetry

Chapter 18 examined economic order under potentially radical and persistent differences in artificial and human capability. At the synthetic level, artificial intelligence matters because it can enter many of the preceding dimensions simultaneously. AI systems can alter production, research, education, administration, cultural generation, coordination, classification, search, monitoring, prediction, and rule execution. Their economic-order significance therefore cannot be inferred from one task benchmark, labor-substitution rate, or productivity statistic.

The relevant object is a configuration of models, compute, data, energy, software, platforms, organizations, human operators, institutional rules, ownership, access, verification, and dependency. This configuration determines how artificial capability becomes practically available, who can redirect it, who bears error, which capabilities are regenerated, and which forms of participation remain consequential. Concentrated technical capability can become economic power where it is converted through infrastructure control, access restrictions, epistemic authority, institutional delegation, or dependency.

AI also intensifies the distinction between performance and capability. A person or organization can perform more effectively with AI while losing the independent capacity to verify, reconstruct, adapt, or continue when the system changes. Conversely, assistance can accelerate learning and widen capability where institutions deliberately support understanding, judgment, transfer, and participation. The economic-

order question concerns the trajectory of the coupled human–AI–institution configuration rather than assistance intensity alone.

Abundance similarly changes location. Generative systems can make symbolic production, search, drafting, simulation, or coding cheaper while attention, trust, provenance, verification, orientation, institutional access, or meaningful participation remain scarce. An economy can therefore become abundant in generated outputs while remaining constrained in the relations through which outputs acquire credibility, meaning, or public consequence.

Proposition 20.9 (AI-order capability condition). *Where artificial systems become recurrent components of consequential economic and institutional processes, economic-order evaluation should include the distribution of AI infrastructure and access together with dependency, verification, human and collective capability reproduction, participation, and institutional revisability.*

The proposition preserves design plurality. It does not predetermine ownership, regulatory, or labor arrangements. It identifies dimensions that become difficult to ignore when artificial capability is embedded in the infrastructure through which economic subjects act and institutions govern.

20.1.9 Research and Application Praxis

GRE is also a theory of inquiry and intervention. Chapters 6–11 developed research-dominant and application-dominant praxis under incomplete knowledge, heterogeneous values, uncertainty, and changing systems. At the order level, this matters because institutional design cannot be separated cleanly from the practices through which institutions are studied, evaluated, implemented, monitored, and revised.

Research-dominant praxis seeks explanation while remaining aware that research categories, measurements, and interventions can alter the systems they describe. Application-dominant praxis seeks responsible action while recognizing that evidence is incomplete, causal mechanisms can be heterogeneous, and interventions can change future conditions. The distinction is one of principal orientation rather than isolation. Policy experiments generate knowledge; research infrastructures affect domains; administrative systems produce data; institutional interventions can reveal mechanisms that were previously invisible.

This reciprocal relation supports an iterative economic-order method. A provisional design is evaluated against evidence and domain knowledge; implementation reveals conversion failures, power relations, unanticipated effects, and historical constraints; those findings revise both the intervention and the framework used to understand it. Reversibility, monitoring, and learning become analytically important because they preserve opportunities for correction when uncertainty is material.

Praxis also places responsibility on evidence architecture. What is measured, whose experience is represented, which time horizons are monitored, which failures become visible, and which domains are absent from evaluation can shape subsequent policy. A generative order therefore depends partly on institutions capable of learning about their own consequences without treating metrics as complete substitutes for judgment.

Proposition 20.10 (Praxis-feedback condition). *Economic-order inquiry should organize research, intervention, monitoring, and revision as mutually corrective processes*

where consequential uncertainty, domain remainder, or institutional learning makes one-pass optimization analytically inadequate.

This condition does not imply perpetual experimentation with basic protections or rights. Some commitments can appropriately be durable. The relevant question is which aspects of an order require continuity and which require revisable operational forms, evidential standards, or implementation pathways.

20.1.10 Open Programme Synthesis

The preceding dimensions form a synthesis because they constrain one another, yet they do not collapse into one master criterion. Historical formation affects relational architecture; relational positions shape conversion; conversion affects value realization; value conflicts interact with power; power influences knowledge; knowledge conditions governance; artificial intelligence changes capability and epistemic dependence; and praxis feeds new evidence back into the programme. Economic order is therefore a coupled configuration whose evaluation is necessarily multidimensional.

This coupling also explains why isolated improvements can be misleading. Higher output can coincide with capability depletion; wider formal access with weaker practical conversion; greater informational abundance with lower verification capacity; stronger short-run resilience with long-run lock-in; efficient platform coordination with concentrated dependency; ecological preservation with exclusionary governance; stable income with declining institutional participation. GRE does not infer that such trade-offs are inevitable. It makes them visible so that their existence, magnitude, and distribution can be investigated rather than assumed away.

An open synthesis should also preserve distinctions among analytical, empirical, formal, and normative claims. A relational model can identify a dependency without establishing that it is unjust. A historical account can explain an institution without legitimating it. A formal representation can clarify dynamics without establishing ontology. A domain remainder can motivate theoretical revision without immediately becoming a universal concept. A normative proposal can be argued for without being presented as a deductive consequence of GRE's descriptive architecture.

The synthesis is open in a second sense: future domains and future historical conditions can revise the framework. Chapter 19 demonstrated that welfare, commons, platforms, migration, ecology, and culture each exposed distinctions that were less visible in the earlier general framework. Chapter 20 should therefore avoid turning the book's final economic synthesis into a closure that would contradict the research programme it develops.

Proposition 20.11 (Open-synthesis condition). *GRE programme synthesis should integrate historically and comparatively warranted structures while preserving explicit scope conditions, unresolved value conflict, domain-specific remainder, empirical uncertainty, and pathways for theoretical and institutional revision.*

This proposition establishes the working discipline for the rest of Chapter 20. The following sections can ask more direct questions about evaluation, policy, institutions, infrastructure, participation, recirculation, abundance, artificial intelligence, governance, and futures because the present section has defined the object they act upon: a relational economic order whose consequences unfold through conversion, history, capability, value, power, knowledge, and changing possibility spaces. The task is now to develop evaluative and institutional tools adequate to that object without trans-

forming the framework into a closed blueprint.

20.2 Generative Economic Evaluation

The role of this section is to develop an economic-order evaluation architecture adequate to the generative relational object defined in Section 20.1. Its objective is to specify how an arrangement, intervention, institution, infrastructure, or economic-order trajectory can be evaluated when consequential effects extend beyond immediate outputs into relations, capabilities, constraints, recursive returns, and future possibility structures. The section therefore moves through ten evaluative dimensions: immediate outcomes, relational incidence, downstream propagation, delayed and cumulative effects, capability formation and regeneration, constraint transformation, option-space and reachability effects, generative return, history-space and transition-potential effects, and historically situated evaluation. The method is layered and claim-indexed. Each evaluative statement is tied to a specified object, affected position, temporal horizon, scale, comparison basis, evidential standing, attribution status, and normative criterion where judgment extends beyond description.

Chapter 13 developed a layered evaluation architecture for allocation. The present section extends that architecture to economic order as a whole. The difference in scope is consequential. Allocation evaluation begins from a focal allocative event or process and traces its effects. Economic-order evaluation can begin from a more distributed configuration in which many institutions, infrastructures, rules, dependencies, and value processes interact over time. The focal object can therefore be a policy regime, welfare architecture, platform ecosystem, labor-market arrangement, research system, public infrastructure configuration, ecological economy, or another historically extended order whose effects cannot be attributed to one allocation event alone.

Economic-order evaluation also requires discipline about aggregation. Some consequences can be represented through prices, quantities, rates, indices, or other scalar measures. Others concern standing, dependency, repair capacity, institutional memory, ecological regeneration, epistemic reliability, interpretive continuity, or practical reachability. These objects can sometimes support partial ordering or domain-specific metrics without supporting one common scale. GRE therefore treats evaluation as a structured profile rather than presuming that adequacy requires a single composite score.

Definition 20.12 (Generative economic evaluation profile). A *generative economic evaluation profile* is a structured, claim-indexed reconstruction of materially relevant effects of an economic arrangement or trajectory across specified subjects or relational positions, spatial and institutional scales, temporal horizons, and evaluative dimensions, together with the comparison basis, evidential support, attribution status, uncertainty, and normative criterion associated with each claim.

Definition 20.12 makes two forms of plurality explicit. The first is plurality of effects: one arrangement can improve an immediate outcome while weakening a capability, increase output while intensifying dependency, or stabilize a service while narrowing future revision paths. The second is plurality of warrants: a measured outcome difference, a reconstructed mechanism, a qualitative account of institutional dependence, a formal scenario, and a normative judgment do not possess the same

Table 20.2: Dimensions of generative economic evaluation.

Dimension	Primary evaluative object	Characteristic question	Principal caution
Immediate outcome	Near-term manifested condition	What changed close to the focal process under the relevant practical clock?	Early observability can underrepresent wider incidence
Relational incidence	Positions, roles, dependencies, standing, and coordination	Which economically consequential relations changed, and for whom?	Recipient-level measures can miss relational redistribution
Downstream propagation	Effects traveling through linked systems or positions	Through which pathways did effects extend beyond the focal boundary?	Tracing requires a materiality-based stopping rule
Delayed and cumulative effects	Latent, compounding, threshold, or maintenance-dependent consequences	Which effects emerged only after time, repetition, or intermediate processes?	Temporal sequence alone does not establish attribution
Capability formation	Individual, collective, institutional, epistemic, or regenerative capability	Which capacities to act, learn, coordinate, maintain, verify, repair, or adapt changed?	Temporary substitution can resemble durable capability
Constraint transformation	Material, institutional, relational, epistemic, normative, or biophysical constraints	Which constraints were relaxed, intensified, redistributed, or converted?	Constraint removal can create new dependencies elsewhere
Option-space effects	Practically reachable actions, exits, revisions, and alternatives	Which possibilities became accessible, fragile, restored, or foreclosed?	Nominal option counts can misstate practical reachability
Generative return	Value-bearing effects re-entering later activity	What generated conditions returned to support later generation, maintenance, or adaptation?	Return requires provenance and does not imply overall desirability
History-space and transition potential	Support for future paths, transition structure, and admissible histories	Did the arrangement reweight paths, alter transitions, or transform the represented possibility structure?	Represented support differs from practical structural change
Historical evaluation	Warrants and consequences across changing knowledge states	How should the arrangement be evaluated at different historical positions?	Ex post knowledge should not silently replace ex ante information

evidential status merely because they appear within one evaluation. A profile keeps these claims jointly visible without erasing their differences.

Table 20.2 summarizes the ten dimensions developed below. The dimensions form an analytical sequence rather than a mandatory checklist. A narrow decision can warrant a narrow profile. Broader profiling becomes important where the arrangement materially alters relations, capacities, constraints, institutions, or future option structures.

Proposition 20.13 (Profile-adequacy condition). *Generative economic evaluation is more adequate when materially relevant effects are represented at the level of differentiation required by their mechanisms, affected positions, horizons, and evidential standing, while aggregation is limited to dimensions for which a defensible translation or common metric has been established.*

Proposition 20.13 is a scope discipline rather than a demand for maximal complexity. It permits conventional outcome measures where they are sufficient for the claim. It requires additional dimensions where economically consequential effects would otherwise remain invisible.

20.2.1 Immediate Outcome Profiles

Immediate-outcome evaluation identifies near-term manifestations that are sufficiently close to the focal arrangement or change to serve as an initial account of what occurred. The relevant clock depends on the process. A payment can have an

immediate outcome within days; an education programme can have an immediate outcome at the end of a term; an infrastructure investment can have an immediate outcome when service becomes operational. GRE therefore indexes immediacy to the mechanism and implementation architecture rather than assigning one universal duration.

Immediate outcomes can concern delivery, access, uptake, continuity, production, safety, income, service quality, participation, utilization, environmental load, administrative processing, or another manifested condition. The object should follow from the stated purpose and mechanism. A welfare reform can be evaluated initially through realized access and income stabilization; a platform rule through participation, visibility, transaction completion, or exclusion; a public-infrastructure change through service availability and reliability; an ecological intervention through specified material or biological indicators.

A comparison basis is required even at this first layer. Depending on the inquiry, evaluation can use a pre-change baseline, an explicit target, a contemporaneous comparator, an estimated counterfactual, a legal or institutional standard, or a plausible historical trajectory. These baselines answer different questions. Improvement relative to the previous period can coexist with deterioration relative to an appropriate comparison group or a failure to meet an institutional obligation.

Distribution should remain visible. Aggregate improvement can coexist with deterioration for particular groups, regions, organizational positions, or subject types. Immediate-outcome profiling should therefore identify whose outcome is being measured, which aggregation rule is being used, and whether the average conceals materially relevant heterogeneity. This requirement is especially important where an order contains differentiated standing or conversion capacity.

Immediate outcomes are often attractive because they are comparatively observable. That observability should not enlarge their interpretive scope. A rise in employment, service uptake, output, or test performance can establish a near-term change under an adequate design without establishing durable capability formation, relational improvement, long-horizon welfare, or generative return. Immediate-outcome evaluation is therefore the entry layer of a broader profile.

Proposition 20.14 (Immediate-outcome specification). *An immediate-outcome claim is adequately specified when the focal manifestation, affected population or position, comparison basis, process-relative horizon, and evidential basis are explicit, and when broader relational or long-horizon significance is treated as a further claim requiring additional support.*

The proposition protects conventional evaluation from two opposite errors. Near-term outcomes should neither be dismissed because they are incomplete nor treated as sufficient merely because they are measurable. Their role is to establish one well-bounded layer of the evaluative profile.

20.2.2 Relational Incidence and Position Effects

Relational evaluation asks how an economic arrangement changes positions and relations through which subjects gain or lose access, authority, recognition, coordination, dependency, bargaining capacity, care, information, or institutional standing. This layer is required because identical recipient-level outcomes can rest on different relational architectures. A household can receive the same income under secure

entitlement or discretionary patronage; a worker can receive the same wage under different exit conditions; a creator can receive the same revenue under different platform dependencies; a community can receive the same service under participatory or externally controlled governance.

The relevant incidence boundary therefore extends beyond the nominal recipient where relational effects are material. A subsidy can alter supplier dependence, household bargaining, regional infrastructure, or administrative standing. A platform rule can change the relation among sellers, customers, complementors, and ranking systems. A research funding regime can change relations among institutions, disciplines, infrastructures, and early-career researchers. An ecological policy can redistribute stewardship obligations and exposure across communities or generations.

Relational incidence can also concern who becomes legible to an institution. Classification, documentation, ranking, verification, eligibility, and recognition systems can create or modify positions even before resource quantities change. Being classified as eligible, high-risk, verified, unemployed, resident, contributor, dependent, or authorized can alter the relations through which later opportunities are mediated. Evaluation should therefore include classification effects where they are economically consequential.

The relational layer also makes distribution more precise. Distribution is not only a distribution of objects. It can be a distribution of discretion, waiting time, verification burden, exposure to monitoring, ability to appeal, access to decision processes, or control over conversion interfaces. These relational distributions can partly determine how formal resources become effective capabilities.

Proposition 20.15 (Relational-incidence condition). *Economic evaluation should extend beyond nominal recipients when an arrangement materially changes relations of access, authority, recognition, coordination, dependency, standing, or conversion among positions that affect realized capability or later economic participation.*

This condition does not require tracing every social relation. It requires a bounded incidence analysis guided by the mechanism and the claim. The relevant boundary expands where omitted relational changes would materially alter the evaluation.

20.2.3 Downstream Propagation Across Configurations

Downstream evaluation concerns consequences that propagate beyond the focal intervention, institution, or administrative boundary through economically relevant connections. Propagation can occur through prices, supply chains, labor markets, migration, information, standards, infrastructure, organizational imitation, financial relations, ecological flows, care networks, or institutional precedent. The resulting effects can appear in positions that were never designated as direct recipients.

The evaluation problem is therefore one of pathway reconstruction. A public investment can alter local demand, mobility, land values, institutional capacity, and later private investment. A platform change can alter seller strategy, consumer search, advertising markets, third-party software, and competitor behavior. A migration regime can affect households, employers, remittance systems, care relations, sending-region institutions, and destination public services. A research infrastructure investment can propagate through training, data reuse, collaboration, standards, and downstream technological development.

Propagation analysis needs a stopping rule because every economic process is connected to wider systems. GRE uses materiality, mechanism, horizon, scale, and decision relevance to bound tracing. An effect belongs inside the evaluation where excluding it would materially change the claim being made or the affected-position profile relevant to the decision. Distant or speculative consequences can remain documented as uncertainty without being assigned the same status as well-supported downstream effects.

Propagation also raises attribution problems. The further an effect travels through independent decisions and changing conditions, the more alternative explanations and interacting causes become relevant. Attribution can therefore weaken with relational or temporal distance even when the original process remains a contributory condition. Distributed causation should be represented where appropriate rather than converted into exclusive causal ownership.

Proposition 20.16 (Downstream-tracing condition). *Downstream evaluation is analytically adequate when materially relevant propagation pathways are traced across the positions and systems through which effects travel, while the stopping rule, attribution strength, intervening conditions, and uncertainty remain explicit.*

This formulation preserves both reach and restraint. Economic-order evaluation can examine propagation without implying that one focal arrangement explains every later event connected to it.

20.2.4 Delayed and Cumulative Effects

Delayed effects emerge after an interval because the relevant mechanism requires maturation, accumulation, learning, institutional reproduction, ecological response, demographic change, network formation, maintenance failure, or another temporally extended process. Cumulative effects arise through repeated episodes whose combined consequence becomes materially different from any one episode considered alone. These structures require an evaluative horizon matched to the mechanism.

Delay can conceal benefit. Education, preventive health, research, infrastructure, institutional capacity, ecological restoration, and cultural preservation can produce important effects only after years of use, maintenance, or transmission. Delay can also conceal harm. Skill erosion, environmental depletion, maintenance debt, institutional dependence, data concentration, loss of interpretive capacity, or weakened local capability can accumulate while short-run outputs remain favorable.

Cumulative effects can be approximately additive in some settings, but many important cases involve thresholds, feedback, path dependence, or changing conversion conditions. Repeated under-maintenance can eventually cause system failure. Small exclusions can accumulate into durable standing differences. Repeated algorithmic ranking can reshape market visibility. Persistent extraction can reduce ecological regenerative capacity. Recurrent emergency substitution can weaken local institutional reproduction. The evaluative object is therefore sometimes a trajectory or process regime rather than a sum of isolated events.

Temporal comparison also requires attention to maintenance. A benefit can appear durable only because continuing resources, labor, care, software updates, administrative capacity, or ecological stewardship remain available. Evaluation should distinguish an effect that persists autonomously from one that persists through continuing

maintenance. The latter can still be highly valuable, but its maintenance dependence belongs in the profile because it affects cost, vulnerability, and transition planning.

Proposition 20.17 (Delayed-and-cumulative condition). *Where material consequences depend on maturation, repetition, accumulation, threshold behavior, maintenance, or institutional reproduction, economic evaluation should use a horizon and process representation capable of distinguishing delayed emergence, cumulative change, and persistence conditions from immediate manifestation alone.*

The condition guards against temporal truncation. It also guards against indefinite extrapolation: later effects remain claims that require mechanism evidence rather than presumed continuation of early trends.

20.2.5 Capability Formation and Regeneration

Capability evaluation asks how an economic arrangement changes practical capacities to act, learn, coordinate, maintain, verify, repair, adapt, participate, or reorganize. The carrier of capability can be an individual, household, organization, institution, community, epistemic network, or another collective configuration. Chapter 19 repeatedly showed that collective and institutional capabilities can be irreducible to a sum of individual skills because they depend on relations, procedures, infrastructures, memory, and coordination.

A central distinction concerns service substitution and capability formation. An external provider can solve a problem without increasing the recipient's ability to solve related future problems. Artificial intelligence can raise current task performance while reducing practice in verification or judgment. Centralized humanitarian logistics can protect life while temporarily substituting for disrupted local systems. Outsourcing can improve short-run service delivery while weakening in-house maintenance knowledge. None of these patterns is intrinsically undesirable. Evaluation should identify which function is being optimized and whether future capability reproduction matters to the arrangement's purpose.

Capability formation also differs from capability regeneration. Formation concerns the creation or strengthening of a capacity. Regeneration concerns the ability to reproduce, renew, repair, transmit, or adapt that capacity after turnover, disruption, technological change, or environmental pressure. A research institution with one exceptional expert can possess high current capability and low regenerative capacity. A public service can function well while succession systems erode. A community can coordinate effectively while losing the practices through which new members acquire stewardship competence.

Capability evaluation should therefore examine carriers, enabling conditions, conversion pathways, maintenance requirements, transmission, and substitutability. It should also preserve distinctions among productive, epistemic, institutional, relational, ecological, and judgment capacities where their mechanisms differ.

Proposition 20.18 (Capability-regeneration condition). *Economic evaluation of capability is more adequate when it distinguishes current performance, formed capability, and regenerative capability, and identifies the subjects or configurations that carry the relevant knowledge, relations, infrastructures, routines, and maintenance conditions.*

This proposition is particularly important for long-horizon economic order because high current output can coexist with low capacity to reproduce the conditions

on which that output depends.

20.2.6 Constraint Transformation and Burden Redistribution

Constraint evaluation asks how an arrangement changes the conditions that limit, channel, protect, stabilize, or structure economic action. GRE treats constraints as typed. Material scarcity, legal rules, administrative procedures, infrastructure limits, social obligations, epistemic uncertainty, platform standards, ecological thresholds, and institutional mandates constrain activity through different mechanisms. Their evaluative meaning depends on the focal process and affected positions.

Constraint relaxation can expand capability. Removing an exclusionary rule, reducing transport barriers, improving interoperability, releasing time, providing translation, or increasing information can open participation. Constraint relaxation can also redistribute burdens. A rule that simplifies participation for one group can shift verification labor to another. A platform that removes seller entry barriers can intensify attention competition. Faster permitting can reduce delay while weakening a protective review process. Increased mobility can expand labor opportunities while increasing dependence on transport, documentation, or digital systems.

Some constraints are generative because they coordinate, protect, or preserve enabling conditions. Safety standards, ecological limits, professional obligations, due-process requirements, data-governance rules, and maintenance protocols can restrict immediate action while sustaining trust, resilience, fairness, or future capability. Evaluation should therefore distinguish the existence of a constraint from its mechanism, incidence, revisability, and relation to the protected object.

Constraint transformation can also occur through conversion. A financial constraint can become a time burden; a legal right can become practically inaccessible through administrative friction; a technological bottleneck can become organizational dependence; an ecological limit can become a distributional burden through pricing or rationing. Evaluating the removed constraint alone can miss the new constraint generated elsewhere in the configuration.

Proposition 20.19 (Constraint-transformation condition). *Generative economic evaluation should identify materially relevant constraints by type and examine whether an arrangement relaxes, intensifies, relocates, converts, or creates them across affected positions, while preserving the distinction between protective coordination and restrictive burden.*

The proposition provides a symmetric discipline: neither more constraint nor less constraint is an evaluative conclusion by itself. The object is the changed constraint architecture and its consequences.

20.2.7 Option-Space and Reachability Effects

Option-space evaluation concerns changes in the practically reachable actions, relations, exits, revisions, and future pathways available to specified positions. The emphasis on reachability is essential. A formally available alternative can have little practical value when cost, standing, information, infrastructure, documentation, skill, location, dependency, or coordination requirements make it inaccessible. Conversely, a modest institutional change can create a consequential option when it removes one binding conversion barrier.

Option-space effects can involve creation, preservation, restoration, diversification, fragilization, or foreclosure. Interoperability can preserve switching options. Savings or social protection can preserve the option to refuse unsafe work. Legal recognition can create a new route to institutional participation. Redundant infrastructure can preserve service alternatives under disruption. Exclusive standards or accumulated platform dependence can narrow exit. Ecological degradation can foreclose histories dependent on damaged systems. Long contracts can support investment while narrowing near-term revision.

More options do not automatically imply a better economic order. Some options can be harmful, exploitative, unsafe, or inconsistent with legitimate commitments. Durable cooperation can require actors to relinquish some unilateral options. Environmental protection can intentionally close destructive pathways. Evaluation should therefore identify which option is being preserved or foreclosed, for whom, why it matters, and which normative or institutional criteria justify the change.

Option-space analysis also makes uncertainty more tractable where precise forecasting is unavailable. An arrangement can be assessed partly by whether it preserves diversified pathways, modularity, liquidity, portability, repairability, reversible commitments, or institutional revision even when the probability of each future state is unclear. These indicators are useful only where the mechanism connecting them to practical reachability is specified.

Proposition 20.20 (Reachability-sensitive option condition). *An option-space claim is economically meaningful when it identifies the relevant option or pathway, the position for which it is reachable, the conversion conditions required for exercise, and the mechanism through which the arrangement creates, preserves, restores, weakens, or forecloses that reachability.*

This condition prevents nominal possibility from standing in for effective freedom while leaving room for justified commitment and protective closure.

20.2.8 Generative Return and Recursive Effects

Chapter 14 defined generative return as a value-bearing effect attributable, with stated scope and evidential standing, to an earlier generative process and re-entering later activity as a condition of further generation, maintenance, coordination, adaptation, participation, or transformation. Economic-order evaluation uses that concept to ask whether an arrangement reproduces the conditions on which later value generation depends.

Recursive effects can take many forms. Education can return capability into later learning and work. Research can return knowledge, methods, infrastructure, or trained researchers. Public infrastructure can return mobility, reliability, or coordination capacity. Care can return health, time, participation, and relational continuity. Commons stewardship can return ecological or institutional viability. Cultural preservation can return interpretive capacity. Platform ecosystems can return complementary innovation while also capturing data or attention in ways that reshape later participation.

Generative return is therefore distinct from financial return, although financial return can be one component. It is also distinct from persistence. A condition can persist without re-entering a later generative process, and a return can occur after transformation into another value form. The evaluative questions concern prove-

nance, re-entry pathway, carrier, incidence, horizon, maintenance conditions, and uncertainty.

Recursive effects can be adverse. Debt, technical lock-in, depleted reserves, institutional burden, surveillance infrastructure, ecological damage, or capability erosion can also re-enter later processes and shape what becomes possible. The language of return is most useful for value-bearing re-entry; burdensome recursive effects should be named directly where calling them returns would obscure their evaluative status.

Attribution should remain distributed where the underlying generation is distributed. A later innovation can depend on public education, prior research, infrastructure, organizational routines, open knowledge, and many contributors. A provenance-sensitive account can identify material contribution without turning visibility at the final step into exclusive ownership of the return.

Proposition 20.21 (Generative-return evaluation condition). *Economic-order claims about generative return should identify the originating process or configuration, the value-bearing condition that later re-enters activity, the affected positions, the re-entry pathway, the relevant horizon, and material attribution uncertainty, while preserving heterogeneous value forms where no warranted common metric exists.*

Generative-return evaluation thus connects current economic performance to the reproduction of future productive, institutional, epistemic, ecological, cultural, and relational conditions without requiring those conditions to be valued in one unit.

20.2.9 History-Space and Transition-Potential Effects

History-space evaluation asks whether an arrangement changes the represented family of possible economic histories, the transition relations among configurations, or the practical accessibility of different continuations. The representation can be qualitative or formal. Chapter 15 introduced typed history weights and transition potentials precisely to distinguish several meanings that numerical or comparative support can carry. Economic evaluation should preserve that typing.

Three kinds of change are especially important. *Path reweighting* changes the relative evidential support, decision support, attractiveness, cost, or practical plausibility assigned to paths already represented. *Transition change* alters how one configuration can lead to another by modifying resources, capacities, constraints, rules, or coordination. *History-space transformation* changes which actions, states, institutions, or histories need to be represented at all because the underlying possibility architecture has changed.

These distinctions matter for evaluation. New evidence can reweight a policy path without changing the economic configuration. A transport investment can change practical transitions by connecting previously separated activities. A new legal institution can create a class of recognized actions that was previously unavailable. A technical standard can close some transition routes while creating others. Artificial intelligence can change both the cost of tasks and the set of feasible organizational forms. Ecological threshold crossing can remove histories that depended on a prior biophysical regime.

Transition-potential analysis should remain typed. A transition can be technically feasible and normatively undesirable, politically difficult, financially expensive, or weakly supported by evidence. A numerical representation of one dimension should

not silently become a probability or welfare ranking. Where the inquiry uses scenario graphs, simulations, partial orders, or dynamical models, the meaning of each weight or transition quantity must therefore remain explicit.

History-space analysis is especially valuable under structural uncertainty. Evaluation can ask whether an arrangement creates robust transition routes, preserves repair or exit pathways, increases dependence on one narrow branch, or makes later institutional revision prohibitively costly even when the likelihood of particular future states is unknown. Such claims can often be supported through mechanism and scenario analysis without assigning precise probabilities to every branch.

Proposition 20.22 (History-space evaluation condition). *Where an economic arrangement materially changes future-path support, practical transition structure, or the set of admissible or represented histories, evaluation should distinguish path reweighting, transition change, and history-space transformation, and should state the type and evidential meaning of any transition-potential or history-weight representation used.*

This condition links evaluation to the book's generative-spacetime architecture while preserving ontological restraint. History spaces are analytical representations of possible economic continuation, not claims that futures exist as a unique pre-given mathematical object.

20.2.10 Historically Situated Evaluation

Historically situated evaluation reconstructs an economic arrangement across changing states of knowledge, institutional capacity, available alternatives, value recognition, and realized consequence. Its role is to prevent later information from silently replacing what decision-makers and affected participants could reasonably know or contest at an earlier historical position. The distinction is central to accountability, learning, and re-epistemization.

At least three evaluative positions are often useful. An *ex ante position* reconstructs the evidence, expectations, alternatives, institutional obligations, capabilities, and uncertainty present before or at the time of decision. An *implementation position* examines how the arrangement was enacted, including deviations, adaptations, participation, failures, and emerging effects. An *later reconstruction position* incorporates delayed outcomes, new evidence, revised concepts, changed values, and historical comparison. These positions can support different judgments because they answer different questions.

A favorable later outcome does not establish that an earlier decision was well warranted. Good fortune, unanticipated complementarity, later repair, or external support can improve an initially weak arrangement. An adverse later outcome likewise does not establish that the earlier decision was unreasonable if material information was unavailable or a low-probability event occurred. Evaluation should therefore distinguish *ex ante* warrant, implementation quality, realized consequence, and later reinterpretation.

Historical evaluation also permits normative learning. Later societies can recognize harms, affected subjects, ecological consequences, data rights, care burdens, or forms of exclusion that earlier institutions did not adequately represent. Present evaluation can legitimately use those criteria while making clear that they are part of a later evaluative standpoint. This distinction supports critique without constructing a fictional history in which earlier actors possessed later concepts and evidence.

The evaluative apparatus itself can be endogenous to economic order. Institutions shape which data are collected, which groups are represented, which indicators become authoritative, which time horizons receive attention, and which failures become legible. A platform can generate the data used to evaluate platform effects; a welfare administration can define the categories through which unmet need is observed; a research system can reward the outputs by which its productivity is later measured. Historically situated evaluation should therefore record the provenance and institutional production of evidence where those conditions materially affect interpretation.

Re-epistemization completes this section's logic. Later evidence can revise judgments about earlier events, but revision should preserve the evidential history through which the judgment changed. A programme can move from plausible to weakly supported, or from apparently harmful to beneficial, as information accumulates. A concept can also change: what counted as access, capability, harm, or value can be refined through domain inquiry. Evaluation is consequently a history of warranted claims as well as a history of economic effects.

Proposition 20.23 (Historical-evaluation condition). *Generative economic evaluation should distinguish the evidence, alternatives, criteria, and institutional capacities available at materially different historical positions, preserve the provenance of later revisions, and separate ex ante warrant, implementation, realized consequence, and retrospective re-epistemization where those judgments can diverge.*

The ten-dimensional architecture developed in this section gives Chapter 20 an evaluation layer suited to the economic-order object defined in Section 20.1. Immediate outcomes remain necessary, yet they are situated within a wider profile of relational incidence, downstream propagation, delayed effects, capability regeneration, constraint transformation, option-space change, generative return, history-space transformation, and historical warrant. This architecture does not predetermine which dimensions should dominate a particular decision. It identifies the kinds of economically consequential effects that require explicit treatment when they are material to the inquiry.

The next section can therefore move from evaluation to policy. Section 20.3 asks how resources, relational infrastructure, capability formation, generative investment, option preservation, adaptation, learning, and exit can be organized when policy is informed by a multidimensional and historically situated evaluation profile rather than by one immediate outcome alone.

20.3 Generative Economic Policy

The role of this section is to translate the economic-order evaluation architecture developed in Section 20.2 into a policy architecture. Its objective is to specify how economic policy can organize resources, rules, infrastructures, capacities, learning, and revision when policy effects are evaluated across immediate outcomes, relational incidence, capability regeneration, constraint transformation, future reachability, and historical change. The section develops eight policy dimensions: allocation-conversion architecture, relational infrastructure provision, capability regeneration, generative investment, option-space preservation, adaptive policy, policy learning, and exit-sensitive closure. The method is design-oriented but non-prescriptive. GRE

identifies policy objects, tracing requirements, revision conditions, and recurrent failure modes without deriving one universally preferred policy instrument, scale, or institutional form.

Economic policy is used here in a broad but bounded sense. It includes public and publicly authorized arrangements that shape economic resources, access, incentives, rules, infrastructures, protections, capacities, and transition conditions over time. Taxation, transfers, public investment, procurement, regulation, standards, service provision, credit architecture, labor-market institutions, research funding, social protection, infrastructure governance, and transition programmes can therefore enter the analysis where they have materially economic effects. The term does not imply that economic order is produced by the state alone. Chapter 19 showed that firms, platforms, communities, research institutions, transnational arrangements, and ecological governance also organize economically consequential relations. Policy operates within and upon these wider configurations.

The distinction between policy and isolated intervention is also important. Chapters 10 and 11 developed general methodologies for application-dominant praxis, decision, intervention, monitoring, reversibility, and practical closure. The present section specializes those resources to economic policy, where commitments are often recurrent, institutionally layered, population-wide, and entangled with infrastructures and expectations that accumulate over time. A policy can therefore generate effects through repeated eligibility rules, financing arrangements, administrative pathways, technical standards, or investment priorities even where no single intervention event captures the whole causal structure.

Definition 20.24 (Generative economic policy configuration). A *generative economic policy configuration* is a historically situated arrangement of policy objectives, instruments, resources, institutional responsibilities, implementation pathways, affected positions, monitoring practices, revision conditions, and transition provisions, evaluated through the immediate and generated economic relations, capabilities, constraints, value processes, and future possibilities that the arrangement materially shapes.

Definition 20.24 gives policy a configuration-level object. A tax rate, subsidy, entitlement, procurement rule, investment programme, or technical standard can remain an analytically useful instrument, yet its effects depend on the institutional and relational configuration through which it operates. Eligibility, information, administrative capacity, market structure, complementary infrastructure, bargaining position, legal standing, timing, and implementation can materially change the realized policy relation.

A generative orientation also changes the temporal scope of policy reasoning. Immediate relief, stabilization, or output can be fully legitimate objectives. The additional question is what conditions the policy creates for later action. A policy can secure present consumption while weakening administrative capacity, or impose a present cost while building infrastructure that lowers future dependency. It can widen present access while creating technical lock-in, or restrict one activity while preserving ecological or institutional capacities on which later activity depends. Policy analysis therefore benefits from a record that connects immediate objectives to generated conditions rather than treating long-horizon effects as a separate afterthought.

Proposition 20.25 (Policy–evaluation alignment condition). *Where an economic pol-*

Table 20.3: Dimensions of generative economic policy.

Policy dimension	Primary object	Generative question	Characteristic policy risk
Allocation–conversion	Resources, rights, access pathways, incidence	Can nominal provision be converted into usable capability across affected positions?	Formal allocation with weak practical conversion
Relational infrastructure	Physical, administrative, legal, digital, epistemic, care, and coordination systems	Which relations require durable provision, maintenance, and interoperability?	Asset provision without maintenance or usable access
Capability regeneration	Human, collective, institutional, epistemic, and maintenance capability	Does policy reproduce capacities needed for later action and adaptation?	Service substitution accompanied by capability erosion
Generative investment	Resource commitment to future productive or enabling conditions	What future capacities, infrastructures, relations, or option structures are being built?	Narrow return measures that omit substrate depletion
Option-space preservation	Reachable alternatives, transition routes, repair and reversal pathways	Which future actions remain practically attainable after commitment?	Present optimization that creates costly lock-in
Adaptive policy	Monitoring, thresholds, modularity, revision, staged commitment	Can policy change as evidence and conditions change?	Flexibility without accountability or revision capacity
Policy learning	Evidence, institutional memory, comparison, re-epistemization	Can implementation generate usable knowledge for later policy revision?	Data accumulation without organizational learning
Exit-sensitive closure	Exit, reversal, transition, residual obligations, burden on remaining positions	Can a policy be ended or transformed without unmanaged relational damage?	Formal sunset or withdrawal with stranded dependencies

icy materially alters relations, capabilities, constraints, infrastructures, dependencies, or future reachability, its design and review should connect the operative policy mechanism to the corresponding dimensions of the generative economic evaluation profile in Section 20.2, with scope proportionate to consequence, uncertainty, duration, and reversibility.

Table 20.3 summarizes the eight policy dimensions developed below. The table is an analytical map rather than a mandatory instrument sequence. A narrowly scoped policy can require only a subset of the dimensions, while broad or durable policy regimes can require explicit treatment of most of them.

20.3.1 Allocation–Conversion Policy Architecture

Allocation remains a central operation of economic policy, yet Chapter 13 showed that allocation becomes economically meaningful through conversion. A policy can distribute money, rights, licenses, quotas, service entitlements, credit, land access, infrastructure access, or time while producing highly unequal realized capability because affected positions face different conversion conditions. Generative policy therefore treats allocation and conversion as one connected design problem.

The first policy task is to specify the allocative object. A monetary transfer differs from a service entitlement, a legal right, a public option, a technical standard, or guaranteed access to infrastructure. The second task is to identify the pathway through which the object becomes usable. Information, documentation, transport, language, digital access, time, care responsibilities, legal status, complementary assets, and administrative capacity can each mediate conversion. The third task is to reconstruct incidence beyond the nominal recipient. A childcare subsidy can alter household time, provider markets, labor participation, public budgets, and care-sector wages. A research grant can affect laboratories, trainees, suppliers, publication infrastructures,

and future research capacity.

Policy can therefore fail even when formal allocation is accurately executed. A benefit can be delivered yet remain inaccessible to people unable to navigate administrative requirements. Infrastructure funding can be allocated while maintenance capability remains absent. Credit can be expanded where market concentration or weak bargaining position prevents productive conversion. Conversely, a modest resource allocation can have large generative effects where complementary capacities and institutions are already present.

Definition 20.26 (Policy conversion pathway). A *policy conversion pathway* is the sequence of institutional, material, informational, legal, relational, and capability conditions through which a policy-provided resource, right, service, or opportunity becomes practically usable by a specified affected position.

The pathway can contain multiple failure points and can differ across positions. Its analysis therefore complements distributive incidence. Equality of nominal allocation can coexist with substantial inequality in realized access, while unequal nominal allocations can sometimes be designed to address unequal conversion conditions. The evaluative justification for such differences remains a normative question that should be stated explicitly rather than embedded silently in administrative design.

Allocation policy should also track burden conversion. Taxes, compliance requirements, waiting periods, reporting obligations, contribution rules, and eligibility tests can translate into different burdens depending on time, expertise, organizational scale, or access to professional assistance. A policy architecture that traces benefits but ignores burden conversion can misidentify its relational incidence.

Proposition 20.27 (Allocation–conversion policy condition). *Where a policy distributes resources, rights, services, opportunities, or obligations, policy design should identify materially relevant conversion pathways for affected positions and distinguish nominal allocation, practical access, realized capability, and redistributed burden where these can diverge.*

This condition does not require exhaustive tracing of every indirect effect. Proportionality remains important. The tracing burden should increase where affected positions face heterogeneous conversion conditions, where access is administratively complex, where policy consequences are durable, or where failure can produce substantial dependency or exclusion.

20.3.2 Relational Infrastructure Provision

Economic policy frequently operates through infrastructures whose contribution is partly invisible when analysis focuses only on transactions or final outputs. Chapter 19 showed that education, research, welfare, communities, platforms, public institutions, migration, ecology, and culture all depend on infrastructures that organize practical relations. These infrastructures can be physical, legal, administrative, digital, epistemic, care-based, ecological, or coordinative. Policy can therefore shape economic possibility by creating, maintaining, connecting, or degrading relational infrastructure.

Relational infrastructure provision differs from project delivery alone. A transport link requires maintenance, operational capacity, standards, institutions, and integration with the activities it is meant to support. A public data system requires

governance, provenance, interoperability, security, correction, and practical access. A legal right depends on procedures, records, representation, enforcement, and institutional capacity. Care infrastructure depends on trained people, time, facilities, continuity, financing, and social recognition. Knowledge infrastructure can depend on archives, standards, software, repositories, libraries, educational institutions, and communities able to interpret and reproduce knowledge.

The policy object is therefore partly the relation that infrastructure makes possible. A bridge supports mobility relations; a registry supports administrative recognition; broadband supports communication and access; an archive supports intergenerational epistemic continuity. This relational view can reveal why capital expenditure without maintenance, institutional capacity, or accessibility can produce a nominal asset with weak generative effect.

Infrastructure also creates dependencies. Centralized technical systems can improve coordination while increasing exposure to one operator, standard, provider, or failure mode. Public procurement can create proprietary lock-in. A national registry can improve access while concentrating informational power. Infrastructure policy should therefore consider interoperability, redundancy, fallback capacity, portability, and governance alongside efficiency and scale.

Proposition 20.28 (Relational-infrastructure policy condition). *Where policy relies on infrastructure to sustain economically material relations, provision should evaluate the infrastructure's practical accessibility, maintenance and renewal capacity, interoperability, dependency profile, governance, and contribution to later collective action in addition to initial asset delivery.*

Section 20.5 will examine relational infrastructure as a broader object of economic order. The present subsection establishes the policy implication: infrastructure spending is generative only through the relations and capacities that the infrastructure can sustain over time.

20.3.3 Capability Regeneration Policy

Policy can provide a service directly, enable subjects to develop relevant capabilities, or support institutions that regenerate capability across time. These operations can overlap, yet they have different long-horizon consequences. Section 20.2.5 distinguished current performance from capability formation and regenerative capability. Generative policy uses that distinction to ask when substitution is appropriate and when policy should also reproduce the capacities that make future action possible.

Direct substitution can be necessary. Emergency income support can substitute for lost earnings. Public healthcare can provide capabilities that individuals cannot reasonably reproduce independently. Infrastructure operators can perform technical functions more effectively than dispersed users. A generative orientation therefore does not require that every service recipient become self-sufficient. The policy question concerns the relevant level and distribution of regenerative capability for the domain.

In education, regeneration can concern the learner's capacity to continue learning. In research, it can concern institutional ability to form researchers and maintain methods. In welfare, it can concern administrative capacity, care capacity, and household resilience. In industrial policy, it can concern technical capability, supply-chain learning, standards competence, and organizational routines. In public administra-

tion, it can concern professional judgment, institutional memory, and succession. In ecological policy, it can concern stewardship capability and the renewal of ecological functions.

Capability policy therefore requires a typed account. Human skill, collective coordination, institutional memory, repair capacity, epistemic competence, and technological capability are different objects. A policy that improves one can weaken another. Automation can increase immediate service capacity while eroding human verification or maintenance capability. Outsourcing can obtain specialized performance while reducing institutional memory. Training can increase individual skill while organizational rules prevent its use.

Proposition 20.29 (Capability-regeneration policy condition). *Where sustained policy performance materially depends on human, collective, institutional, epistemic, technical, or maintenance capability, policy design should identify which capabilities require preservation, formation, renewal, or external provision and should monitor whether implementation changes the capacity to reproduce those capabilities over time.*

The condition is intentionally plural. Different economic orders can legitimately allocate capability across individuals, communities, markets, public institutions, and technical systems in different ways. GRE asks whether the resulting dependency and regeneration architecture remains visible and revisable.

20.3.4 Generative Investment Architecture

Economic policy often uses investment language to justify present resource commitment by reference to later benefit. GRE broadens the analytical object while preserving the ordinary financial meaning where it is appropriate. Public capital, research, education, care systems, ecological restoration, administrative capacity, standards, cultural infrastructure, community institutions, and open knowledge can generate later value through pathways that are only partially represented by financial return.

Definition 20.30 (Generative policy investment). *A generative policy investment is a policy-supported commitment of resources, institutional attention, or protected time whose justification materially includes the formation, regeneration, or connection of capabilities, infrastructures, relations, knowledge, ecological functions, or option structures expected to support later value generation or collective action.*

The definition does not classify every socially beneficial expenditure as investment. A generative investment claim should identify what is being formed, the plausible generation pathway, the relevant horizon, the affected positions, the maintenance requirements, and the uncertainty surrounding later return. The language becomes weak when future benefit is merely asserted.

Generative investment also requires attention to substrates. A productive activity can generate measured economic return while drawing down ecological functions, public infrastructure, care capacity, institutional trust, or knowledge commons on which later activity depends. Policy can therefore examine both investment and depletion within the same configuration. Section 20.2.8 introduced generative return as value-bearing conditions that re-enter later activity. Investment policy asks how such returns are produced, distributed, and maintained.

Portfolio reasoning is useful because generative returns can be heterogeneous and uncertain. Some investments yield predictable infrastructure capacity; others

support exploratory research, institutional learning, community capability, or option creation whose specific future use is uncertain. An economic policy architecture can therefore distinguish reliable provision, strategic capability formation, exploratory investment, maintenance, and resilience without forcing all categories into one expected-return metric.

Investment also has incidence. Public support can create private asset appreciation, proprietary capability, regional concentration, or platform dependence even where the originating expenditure was broadly financed. Provenance-sensitive analysis can ask who contributes to the generative substrate, who captures realized returns, and whether sufficient value or capability returns to the institutions and relations required for continued generation.

Proposition 20.31 (Generative-investment policy condition). *A policy framed as generative investment should specify the capability, infrastructure, relation, knowledge, ecological function, or option structure being formed; the plausible pathway through which later value or action becomes possible; the maintenance conditions; the distribution of generated benefits and burdens; and the principal uncertainties and depletion risks relevant to the investment claim.*

This condition supplies a bridge to Section 20.7, which will examine value recirculation and social reinvestment more directly.

20.3.5 Option-Space Preservation

Policy often narrows possibilities deliberately. Safety rules prohibit some actions. Standards reduce technical variety to improve interoperability. Land-use decisions commit space to particular purposes. Infrastructure creates path dependence. Long-term contracts stabilize expectations. A generative policy orientation therefore cannot equate openness with maximum optionality. The relevant object is the preservation of economically and normatively material future alternatives under conditions where current commitment is necessary.

Section 20.2.7 distinguished nominal options from practically reachable options, while Chapter 15 developed reachability and transition potential across history spaces. Policy can use these distinctions to ask whether current decisions preserve repair paths, alternative providers, institutional revision, technological substitution, fiscal room, ecological recovery, or practical exit where future uncertainty makes such alternatives valuable.

Option preservation has costs. Redundancy can be expensive. Interoperability requirements can slow optimization. Maintaining multiple technologies can reduce scale economies. Reversible infrastructure can be less efficient than a specialized irreversible system. Policy analysis should therefore treat option preservation as an evaluative tradeoff rather than a categorical priority. Its importance increases where uncertainty is high, consequences are durable, dependency is concentrated, or the costs of later reversal are strongly asymmetric.

Definition 20.32 (Option-preservation architecture). *A policy option-preservation architecture is the set of institutional, technical, fiscal, legal, informational, and relational provisions that keep specified future alternatives practically reachable after a policy commitment, including where relevant modularity, interoperability, reserves, fallback capacity, review rights, alternative providers, repair pathways, and reversible stages.*

The definition also permits explicit non-preservation. A policy can justifiably close harmful, unsafe, or institutionally unacceptable options. The important requirement is to identify which options are being closed, which are being preserved, and how the judgment is warranted under the available evidence and values.

Proposition 20.33 (Option-preservation policy condition). *Where a policy creates durable path dependence under substantial uncertainty, design should identify materially valuable future alternatives and assess whether their practical reachability warrants protection through modularity, interoperability, reserves, staged commitment, review, fallback, or other locally appropriate mechanisms.*

Option preservation thereby connects economic policy to intergenerational possibility without assuming that future preferences, technologies, or institutions can be fully specified in advance.

20.3.6 Adaptive Policy Architecture

Adaptive policy concerns the organized capacity to revise a policy when evidence, conditions, technologies, institutions, or value judgments change. Adaptation is more demanding than discretionary flexibility. A policy can be formally adjustable while lacking monitoring, decision rights, technical modularity, administrative capacity, or political procedures needed for actual revision. Conversely, frequent discretionary change can reduce predictability, weaken rights, or expose affected positions to arbitrary authority.

Chapter 10 developed provisional closure, monitoring, reversibility, revision, and reopening as practical governance resources. Economic policy adds several scale-specific issues. Policies can shape expectations and investment, create reliance interests, redistribute property values, alter organizational capability, and become embedded in infrastructure or administrative systems. Revision therefore has both benefits and transition costs.

Adaptive design begins by identifying the variables that matter for reconsideration. These can include outcome thresholds, access failures, fiscal stress, distributional burden, ecological indicators, technological change, dependency concentration, capability erosion, or new evidence about causal mechanisms. A review schedule without a substantive reconsideration rule can become ceremonial. A substantive rule without data, institutional capacity, or authority can remain inoperative.

Modularity can support adaptation. Pilot regions, phased implementation, separable programme components, interoperable standards, bounded experimental authority, and staged investment can permit learning while limiting irreversible exposure. Yet modularity is not universally feasible. Network infrastructures, macroeconomic stabilization, legal rights, and emergency response can require coordinated commitment at scale. The design question is therefore how much modularity and reversibility the policy object permits.

Definition 20.34 (Adaptive policy architecture). *An adaptive policy architecture is a policy arrangement in which materially relevant monitoring, review authority, revision procedures, implementation modularity where feasible, transition protections, and institutional capacity are organized so that policy commitments can be recalibrated in response to specified changes in evidence or conditions without dissolving accountability or basic continuity.*

Proposition 20.35 (Adaptive-policy condition). *Where material uncertainty, technological change, ecological dynamics, institutional learning, or evolving dependency can alter the warrant for an economic policy, policy design should connect monitoring to a practicable revision architecture and should specify how continuity, affected-party protections, and accountability are maintained during adaptation.*

Adaptation therefore concerns governed responsiveness. It does not mean that every policy should remain permanently unsettled. Durable rights and predictable rules can themselves be generative infrastructure, while the procedures through which they are interpreted or amended remain contestable and revisable.

20.3.7 Policy Learning Architecture

Policy learning concerns the capacity of implementation to generate knowledge that can inform later judgment. Monitoring produces observations; learning requires a relation among evidence, interpretation, institutional memory, comparison, and revision. The distinction is important because policy systems can accumulate extensive data while repeating the same interpretive or organizational failures.

A learning architecture should preserve the history of policy assumptions. The original problem formulation, causal expectations, target population, value judgments, uncertainty, and implementation constraints provide the baseline against which later evidence can be interpreted. If these assumptions disappear from institutional memory, outcome data can be detached from the claims they were meant to test.

Learning should also preserve heterogeneity of evidence. Administrative data can reveal utilization and distribution. Qualitative inquiry can reveal barriers, unintended effects, or changes in meaning. Comparative designs can identify differential effects. Historical reconstruction can explain path dependence. Formal or computational models can explore mechanisms and scenarios. The appropriate combination depends on the policy question; methodological plurality from Chapters 6–9 remains active.

Policy learning can be asymmetric across positions. A programme can learn efficiently about fiscal cost while remaining weakly informed about administrative burden, local institutional effects, care responsibilities, trust, or excluded groups. Evidence architecture therefore has distributive consequences: what the policy can learn depends partly on what it records and whose experience becomes legible.

Definition 20.36 (Policy learning record). *A policy learning record is a versioned reconstruction of a policy's problem formulation, assumptions, expected mechanisms, evidence, implementation changes, observed effects, interpretive revisions, unresolved uncertainty, and resulting changes in policy warrant across materially distinct historical positions.*

A learning record supports re-epistemization. Later evidence can revise earlier judgments without erasing what was reasonably knowable at the time. It can also reveal that the original categories were inadequate: an indicator may have obscured a conversion barrier, an eligibility category may have excluded a relevant subject, or a success metric may have omitted capability erosion. Learning can therefore modify the policy's conceptual architecture as well as its parameter values.

Proposition 20.37 (Policy-learning condition). *A policy that is materially expected to learn from implementation should preserve traceable links among its initial assump-*

tions, evidence architecture, implementation history, observed effects, interpretive revisions, and subsequent policy changes, while keeping unresolved uncertainty and materially excluded evidence visible.

Policy learning thus gives adaptive policy an epistemic substrate. Adaptation without learning can become reactive change; learning without revision can become archival accumulation without practical consequence.

20.3.8 Exit-Sensitive Policy Closure

Economic policies eventually face continuation, renewal, transformation, replacement, or termination. Policy exit is therefore part of design even where no near-term termination is intended. Chapter 10 distinguished revision, reversal, and exit within practical closure. Economic policy adds a configuration-level concern: withdrawal can affect subjects whose livelihoods, rights, investments, organizations, technical systems, or expectations have adapted to the policy.

A formal sunset clause does not by itself provide an adequate exit architecture. Ending a subsidy can strand assets. Closing a public programme can disrupt care relations or administrative records. Withdrawing infrastructure support can undermine complementary services. Ending a regulatory exemption can impose abrupt transition costs. Terminating a platform-dependent public service can create portability and continuity problems. Policy exit therefore has both a decision condition and a transition condition.

Exit design can include advance notice, grandfathering, portability, record preservation, replacement services, compensation, retraining, debt restructuring, technical migration, staged reduction, ecological restoration, or institutional handoff depending on the policy object. These mechanisms are not automatically required. Their relevance depends on legitimate reliance, dependency, reversibility, distributional burden, public obligation, and the extent to which the policy itself generated the dependence that makes exit costly.

Exit should also remain distinct from policy failure. A successful temporary programme can end because its objective has been met. A programme can be replaced because a better instrument becomes available. A long-lived institution can require transformation rather than termination. Conversely, continuing a policy merely because exit has become costly can entrench lock-in. An explicit exit architecture makes these possibilities easier to distinguish.

Definition 20.38 (Policy exit architecture). *A policy exit architecture is the set of criteria, authorities, transition provisions, continuity protections, record-preservation practices, residual obligations, and burden-allocation rules through which a policy can be ended, replaced, substantially transformed, or allowed to expire.*

The architecture should account for exit remainders. Some effects persist after formal termination: sunk infrastructure, damaged ecosystems, disclosed data, changed expectations, institutional capability loss, accumulated debt, legal precedents, or dependencies among remaining actors. A policy can therefore require post-exit monitoring or repair even when the principal instrument has ceased.

Proposition 20.39 (Exit-sensitive policy condition). *Where an economic policy can generate material reliance, dependency, irreversible effects, or transition burdens, its closure architecture should specify conditions for continuation, revision, replacement,*

or termination and should identify practicable transition protections, residual obligations, and post-exit remainders proportionate to the policy's consequences.

The eight dimensions developed in this section connect generative evaluation to policy design without converting GRE into a universal policy formula. Allocation is linked to conversion; infrastructure to maintenance and dependency; service provision to capability regeneration; investment to future generative conditions; commitment to option-space preservation; uncertainty to governed adaptation; implementation to learning; and closure to exit-sensitive transition. Their relative importance depends on the policy object, affected positions, institutional scale, available evidence, values, urgency, and reversibility.

Generative economic policy is therefore best understood as a discipline of policy construction and revision rather than a catalogue of preferred instruments. The framework asks what a policy generates in addition to what it immediately delivers, which capacities and dependencies it reorganizes, which future pathways it opens or closes, how it can learn, and how commitments can be transformed responsibly when their warrant changes. Section 20.4 turns next to the institutional architecture required to sustain such policy capacities over time.

20.4 Generative Economic Institutions

The role of this section is to specify the institutional architecture through which the evaluation and policy principles developed in Sections 20.2 and 20.3 can persist beyond isolated decisions or temporary programmes. Its objective is to identify the properties of economic institutions that can hold relational mandates, reproduce capabilities, learn from experience, recirculate value, organize participation, remain contestable, and evolve without losing the continuity required for collective action. The section develops eight institutional dimensions: relational mandates, institutional learning, value recirculation, capacity formation, participation and standing, contestability and correction, institutional generativity, and institutional evolution. The method is architectural rather than constitutional. GRE does not derive one preferred ownership form, organizational scale, legal personality, or public-private boundary; it asks what institutional functions and relations must be visible when an institution is evaluated through its generated economic consequences.

The term *economic institution* is used broadly enough to include organizations and durable rule-bearing arrangements whose operation materially structures access, allocation, production, exchange, knowledge, care, infrastructure, finance, ecological stewardship, social protection, or economic participation. A ministry, cooperative, university, pension system, platform, standards body, public bank, professional association, commons institution, foundation, insurer, labor organization, infrastructure operator, or community-governance arrangement can therefore enter the analysis where it stabilizes expectations and allocates rights, obligations, capabilities, resources, or decision authority. The category does not imply organizational homogeneity. Some institutions are formally incorporated organizations; others are distributed rule systems embedded across several organizations and practices.

Institutional analysis also differs from policy analysis. A policy can specify an entitlement, standard, investment, tax, or transition rule, yet its practical effects depend on institutions able to interpret, administer, maintain, learn, correct, and eventually

revise that rule. Conversely, institutions can outlive particular policies and preserve capabilities, records, routines, authority, and dependencies that shape later policy possibilities. Section 20.3 therefore supplies one immediate input to the present analysis, while Chapter 19 supplies domain evidence showing that institutional capacity, memory, standing, and maintenance recur across education, research, work, welfare, commons, platforms, public infrastructure, migration, ecology, and culture.

Definition 20.40 (Generative economic institution configuration). A *generative economic institution configuration* is a history-bearing arrangement of mandates, rules, authority, resources, capabilities, infrastructures, membership or affected positions, learning practices, accountability mechanisms, value flows, and revision pathways through which an institution organizes present economic relations while reproducing or transforming the conditions for later collective action.

Definition 20.40 makes institutional generativity a configuration-level property rather than a label attached to organizational form. Public ownership, cooperative membership, private ownership, nonprofit status, decentralization, hierarchy, or network governance can each support or weaken generative conditions depending on the relations through which authority, capability, dependency, participation, and value are organized. The relevant institutional question is therefore not whether one form is inherently generative, but what the form enables, reproduces, concentrates, depletes, or makes revisable under specified historical conditions.

Institutional continuity is equally important. Economic life relies on arrangements that persist sufficiently for rights, expectations, knowledge, infrastructure, and cooperation to remain usable. Yet continuity can become lock-in where mandate, authority, or capability cannot be revised as conditions change. A generative institutional architecture therefore combines enough stability to support coordinated action with enough learning, contestability, succession, and redesign capacity to remain historically revisable.

Proposition 20.41 (Institutional generativity condition). *Where an economic institution materially organizes access, capability, value, dependency, infrastructure, or participation across time, evaluation should examine both its present functional performance and its capacity to reproduce, repair, contest, learn from, and revise the relations on which later collective action depends.*

Table 20.4 summarizes the eight institutional dimensions developed below. The dimensions are analytical rather than a universal checklist. Their relevance depends on institutional function, scale, duration, consequence, and the degree to which affected positions depend on the institution's continued operation.

20.4.1 Relational Institutional Mandates

Institutions act through mandates. A mandate can be legal, contractual, fiduciary, professional, constitutional, customary, community-based, or organizational. It specifies what an institution is authorized or expected to do, but its practical significance depends on the relations through which the mandate is realized. A public agency charged with service access, a university charged with research and education, a co-operative charged with member benefit, or a platform charged by contract with mediating transactions can each exercise authority beyond the literal wording of a formal purpose because infrastructure, information, standards, and dependency shape practical choice.

Table 20.4: Dimensions of generative economic institutions.

Institutional dimension	Primary object	Generative question	Characteristic institutional risk
Relational mandate	Authorized purpose, affected relations, obligations, scope	Which relations and positions does the institution have warrant to organize, protect, or transform?	Mission language detached from operative authority and incidence
Institutional learning	Evidence, memory, interpretation, revision	Can experience change institutional understanding and practice?	Data accumulation without retained learning or conceptual revision
Value recirculation	Revenue, surplus, capability, knowledge, maintenance return	Which generated value returns to the substrates required for continued operation?	Extraction or capture accompanied by substrate depletion
Capacity formation	Human, collective, professional, technical, administrative capability	Does the institution reproduce the capabilities required for future performance and adaptation?	Output maintained through capability erosion or concentrated dependence
Participation and standing	Membership, voice, representation, affectedness, contribution	Which positions can influence, contest, or participate in consequential institutional processes?	Formal inclusion with weak practical standing
Contestability and correction	Review, appeal, audit, explanation, remedy, counter-power	Can consequential institutional decisions be challenged and corrected?	Durable authority without practicable correction pathways
Institutional generativity	Reproduction of relations, capability, infrastructure, learning, option space	Does institutional operation renew the conditions for later collective action?	Current performance purchased through long-horizon generative depletion
Institutional evolution	Succession, redesign, boundary change, transformation, dissolution	Can the institution change form while preserving warranted continuity and managing inherited obligations?	Persistence through inertia or abrupt transformation with lost institutional memory

A relational mandate therefore includes more than a statement of mission. It identifies the subjects and positions whose relations the institution can materially alter; the resources, rules, infrastructures, or capabilities within institutional reach; the obligations generated by reliance on institutional services; and the boundaries beyond which additional authorization is required. Chapter 16 showed that power can arise through conversion mechanisms, access control, dependency, and institutional mediation. Institutional mandate analysis makes these mechanisms visible before authority is treated as self-justifying simply because it is organizationally established.

Mandates can also conflict internally. A public bank can be expected to preserve financial soundness while expanding access to credit. A research university can pursue frontier knowledge, education, public contribution, and organizational survival. A welfare institution can protect continuity while preventing administrative lock-in. These tensions need not be resolved by one permanent hierarchy. Institutions can use differentiated decision rules, procedural safeguards, protected minima, or issue-specific balancing where relevant values and obligations cannot be reduced to one metric.

Definition 20.42 (Relational institutional mandate). *A relational institutional mandate is the historically situated set of authorized purposes, obligations, affected positions, protected relations, scope boundaries, and revision conditions through which an institution's authority to organize economically consequential relations is specified and interpreted.*

A relational mandate should also expose mandate drift. Institutions can acquire new technical capabilities, data, infrastructure, market position, or public reliance that expand their practical influence without corresponding revision of formal authorization. Conversely, old mandates can remain formally broad while institutional

capacity has narrowed to the point that promised obligations are no longer practically realizable. Mandate adequacy therefore requires correspondence among authorized purpose, practical power, institutional capacity, and affected positions.

Proposition 20.43 (Mandate–power alignment condition). *Where an institution's practical control over access, infrastructure, information, resources, or dependency materially exceeds or falls short of the relations contemplated by its formal mandate, institutional review should examine whether authority, obligation, capacity, and accountability remain aligned with the institution's actual economic position.*

Relational mandates provide the normative and functional boundary within which the remaining dimensions operate. Learning can revise interpretation of the mandate; participation can reveal affected positions omitted from it; contestability can correct abuses within it; and institutional evolution can eventually require its formal redesign.

20.4.2 Institutional Learning Architecture

Institutions require more than information to learn. Learning occurs when evidence changes institutional interpretation, routines, categories, resource allocation, or mandate implementation in ways that can be retained and later reassessed. Chapter 17 treated knowledge as an economic field with infrastructures, dependencies, and preservation problems. Section 20.3.7 specialized that concern to policy learning. The institutional problem is broader because an organization or rule system must preserve learning across personnel turnover, political cycles, leadership changes, technological replacement, and shifts in the problems it confronts.

Institutional learning therefore has at least four components. First, observations must be generated and retained. Second, those observations must remain connected to the assumptions, categories, and decisions they bear upon. Third, interpretation must be able to change rather than merely confirm existing routines. Fourth, revised understanding must enter operational practice, training, governance, or mandate review. Failure at any stage can produce an institution rich in records yet poor in learning.

Tacit knowledge complicates the architecture. Some institutional competence resides in professional judgment, informal coordination, maintenance practices, local relationships, and accumulated experience that cannot be fully encoded in manuals or databases. Succession planning, apprenticeship, team continuity, communities of practice, and reflective review can therefore be as important as formal record keeping. Automation can preserve some procedures while simultaneously weakening the human capabilities needed to diagnose exceptions or reconstruct why the procedure exists.

Definition 20.44 (Institutional learning architecture). *An institutional learning architecture is the arrangement of evidence generation, record preservation, interpretive review, tacit-knowledge transmission, decision revision, and organizational memory through which an institution can update both its operational practices and its understanding of the problems those practices address.*

Learning should remain historically indexed. A later institution can reasonably reject an earlier decision while preserving the fact that the earlier decision was made under different evidence, constraints, or values. Re-epistemization is stronger than retroactive condemnation because it reconstructs why judgment changed. This his-

torical record also improves accountability by making institutional evolution traceable rather than presenting each new rule as though it emerged without a predecessor.

Proposition 20.45 (Institutional-learning continuity condition). *An institution expected to operate across changing conditions should maintain practicable links among evidence, historical assumptions, tacit knowledge, interpretive revision, operational change, and succession so that organizational learning can survive turnover and remain open to later re-epistemization.*

Institutional learning becomes especially consequential when policy or technology changes rapidly. An adaptive rule system without memory can oscillate; a stable rule system without learning can become obsolete. Generative institutional design requires both continuity and the capacity to revise the reasons for continuity.

20.4.3 Value Recirculation Architecture

Institutions consume and generate heterogeneous forms of value. They use financial resources, professional capability, public legitimacy, knowledge, ecological functions, care, attention, infrastructure, data, and relational trust. Their operation can then generate revenue, surplus, expertise, reputation, data, social capability, technological assets, public value, or new dependencies. Chapter 14 developed generation, conversion, circulation, accumulation, capture, and generative return as distinct value processes. Institutional analysis asks how these processes are organized within durable structures.

Recirculation is one mechanism through which an institution reproduces its substrate. A university can return value through training, open knowledge, research infrastructure, and professional communities. A cooperative can return surplus or capability to members. A platform can reinvest in interoperability, participant safety, developer ecosystems, or portability. A public service can return value through maintained infrastructure and institutional capacity. An ecological commons institution can return resources to stewardship and regeneration. These pathways differ in value form and cannot be evaluated through financial retention alone.

Value recirculation should also remain distinct from internal accumulation. An institution can retain a large surplus while underinvesting in maintenance, employee capability, public infrastructure, ecological repair, community relations, or knowledge preservation. Conversely, an institution can distribute resources outward while weakening its own capacity to discharge future obligations. The relevant question is how value returns are distributed among institutional continuity, contributors, affected positions, shared infrastructures, and the wider relational substrates on which continued generation depends.

Definition 20.46 (Institutional value-recirculation architecture). *An institutional value-recirculation architecture is the set of rules, practices, and pathways through which value generated, captured, or accumulated through institutional activity is returned, retained, converted, or redistributed among the institution, contributors, affected positions, shared infrastructures, and other substrates required for continued generative activity.*

The definition does not imply that every institution owes every generated value form back to every contributing relation. It creates an object for tracing. A research institution can legitimately retain resources for future research; a pension institu-

tion must preserve long-horizon obligations; a public utility may require reserves; a cultural institution may devote resources to preservation. The analytical task is to identify which substrates are being replenished, which are being depleted, and how the chosen return architecture relates to institutional mandate and justice.

Proposition 20.47 (Institutional value-return condition). *Where institutional activity materially depends on shared, public, relational, epistemic, ecological, or participant-supplied substrates, evaluation should trace whether generated value returns in forms and pathways sufficient to support the continued viability of the substrates on which later institutional activity depends.*

Section 20.7 develops value recirculation and social reinvestment in greater depth. The present subsection establishes the narrower institutional requirement: an institution's value architecture should make its own reproduction and its dependence on wider substrates jointly visible.

20.4.4 Institutional Capacity Formation

Institutions can perform while degrading the capacities that make performance possible. Short-term output can be preserved by overloading experienced staff, outsourcing critical functions, relying on one technical vendor, postponing maintenance, or automating tasks without reproducing diagnostic knowledge. The resulting institution can appear efficient while becoming more brittle. A generative institutional perspective therefore treats capacity formation and regeneration as part of institutional performance rather than as a separate human-resources or investment concern.

Institutional capacity is typed. Professional expertise, administrative competence, legal capability, technical maintenance, data stewardship, financial management, coordination, public communication, research capability, conflict resolution, and leadership succession are not freely substitutable. Collective capacity can also exceed the sum of individual skill because routines, role differentiation, trust, infrastructure, and shared memory make coordinated performance possible. Chapter 19 repeatedly encountered such configuration-level capability in research institutions, organizations, commons, public institutions, and ecological stewardship.

Capacity formation therefore includes recruitment and training but extends further. Institutions need pathways through which novices become capable contributors, expertise is distributed rather than trapped in one position, critical functions have succession or redundancy, and changes in technology are accompanied by corresponding changes in verification and judgment capacity. Outsourcing can be appropriate, yet the institution should understand which capabilities it is relinquishing, which it retains for oversight, and whether re-entry remains possible if the external dependency changes.

Definition 20.48 (Institutional capability reproduction). *Institutional capability reproduction* is the process through which an institution forms, maintains, transmits, distributes, and renews the human, collective, technical, administrative, epistemic, and maintenance capabilities required to discharge its mandate and adapt to materially changing conditions.

Capability reproduction has temporal incidence. Training can reduce immediate throughput while strengthening later resilience. Redundancy can look inefficient under ordinary conditions while preserving continuity during disruption. Apprenticeship can require expert time while preventing future knowledge loss. Evaluation

should therefore connect capacity costs to the horizon over which institutional obligations are expected to persist.

Proposition 20.49 (Institutional-capability condition). *Where institutional obligations are durable or difficult to substitute, institutional design should identify the capabilities whose loss would materially impair continuity, oversight, learning, maintenance, or adaptation and should organize practicable pathways for their reproduction, distribution, and succession.*

Institutional capability formation creates one bridge to Section 20.5, where relational infrastructure will be examined more directly. Capabilities depend on infrastructures, while infrastructures remain usable only where institutional capacities for maintenance, interpretation, and coordination persist.

20.4.5 Participation and Institutional Standing

Institutions contain multiple positions whose relations to authority differ. Formal members, employees, users, beneficiaries, contractors, contributors, residents, citizens, suppliers, regulated parties, funders, and indirectly affected communities can all have economically consequential relations to one institution. Chapter 19 showed that membership, contribution, affectedness, representation, and participation often diverge. Institutional design therefore benefits from a multidimensional account of standing rather than a single inside–outside boundary.

Standing can concern information, voice, representation, decision rights, appeal, contribution, access, protection, or entitlement to explanation. These dimensions can legitimately differ. A technical user may require reliable access and appeal without voting rights over every strategic decision. Workers can require voice concerning workplace conditions while customers hold different protections. Future generations, ecosystems, or dispersed affected populations may require representation because direct participation is unavailable or conceptually inappropriate. The design problem is therefore to match forms of standing to the institution’s mandate, power, dependency relations, and affected positions.

Participation also has conversion conditions. A formal consultation mechanism can remain inaccessible because of time, language, information asymmetry, technical complexity, social risk, or lack of consequence. Practical participation requires pathways through which input becomes institutionally legible and can affect decisions or review. Participation without any plausible connection to institutional action can become ceremonial and may weaken rather than strengthen trust.

Definition 20.50 (Institutional standing profile). *An institutional standing profile specifies the forms of access, information, voice, representation, contribution, protection, appeal, and decision influence available to a position in relation to an institution, together with the practical conversion conditions through which those forms become usable.*

Institutional standing should remain proportional to the relation rather than mechanically equalized. Some decisions require specialist authority; some obligations are fiduciary; some data are confidential; some emergency decisions require speed. A generative architecture asks where differentiated authority is warranted and which complementary protections, explanations, review rights, or representative mechanisms are needed because other positions remain materially affected.

Proposition 20.51 (Standing–incidence condition). *Where an institution materially affects a position’s access, livelihood, capability, rights, dependency, or future options, institutional design should identify the forms of standing appropriate to that relation and assess whether formal standing can be practically exercised under the relevant conversion conditions.*

Section 20.6 will examine economic participation across production, knowledge, care, institutions, communities, and activity beyond employment. The present subsection establishes the institutional component: participation requires specified standing within the structures that organize consequential decisions.

20.4.6 Institutional Contestability and Correction

Institutions make classifications, allocate access, enforce rules, distribute resources, interpret mandates, and sometimes exercise authority that affected positions cannot readily avoid. Contestability provides one mechanism through which errors, exclusions, abuse, outdated categories, and unexpected consequences can be surfaced and corrected. Chapter 16 connected power analysis to counter-power, procedural safeguards, and governance. Institutional contestability specifies the operational architecture through which those protections become usable.

Contestability contains several distinct operations. A person can request explanation, challenge factual error, appeal a decision, seek independent review, present new evidence, contest the rule itself, or seek remedy for harm. Audit and transparency can support these processes but do not substitute for them. Information about a decision is valuable, yet correction also requires authority, procedure, timing, and a practical remedy. Some institutional systems therefore benefit from layered pathways: frontline correction, internal review, independent appeal, judicial review, ombuds functions, member governance, or external regulatory oversight depending on the institutional form.

Correction should also feed learning. Repeated appeals can reveal a category problem rather than isolated mistakes. Disparate error patterns can expose data or model failures. Complaints can reveal conversion barriers invisible in administrative metrics. An institution that resolves individual cases while failing to aggregate what those cases teach can remain operationally responsive yet structurally unlearning.

Definition 20.52 (Institutional contestability architecture). *An institutional contestability architecture is the arrangement of explanation, challenge, evidence submission, review, counter-authority, correction, remedy, and learning pathways through which materially consequential institutional decisions or rules can be questioned and, where warranted, revised.*

Contestability has costs and boundaries. Endless appeal can paralyze administration; disclosure can violate privacy; technical systems can require specialized review; emergency decisions can precede full process. The relevant design question is proportionality: consequences, reversibility, dependency, error cost, and power asymmetry can justify different levels of explanation and review.

Proposition 20.53 (Contestability–correction condition). *Where institutional decisions materially shape access, standing, resources, rights, or dependency, contestability should connect practicable challenge to an authority capable of explanation, correction, remedy, or rule revision, with procedural intensity proportionate to consequence and reversibility.*

Contestability thereby supports both justice and institutional intelligence. It creates a channel through which excluded evidence and affected experience can modify institutional understanding rather than remaining external criticism with no route into practice.

20.4.7 Institutional Generativity

The preceding dimensions can now be integrated. An institution can discharge its current mandate while consuming the capacities, trust, infrastructure, ecological conditions, knowledge, or participation on which later operation depends. It can also preserve itself indefinitely while ceasing to generate useful collective possibilities. Institutional generativity therefore concerns the relation between present function and the reproduction or transformation of future institutional capability.

Generativity is not synonymous with growth, innovation rate, organizational survival, or expansion of authority. A small institution can be highly generative if it maintains a critical commons, reproduces expertise, preserves records, or enables many actors to act independently. A growing organization can be generatively weak if expansion concentrates dependency, depletes contributors, erodes contestability, or destroys alternative pathways. Institutional generativity is therefore indexed to the relations and capacities generated, maintained, or foreclosed by institutional operation.

Maintenance belongs inside this concept. Reliable payroll, archival preservation, infrastructure repair, routine service continuity, professional succession, ecological stewardship, and procedural upkeep can all preserve the substrate of future action. Novelty can be generative where it expands capability or option space, but maintenance can be equally generative where deterioration would narrow those possibilities.

Definition 20.54 (Institutional generativity). *Institutional generativity* is the capacity of an institution, through its continuing operation and revision, to reproduce or strengthen the relations, capabilities, infrastructures, knowledge, value-return pathways, participatory standing, and option structures required for later collective action while keeping materially consequential dependencies and authority sufficiently visible and revisable.

The definition leaves room for differentiated institutional purposes. A court, central bank, school, cooperative, research institute, hospital, platform, utility, and commons organization need not generate the same capabilities or values. Generativity concerns adequacy relative to mandate, affected positions, historical conditions, and the wider economic order in which the institution operates.

Proposition 20.55 (Institutional-generativity evaluation condition). *Assessment of institutional generativity should distinguish current output from the reproduction of capability, infrastructure, learning, value return, participation, maintenance, and future option structures and should identify where present performance depends on depletion or concentration that weakens those later conditions.*

This proposition connects institutional analysis back to the generative economic evaluation profile in Section 20.2. Institutions become one important carrier of recursive economic effects because they preserve or transform the conditions through which future allocations, policies, and collective decisions become possible.

20.4.8 Institutional Evolution and Succession

Institutions change. Mandates expand or contract; technologies alter operational possibilities; professional fields evolve; populations and memberships change; crises create new responsibilities; organizations merge, split, decentralize, federate, privatize, publicize, automate, or dissolve. A generative framework therefore needs an account of institutional evolution that is neither simple preservation nor unrestricted adaptation.

Institutional evolution has at least three temporal layers. Incremental revision changes rules, routines, or capacities while organizational identity remains relatively continuous. Structural transformation changes authority, ownership, boundaries, or core operating architecture. Succession transfers functions, obligations, records, capabilities, or rights to a new institutional configuration. Each layer creates different continuity problems. A procedure can be revised without altering institutional identity, while dissolution of a pension fund, archive, public agency, or infrastructure operator can require explicit transfer of obligations that outlive the organization itself.

Institutional inheritance matters because organizations carry history. Records, contracts, legal precedents, professional communities, technical debt, public expectations, ecological liabilities, data, and tacit knowledge persist into later configurations. A successor institution can acquire formal assets while losing the relational and epistemic conditions required to use them. Institutional evolution therefore requires more than asset transfer; it can require preservation of provenance, capability, standing, maintenance obligations, and unresolved claims.

Definition 20.56 (Institutional evolution pathway). *An institutional evolution pathway is a historically ordered sequence of revisions, capacity changes, boundary changes, authority transformations, and succession arrangements through which an institution changes form while carrying forward, reallocating, or terminating specified mandates, capabilities, records, dependencies, rights, and obligations.*

Evolution should also permit institutional death. An institution can complete its purpose, become obsolete, lose legitimate warrant, or impose costs that exceed the value of continuity. Generativity therefore does not require permanent survival. What matters is whether transformation or closure manages inherited obligations and preserves those capabilities, records, relationships, or infrastructures that remain independently valuable.

Succession can be designed before crisis. Modular records, interoperable infrastructure, distributed expertise, clear ownership of data and obligations, portable entitlements, and documented maintenance practices can reduce the cost of institutional transformation. These provisions parallel the exit-sensitive policy architecture of Section 20.3.8, but the institutional horizon can be longer because organizations and rule systems can persist across multiple generations of policy.

Proposition 20.57 (Institutional-evolution condition). *Where an institution carries durable mandates, dependencies, records, infrastructures, or obligations, material transformation or succession should identify what requires continuity, what can be re-designed, what can legitimately terminate, and how capabilities, standing, provenance, and residual responsibilities are transferred or resolved across the institutional change.*

The eight dimensions developed in this section specify an institutional architecture capable of carrying the policy and evaluation disciplines of the preceding sections

across time. Relational mandates connect authority to affected relations; learning connects experience to revision; value recirculation connects generated value to institutional and wider substrates; capacity formation reproduces the means of future performance; participation gives differentiated positions practical standing; contestability connects authority to correction; institutional generativity integrates present function with future conditions; and institutional evolution makes continuity itself revisable.

Generative economic institutions are therefore not a distinct institutional sector or a fixed organizational type. They are institutions whose mandates, capabilities, value pathways, participation structures, correction mechanisms, and evolution can be analyzed in relation to what they make possible over time. Section 20.5 turns next to relational infrastructure, examining the physical, legal, digital, epistemic, care, mobility, communication, and access systems through which institutional and economic participation become practically possible.

20.5 Relational Infrastructure

The role of this section is to identify the infrastructures through which the evaluation, policy, and institutional architectures developed in Sections 20.2–20.4 become practically usable in economic life. Its objective is to treat infrastructure as a relational condition of access, coordination, capability, standing, and future participation rather than as a residual category of fixed capital. The section develops eight dimensions: public space and spatial access, mobility and reachability, communication and coordination, knowledge and epistemic access, care and relational reproduction, digital interoperability, legal standing, and integrated institutional access. The method is configurational. GRE examines how infrastructures connect subjects, institutions, resources, rights, information, and places across time and how those connections are maintained, repaired, governed, and revised.

Infrastructure in this sense includes physical assets, but its economic significance arises through the relations those assets support. A railway line is consequential through the destinations, schedules, prices, accessibility conditions, employment patterns, and institutional connections it makes reachable. A library is consequential through collections, staff, catalogues, opening rules, interpretive assistance, preservation, and the communities able to use them. A digital identity system is consequential through the services it unlocks, the records it connects, the errors it propagates, and the correction procedures available when identification fails. Similar reasoning applies to public space, communication systems, care arrangements, legal institutions, and knowledge repositories.

The category is therefore broader than public infrastructure and narrower than the totality of social relations. Relational infrastructure consists of durable or recurrent arrangements whose continued operation materially conditions repeated access, coordination, capability conversion, or institutional participation for multiple subjects or positions. Such infrastructure can be publicly provided, privately owned, cooperatively governed, community maintained, professionally organized, digitally mediated, or assembled through hybrid arrangements. Ownership form remains analytically relevant, especially where it shapes dependency or access, yet it does not by itself determine infrastructural generativity.

Definition 20.58 (Relational infrastructure configuration). A *relational infrastructure configuration* is a history-bearing arrangement of physical, spatial, communicative, epistemic, care, digital, legal, and administrative systems whose repeated operation materially conditions access, coordination, capability conversion, institutional standing, and participation across subjects, places, and time.

Definition 20.58 makes maintenance and accessibility part of the analytical object. Construction alone does not establish infrastructural adequacy. Reliability, affordability, interoperability, repair, documentation, staffing, temporal availability, accessibility, governance, and correction can determine whether nominal provision becomes practical capability. The same asset can therefore have different relational effects for subjects with different locations, languages, legal status, disabilities, care responsibilities, digital access, or institutional standing.

Infrastructure also has temporal depth. Present systems inherit routes, standards, property arrangements, protocols, professional practices, technical debt, legal categories, and settlement patterns generated earlier. New infrastructure can alter future location choices, dependencies, institutional boundaries, and option structures for long periods. This temporal depth makes infrastructural evaluation closely related to the historical and option-space dimensions developed in Section 20.2.

Proposition 20.59 (Relational-infrastructure condition). *Where infrastructure materially conditions repeated economic access, coordination, capability conversion, or participation, evaluation should examine practical usability, maintenance, interoperability, dependency, correction, and long-horizon option effects in addition to nominal provision or installed capacity.*

Table 20.5 summarizes the eight infrastructure dimensions developed below. The table is diagnostic rather than exhaustive; particular economic configurations can require additional domain-specific infrastructures or can combine several dimensions within one institutional arrangement.

20.5.1 Public Space and Spatial Access

Economic participation takes place somewhere. Streets, plazas, markets, parks, libraries, transit nodes, schools, civic buildings, community facilities, waterfronts, sidewalks, and other shared spaces condition encounter, movement, visibility, informal exchange, rest, learning, care, and collective life. Their economic significance does not depend on every use being monetized. A public bench, shaded route, accessible toilet, safe crossing, library reading room, or community hall can alter whether a person can remain in an area long enough to work, learn, care, meet, or participate in institutional life.

Public space is relational because practical use depends on more than formal designation. Location, opening hours, safety, accessibility, climatic protection, surveillance, policing, commercial pressure, social norms, maintenance, crowding, and nearby transport can distribute use unevenly. The same formally public site can support one group while remaining practically difficult for another. Spatial access therefore has to be indexed to subjects, activities, times, and the surrounding infrastructural configuration.

Public space also provides low-threshold interfaces among domains that are otherwise institutionally separated. Libraries can combine knowledge access, digital connectivity, study space, civic information, and shelter from environmental con-

Table 20.5: Dimensions of relational infrastructure in generative economic order.

Infrastructure dimension	Primary relation	Generative question	Characteristic infrastructural risk
Public space and spatial access	Presence, encounter, proximity, common use	Which subjects can safely and practically occupy, encounter, and use shared economic space?	Nominal openness with exclusion through location, design, time, or policing
Mobility and reachability	Movement between activities, services, institutions, and relations	Which economically consequential destinations are practically reachable within relevant time and resource constraints?	Transport supply accompanied by weak practical reachability
Communication and coordination	Information exchange, addressing, language, signaling, coordination	Can participants communicate reliably enough to coordinate, contest, learn, and maintain relations?	Connectivity without intelligibility, trust, or effective coordination
Knowledge and epistemic access	Records, repositories, expertise, provenance, interpretive support	Can knowledge be found, understood, verified, preserved, and reused?	Information abundance with weak interpretation or provenance
Care and relational reproduction	Care availability, continuity, time, support, social reproduction	Does the configuration reproduce the bodily and relational conditions of continued participation?	Economic participation sustained through hidden care depletion
Digital interoperability	Networks, compute, identity, protocols, data, interfaces, fallback	Can digital participation remain portable, secure, intelligible, and recoverable across systems?	Concentrated technical dependency and non-portable access
Legal infrastructure and standing	Legal identity, rights, procedures, enforcement, remedy	Can formal rights and obligations be practically realized and corrected?	Formal entitlement without practicable standing or remedy
Institutional access integration	Cross-system eligibility, navigation, coordination, handoff	Can subjects move through coupled infrastructures without avoidable exclusion at their interfaces?	Fragmented access in which failure at one interface blocks otherwise available capabilities

ditions. Parks can support health, care, community relations, informal education, and ecological functions. Transit concourses can become sites of commerce, information, and public service access. Such multifunctionality can be generative where it increases practical combinations among activities without requiring every relation to pass through a commercial transaction.

Definition 20.60 (Public-space access profile). *A public-space access profile specifies, for a subject or position and a relevant activity, the spatial, temporal, physical, social, legal, environmental, and institutional conditions that determine whether a formally shared space can be safely and practically used.*

Spatial access also interacts with private and semi-public space. Shopping centers, workplaces, campuses, stations, platforms, and privately owned public spaces can perform public-facing functions while remaining governed by differentiated admission, conduct, surveillance, and exclusion rules. GRE therefore examines practical standing within the space rather than assuming that the public–private legal category fully describes relational access.

Proposition 20.61 (Spatial-access condition). *Where shared space materially supports economic, civic, epistemic, care, or community participation, infrastructural evaluation should examine who can use the space, for which activities, at which times, under what conditions of safety and standing, and with what capacity for continued or alternative access.*

Public space provides the spatial substrate for the mobility relations considered next. A destination can be formally open yet economically remote where transport, time, cost, accessibility, or legal constraints make it difficult to reach.

20.5.2 Mobility and Reachability Infrastructure

Mobility infrastructure connects subjects to employment, education, care, markets, institutions, communities, public space, and other forms of participation. Roads, railways, buses, pedestrian systems, cycling networks, ports, mobility services, scheduling systems, ticketing, information, and accessibility arrangements together shape practical movement. The economic object is therefore broader than transport supply. What matters is the reachability of valued or necessary relations under actual constraints.

Reachability is relative to time, cost, reliability, safety, physical accessibility, documentation, operating hours, and the timing of linked institutions. A clinic can be geographically close while practically unreachable if transport ends before an appointment concludes. A job can be accessible by distance yet incompatible with care schedules. A low-cost route can become unusable where transfers are unreliable or physical design excludes particular bodies. Mobility infrastructure consequently converts spatial separation into differentiated practical possibility.

Mobility also structures bargaining and dependency. Access to multiple employers, suppliers, schools, hospitals, markets, or administrative offices can reduce dependence on a single local gatekeeper. Conversely, a region organized around one transport corridor or one costly mobility provider can concentrate dependency even when aggregate mobility appears high. Reachability therefore belongs inside analysis of power and option space as well as infrastructure performance.

Definition 20.62 (Practical reachability profile). A *practical reachability profile* specifies the set of economically consequential destinations and relations that a subject or position can access within relevant constraints of time, cost, reliability, safety, physical accessibility, legal permission, information, and linked institutional schedules.

The profile can change without new construction. Integrated fares, accessible information, schedule coordination, safer streets, portable mobility benefits, or revised operating hours can expand practical reachability using existing physical systems. Conversely, deterioration, congestion, service cuts, digital-only ticketing, or lost affordability can shrink reachability while installed infrastructure remains unchanged.

Proposition 20.63 (Mobility–conversion condition). *Where economic opportunities or entitlements depend on physical movement, policy and institutional evaluation should distinguish installed transport capacity from the practical reachability through which subjects can convert spatial mobility into access, participation, and alternative options.*

Mobility makes physical relations reachable. Communication infrastructure performs a related function for information, coordination, and relational continuity across distance.

20.5.3 Communication and Coordination Infrastructure

Economic relations require communication. Prices, schedules, requests, warnings, contracts, care needs, research findings, institutional explanations, claims, appeals, and community coordination depend on channels through which information can move among participants. Communication infrastructure includes telecommunications and media systems, but it also includes addressing systems, language services, notification practices, standards, emergency channels, trusted directories, interpreta-

tion, and the routines through which messages become actionable.

Connectivity alone therefore provides an incomplete measure. A participant can have network access while lacking linguistic intelligibility, trusted addressing, reliable notification, accessible formats, or the institutional knowledge required to interpret what is received. Communication can also be asymmetric: one party can broadcast rules or demands while the other lacks a practical reply, correction, or appeal channel. Relational infrastructure analysis examines the direction, intelligibility, reliability, and consequence of communication rather than only its technical availability.

Communication infrastructure supports coordination when participants can align expectations and actions across time. Supply chains, public services, care networks, research collaborations, emergency response, workplaces, and communities all rely on coordination capacity. Redundancy can be generative here. Multiple communication channels, offline fallback, interoperable standards, and preserved contact records can sustain coordination when one channel fails or becomes inaccessible.

Definition 20.64 (Communicative infrastructure capacity). *Communicative infrastructure capacity* is the capability of a configuration to support sufficiently reliable, intelligible, accessible, bidirectional, and recoverable communication for the coordination, explanation, contestation, learning, and maintenance of economically consequential relations.

The definition includes institutional response as part of communication quality. A complaint channel that accepts messages without producing acknowledgment, review, or response has different relational significance from a channel embedded in a correction process. Similarly, public information gains practical value when subjects can identify its relevance, provenance, and consequences for action.

Proposition 20.65 (Communication–coordination condition). *Where economic relations depend on distributed coordination, communication infrastructure should be evaluated through intelligibility, directionality, reliability, accessibility, response capacity, and fallback arrangements as well as nominal connectivity or message volume.*

Communication provides channels through which knowledge can circulate, but epistemic infrastructure adds preservation, provenance, verification, interpretation, and reuse.

20.5.4 Knowledge Infrastructure and Epistemic Access

Chapter 17 developed knowledge as an economic field rather than a frictionless informational input. Relational infrastructure brings that argument into economic-order design. Libraries, archives, repositories, schools, universities, laboratories, standards systems, documentation, public data, professional communities, search systems, provenance records, and interpretive expertise can all function as knowledge infrastructure when they make reliable knowledge repeatedly available for learning, verification, coordination, innovation, and institutional memory.

Epistemic access involves more than possession of information. Subjects need to locate relevant material, understand its language and categories, assess provenance, connect evidence to decisions, and sometimes obtain expert assistance. Knowledge can therefore be formally open while remaining practically inaccessible because of paywalls, technical complexity, missing metadata, language, disability barriers, in-

compatible formats, absent documentation, or loss of the contextual knowledge required for interpretation.

Preservation is a further infrastructural function. Records, datasets, software, institutional decisions, scientific methods, cultural materials, and administrative histories can lose practical meaning even while files survive. Chapter 17 treated re-epistemization as reconstruction of the conditions under which knowledge claims were generated and interpreted. Economic-order infrastructure should therefore preserve provenance, version history, dependencies, and interpretive context where later verification or reuse is materially important.

Definition 20.66 (Epistemic infrastructure access). *Epistemic infrastructure access* is the practical capability to locate, retrieve, interpret, verify, preserve, and reuse knowledge relevant to economic participation, institutional action, or collective learning, including the provenance, expertise, documentation, and technical means required for those operations.

AI-mediated search and generation can expand apparent access while changing its dependency structure. If discovery, synthesis, translation, or verification becomes concentrated in systems whose provenance or continued availability is weak, immediate epistemic convenience can coexist with reduced regenerative capability. The infrastructure question therefore includes human expertise, alternative retrieval paths, durable records, and the capacity to reconstruct knowledge when a mediation layer changes.

Proposition 20.67 (Epistemic-infrastructure continuity condition). *Where economic coordination or institutional learning depends on durable knowledge access, infrastructure should preserve not only retrievable content but also sufficient provenance, interpretive capability, documentation, and alternative access pathways for later verification, reuse, and re-epistemization.*

Knowledge infrastructure helps participants understand and revise economic relations. Care infrastructure supports the bodily, temporal, and relational reproduction through which participation can continue at all.

20.5.5 Care Infrastructure and Relational Reproduction

Economic systems rely on care. Childcare, healthcare, disability support, elder care, mental and social support, household coordination, respite, community care, and other forms of relational maintenance shape whether people can work, learn, participate, recover, move, or sustain commitments over time. Chapter 19 showed that care cannot be reduced to one sector because it appears across welfare, organizations, communities, migration, education, and public institutions. In an economic-order synthesis, care therefore enters as infrastructure when its recurring availability materially conditions the continuity of multiple forms of participation.

Care infrastructure includes facilities and professional services, yet it also includes staffing, scheduling, transport, information, continuity, leave arrangements, coordination among providers, informal networks, payment systems, and recognition of care recipients and caregivers. Formal service capacity can therefore coexist with care gaps if operating hours, cost, eligibility, language, geography, or staffing make services unusable in practice.

Care infrastructure has a distinctive temporal structure. Care needs can be recur-

rent, unpredictable, intensive, or long-duration. A configuration that relies on unpaid or under-supported care may sustain measured production while transferring depletion into households, families, or particular social positions. Generative analysis therefore asks whether care relations reproduce the capacities of both recipients and caregivers and whether institutions retain enough redundancy and continuity to absorb shocks without cascading exclusion from work, education, or community participation.

Definition 20.68 (Care infrastructure configuration). *A care infrastructure configuration is the arrangement of services, facilities, labor, time, finance, mobility, information, coordination, informal relations, and institutional protections through which recurrent care needs are met and the bodily and relational conditions of continued participation are reproduced.*

Care also interacts with infrastructure design elsewhere. Accessible transport can reduce care burdens; public space can support caregivers and dependents; digital systems can ease coordination while creating new exclusion; legal rules can allocate leave, guardianship, entitlement, and responsibility. Treating care as infrastructure therefore reveals interfaces that disappear when care is analyzed only as private consumption or household labor.

Proposition 20.69 (Care-reproduction condition). *Where economic participation depends on recurrent care, evaluation should examine whether the care configuration reproduces the capabilities and continuity of care recipients, caregivers, and supporting institutions without relying on hidden depletion that narrows later participation or recovery capacity.*

Digital infrastructure increasingly mediates each of the preceding dimensions, making interoperability and recoverability central economic-order concerns.

20.5.6 Digital Infrastructure and Interoperability

Digital infrastructure now mediates payments, identity, communication, knowledge, employment, public services, logistics, education, health, research, platform participation, and institutional administration. Its components include networks, compute, storage, identity systems, authentication, data architectures, software, protocols, interfaces, cybersecurity, models, registries, cloud services, and technical standards. Because these layers are coupled, failure or exclusion at one layer can propagate into many economic domains.

Digital access has at least three levels. Connection provides technical reach to a system. Functional access provides the devices, credentials, interfaces, accessibility, skills, and permissions required to use it. Recoverable access provides the ability to restore participation after error, device loss, account compromise, provider failure, migration, or system change. A configuration can perform well at the first level while remaining fragile at the second or third.

Interoperability affects generative capacity because it shapes whether data, identity, reputation, records, workflows, and services can move across institutional boundaries. Interoperability can lower switching costs and reduce dependency, although it can also create security, privacy, and governance challenges. GRE therefore treats interoperability as a scoped design relation rather than an unconditional objective. The relevant question is which functions require portability or substitutability and under what protections.

Definition 20.70 (Digital infrastructural dependency profile). A *digital infrastructural dependency profile* identifies the technical layers, providers, credentials, protocols, data stores, models, interfaces, and recovery pathways on which a subject, institution, or economic function depends, together with their substitutability, interoperability, failure modes, and control relations.

The profile is especially important where digital infrastructure becomes invisible through convenience. A public service can appear simple at the user interface while depending on identity providers, cloud infrastructure, payment processors, proprietary formats, model APIs, or external cybersecurity services. Concentrated dependencies can be entirely appropriate under some conditions, yet their criticality, fallback arrangements, contractual governance, and exit pathways should remain visible.

Proposition 20.71 (Digital-interoperability condition). *Where digital systems mediate economically consequential access or institutional continuity, infrastructure design should identify critical dependencies and specify the interoperability, portability, security, fallback, and recovery arrangements required to keep participation and institutional obligations practicable under foreseeable system change or failure.*

Digital systems frequently encode legal status and institutional eligibility. Legal infrastructure therefore concerns the practical realization of rights, obligations, standing, and remedy across both digital and non-digital settings.

20.5.7 Legal Infrastructure and Practical Standing

Economic relations depend on legal infrastructure even where legal institutions are not continuously visible. Legal identity, property and use rights, contracts, labor protections, organizational forms, registries, licensing, family status, welfare entitlements, insolvency rules, dispute resolution, administrative law, courts, enforcement, and remedies structure who can act, claim, transfer, coordinate, and contest. These arrangements provide durable expectations that other infrastructures rely upon.

Formal rights nevertheless require realization pathways. A contractual entitlement has limited practical significance if enforcement is prohibitively costly or slow. A welfare right can remain unusable where identity documents, registration, language, digital access, or appeal procedures are inaccessible. A right to mobility can be constrained by documentation or jurisdiction. Legal infrastructure therefore connects normative status to administrative and material capability.

Practical standing has both enabling and protective dimensions. Legal infrastructure can authorize action, recognize relationships, protect assets, stabilize expectations, and create remedies. It can also impose obligations, exclusions, liabilities, or classifications that structure dependency. GRE does not reduce these effects to transaction-cost reduction. The relevant analysis asks how legal arrangements constitute and transform relations, which subjects and positions they recognize, and how correction operates when classifications or decisions are contested.

Definition 20.72 (Legal realization pathway). A *legal realization pathway* is the sequence of recognition, documentation, procedure, representation, decision, enforcement, correction, and remedy through which a formal legal status, right, obligation, or claim becomes practically consequential for an affected subject or position.

Legal infrastructure also has memory. Precedent, registries, contracts, administra-

tive records, organizational histories, and rights accumulated over time can affect later claims. Digitalization can improve retrieval and coordination while creating new dependencies on data quality, system compatibility, and identity infrastructure. Preservation and correction therefore become legal-infrastructure concerns as well as technical ones.

Proposition 20.73 (Legal-infrastructure realization condition). *Where economic capability or protection depends on legal status, rights, or obligations, evaluation should trace the practical realization pathway through documentation, procedure, representation, enforcement, correction, and remedy rather than infer effective standing from formal recognition alone.*

The preceding infrastructures converge at institutional interfaces. The final subsection therefore examines whether people can actually traverse the coupled systems through which economic rights, services, and opportunities are delivered.

20.5.8 Institutional Access and Infrastructure Integration

Economic participation often requires movement through several infrastructures at once. Applying for a benefit can require legal identity, digital access, communication, mobility, knowledge of procedure, care-compatible time, and an administrative institution capable of processing the claim. Entering education can require transport, housing, information, documentation, finance, digital systems, and care. Employment can depend on similar combinations. Failure at one interface can therefore block the conversion of otherwise available resources or rights.

Institutional access is accordingly an integration problem. Fragmented systems can shift coordination costs onto individuals, especially where eligibility criteria, records, schedules, digital identities, or administrative categories do not align. People with greater time, money, language capacity, professional advice, or social networks can often absorb these frictions more easily, so interface complexity can generate unequal effective access even when formal rules are uniform.

Integration does not require one centralized system. Federated institutions can preserve specialization, plural governance, and local knowledge while using interoperable records, referral pathways, common standards, portable credentials, human navigators, or explicit handoff protocols. The appropriate degree of integration depends on privacy, autonomy, security, institutional diversity, and the risks of concentrated failure. The analytical requirement is to make the interface visible.

Definition 20.74 (Integrated institutional access architecture). *An integrated institutional access architecture is the arrangement of eligibility, navigation, records, identity, communication, referral, handoff, correction, and fallback mechanisms through which subjects move across multiple infrastructures and institutions to realize economically consequential rights, services, opportunities, or forms of participation.*

An access architecture can be evaluated through the conversion profile developed in Section 20.3.1. Nominal availability provides one layer; practical access requires that subjects can traverse the relevant interfaces; realized capability requires that the resulting service or resource can be converted into meaningful action; and long-horizon generativity requires that continued use does not depend on hidden depletion or irreversible concentration that undermines future alternatives.

Integration also creates governance questions. Shared data can improve continuity

while expanding surveillance risk. Common standards can improve portability while centralizing classification power. One-stop interfaces can reduce administrative burden while creating a single point of exclusion. Infrastructure integration should therefore preserve contestability, correction, proportional data use, and alternative pathways where the consequences of failure are high.

Proposition 20.75 (Infrastructure-integration condition). *Where economically consequential participation depends on several coupled infrastructures, institutional design should identify interface failures, coordination burdens, and single points of exclusion and should provide proportionate interoperability, navigation, correction, and fallback arrangements while preserving warranted institutional plurality and contestability.*

The eight dimensions developed in this section show that relational infrastructure is neither a secondary background condition nor a synonym for physical capital. Public space shapes encounter and presence; mobility shapes reachability; communication shapes coordination; knowledge infrastructure shapes epistemic access; care infrastructure reproduces participation; digital infrastructure mediates interoperability and dependency; legal infrastructure converts formal standing into practical consequence; and institutional access determines whether these systems can be traversed as a coherent configuration.

A generative relational economic order therefore has to evaluate infrastructure through the relations and capabilities it enables, the dependencies it creates, the maintenance it requires, and the future options it preserves or forecloses. Section 20.6 turns next to economic participation. Infrastructure provides conditions of possibility, while participation concerns the positions from which subjects actually contribute, learn, care, deliberate, organize, and shape the economic relations that infrastructure makes accessible.

20.6 Economic Participation

The role of this section is to specify the positions through which subjects and collectives enter, sustain, and reshape economic processes once the policy, institutional, and infrastructural architectures of Sections 20.3–20.5 are in place. Its objective is to treat participation as a differentiated economic relation rather than as a synonym for employment, market exchange, institutional membership, or formal voice. The section develops eight dimensions: productive participation, epistemic participation, care participation, institutional participation, community participation, participation beyond employment, participation inequality, and generative participation. The method is relational and configurational. GRE asks what practical pathways connect a participant to consequential activity, what standing the participant acquires, what capabilities are formed or depleted through participation, how contribution is recognized, and whether participation can influence the later configuration of economic life.

Chapter 12 introduced economic participation as a broad relation through which subjects can contribute to, be represented in, influence, depend on, or be affected by economic processes. Chapter 18 then showed why participation becomes especially important when productive necessity and employment no longer reliably determine who can contribute to knowledge, care, institutions, communities, culture, or future formation. The present section works at the level of economic order. It asks how an

order distributes practical pathways of participation across these domains and how participation itself changes capability, standing, dependency, recognition, and future possibility.

Participation should therefore be separated from mere presence. A worker can be physically present in production while having little influence over process design, learning, recognition, or organizational decisions. A citizen can possess formal political rights while lacking practical access to the information, time, language, or institutional pathways required for consequential participation. A learner can receive knowledge without entering the processes through which questions are formed, claims are verified, or research agendas are revised. A family member can perform extensive care while remaining economically invisible. A community member can contribute to maintenance, culture, or stewardship without receiving formal organizational standing. In each case, a thin indicator of participation can coexist with a much narrower practical participation relation.

Nor is participation intrinsically desirable. Economic configurations can compel participation, expose participants to risk, extract unpaid contribution, distribute responsibility without authority, or make exit prohibitively costly. Participation can reproduce hierarchy as well as capability. GRE therefore evaluates participation through the relation between access, contribution, standing, recognition, capability formation, burden, dependency, contestability, and exit. Increasing the quantity of participation is not a sufficient objective.

Definition 20.76 (Economic participation configuration). *An economic participation configuration is a history-bearing arrangement of positions, access pathways, contribution relations, recognition practices, decision interfaces, capability effects, dependencies, protections, and exit conditions through which subjects or collectives enter and affect economically consequential processes.*

Definition 20.76 makes participation positional. Different participants in the same process can have substantially different participation profiles. A platform seller, platform employee, consumer, model developer, content moderator, shareholder, regulator, and affected non-user can all be connected to the same digital-economic configuration through different access, contribution, authority, dependency, and exit relations. The same applies to a school, hospital, research institution, cooperative, public agency, neighborhood commons, or care network.

Participation is also temporal. Entry can create learning, reputation, credentials, social relations, institutional memory, obligations, or dependencies that change later participation. Conversely, exclusion from one stage can remove access to later stages. Internship access can shape professional entry; participation in research can shape later epistemic authority; care interruption can constrain later employment; exclusion from public decision processes can alter infrastructures that subsequently determine access. Economic participation therefore has pathway effects that extend beyond the immediate activity.

Proposition 20.77 (Participation-architecture condition). *Evaluation of economic participation should distinguish formal admission from practical access, activity from consequential contribution, contribution from recognition, presence from decision standing, and current participation from the capability and dependency effects that shape later participation.*

Table 20.6 summarizes the eight participation dimensions developed below. The dimensions overlap in practice. Productive, epistemic, care, institutional, and com-

Table 20.6: Dimensions of economic participation in generative relational economic order.

Participation dimension	Primary relation	Generative question	Characteristic participation failure
Productive participation	Contribution to production, maintenance, coordination, and transformation	Can participants contribute, learn, and influence productive processes without contribution being reduced to measured output?	Output extraction with weak recognition, learning, or process standing
Epistemic participation	Question formation, interpretation, verification, knowledge production, and reuse	Who can enter the processes through which economically consequential knowledge is formed and revised?	Information access without practical epistemic standing
Care participation	Provision, receipt, coordination, and reproduction of care relations	Are care participants supported, recognized, and able to sustain the relations on which wider participation depends?	Participation elsewhere sustained through hidden care depletion
Institutional participation	Membership, representation, deliberation, challenge, and decision interfaces	Which affected positions have practical standing in consequential institutional processes?	Formal voice without information, response, correction, or influence
Community participation	Shared practice, stewardship, mutual provision, maintenance, and collective formation	Can communities reproduce collective capabilities and shared relations across time?	Reliance on uncompensated or non-renewed community capacity
Post-employment participation	Economically consequential activity beyond employment or labor scarcity	Which pathways remain available when employment ceases to organize income, contribution, and standing together?	Material support without consequential participatory pathways
Participation inequality	Unequal conversion of formal opportunity into practical participation	Which conditions distribute entry, standing, burden, recognition, and exit unequally?	Nominal equality with unequal conversion conditions
Generative participation	Participation that reproduces or enlarges later participation capacity	Does participation strengthen capabilities, relations, standing, and future-forming pathways?	Present activity accompanied by later deskilling, exclusion, or generative foreclosure

munity participation can occur within one activity, and an adequate analysis should preserve those overlaps where they are economically consequential.

20.6.1 Productive Participation Relations

Productive participation concerns the positions through which subjects contribute to production, maintenance, coordination, transformation, and organizational continuity. Employment is one important pathway, but productive participation also includes self-employment, cooperative work, informal activity, voluntary contribution, household production, maintenance, peer production, platform-mediated work, and contributions performed through mixed human-machine arrangements. The analytical unit is therefore the participation relation rather than the employment contract alone.

Production also contains more than execution. Participants can identify problems, interpret local conditions, coordinate interdependent tasks, maintain tools, prevent errors, transmit tacit knowledge, mentor others, reorganize workflows, and notice emerging risks. An economic order that recognizes only directly measurable output can understate these contributions and can weaken the very relations through which productive systems remain adaptable.

Productive participation can therefore be differentiated along several axes: access to productive resources; discretion over task execution; opportunity to learn; visibility of contribution; recognition and compensation; exposure to risk; ability to chal-

lenge process decisions; portability of acquired skills or records; and access to later roles. Two workers with the same job title can occupy very different productive participation positions if one has substantial learning, discretion, recognition, and mobility while the other performs tightly monitored tasks with little transferable capability.

Definition 20.78 (Productive participation profile). A *productive participation profile* specifies, for a participant or position, the practical access, contribution scope, discretion, learning opportunity, recognition, compensation, risk exposure, process influence, capability formation, and exit or transition conditions associated with participation in a productive configuration.

Automation can change this profile even where employment persists. A person may remain employed while moving from direct production into verification, exception handling, customer relations, maintenance, or system oversight. Such transitions can increase discretion in some settings and reduce understanding in others. The relevant question is not whether a human remains in the process, but which economically consequential capabilities and decision interfaces the human position retains or acquires.

Productive participation also affects collective capability. Teams often possess coordination knowledge, routines, shared memory, and distributed competence that cannot be attributed to one member. High turnover, excessive fragmentation, or outsourcing can preserve short-run output while reducing collective capacity to diagnose unusual failures or redesign the process. Participation analysis therefore connects individual positions to the reproduction of organizational capability developed in Section 20.4.

Proposition 20.79 (Productive-participation condition). *Where productive activity depends on distributed judgment, maintenance, learning, or coordination, evaluation should examine whether the participation configuration reproduces those capabilities and recognizes their contribution rather than inferring productive adequacy from output or employment counts alone.*

20.6.2 Epistemic Participation Relations

Epistemic participation concerns entry into processes through which questions are formulated, evidence is produced, claims are interpreted, knowledge is verified, records are maintained, and later inquiry is oriented. The knowledge infrastructure developed in Section 20.5.4 provides conditions of possibility; epistemic participation concerns the positions from which subjects actually use and reshape that infrastructure.

Information access is therefore only one layer. A participant may be able to read a report without possessing the language, background knowledge, time, institutional standing, or verification tools required to challenge it. Conversely, local practitioners, patients, workers, community members, or users can possess relevant knowledge while lacking institutional channels through which it becomes legible to formal decision processes. Epistemic participation requires attention to both reception and contribution.

Question formation is especially important. If participation begins only after a problem, metric, dataset, or model has already been selected, participants can influence answers while remaining excluded from the framing that determines which answers matter. Economic institutions can therefore distribute epistemic standing

through agenda-setting, data categories, evaluation criteria, expert credentials, access to records, and the authority to define uncertainty.

Definition 20.80 (Epistemic participation profile). *An epistemic participation profile specifies the practical ability of a participant or position to access, interpret, question, contribute to, verify, preserve, contest, and revise economically consequential knowledge, including the ability to participate in problem formation and evidential framing where relevant.*

Artificial intelligence can widen epistemic participation by lowering language, coding, search, modeling, or drafting barriers. It can also concentrate epistemic mediation where access to models, provenance, verification resources, or decision systems is uneven. The resulting configuration should therefore be evaluated through the distribution of question-forming capacity, verification capacity, interpretive autonomy, and correction pathways, not solely through access to generated answers.

Epistemic participation also has regenerative effects. Participation in inquiry can build later capability, while repeated dependence on opaque outputs can weaken independent verification. Archives, reproducible workflows, mentorship, open methods, and plural expert communities can increase the capacity of later participants to reconstruct or contest earlier knowledge. In this sense, epistemic participation is one mechanism through which an economic order preserves its ability to re-epistemize its own decisions.

Proposition 20.81 (Epistemic-participation condition). *Where knowledge materially shapes economic allocation, governance, or institutional action, participation should be evaluated through access to problem formation, interpretation, verification, contribution, contestation, and preservation rather than through information availability alone.*

20.6.3 Care Participation Relations

Care participation includes the provision, receipt, coordination, financing, maintenance, and institutional organization of relations through which bodily, emotional, developmental, and dependency needs are supported. Section 20.5.5 treated care as infrastructure because wider economic participation depends on its continuity. The present subsection examines care as a participation relation with its own standing, burdens, capabilities, and value processes.

Care relations often combine asymmetrical needs with mutual dependence. Infants, older persons, persons with disabilities, patients, and others can require support that cannot be reduced to market exchange or reciprocal contribution within a short horizon. Caregivers can possess specialized knowledge and responsibility while having limited institutional authority or economic recognition. Recipients can depend heavily on continuity while having weak control over scheduling, provider changes, or eligibility rules. Participation analysis therefore has to include both caregiver and care-recipient positions.

Care also changes the participation possibilities of others. Reliable childcare can expand education, employment, civic, or community participation. Inadequate care can shift time and risk into households, often making one person's formal opportunity depend on another person's unpaid or under-supported labor. The relevant economic relation is thus distributed across care recipients, caregivers, households, employers, public systems, community institutions, and service providers.

Definition 20.82 (Care participation profile). A *care participation profile* specifies the care roles, time commitments, dependencies, continuity requirements, recognition, compensation, decision standing, support infrastructure, capability effects, and transition conditions experienced by relevant caregivers, recipients, and coordinating positions within a care configuration.

Care participation also produces knowledge. Long-term caregivers can hold tacit knowledge about routines, vulnerabilities, communication, and context that is difficult to reconstruct after abrupt turnover. Recipients can possess experiential knowledge about what forms of support are usable or dignified. Institutions that treat care as standardized delivery can therefore lose relational knowledge that is central to quality and continuity.

A generative economic order does not require all care to become formal employment. Informal, familial, communal, and professional care can coexist. The analytical requirement is to make the burden, dependency, standing, support, and capability effects visible enough that one form of participation is not sustained through systematic depletion of another.

Proposition 20.83 (Care-participation condition). *Where wider economic participation depends on care relations, evaluation should identify how care responsibilities, continuity, recognition, decision standing, and support are distributed and whether the care configuration reproduces the capabilities of both recipients and caregivers across time.*

20.6.4 Institutional Participation Relations

Institutional participation concerns the positions through which members, users, workers, affected groups, experts, funders, regulators, or other relevant subjects enter institutional processes. Section 20.4.5 established participation and institutional standing as one dimension of generative institutions. The present subsection broadens that analysis to economic order by examining how standing is distributed across heterogeneous institutions and how institutional participation connects to consequential decisions.

Formal consultation is a weak proxy for institutional participation. Participants may be invited to meetings after key options have already been excluded, may receive information too late to influence decisions, or may lack the technical support required to interpret proposals. Representation can also become disconnected from represented positions where representatives have weak accountability or limited access to the experiences they are expected to convey.

Institutional participation therefore includes agenda access, information access, deliberative opportunity, representation, decision influence, challenge, review, and correction. The appropriate combination depends on the institution. A court, central bank, school, research funder, hospital, cooperative, utility, and digital platform do not require identical participation arrangements. The participation architecture should correspond to the mandate, authority, affected positions, risks, and feasible forms of standing.

Definition 20.84 (Institutional participation profile). An *institutional participation profile* specifies the information, agenda, deliberative, representative, decision, challenge, review, and correction interfaces practically available to a participant or affected position within an institution or institutional network.

Participation can also distribute responsibility. Institutions sometimes invite front-line workers, community representatives, or users to contribute to decisions without giving them authority over resources or implementation, while later attributing responsibility to the participatory process. Such configurations can create symbolic inclusion while leaving power relations largely unchanged. Participation analysis should therefore keep decision influence, responsibility, and accountability distinct.

Institutional participation can nevertheless be generative when it improves problem detection, preserves plural knowledge, creates learning across positions, and strengthens the capacity of institutions to revise themselves. These effects depend on whether contributions receive consequential response and whether participants can see how decisions were transformed by the process.

Proposition 20.85 (Institutional-participation condition). *Where institutions exercise consequential authority over affected positions, participation should be evaluated through practical information, agenda, representation, decision, challenge, and correction pathways and through the correspondence between assigned responsibility and actual influence.*

20.6.5 Community Participation Relations

Community participation concerns repeated contribution to shared practices, local institutions, commons, mutual support, culture, stewardship, maintenance, and collective problem solving. Communities can supply capabilities that neither markets nor formal public institutions reproduce easily: local knowledge, trust, continuity, mutual aid, social memory, cultural interpretation, informal care, and stewardship of shared resources. Yet these capacities can be depleted when treated as free background conditions.

Participation in communities is heterogeneous. Some members contribute labor; others contribute money, knowledge, space, contacts, or care. Some participate intermittently because of age, disability, employment, migration, or caregiving responsibilities. Some are strongly affected by community decisions while having weak formal membership. A community participation architecture therefore needs more than attendance counts or volunteer hours.

Community participation can also carry exclusion. Longstanding norms can privilege incumbents, informal networks can make entry difficult, and high expectations of unpaid contribution can burden those with fewer resources. Strong internal cohesion can coexist with exclusion of neighboring groups or newcomers. GRE therefore treats community participation through access, standing, reciprocity, burden, recognition, conflict resolution, and exit rather than romanticizing community as inherently inclusive.

Definition 20.86 (Community participation profile). *A community participation profile specifies practical entry, contribution forms, standing, reciprocal support, recognition, burden, learning, conflict-resolution access, stewardship roles, and exit or mobility conditions within a community-based economic configuration.*

Community participation can generate collective capability. Repeated collaboration creates shared routines, local knowledge, trust, governance experience, and the capacity to respond to events that were not anticipated when the institution was designed. This capacity can be lost through demographic change, displacement, platform substitution, commercialization, or withdrawal of shared space even where in-

dividual capabilities remain.

Relational infrastructure therefore matters again. Public space, meeting facilities, digital systems, transport, legal recognition, funding channels, and knowledge repositories can determine whether community participation remains practical. Section 20.5 provides the infrastructural side of this relation; community participation identifies the collective practices those infrastructures enable.

Proposition 20.87 (Community-participation condition). *Where community practices provide economically consequential stewardship, care, knowledge, culture, maintenance, or mutual support, evaluation should examine whether contribution burdens, standing, reciprocity, entry, conflict resolution, and collective capability are reproduced rather than treating community capacity as an uncosted background resource.*

20.6.6 Post-Employment Participation Pathways

Employment has historically bundled several functions: income, daily structure, social recognition, skill development, institutional membership, contribution, access to networks, and sometimes political or organizational representation. These functions can separate. A person can receive income without employment, perform socially consequential activity without wages, work through intermittent contracts without durable membership, or remain employed while much consequential contribution migrates elsewhere.

This separation becomes especially important under automation and artificial intelligence. Reduced demand for particular forms of labor does not determine whether persons can continue to participate in research, education, care, culture, ecological stewardship, public institutions, communities, open-source production, local governance, or exploratory activity. The participation problem is therefore broader than income replacement.

Definition 20.88 (Post-employment participation pathway). *A post-employment participation pathway is an institutionally or relationally supported route through which a person or collective can enter economically consequential activity, learning, contribution, governance, care, knowledge, culture, stewardship, or community formation without practical admission depending primarily on conventional employment status or scarcity of the participant's labor.*

Such pathways require material time. Income security, housing, healthcare, care support, mobility, digital access, public space, education, and legal standing can all determine whether nominal opportunities become usable. They also require consequential interfaces. A person who is materially supported but has access only to recreational or symbolic activities can remain excluded from processes through which institutions, knowledge, infrastructures, or shared futures are actually shaped.

Post-employment participation does not imply that every activity should be publicly funded or institutionally recognized. Nor does it imply the disappearance of employment. The analytical issue is whether economic standing and meaningful participation remain excessively coupled to one labor-market relation under conditions in which productive necessity becomes more uneven. Plural pathways can include public institutions, cooperatives, commons, research networks, community organizations, cultural institutions, educational systems, care arrangements, entrepreneurial activity, and hybrid forms that do not fit traditional employment categories.

Proposition 20.89 (Post-employment participation condition). *Where employment becomes a weaker organizer of income, contribution, and social standing, economic-order evaluation should examine whether material security is coupled with practical pathways into consequential learning, contribution, governance, care, knowledge, community, cultural, and stewardship activity.*

20.6.7 Participation Inequality

Formal participation opportunities can be distributed equally while practical participation remains highly unequal. Time, income, language, education, health, disability, care obligations, mobility, digital access, legal status, documentation, social networks, safety, reputation, and institutional familiarity can all affect whether a participation pathway is usable. Participation inequality is therefore a conversion problem as well as an admission problem.

Unequal participation can accumulate. Early access to selective institutions creates credentials, relationships, confidence, and knowledge that expand later opportunity. Repeated exclusion can have the opposite effect. A single participation gap can therefore alter later capability and standing even after formal barriers are removed. This cumulative structure connects participation inequality to the historical and option-space evaluation developed in Section 20.2.9.

Unequal burden is another dimension. Some participants bear disproportionate maintenance, care, emotional, administrative, or coordination work while others receive more visible recognition or decision authority. A participatory institution can therefore appear inclusive while reproducing unequal burdens within the participation process itself.

Definition 20.90 (Participation conversion profile). *A participation conversion profile specifies the material, temporal, spatial, informational, linguistic, legal, social, technological, care, and capability conditions through which a formal participation opportunity becomes practical entry, sustained contribution, consequential standing, and viable exit for a specified participant or position.*

Participation inequality should also include asymmetric exit. Persons with wealth, credentials, portable reputation, alternative networks, or legal mobility can leave a failing institution or platform more easily than those whose income, care, identity, data, status, or community ties are concentrated within it. Strong nominal participation can therefore coexist with weak bargaining power when exit is structurally unequal.

This subsection does not imply that all participation outcomes should be equal. Different roles, expertise, responsibilities, and preferences can support differentiated participation. The evaluative task is to identify whether differences correspond to defensible functions and choices or arise from avoidable conversion barriers, concentrated dependency, inherited exclusion, or unrecognized burden.

Proposition 20.91 (Participation-inequality condition). *Claims of participatory inclusion should be qualified by the conversion conditions governing practical entry, sustained contribution, recognition, influence, burden, and exit and by the cumulative effects through which present participation differences alter later capability and standing.*

20.6.8 Generative Economic Participation

The preceding dimensions can now be integrated. Productive, epistemic, care, institutional, community, and post-employment participation differ in object and mechanism, yet each can reproduce or deplete the capabilities and relations through which later participation remains possible. Generative participation names this recursive property.

Definition 20.92 (Generative economic participation). *Generative economic participation* is participation whose operation materially contributes to economically consequential activity while also reproducing, enlarging, or making more revisable the capabilities, relations, standing, knowledge, infrastructures, and participation pathways through which relevant subjects or collectives can take part in later economic formation.

The definition does not require every participation episode to increase every capability. Training can involve temporary dependence; care can constrain caregiver time; emergency institutions can centralize decisions; specialized production can narrow task scope. Generativity is evaluated relative to purpose, horizon, affected positions, and the wider configuration. The relevant question is whether the participation arrangement systematically renews or erodes the conditions of later participation.

Generative participation also has a recognition dimension. Contributions that remain persistently invisible can be difficult to reproduce because participants lack income, status, institutional memory, succession pathways, or bargaining power. Yet recognition need not always take the form of payment. Attribution, credentialing, representation, public acknowledgment, access rights, governance standing, community reciprocity, and capability return can all matter depending on the domain.

Participation and value therefore connect directly to the next section. Participants contribute labor, knowledge, care, maintenance, trust, data, legitimacy, ecological stewardship, culture, and institutional capacity. These contributions can generate value that is captured elsewhere, dissipated, or returned to the substrates that made generation possible. Section 20.7 will examine these return and reinvestment pathways in detail.

Generative participation also provides one response to generative foreclosure. Where an economic order preserves plural practical pathways into knowledge, institutions, care, production, communities, culture, and stewardship, technological or institutional change is less likely to eliminate the capacities through which alternatives can later be formulated and organized. This does not guarantee just outcomes. It preserves a wider field in which affected positions can continue to learn, contest, contribute, and reorganize.

Proposition 20.93 (Generative-participation condition). *An economic participation configuration has stronger generative warrant when it couples practical access and consequential contribution with capability formation, recognition, contestability, revisable dependency, viable transition or exit, and the reproduction of pathways through which affected subjects and collectives can participate in later economic formation.*

Economic participation is therefore neither a residual social objective nor a simple count of workers, voters, members, users, or volunteers. It is an architecture of positions through which economic subjects enter processes of production, knowledge, care, institutions, communities, and future formation. Sections 20.4 and 20.5 established the institutional and infrastructural conditions that carry these positions. The

present section has specified how participation itself can reproduce or erode later capability and standing. Section 20.7 turns next to value recirculation and social reinvestment, asking how value generated through these distributed participation relations returns to the capabilities, infrastructures, communities, and institutions on which continued generation depends.

20.7 Value Recirculation and Social Reinvestment

The role of this section is to specify how value generated, realized, accumulated, or captured within a generative relational economic order can return to the relations and substrates that support continued generation. Its objective is to connect the value-process architecture of Chapter 14, the generative-return analysis of Chapter 19, and the institutional and participation architectures of Sections 20.4–20.6 at the level of economic order. The section develops ten dimensions: return-flow architecture, public reinvestment, community reinvestment, knowledge reinvestment, capability reinvestment, relational reinvestment, long-horizon reinvestment, generative depletion, transfer pathways and incidence, and justice in return–transfer relations. The method is relational, provenance-sensitive, and non-scalar. GRE asks which value-bearing conditions are generated, which positions and substrates contribute to that generation, where value is realized or captured, through which pathways it returns, what the return actually maintains or regenerates, and which burdens or depleted conditions remain outside the apparent cycle.

Chapter 14 distinguished value generation, transmission, conversion, recirculation, accumulation, dissipation, and generative return. The present section does not redefine those processes. It asks how an economic order organizes them recurrently across institutions, infrastructures, communities, public systems, knowledge environments, and heterogeneous forms of participation. This order-level perspective matters because a value-generating activity can remain locally profitable or productive while progressively depleting public capacity, ecological conditions, care relations, knowledge commons, worker capability, community trust, or technical infrastructure. Conversely, a return can be economically consequential even where it is neither paid to the original contributor nor expressed in the same value form as the contribution.

Return, recirculation, reinvestment, redistribution, and maintenance should therefore remain distinct. A *return* identifies a later flow or condition connected to an earlier generative relation. *Recirculation* requires that a returned condition re-enter later maintenance, regeneration, coordination, conversion, or generation. *Reinvestment* is a purposeful commitment of resources or capability to conditions expected to support later activity. *Redistribution* concerns the reallocation of resources, rights, burdens, or claims across positions and need not re-enter a generative substrate. *Maintenance* concerns preservation of function or relation and can itself be generative where continued functioning preserves later possibility. These processes can overlap, but treating them as synonyms makes it difficult to identify what an apparent return actually does.

Social reinvestment is used here in a similarly bounded sense. It does not imply that every social relation should be financed, monetized, or evaluated through an investment metaphor. Nor does it presume a single public authority or one distribu-

tive formula. It identifies the recurrent commitment of value-bearing conditions to shared, public, community, epistemic, capability, relational, or intergenerational substrates whose continued viability materially shapes later economic participation and generation. The relevant return can be financial, infrastructural, epistemic, institutional, ecological, relational, or capability-bearing.

Definition 20.94 (Economic value-recirculation architecture). *An economic value-recirculation architecture is a history-bearing arrangement of generation, realization, capture, transfer, return, conversion, maintenance, reinvestment, and incidence pathways through which value-bearing conditions produced within an economic configuration re-enter, bypass, or deplete the capabilities, relations, infrastructures, institutions, communities, and other substrates relevant to later economic generation.*

Definition 20.94 makes the architecture broader than one circular flow. Several return paths can coexist; some can be blocked; some can move across scales; and one substrate can be regenerated while another is depleted. A platform can reinvest heavily in technical infrastructure while underinvesting in participant capability or community trust. A public system can expand service expenditure while allowing maintenance capacity to erode. A community enterprise can return revenue locally while relying on ecological depletion outside the community boundary. Order-level analysis should therefore reconstruct a portfolio of return and depletion pathways rather than infer adequacy from the existence of one visible cycle.

Proposition 20.95 (Recirculation-specification condition). *A claim that an economic arrangement recirculates value should identify the originating or contributing relations, the value-bearing condition realized or captured, the return pathway, the receiving position or substrate, the conversion through which the return becomes usable, the relevant time horizon, and any materially significant depletion or burden displaced outside the stated cycle.*

Table 20.7 summarizes the ten dimensions developed below. The rows are analytical perspectives rather than exclusive categories. One return can simultaneously be public, epistemic, capability-bearing, relational, and long-horizon.

20.7.1 Return-Flow Architecture

Return flows form the immediate connective tissue of recirculation. An economic process can generate revenue, knowledge, reputation, capability, data, public revenue, ecological improvement, or other value-bearing conditions. Some of these conditions remain with the realizing institution; some move to investors, workers, users, communities, public authorities, or shared infrastructures; some dissipate; and some never become practically available to positions that contributed to generation. Return-flow analysis traces these paths without assuming that source contribution and later receipt are identical in form or quantity.

A return can be direct or converted. Wages, royalties, dividends, tax receipts, repayments, and shared revenues are relatively direct financial examples. Converted returns include training financed from revenue, public infrastructure supported by taxation, maintenance funded from service income, knowledge returned through documentation, ecological restoration financed from extractive activity, or improved institutional procedures derived from participant experience. Cross-form return is common, but conversion creates an additional evaluative burden. A symbolic acknowl-

Table 20.7: Dimensions of value recirculation and social reinvestment in generative relational economic order.

Dimension	Primary return object	Generative question	Characteristic analytical failure
Return-flow architecture	Resources, rights, knowledge, recognition, capability, restoration, or other value-bearing conditions	What returns, to whom or what, through which conversion pathway, and with what re-entry effect?	Treating any reverse flow as regeneration
Public reinvestment	Public capacity, common infrastructure, services, maintenance, and public knowledge	Do publicly mobilized returns reproduce the conditions of collective provision and practical access?	Expenditure volume without conversion, maintenance, or capability analysis
Community reinvestment	Shared capability, local infrastructure, stewardship, institutions, and relational continuity	Does generated value strengthen the community capacities on which later collective action depends?	Romanticized locality that hides internal asymmetry or externalized burden
Knowledge reinvestment	Documentation, verification, preservation, training, provenance, and open or shared epistemic capacity	Can generated knowledge be understood, tested, transmitted, and reused later?	Information release without interpretive or verification capacity
Capability reinvestment	Human, collective, institutional, technical, and maintenance capability	Does current activity reproduce the abilities required for later action and oversight?	Present service or output accompanied by later deskilling or capacity loss
Relational reinvestment	Trustworthiness, coordination, care, recognition, legitimacy, and durable cooperation pathways	Which economically necessary relations are maintained or repaired through the return?	Treating relational substrates as costless background conditions
Long-horizon reinvestment	Renewal, succession, reserves, ecological regeneration, preservation, and option capacity	Are delayed maintenance and regeneration requirements visible across relevant horizons?	Short-horizon return combined with deferred depletion
Generative depletion	Erosion of capabilities, relations, infrastructure, knowledge, ecology, or future options	Which substrates are consumed faster than they are maintained, regenerated, substituted, or legitimately transformed?	Positive current return masking reproductive deficit
Transfer pathways and incidence	Intermediaries, rules, eligibility, timing, control, leakage, conversion, and burden	Where does the return actually arrive, and who controls or bears the pathway?	Nominal allocation treated as realized incidence
Return-transfer justice	Claims of contribution, affectedness, need, standing, historical burden, and shared substrate	Which return claims are relevant, how are conflicts mediated, and which remainders remain after transfer?	One distributive rule presented as universally sufficient

edgment does not automatically compensate for material extraction; financial payment does not automatically restore ecological function; and infrastructure provision does not automatically replace political standing.

The source position also requires care. Value is often generated through configurations rather than isolated generators. A scientific result can depend on researchers, participants, public funding, prior knowledge, data infrastructure, software, reviewers, and institutional support. A platform service can depend on workers, complementors, users, data, public infrastructure, standards, and community-generated content. A care system can depend on paid workers and unpaid household labor simultaneously. Return claims therefore cannot always be derived by identifying one originator.

Definition 20.96 (Return-flow profile). A *return-flow profile* specifies, for a bounded value-generating process, the relevant contributing relations and substrates, the value-bearing conditions later realized or captured, the pathways through which

returns move, their form and timing, the positions or substrates receiving them, the conditions required for realization, and the material residuals or burdens left outside the return path.

A return-flow profile can reveal asymmetry even when total return is large. Early, liquid, enforceable returns can accrue to positions with strong control, while delayed, contingent, symbolic, or infrastructure-dependent returns accrue elsewhere. Some contributors can receive benefits only if they remain inside a platform, employer, jurisdiction, or institutional relationship. Timing and control are therefore part of incidence rather than administrative detail.

Proposition 20.97 (Return-flow adequacy condition). *Evaluation of a return flow should preserve the form, timing, control, conversion requirements, incidence, and residual burden of the return and should avoid inferring regenerative adequacy from the gross quantity returned alone.*

20.7.2 Public Reinvestment Architecture

Public systems are major sites of recirculation because they mobilize taxation, fees, public revenues, borrowing capacity, common assets, regulatory authority, knowledge, and administrative capability and redirect these conditions toward infrastructures and services that shape later economic possibility. Public reinvestment can support transport, education, research, health, care, legal administration, digital infrastructure, ecological restoration, public space, social protection, and institutional maintenance. The generative question concerns how these returns reproduce practical access and collective capability rather than whether expenditure is public in form.

Public reinvestment should therefore be separated from spending volume. A capital project can expand nominal infrastructure while creating unsustainable maintenance obligations. A social programme can transfer resources while leaving administrative access weak. Research funding can generate outputs while eroding long-term institutional capacity through unstable employment or fragmented infrastructure. Public reinvestment is generative when the return supports the conditions through which later provision, participation, maintenance, adaptation, and correction remain possible.

Public return also has scale. National revenue can support local systems; local taxation can finance shared infrastructure; public research can diffuse across sectors; ecological restoration can create downstream benefits beyond the financing jurisdiction. Cross-scale return can be desirable, but it can also obscure incidence where one region, community, or generation bears the cost while another receives the benefit. A public reinvestment architecture should therefore trace territorial, institutional, and intergenerational incidence where these differences matter.

Definition 20.98 (Public reinvestment architecture). *A public reinvestment architecture is the arrangement through which publicly mobilized resources, capabilities, knowledge, authority, or returns are committed to the maintenance, regeneration, expansion, or revision of public and shared conditions of economic participation across specified positions, scales, and time horizons.*

The definition leaves open the institutional vehicle. Public reinvestment can operate through direct public provision, grants, procurement, shared funds, public enterprises, intergovernmental transfers, partnerships, or support for community and knowledge infrastructures. The analytical requirement is to specify the relation be-

tween public mobilization and later public or shared capability.

Proposition 20.99 (Public-reinvestment condition). *Claims of generative public reinvestment should identify the public or shared capability, infrastructure, relation, or option structure being reproduced, the conversion pathway through which expenditure becomes usable capacity, and the maintenance, learning, and distributional conditions required for that return to persist.*

20.7.3 Community Reinvestment Architecture

Communities often contribute value that is only partially represented in formal accounts. Local knowledge, mutual aid, cultural practice, trust, stewardship, maintenance, informal care, volunteer activity, social coordination, and place-specific legitimacy can support enterprises, public systems, tourism, research, platforms, commons, and development interventions. Community reinvestment asks how generated value returns to the collective capabilities and shared conditions through which those contributions remain possible.

Local return should not be romanticized. A transfer to a community organization can reproduce internal hierarchy; a locally owned enterprise can externalize ecological burdens; a community fund can benefit highly visible groups while overlooking less organized positions. Community boundaries themselves can be contested. The relevant unit is therefore the return relation and its incidence, not locality as an automatic marker of justice.

Community reinvestment can take many forms: maintenance of shared spaces, local training, commons stewardship, cooperative reserves, cultural transmission, community health, legal support, local data governance, participatory funds, shared equipment, or support for care and volunteer infrastructures. The value form returned need not match the contribution form. What matters is whether the returned condition strengthens a relation or capability materially involved in later community action.

Definition 20.100 (Community reinvestment pathway). *A community reinvestment pathway connects value generated partly through community relations, knowledge, labor, legitimacy, place, or shared resources to later maintenance, capability, infrastructure, stewardship, participation, or institutional capacity within the relevant community configuration.*

Community reinvestment can also support autonomy from the returning institution. Training, portable infrastructure, shared ownership, open knowledge, or diversified funding can reduce dependence even when they arise from a current partnership. In this sense, a strong return can enlarge the recipient community's later capacity to choose different relations.

Proposition 20.101 (Community-reinvestment condition). *Evaluation of community reinvestment should identify internal incidence, boundary and representation questions, externalized burdens, and whether the returned value strengthens practical collective capability and option space rather than merely reproducing dependence on the source of return.*

20.7.4 Knowledge Reinvestment Architecture

Knowledge is a particularly recursive value form because generated knowledge can become infrastructure for later generation. Research findings, operational lessons, software, documentation, datasets, archives, classifications, models, and tacit practices can all increase later capability when they remain interpretable, verifiable, maintainable, and practically accessible. Knowledge reinvestment concerns the conditions through which epistemic outputs are returned to future inquiry, practice, education, institutional learning, and public understanding.

Publication or data release is therefore only one possible return mechanism. A document can be formally open yet practically unusable because of missing provenance, inaccessible language, proprietary dependencies, absent metadata, lost software environments, or lack of interpretive capability. Knowledge can also remain trapped inside an institution when staff turnover, outsourcing, undocumented automation, or weak archival practice removes the ability to reconstruct how decisions were made.

Knowledge reinvestment includes documentation, preservation, training, replication, provenance, versioning, translation, verification capacity, maintenance of software and data infrastructures, and the return of findings to participants or practitioners where appropriate. It can also include time for reflection and synthesis. An economic order oriented only toward immediate output can underinvest in these slower epistemic functions even while producing large quantities of information.

Definition 20.102 (Knowledge reinvestment architecture). A *knowledge reinvestment architecture* is the arrangement through which knowledge, evidence, records, methods, data, models, software, and interpretive capability generated through economic activity are preserved, verified, transmitted, taught, maintained, and made practically reusable for later inquiry and action.

This definition connects directly to the epistemic economy of Chapter 17. Knowledge return is generative where later actors can re-epistemize prior claims rather than merely inherit conclusions whose evidential history has disappeared.

Proposition 20.103 (Knowledge-reinvestment condition). *Knowledge reinvestment should be evaluated through later interpretability, provenance, verification, maintainability, transmission, and reuse capacity rather than through information volume or formal openness alone.*

20.7.5 Capability Reinvestment Architecture

Economic activity continually uses capability. Workers exercise skills, institutions consume administrative and professional capacity, communities use stewardship and coordination capacity, caregivers expend time and attention, technical systems require maintenance expertise, and public infrastructures rely on institutional competence. Activity can also form capability through learning, mentoring, problem solving, responsibility, and repeated practice. Capability reinvestment asks whether the configuration reproduces the abilities it relies upon or progressively substitutes for, concentrates, or exhausts them.

The distinction between service substitution and capability formation developed earlier in the book becomes especially important here. Outsourcing or automation can provide excellent immediate service while reducing the recipient's ability to verify, maintain, adapt, or exit later. Conversely, requiring every participant to repro-

duce specialist capability internally can be inefficient or unrealistic. Capability reinvestment is therefore selective. It asks which capabilities need to remain distributed, local, public, collective, or independently recoverable given the relevant dependency and risk structure.

Capability return can operate through training, apprenticeships, professional development, mentoring, participatory practice, documentation, shared technical systems, institutional succession, protected experimentation, and opportunities to exercise judgment. It can also involve creating time and security for learning. Formal training budgets are an incomplete proxy where work organization leaves no practical opportunity to acquire or use the capability.

Definition 20.104 (Capability reinvestment profile). *A capability reinvestment profile specifies which human, collective, institutional, technical, epistemic, maintenance, or governance capabilities an economic configuration uses, forms, concentrates, substitutes for, depletes, or returns and identifies the pathways through which those capabilities can be reproduced or recovered over time.*

Capability reinvestment also has distributive implications. One position can accumulate strategic knowledge while others become deskilled; one institution can internalize data and model capability while dependent organizations lose independent verification; one generation can benefit from inherited public capacity while failing to reproduce it. These are return questions as well as capability questions.

Proposition 20.105 (Capability-reinvestment condition). *Where continued economic activity depends materially on a capability, evaluation should examine whether that capability is being reproduced, diversified, transferred, or recoverably substituted at a rate and distribution adequate to the relevant long-horizon dependency structure.*

20.7.6 Relational Reinvestment Architecture

Many economic processes depend on relational conditions that do not appear as separable assets. Trustworthiness, care, recognition, professional norms, legitimacy, mutual knowledge, coordination routines, shared expectations, and durable channels of communication can lower the cost of cooperation and make complex collective activity possible. These conditions can be generated through repeated interaction, but they can also be consumed. Organizations can rely on worker commitment while weakening reciprocity; public institutions can rely on compliance while eroding procedural legitimacy; communities can provide social coordination while receiving little support for the relations that sustain it.

Relational reinvestment is broader than expenditure on social programmes. It concerns practices through which economically consequential relations are maintained, repaired, or made more revisable. Fair process, recognition, predictable obligations, time for coordination, conflict resolution, continuity of care, transparent explanation, participatory governance, and repair after institutional error can all function as relational returns.

The relation should be specified rather than idealized. Trust can support coordination but can also conceal weak verification. Strong relational continuity can become exclusionary. Loyalty can be extracted. Care can be imposed unequally. Relational reinvestment therefore includes contestability, boundary conditions, and the possibility of exit alongside continuity.

Definition 20.106 (Relational reinvestment pathway). *A relational reinvestment pathway is a process through which resources, recognition, time, authority, care, repair, or institutional support are directed toward maintaining or regenerating an economically consequential relation, together with the standing and revision conditions required for that relation to remain viable without becoming coercively closed.*

This concept links value recirculation to the relational architecture of GRE directly. Some returns matter because they preserve a relation rather than because they create a transferable asset. Such return remains economically consequential where later generation depends on that relation.

Proposition 20.107 (Relational-reinvestment condition). *Claims of relational reinvestment should specify the relation being maintained or repaired, the contribution of that relation to later economic capability or coordination, the distribution of relational burden, and the mechanisms through which participants can contest, renegotiate, or exit the relation where warranted.*

20.7.7 Long-Horizon Reinvestment Architecture

Return timing can materially alter an economic trajectory. Some returns are realized quickly through income, consumption, or current service. Others require long periods of maintenance before their value becomes visible. Education, research, ecological restoration, institutional capacity, public infrastructure, cultural preservation, archives, care systems, and technical standards can all depend on recurrent commitments whose immediate measurable return is modest relative to their later enabling role.

Long-horizon reinvestment concerns these delayed reproduction requirements. It asks which present configurations depend on conditions that will deteriorate without renewal, succession, reserve capacity, or regeneration. The relevant horizon varies by object. Software dependencies can become obsolete within years; transport networks can require maintenance over decades; ecological processes can unfold across much longer periods; institutional trust and professional capability can accumulate slowly and erode rapidly.

Discounting and uncertainty complicate long-horizon return. GRE does not require one universal discount rule. It asks that the horizon and normative assumptions be explicit and that uncertainty not automatically erase later affected positions from consideration. Some returns can be staged, diversified, or made reversible. Others involve irreversible loss or threshold effects that require different treatment.

Definition 20.108 (Long-horizon reinvestment profile). *A long-horizon reinvestment profile identifies delayed maintenance, regeneration, succession, reserve, preservation, and option-support requirements associated with an economic configuration and relates them to the timing, uncertainty, reversibility, and intergenerational incidence of present return decisions.*

Long-horizon reinvestment also includes preservation of institutional and epistemic memory. A later generation cannot exercise meaningful revisability where records, provenance, expertise, or infrastructure have disappeared. Reinvestment in memory can therefore be part of preserving future option space.

Proposition 20.109 (Long-horizon reinvestment condition). *Where current economic benefit depends on conditions subject to delayed deterioration or regeneration, evalua-*

tion should make future maintenance, succession, preservation, reserve, and restoration requirements visible together with the positions expected to finance, perform, or bear those obligations.

20.7.8 Generative Depletion Dynamics

Recirculation analysis becomes most informative when it can also identify failure of return. An economic configuration can generate considerable present value while consuming the conditions of its own continuation or transferring the cost of reproduction to less visible positions. This is *generative depletion*: erosion of capabilities, relations, infrastructures, knowledge, ecological functions, care capacity, legitimacy, or future options that are materially relevant to later generation.

Depletion is not identical to resource use. Some conditions are deliberately transformed; some capabilities become obsolete; some institutions should disappear; some ecological or technical substitutions are warranted. The question is whether the loss is accompanied by adequate maintenance, regeneration, substitution, transition, or legitimate closure. A reproductive deficit exists where the arrangement persistently draws on a relevant substrate without reproducing, replacing, repairing, or intentionally winding down the dependency that makes the substrate necessary.

Generative depletion can be hidden by accounting boundaries. A firm can appear productive while households reproduce labor capacity through unpaid care. A platform can appear asset-light while relying on public digital infrastructure and user-generated data. A public service can meet targets while degrading staff capability. A research system can increase publication counts while eroding replication, archives, or mentorship. A low-price commodity can externalize ecological restoration costs. Order-level analysis should therefore ask where the reproduction cost has gone.

Definition 20.110 (Generative depletion profile). *A generative depletion profile specifies the capabilities, relations, infrastructures, knowledge conditions, ecological functions, standing, or option structures materially consumed or weakened by an economic configuration, the positions bearing that depletion, and the extent to which maintenance, regeneration, substitution, transition, or legitimate closure addresses the resulting reproductive deficit.*

Depletion can be cumulative and nonlinear. Small annual reductions in maintenance or training can produce sudden later failure. Trust can deteriorate after repeated procedural injury. Ecological systems can cross thresholds. Institutional knowledge can disappear abruptly when experienced cohorts leave. The visibility of current output can therefore be a poor guide to the depth of a latent reproductive deficit.

Proposition 20.111 (Generative-depletion condition). *An economic arrangement should be treated as generatively depleting, for the purpose of a bounded inquiry, where it persistently weakens a condition materially required for later generation without an adequate pathway of maintenance, regeneration, recoverable substitution, transition, or justified closure at the relevant scale and horizon.*

20.7.9 Transfer Pathways and Incidence

A reinvestment decision is not complete when a budget is allocated. Transfers pass through administrative, financial, organizational, legal, technical, and rela-

tional pathways that can alter their form and incidence. Eligibility rules, timing, intermediaries, transaction costs, matching requirements, procurement procedures, platform fees, information asymmetry, conversion conditions, and control rights can determine whether a nominal return becomes a practical one.

The distinction between intended recipient and realized incidence is therefore essential. A subsidy directed toward households can partly capitalize into prices. Funding for a community can be controlled by a narrow intermediary. Training money can reach providers while participants receive little usable capability. Public infrastructure spending can increase land values elsewhere. Knowledge-return requirements can produce documents that satisfy formal reporting without becoming usable by contributors. Return should be traced through its pathway rather than inferred from the destination named in policy.

Incidence also includes burden. A return programme can require unpaid administrative labor; data disclosure, compliance costs, travel, documentation, or care time from the intended beneficiaries. A community grant can increase reporting obligations. Portability schemes can shift technical integration costs onto smaller organizations. The pathway itself can therefore generate new dependencies or exclusions.

Definition 20.112 (Return-transfer pathway). A *return-transfer pathway* is the ordered or partially ordered set of institutional, financial, legal, technical, administrative, and relational interfaces through which a value return or reinvestment commitment moves from its mobilization point toward realized incidence, including intermediaries, conversion conditions, control rights, timing, transaction burdens, and residual leakage or displacement.

This definition makes transfer pathways compatible with the broader intervention methodology of the book. The same nominal allocation can have different effects under different institutional pathways, and pathway redesign can sometimes matter more than increasing the nominal transfer.

Proposition 20.113 (Return-incidence condition). *Evaluation of social reinvestment should distinguish mobilized resources, nominal allocation, pathway control, practical access, realized incidence, conversion into capability or maintenance, and burdens created by the transfer process itself.*

20.7.10 Justice in Return–Transfer Relations

Return and transfer also raise questions of justice. A value-generating configuration can involve contributors, investors, workers, users, affected communities, public infrastructures, knowledge commons, ecological systems, caregivers, and later generations whose claims differ in kind. Some claims arise from contribution; some from affectedness; some from need, standing, prior entitlement, historical burden, public mandate, stewardship, or responsibility for future maintenance. GRE should preserve these different bases rather than derive one universal entitlement from the concept of generativity itself.

Contribution is therefore relevant but not exhaustive. An actor can have a strong claim to protection or return without having produced the value in question. Children, disabled persons, future persons, ecological systems, and populations affected by externalities illustrate why contribution cannot exhaust justice. Conversely, contribution claims can matter where labor, knowledge, data, care, community legitimacy, or ecological stewardship create value captured elsewhere. Justice analysis should

identify which claim is being made and why.

Return form also matters. Financial payment can be appropriate for some claims, while others concern access, capability, repair, restoration, recognition, governance rights, public provision, or changes in control. Cross-form return can be justified, but the conversion should be explicit. An institution should not presume that one value form compensates for another where the affected positions reject or cannot practically use the substitution.

Justice also concerns who decides the return. A formally generous reinvestment can remain paternalistic where affected positions have no standing in defining the relevant substrate, choosing the form of return, or contesting the conversion. Participation from Section 20.6 therefore re-enters the value architecture. Return justice includes procedural standing as well as material incidence.

Definition 20.114 (Return–transfer justice profile). *A return–transfer justice profile identifies the relevant bases of claim in a return or reinvestment process, the affected and represented positions, the forms and timing of return, the conversion and transfer pathways, the distribution of control and burden, the procedures for contestation and revision, and the material normative remainder left after the transfer.*

The normative remainder is important because a return can be justified along one dimension while remaining problematic along another. A compensation payment can address material loss without restoring political standing. Community investment can support local capability while leaving ecological harm unresolved. Open access can improve knowledge return while leaving data extraction or labor recognition contested. Justice analysis should preserve these residual claims rather than treat the return as closing the case automatically.

Proposition 20.115 (Return–transfer justice condition). *A justice claim concerning value return or social reinvestment should specify its basis of claim, affected positions, return form, conversion pathway, incidence, control, temporal horizon, and contestability and should preserve materially relevant normative remainders where one transfer cannot settle heterogeneous claims.*

The ten dimensions developed in this section provide an order-level account of how generated value can return to the conditions of later generation. Return-flow architecture identifies the path; public and community reinvestment locate collective sites of reproduction; knowledge and capability reinvestment reproduce epistemic and practical ability; relational reinvestment maintains cooperative substrates; long-horizon analysis exposes delayed obligations; depletion analysis identifies reproductive deficits; transfer analysis reconstructs realized incidence; and justice analysis keeps heterogeneous claims and procedural standing visible.

Value recirculation therefore does not imply a closed or harmonious economic cycle. Generative relational economic order can contain extraction, dissipation, justified consumption, transformation, redistribution, accumulation, and irreducible conflict alongside recirculation. The analytical contribution is narrower and more useful: it asks whether an order can see the substrates on which its value generation depends, trace how returns reach or fail to reach them, distinguish maintenance from depletion, and revise return architectures when value generation persistently consumes the conditions of later possibility. Section 20.8 turns next to economic order under plural values, where the problem of return must be situated within deeper incommensurability among value forms, subjects, and normative claims.

20.8 Plural-Value Economic Order

The role of this section is to specify how a generative relational economic order can be evaluated and organized where several value structures, subject positions, and domain-specific normative claims coexist without complete commensurability. Its objective is to connect the heterogeneous value architecture of Chapter 14, the subject-value analysis developed for artificial-intelligence-mediated economies in Chapter 18, the domain translations of Chapter 19, and the evaluation, institutional, participation, and recirculation architectures developed in Sections 20.2–20.7. The discussion develops eight dimensions: value-plural order architecture, incommensurable value relations, heterogeneous subject-value standing, plural-value coexistence, procedural accommodation and mediation, domain-specific value structures, aggregation scope and evaluative remainders, and open normative economic order. The method is relational, institutionally explicit, and procedurally plural. It treats value disagreement as part of economic order rather than as a residual problem to be removed before economic analysis can begin.

Chapter 14 established that material, financial, capability, relational, epistemic, institutional, participatory, option, future, and ecological values can coexist and undergo only partial conversion. Chapter 18 further showed that heterogeneous human, artificial, collective, and non-human subject positions can become economically consequential without sharing one ontology, one utility representation, or one form of standing. The present section shifts the analytical level. It asks how an economic order can coordinate allocation, participation, infrastructure, institutional authority, return, and long-horizon revision when the relevant value field remains plural.

Plurality should not be equated with permanent disagreement or with the absence of decision. Economic coordination often requires closure at a particular time, scale, or institutional interface. A budget must be allocated, a standard adopted, a service configured, a right adjudicated, a platform rule applied, or an ecological threshold respected. GRE therefore distinguishes *operational closure* from *normative closure*. Operational closure produces a decision or rule sufficient for action within a bounded setting. Normative closure makes the stronger claim that the relevant values have been fully compared, translated, or resolved. The first can be necessary even where the second remains unwarranted.

The resulting problem is architectural. Economic order requires institutions and procedures capable of making heterogeneous values actionable while preserving material remainders, subject standing, provenance, and routes of contestation. Some values can be monetized for limited purposes; some can be represented by thresholds, constraints, rights, lexicographic priorities, or multi-criteria procedures; some can be translated only partially; and some can remain explicitly unresolved. The adequacy of the order therefore depends partly on how it organizes comparison and non-comparison, not merely on which aggregate outcome it produces.

Table 20.8 summarizes the eight dimensions developed below. The table is diagnostic rather than prescriptive. Different institutions can instantiate the dimensions through different legal, political, market, professional, community, technical, or deliberative mechanisms.

Table 20.8: Dimensions of plural-value economic order in Generative Relational Economics.

Dimension	Primary analytical object	Order-level question	Characteristic analytical failure
Value-plural order architecture	Heterogeneous value forms, sources, carriers, and decision interfaces	Which values enter the order, through which representations, and with what institutional standing?	Treating one visible metric as the complete value field
Incommensurable value relations	Partial comparison, failed conversion, incomparable dimensions, and normative remainder	Which comparisons are warranted, which remain partial, and what is lost through conversion?	Treating numerical representation as proof of commensurability
Subject-value standing	Subjects, affected positions, representatives, and typed standing	Whose values become actionable, through which standing or representation pathway?	Treating institutional legibility as equivalent to complete subject representation
Plural-value coexistence	Institutional plurality, bounded domains, thresholds, rights, and parallel value spaces	How can heterogeneous value structures coexist without forced equivalence or destructive isolation?	Equating coexistence with either total integration or complete separation
Procedural accommodation	Deliberation, rights, review, negotiation, mediation, justification, and appeal	Which procedure is authorized to close a bounded conflict, and how can the closure be challenged or revised?	Treating procedure as neutral to power, access, or representation
Domain-specific value structures	Domain-local values, conversion interfaces, and translation remainders	Which value structures are local to education, care, ecology, research, culture, or other domains?	Importing one domain's metric into another without translation warrant
Aggregation scope	Scalar, vector, threshold, lexicographic, constrained, and partially ordered representations	At what scope does aggregation preserve enough material structure for the decision at hand?	Extending a locally useful aggregate into a universal welfare criterion
Open normative order	Normative records, revision triggers, unresolved disagreement, and future standing	How can economic coordination remain revisable as subjects, values, evidence, and conditions change?	Prematurely treating temporary institutional closure as final normative settlement

20.8.1 Value-Plural Order Architecture

A plural-value economic order begins from the observation that economically consequential activity can generate, depend on, and transform several value forms at once. A hospital can produce health capability, professional knowledge, public trust, employment, institutional continuity, financial obligations, and relational care. A research system can produce knowledge, prestige, training, infrastructure, public capability, and future options. A platform can generate revenue, data, convenience, network access, dependence, visibility, and forms of cultural or political influence. One scalar account can illuminate part of such a configuration while leaving other value-bearing relations outside its field of representation.

Order-level analysis therefore requires a map of value sources, carriers, realization sites, conversion interfaces, and institutional standing. The purpose is not to create an exhaustive catalogue before action. The purpose is to prevent one readily measured form of value from silently defining the economic order for every affected position. Which value forms require explicit representation depends on the research question, domain, scale, and stakes.

Value plurality also has a temporal dimension. Present income, future capability, institutional maintenance, ecological regeneration, cultural continuity, epistemic preservation, and option-space preservation can become relevant on different horizons. An economic order can appear coherent at one horizon while transferring large reproduction costs into another. Section 20.7 treated such transfer through recircula-

tion and generative depletion. The present section adds that the relevant losses can remain normatively heterogeneous even where they are causally linked.

Definition 20.116 (Value-plural order architecture). A *value-plural order architecture* is a history-bearing arrangement of value forms, subject positions, realization and conversion interfaces, institutional standing, comparison rules, decision procedures, and revision pathways through which heterogeneous values become economically consequential without requiring complete commensurability among them.

Definition 20.116 keeps plurality connected to institutional process. Values become economically consequential through budgets, rights, prices, professional standards, community rules, public mandates, ecological constraints, technological objectives, participation structures, and other interfaces. These arrangements can preserve plurality, compress it, exclude it, or transform it.

Proposition 20.117 (Value-plural specification condition). A *plural-value evaluation of economic order* should identify the value forms materially relevant to the bounded inquiry, the positions through which they are generated or affected, the interfaces through which they become institutionally legible, and the material value dimensions that remain outside the operative representation.

This condition supports bounded analysis. A transport project may require monetary cost, mobility capability, disability access, ecological burden, neighborhood continuity, and future-option analysis without requiring every possible value to enter one model. Adequacy depends on the relation between the decision and the material values omitted or represented.

20.8.2 Incommensurable Value Relations

Value plurality becomes analytically demanding when conversion or comparison remains partial. Incommensurability can arise for different reasons and should therefore be typed rather than invoked as a general prohibition on comparison. Two values can lack a defensible common unit; conversion can depend on a disputed institutional rule; comparison can be meaningful only within a limited range; one value can function as a threshold or side constraint; or the values can represent different subject positions whose interpersonal comparison remains normatively contested.

The distinction between *incommensurability*, *incomparability*, and *non-equivalence* is useful here. Values can be non-equivalent while still permitting partial comparison. Two alternatives can be comparable for a particular decision without the underlying values being reducible to one substance. Conversely, numerical scores can be assigned to heterogeneous objects without establishing that the scores preserve the normative structure relevant to the decision. A monetary estimate of ecological restoration cost, for example, can be useful for budgeting while remaining an incomplete representation of ecological value, irreversibility, or intergenerational standing.

Conversion therefore leaves remainders. Chapter 14 developed conversion loss and provenance as part of value transformation. At order level, the relevant issue is how institutions treat the remainder. It can be ignored, recorded, protected through constraints, represented by another institution, carried forward for later review, or used to block a proposed conversion. The treatment of remainder is itself part of economic governance.

Definition 20.118 (Incommensurability profile). An *incommensurability profile* spec-

ifies the value dimensions or claims whose comparison, conversion, aggregation, or substitution is partial, contested, threshold-bound, or unsupported within a stated decision context, together with the institutional rule, evidential basis, provenance, and normative remainder associated with the attempted relation.

An incommensurability profile can therefore be local. Health outcomes may be compared within one clinical allocation procedure while some rights remain non-tradable. Ecological damage may be monetized for one compensation calculation while specific irreversible losses remain subject to separate protection. Research proposals may be scored on feasibility and expected contribution while disciplinary plurality or high-risk exploration is protected through portfolio rules.

Proposition 20.119 (Incommensurability-preservation condition). *Where an economic decision relies on partial comparison among heterogeneous values, the decision architecture should identify the scope of the comparison, the rule authorizing it, the dimensions excluded from the comparison, and any material normative remainder that should constrain, qualify, or remain contestable after operational closure.*

The proposition allows comparison while preserving scope. It also prevents incommensurability from becoming a rhetorical device that blocks analysis. The task is to specify where comparison is possible, how it is justified, and where the relation remains incomplete.

20.8.3 Heterogeneous Subject–Value Standing

Values do not enter economic order independently of subjects, affected positions, institutions, and representation. Persons, households, organizations, communities, future generations, ecosystems, artificial agents, professional bodies, public institutions, and other configurations can become economically relevant through different dimensions of standing. Chapter 18 examined heterogeneous subject–value structures under artificial-intelligence-mediated conditions. The present analysis generalizes the standing problem to economic order.

Standing should be typed. A subject can have a right to receive information, participate in deliberation, claim protection, contribute evidence, appeal a decision, receive compensation, exercise delegated authority, or hold decision power. These positions should not be collapsed into one generic category of stakeholder status. A future generation cannot directly participate in current deliberation but can be represented through institutional obligations, trusteeship, ecological standards, or intergenerational procedures. An ecosystem can be causally affected and institutionally represented without assuming that it participates through the same mechanism as a human citizen. An AI system can execute delegated transactions without thereby inheriting the moral or legal standing of the delegating institution.

Representation also changes value expression. Preferences, rights claims, capability indicators, legal testimony, expert assessment, ecological measurement, community deliberation, model outputs, and organizational objectives preserve different structures. The route by which a value becomes legible can amplify some dimensions and suppress others. Standing analysis therefore requires attention to representation provenance as well as formal inclusion.

Definition 20.120 (Subject–value standing profile). *A subject–value standing profile identifies an economically relevant subject or affected position, the value dimensions attributed to or represented for that position, the institutional channels through*

which those dimensions become actionable, and the associated rights of information, contribution, protection, representation, challenge, appeal, or decision influence.

The profile supports differentiated participation. A community can possess standing over land-use decisions while individuals retain distinct rights. A professional body can represent expertise without representing every affected citizen. A public authority can act for a diffuse public mandate while remaining contestable by those subject to its decisions. Multiple standing relations can therefore overlap without becoming interchangeable.

Proposition 20.121 (Standing-specification condition). *An economic-order decision that claims to accommodate heterogeneous values should specify which subject positions possess standing, how those positions are represented, which value dimensions the representation preserves, and which routes exist for challenging misrepresentation, exclusion, or unauthorized substitution among subject positions.*

This condition links plural value directly to power. The ability to define who counts, what can be represented, and which forms of evidence are admissible can shape the effective value field before aggregation or deliberation begins.

20.8.4 Plural-Value Coexistence

Economic orders often coordinate groups and institutions that do not share one comprehensive value structure. Coexistence therefore requires more than mutual tolerance and less than complete normative integration. Different communities can retain distinct cultural practices while sharing public infrastructure. Professional domains can use different standards of evidence while coordinating through common legal rules. Public institutions can protect rights that constrain market exchange while markets continue to coordinate many other transactions. Ecological thresholds can limit otherwise permissible production without converting ecological value into the same metric used for profitability.

Several institutional architectures can support such coexistence. Jurisdictional boundaries can allocate decision authority across domains or scales. Rights can protect some dimensions from routine aggregation. Thresholds can establish minimum conditions. Parallel institutions can preserve alternative modes of valuation. Modular or federated systems can permit local difference while sharing infrastructure. Portfolio rules can preserve diversity where the appropriate future value remains uncertain. None of these mechanisms is automatically adequate; each can generate exclusion, fragmentation, lock-in, or hidden hierarchy.

Coexistence also requires interfaces. Complete separation is rarely feasible because value domains interact through land, labor, finance, technology, public budgets, data, environmental effects, and shared institutions. The question is therefore how interfaces are governed. A value boundary that protects one domain may transfer burden into another. Institutional pluralism needs mechanisms for cross-boundary incidence, conflict, and revision.

Definition 20.122 (Plural-value coexistence architecture). *A plural-value coexistence architecture is an arrangement of domain boundaries, shared rules, protected standing, thresholds, parallel institutions, translation interfaces, and conflict-resolution pathways through which heterogeneous value structures can operate within one economic order without requiring full equivalence or complete institutional separation.*

Coexistence can therefore be layered. Some rules can be common across the order, such as procedural protections or baseline rights, while valuation practices remain domain-specific. Other issues can require negotiated interfaces. The architecture should make clear which differences are protected, which are translated, which are aggregated, and which are subject to common constraints.

Proposition 20.123 (Plural-value coexistence condition). *A plural-value economic order is more adequately specified where the boundaries among value domains, their shared infrastructures and obligations, the interfaces through which conflicts propagate, and the procedures for revising those boundaries are made explicit rather than left to implicit dominance by the most institutionally powerful value representation.*

The proposition does not presume that every value system deserves institutional preservation. Coexistence remains bounded by rights, evidence, public obligations, ecological constraints, and other justified limits. The point is that closure should be institutionally specified rather than concealed inside an apparently neutral aggregate.

20.8.5 Procedural Accommodation and Mediation

Plural values require procedures because many economically consequential decisions cannot remain indefinitely open. Procedural accommodation concerns the authorized processes through which competing claims become represented, compared where appropriate, negotiated, constrained, justified, decided, reviewed, and revised. Relevant procedures include markets, contracts, courts, public budgeting, professional review, community governance, administrative hearings, standards processes, democratic institutions, negotiated agreements, and mixed human–technical systems.

Procedure does not become neutral merely because it is formal. Agenda setting, admissible evidence, representation cost, technical complexity, time requirements, appeal rights, default rules, and enforcement capacity affect who can participate effectively. A technically consistent procedure can therefore reproduce asymmetry if some positions lack the capability to use it. Section 20.6 treated participation conversion at the order level. Procedural accommodation adds that value mediation depends on the practical accessibility of the procedure itself.

Several closure rules are possible. Majority decision, consent, bargaining, rights-based constraint, professional judgment, random selection, judicial review, delegated expertise, threshold rules, and multi-criteria assessment each encode different standing and comparison assumptions. GRE does not identify one universal procedure. It asks whether the procedure fits the object, preserves relevant standing, makes its comparison rules visible, supports challenge, and remains revisable where conditions or evidence change.

Definition 20.124 (Procedural value-mediation architecture). *A procedural value-mediation architecture is an authorized arrangement of representation, evidence, comparison, deliberation, negotiation, constraint, decision, explanation, review, appeal, and revision through which a bounded plural-value conflict becomes operationally actionable while preserving materially relevant standing and normative remainder.*

This definition makes the procedure itself part of economic architecture. AI-assisted systems can support translation, summarization, simulation, matching, forecasting, or administrative processing within such architectures. Their role does

not remove the need to specify who authorized the objective, who can contest the representation, and where responsibility for closure remains located.

Proposition 20.125 (Procedural-accommodation condition). *A procedure used to accommodate plural economic values should make visible its standing rules, evidential requirements, comparison or constraint logic, decision authority, burden of participation, review pathway, and conditions of revision, especially where the procedure can systematically privilege one value representation or subject position.*

Procedural adequacy is therefore partly relational. A low-cost appeal channel can matter more than formal transparency where decisions are frequently erroneous. Representation support can matter where participation costs are uneven. Multiple decision fora can reduce dependence on one gatekeeper while also increasing complexity. The appropriate architecture remains contextual.

20.8.6 Domain-Specific Value Structures

Chapter 19 demonstrated that values acquire different practical meanings across education, research, work, development, welfare, communities, platforms, public institutions, migration, ecology, and culture. Capability in education differs from professional capability in an organization; ecological regeneration differs from institutional maintenance; cultural continuity differs from knowledge preservation; public legitimacy differs from platform trust. Shared vocabulary can therefore conceal domain-specific value structures.

Economic order coordinates these domains through budgets, labor, law, infrastructure, technology, taxation, property, data, public authority, and interdependence. Coordination can create pressure for a common metric. Cost-benefit analysis, accounting standards, performance indicators, rankings, procurement criteria, and automated objectives can all support coordination, yet each can also export the value assumptions of one domain into another. Domain-specific value analysis asks when such transfer is warranted and what remainder it leaves.

The same caution applies in reverse. Domain specificity should not become a reason to ignore cross-domain incidence. A cultural preservation rule can affect housing access; an ecological restriction can affect employment and mobility; a healthcare priority can affect public budgets; a research-funding decision can reshape regional capability. The value structures remain domain-specific while their consequences propagate across domains.

Definition 20.126 (Domain value profile). *A domain value profile specifies the value forms, standing relations, realization practices, evidential indicators, conversion interfaces, temporal horizons, and normative remainders characteristic of a bounded domain, together with the interfaces through which those values interact with other parts of economic order.*

Domain value profiles are provisional and revisable. They can change as technologies, institutions, cultural practices, ecological conditions, and research knowledge change. Their function is analytical: they prevent cross-domain coordination from silently erasing the structures through which value is locally realized.

Proposition 20.127 (Domain-value translation condition). *Where an economic-order decision transfers a metric, criterion, or value representation across domains, the analysis should state the structural correspondence supporting the transfer; the domain-*

specific dimensions transformed or omitted, and the institutional treatment of any resulting remainder or conflict.

This condition carries forward the domain-translation discipline of Chapter 19. Cross-domain economic order requires translation, but translation remains a claim to be justified rather than an automatic consequence of shared terminology.

20.8.7 Aggregation Scope and Evaluative Remainders

Aggregation is often indispensable. Public budgets combine claims across programmes; firms compare projects; households allocate scarce time and income; platforms rank options; regulators assess risks; researchers construct indices. GRE therefore treats aggregation as a scoped representational operation rather than as an error in itself. The central question is what structure an aggregate preserves, what it compresses, and whether the compression is adequate for the decision at hand.

Several aggregation forms can coexist. Scalar aggregation combines dimensions into one number. Vector representations preserve several dimensions. Threshold and constraint architectures classify some dimensions as minimum conditions. Lexicographic rules give priority to specified values. Partial orders permit some alternatives to remain incomparable. Portfolio approaches can preserve diversity rather than select one global optimum. Deliberative procedures can use quantitative summaries without allowing the summaries to determine final closure.

The strongest risk arises when a locally useful aggregate acquires wider normative authority. A cost index can become a welfare criterion; an engagement score can become a measure of social value; a standardized test can become a proxy for educational worth; a publication metric can become a proxy for epistemic contribution. Such expansion can occur gradually through administrative convenience, data availability, automation, or institutional dependence.

Definition 20.128 (Aggregation-warrant profile). *An aggregation-warrant profile specifies the values and subject positions included in an aggregate representation, the comparison and weighting assumptions used, the decision scope for which the representation is intended, the dimensions retained through constraints or parallel indicators, and the evaluative remainder excluded from the aggregate.*

The profile turns aggregation into an auditable claim. It also allows different levels of aggregation. A local operational score can remain fully legitimate while broader normative evaluation uses additional dimensions. The issue is therefore scope discipline rather than rejection of quantification.

Proposition 20.129 (Aggregation-scope condition). *An aggregate value representation is warranted for a bounded economic-order decision to the extent that its comparison assumptions are defensible for that scope, materially relevant omitted dimensions are protected or separately evaluated, and the aggregate is not granted broader normative authority without an additional argument.*

Evaluative remainder should remain visible after aggregation. A policy can score well overall while imposing a severe burden on a small group; an investment can have positive expected value while crossing an ecological threshold; a productivity gain can weaken participation or capability. Separate standing, constraints, compensation, review, or veto structures can be necessary where aggregation alone does not preserve the relevant normative relation.

20.8.8 Open Normative Economic Order

Plural-value order ultimately requires a conception of normative openness. Openness does not mean indefinite hesitation, absence of law, or refusal to institutionalize commitments. Durable rights, standards, public mandates, contracts, safety rules, ecological protections, and long-horizon investments can all require stability. Normative openness concerns the relation between such closure and the possibility of justified revision when subjects, evidence, technologies, value structures, or historical conditions change.

The economic order therefore benefits from preserving a record of normative closure. A rule can record which values were considered, which positions possessed standing, which evidence supported the decision, which dimensions remained unresolved, what assumptions enabled aggregation, and under what conditions review should occur. Such a record makes later re-epistemization possible. It also allows institutional continuity without requiring later participants to reconstruct the original normative architecture from incomplete traces.

Openness has a distributive dimension. Future participants inherit present infrastructures, debts, ecological conditions, technical standards, legal rules, model dependencies, cultural institutions, and value-conversion interfaces. They also inherit the closures embedded in those arrangements. Preserving future normative agency therefore concerns more than preserving abstract choice. It can require records, contestability, institutional capacity, interoperability, succession, and practical pathways through which inherited arrangements can be understood and revised.

Definition 20.130 (Open normative economic order). An *open normative economic order* is an economic configuration whose operational rules can support durable coordination while preserving sufficiently intelligible records, standing, contestability, evaluative remainder, institutional capability, and revision pathways for later reconsideration of materially consequential normative closures.

The definition does not privilege permanent institutional fluidity. Some commitments appropriately raise the cost of revision because they protect rights, continuity, safety, trust, or long-horizon cooperation. The analytical task is to make the revision architecture proportionate to the stakes, reversibility, uncertainty, and burden distribution of the closure.

Proposition 20.131 (Open-normative-order condition). A *plural-value economic order* preserves normative openness where consequential closures are accompanied, at a level proportionate to their stakes, by identifiable standing, justification, provenance, unresolved remainders, review conditions, and practical institutional capacity for correction or revision when the grounds of the closure materially change.

This final condition links plural values to the wider architecture of Chapter 20. Generative evaluation in Section 20.2 requires plural profiles rather than automatic scalar collapse. Policy in Section 20.3 requires conversion and revision architecture. Institutions in Section 20.4 require standing, contestability, and learning. Relational infrastructure in Section 20.5 determines whether plural standing is practically usable. Participation in Section 20.6 determines whose values can enter economic formation. Value recirculation in Section 20.7 determines which substrates and claims receive return. Plural-value economic order integrates these dimensions while preserving the possibility that important normative disagreement remains real after a decision is made.

The next analytical problem concerns the distribution of scarcity itself. Technological, institutional, and AI-mediated change can reduce some material, symbolic, or informational scarcities while intensifying scarcity in attention, trust, orientation, participation, and generative opportunity. Section 20.9 therefore examines productive abundance together with the relocation and transformation of scarce economic conditions.

20.9 Productive Abundance and Scarcity Relocation

The role of this section is to examine how increasing productive capacity changes the location and form of scarcity within a generative relational economic order. Its objective is to distinguish abundance of material output, symbolic production, and knowledge availability from the complementary scarcities that can emerge in attention, trust, orientation, participation, and access to future-forming opportunities. The section develops eight dimensions: material abundance and conversion constraints, symbolic abundance and representational bottlenecks, knowledge abundance and epistemic bottlenecks, attention allocation, trust formation, orientation, participation, and generative opportunity. The method is relational, positional, and historical. Abundance is analyzed relative to specified objects, positions, functions, infrastructures, and temporal horizons rather than as a claim that an economic configuration has escaped scarcity in general.

The analysis extends the abundance architecture developed in Chapter 17 and Chapter 18 to the level of economic order. Chapter 17 showed that expanded informational and epistemic production can coexist with scarce verification, attention, orientation, and trust. Chapter 18 then examined artificial productive capacity, symbolic abundance, research orientation, and generative participation under radical capability asymmetry. The present section asks a broader economic-order question. When production, reproduction, computation, communication, or symbolic generation become substantially cheaper or more scalable, which constraints are relaxed, which complementary capacities become binding, and which positions acquire greater control over the resulting bottlenecks?

Scarcity relocation should be distinguished from a simple substitution of one scarce good for another. Some scarcities are technically reduced. Others become more visible because an earlier constraint has been relaxed. Still others are generated by the abundance process itself. Cheap content generation can increase verification burdens; abundant options can increase orientation burdens; widespread formal access can intensify competition for visibility; productive automation can reduce labor requirements while narrowing pathways through which people acquire recognition, experience, or institutional standing. The resulting configuration can therefore contain simultaneous abundance and scarcity at different layers.

Definition 20.132 (Abundance–scarcity relocation profile). An *abundance–scarcity relocation profile* specifies, for a bounded economic configuration, the objects or operations whose supply, reproducibility, or productive capacity has materially expanded; the positions for which that expansion is practically available; the complementary capacities, infrastructures, conversion pathways, and institutional permissions required for use; the scarcities relaxed, intensified, revealed, or generated; and the later capability, dependency, participation, and option-space effects associated

Table 20.9: Dimensions of productive abundance and scarcity relocation in generative relational economic order.

Dimension	Primary abundance or scarcity object	Generative question	Characteristic analytical failure
Material abundance	Goods, energy services, computation, productive throughput, or reproducible physical outputs	Which material constraints are genuinely relaxed, and which conversion, ecological, infrastructural, or access constraints become binding?	Treating aggregate output growth as universal practical abundance
Symbolic abundance	Text, images, code, signals, classifications, credentials, and representations	Which representational functions become cheap, and which provenance, verification, interpretation, or visibility bottlenecks relocate value?	Equating symbolic volume with meaning, credibility, or cultural value
Knowledge abundance	Information, explanations, models, methods, records, and candidate solutions	Can relevant positions locate, understand, verify, combine, and act on abundant epistemic objects?	Treating availability as warranted knowledge or usable capability
Attention scarcity	Reception, processing, deliberation, and institutional response capacity	How is finite attention allocated when available signals and claims exceed practical processing capacity?	Treating visibility as a neutral consequence of supply
Trust scarcity	Justified practical reliance on persons, institutions, procedures, representations, and infrastructures	Which verification, provenance, accountability, and correction structures support reliance under abundance?	Treating either reputation or formal verification as complete trust
Orientation scarcity	Selection of questions, priorities, trajectories, and commitments	Which capacities support consequential selection when candidate actions, problems, and solutions proliferate?	Treating a larger option set as automatically improving direction
Participation scarcity	Access to consequential roles, standing, contribution, recognition, learning, and decision interfaces	Do abundant outputs coexist with scarce pathways into the processes that shape economic formation?	Equating consumption or formal access with consequential participation
Generative opportunity scarcity	Practical access to future-forming projects, infrastructures, relations, and institutional pathways	Which positions can originate, sustain, revise, and realize new trajectories when outputs become abundant?	Equating abundant artifacts with abundant capacity to create future alternatives

with the resulting configuration.

Definition 20.132 prevents abundance from being represented by output quantity alone. The same productive change can be abundant for one position and inaccessible for another. It can remove a material bottleneck while increasing dependence on a technical infrastructure. It can enlarge the set of candidate actions while concentrating the capacity to rank or authorize them. Table 20.9 summarizes the eight dimensions developed below.

Proposition 20.133 (Scarcity-relocation condition). *An increase in productive abundance improves a specified economic condition to the extent that it relaxes a materially relevant constraint for the affected positions and does not merely transfer the binding constraint into less visible conversion, verification, infrastructural, participatory, ecological, or institutional bottlenecks whose burdens offset or reverse the gain.*

Proposition 20.133 does not imply that every relocation is harmful. Scarcity can move toward functions that are easier to govern, distribute, or expand. Increased production can make specialized verification economically worthwhile. Reduced material scarcity can free time for education, care, culture, or research. Better infrastructure can transform a previously scarce service into a dependable background condition. The analytical task is to trace the new configuration rather than infer welfare, justice, or generativity from abundance alone.

20.9.1 Material Abundance and Conversion Constraints

Material abundance concerns conditions in which specified goods, productive services, energy services, computational resources, or physical outputs become available at substantially lower real cost, higher volume, greater reliability, or wider reproducibility relative to a relevant reference position. The concept is necessarily bounded. Food can be abundant at the national level while nutrition remains inaccessible to particular households. Electricity-generation capacity can be ample while grid constraints or payment systems restrict practical access. Manufactured goods can be inexpensive while housing, land, care, maintenance, or ecological assimilation remain scarce. Aggregate abundance therefore does not establish practical abundance across positions.

The conversion architecture developed in Chapters 13 and 20 is especially important here. Material supply becomes economically useful through transport, storage, standards, complementary infrastructure, information, legal permission, time, care, technical capability, and institutional access. A fall in production cost can consequently relocate scarcity toward these complements. Cheap computing hardware can increase demand for electricity, cooling, networks, data, and specialized expertise. Abundant manufactured devices can increase repair, recycling, disposal, and interoperability requirements. Abundant food calories can coexist with scarce access to nutritious diets, care time, or distribution infrastructure.

Material abundance also has a scale and boundary problem. A configuration can become materially abundant by drawing on distant ecological, labor, infrastructural, or geopolitical substrates. Low local prices can coexist with high extraction, waste, maintenance, or vulnerability elsewhere. Section 19.11 showed why ecological flows and regenerative capacity remain part of economic architecture. Material abundance should therefore preserve the resource, ecological, maintenance, and dependency conditions through which the apparent abundance is sustained.

Definition 20.134 (Material-abundance conversion profile). *A material-abundance conversion profile specifies the material goods or productive services whose effective supply has expanded, the positions for which they are available, the complementary infrastructures and capabilities required for use, the resource and maintenance conditions supporting continued provision, and the residual constraints or burdens that determine whether aggregate abundance becomes practical abundance.*

The definition distinguishes a technologically feasible abundance from an institutionally realized one. It also makes room for abundance that is intentionally bounded. Safety, ecological protection, public-space limits, or long-horizon infrastructure constraints can justify restrictions even where marginal production is cheap. GRE therefore does not define progress as removal of every material constraint.

Proposition 20.135 (Material abundance–conversion condition). *Material abundance has broad practical significance where increased productive availability is accompanied by sufficiently accessible conversion pathways, maintainable complementary infrastructure, visible dependency conditions, and treatment of displaced ecological or social burdens at the scale relevant to continued provision.*

This condition prepares a broader point that recurs throughout the section. Productive abundance can reduce one cost while increasing the relative importance of conditions that were previously secondary. As marginal production becomes cheaper, maintenance, distribution, coordination, recognition, and institutional access can be-

come more economically consequential than the production act itself.

20.9.2 Symbolic Abundance and Representational Bottlenecks

Symbolic abundance concerns the rapid and inexpensive production, reproduction, transformation, and circulation of text, images, audio, code, classifications, simulations, credentials, reports, and other representational artifacts. Digital systems already lowered reproduction costs for many symbolic objects; contemporary generative systems further lower the cost of producing new candidate artifacts. Sections 17.3 and 18.11 developed the epistemic and representational consequences of this shift. At the level of economic order, the additional question concerns which functions of symbolic production become abundant and where economic scarcity subsequently relocates.

A symbolic artifact can serve multiple functions: communication, evidence, coordination, advertising, cultural expression, identity, institutional record, software instruction, contractual specification, education, or research. Abundance affects these functions differently. Cheap production can broaden expressive access, reduce drafting costs, support translation, and multiply candidate designs. Yet the same abundance can weaken historical cues that once linked scarcity of production to presumed effort, expertise, authorship, or authenticity. Value can relocate toward provenance, reputation, institutional verification, curation, interpretation, live performance, trusted relationships, or controlled channels of attention.

Symbolic abundance also changes competitive visibility. When many positions can produce polished artifacts, the bottleneck can move from production to discovery. Search ranking, recommendation, platform distribution, institutional selection, editorial authority, professional credentials, and social networks can acquire greater influence over which artifacts become consequential. Section 19.8 showed that formal platform access can coexist with scarce effective visibility. Symbolic abundance generalizes this problem beyond platforms: a larger representational field can make selection infrastructure more economically central.

Definition 20.136 (Symbolic-abundance bottleneck profile). A *symbolic-abundance bottleneck profile* specifies the symbolic objects whose production or reproduction has become abundant, the functions those objects are expected to perform, the provenance and verification requirements attached to consequential use, the attention and distribution mechanisms governing visibility, and the interpretive or institutional capacities that remain scarce.

Provenance is one useful response to symbolic abundance. The C2PA framework, for example, provides technical mechanisms for signed provenance assertions and validation while explicitly leaving broader judgments of truth or quality outside that technical layer (Coalition for Content Provenance and Authenticity 2026). This separation is consistent with GRE's architecture. Better provenance can reduce uncertainty about production history without eliminating the need for interpretation, evidence evaluation, cultural judgment, or institutional responsibility.

Proposition 20.137 (Symbolic abundance–bottleneck relocation). *As the marginal cost of producing consequential symbolic artifacts falls, economic scarcity can relocate toward provenance, verification, interpretation, attention, distribution, recognition, and accountable institutional judgment; the resulting configuration should therefore be evaluated across these complementary layers rather than through symbolic out-*

put volume alone.

The proposition also protects against an opposite simplification. Symbolic abundance need not imply representational degradation. It can increase linguistic inclusion, experimentation, accessibility, education, documentation, and cultural production. The relevant issue is which institutions and capabilities allow abundance to be converted into meaningful, credible, and plural symbolic participation.

20.9.3 Knowledge Abundance and Epistemic Bottlenecks

Knowledge abundance is more demanding than information or symbolic abundance. A configuration can contain vast quantities of documents, data, and generated explanations while reliable knowledge remains unevenly distributed. Knowledge requires relations of interpretation, warrant, provenance, verification, transmission, and practical use. Chapter 17 therefore treated epistemic abundance as a profile in which output expansion can coexist with scarcity in synthesis, expertise, verification, or institutional uptake. The economic-order question is how these epistemic bottlenecks affect production, governance, participation, and future capability.

The distinction is visible in research and professional practice. A larger literature can reduce search scarcity while increasing synthesis burdens. Open data can improve transparency while increasing demand for statistical, legal, or contextual expertise. Generated code can expand the supply of candidate implementations while making testing, security review, architecture judgment, and maintenance more important. Educational explanations can become abundant while sustained mentorship, feedback, assessment, and problem-forming capability remain scarce. Knowledge abundance therefore depends on more than the number of epistemic objects available.

The conversion pathway is again central. Epistemic objects must be located, understood, evaluated, combined, adapted, and institutionally authorized where appropriate. These operations require language, education, time, tools, domain knowledge, social standing, and access to verification infrastructure. Abundance can therefore widen the gap between positions that possess strong epistemic conversion capability and positions that merely receive more information.

Definition 20.138 (Knowledge-abundance use profile). *A knowledge-abundance use profile specifies the epistemic objects and methods available to a position, the capabilities required to locate, interpret, verify, combine, preserve, and apply them, the institutional pathways through which epistemic claims acquire standing, and the bottlenecks that constrain warranted use despite high informational or symbolic availability.*

Knowledge abundance can also change the value of preserved context. When new content is easy to generate, records of how claims were produced, revised, challenged, or withdrawn can become more important. Institutional memory, reproducible workflows, archival continuity, and provenance are therefore complementary infrastructures of abundant knowledge rather than relics of a scarcity regime.

Proposition 20.139 (Knowledge abundance–epistemic conversion condition). *An increase in available epistemic objects expands usable knowledge for a position to the extent that the position can practically locate, interpret, verify, combine, and apply those objects and can distinguish generated or available claims from institutionally warranted knowledge where the distinction matters for action.*

The condition links abundance directly to capability inequality. Cheap access to candidate answers can reduce one barrier while making epistemic judgment, professional responsibility, or verification infrastructure more consequential. Economic order under knowledge abundance therefore depends partly on how these complementary capacities are distributed and regenerated.

20.9.4 Attention Allocation and Reception Scarcity

Attention scarcity becomes structurally important when the supply of potentially relevant signals, claims, opportunities, products, problems, and requests grows faster than the reception and processing capacity of persons or institutions. Simon's account of information-rich environments identified the basic relation: abundant information consumes scarce recipient attention (Simon 1971). In GRE, attention scarcity is treated as an allocation problem with distributive and generative consequences.

Attention allocation determines more than what is seen. It can affect which complaints receive institutional response, which research questions obtain resources, which workers receive recognition, which cultural works become visible, which risks trigger investigation, which political claims enter an agenda, which products reach consumers, and which future possibilities receive sustained development. Under abundance, the architecture that directs attention can therefore acquire substantial economic power.

Attention capacity can be expanded. Search, indexing, filtering, delegation, summarization, specialization, scheduling, and automation can increase effective processing. Yet each mechanism also redistributes visibility and dependence. A recommender system can reduce overload while concentrating ranking power. Professional curation can improve reliability while creating entry barriers. Organizational triage can protect scarce expert attention while systematically delaying low-status claims. The analysis should therefore track both capacity expansion and the institutional rules through which scarce attention is allocated.

Definition 20.140 (Attention-allocation profile). An *attention-allocation profile* specifies the objects competing for reception, the persons or institutions whose processing capacity is scarce, the mechanisms that rank, filter, defer, summarize, delegate, or exclude claims, the visibility and response positions created by those mechanisms, and the later capability or opportunity effects associated with sustained attention or neglect.

Attention is also recursive. Visibility can generate engagement, reputation, revenue, data, and future visibility. Neglect can weaken capability, reputation, or organizational survival even where the neglected activity is substantively valuable. Attention allocation can therefore contribute to cumulative advantage and path dependence without being equivalent to a final judgment of value.

Proposition 20.141 (Attention-scarcity governance condition). *Where abundant supply makes attention a binding economic bottleneck, an adequate order-level analysis should examine the criteria, infrastructure, authority, feedback, and contestability through which attention is allocated and should distinguish visibility from substantive value, standing, or merit.*

The proposition does not require equal attention to every claim. Scarce attention necessarily involves selection. The generative question concerns whether selection architectures preserve sufficiently diverse entry, correction, and discovery pathways

for consequential signals that were not initially dominant.

20.9.5 Trust Formation and Reliance Scarcity

Trust scarcity concerns the conditions under which practical reliance becomes difficult even when information or symbolic signals are abundant. Economic coordination routinely requires reliance on persons, organizations, records, standards, infrastructures, contracts, models, and public institutions. Arrow emphasized the economic importance of trust and other social virtues in exchange relations (Arrow 1972). Under abundance, however, direct verification can become increasingly infeasible because the volume, speed, or technical complexity of relevant claims exceeds the checking capacity of each participant.

Trust should not be represented as a generalized attitude. A person can trust an institution's payment reliability while distrusting its data governance. A regulator can rely on a technical standard for interoperability while reserving judgment about the provider's incentives. A researcher can trust a repository's preservation procedures while independently verifying a substantive claim. Trust is therefore typed by object, function, scope, and fallback condition.

Abundance can relocate scarcity toward trustworthiness infrastructure. Provenance, professional standards, audits, warranties, review procedures, institutional reputation, liability, redundancy, transparent records, and appeal pathways can support reliance. These mechanisms reduce the need for universal direct verification, but they can also concentrate gatekeeping power in certifiers, platforms, professional bodies, or public authorities. Trust architecture therefore requires both reliability and contestability.

Definition 20.142 (Reliance-trust profile). A *reliance-trust profile* specifies the object and function on which reliance is placed, the evidence or institutional pathway supporting that reliance, the verification burden retained by the relying position, the authority and incentives of relevant intermediaries, the consequences of error, and the correction, fallback, or exit mechanisms available when reliance fails.

This profile distinguishes trust scarcity from simple uncertainty. Some uncertainty can remain while a reliable institutional pathway makes action possible. Conversely, abundant ratings, badges, scores, or certificates can create an appearance of trust while their production conditions remain opaque. The issue is the structure through which justified reliance becomes practicable.

Proposition 20.143 (Trust-scarcity conversion condition). *In abundance-intensive configurations, trust scarcity is reduced where reliable provenance, verification, accountability, correction, and fallback mechanisms lower the cost of justified reliance without making consequential participation dependent on opaque or effectively unchallengeable trust intermediaries.*

Trust can therefore become a scarce institutional capability even where data and representations are plentiful. Its reproduction depends on practices, records, competence, accountability, and repair rather than on symbolic reassurance alone.

20.9.6 Orientation and Selection Scarcity

Orientation scarcity arises when the feasible set of questions, projects, products, explanations, investments, or institutional alternatives expands faster than the capacity to identify which trajectories deserve sustained commitment. Attention concerns what receives processing; orientation concerns the direction given to processing and action. A system can allocate attention efficiently while still directing it toward poorly framed objectives.

This distinction becomes important under generative systems. When candidate answers, designs, simulations, code, or plans can be produced rapidly, the scarce activity can move toward problem formation, criteria formation, contextual interpretation, historical sensitivity, and judgment about which possibilities merit development. Section 18.12 analyzed this issue within research orientation. At the level of economic order, the same structure appears in investment, public policy, organizational strategy, education, culture, and community development.

Orientation cannot be reduced to preference satisfaction. Preferences can be incomplete, historically formed, institutionally shaped, or themselves affected by abundant recommendation and symbolic production. Nor can orientation be reduced to expert selection. Experts possess domain-specific judgment but can remain distant from affected values, local knowledge, or emerging possibilities. Generative orientation can therefore require plural mechanisms: expertise, participation, experimentation, historical inquiry, aesthetic or practical judgment, institutional memory, and explicit evaluation of uncertainty.

Definition 20.144 (Orientation-capacity profile). An *orientation-capacity profile* specifies the actors and institutions involved in selecting questions, priorities, projects, or trajectories; the knowledge, evaluative criteria, historical context, participatory inputs, and judgment practices informing selection; the mechanisms for revising orientation; and the opportunity costs or excluded possibilities created by sustained commitment.

Orientation has a temporal character. Early selection can shape later capability, infrastructure, data, reputation, and institutional attention. A research field can become highly capable in questions it repeatedly funds while losing capability elsewhere. A city can build complementary infrastructure around one transport regime. A platform can train participants to optimize for one ranking system. Orientation therefore changes the future landscape from which later selection occurs.

Proposition 20.145 (Orientation-scarcity condition). *Where productive or symbolic abundance expands the set of feasible trajectories faster than evaluative and institutional orientation capacity, economic performance increasingly depends on the quality, plurality, revisability, and historical awareness of the mechanisms through which problems and commitments are selected.*

The condition does not establish one ideal orientation procedure. Different domains can require different combinations of expertise, rights, public reasoning, market discovery, professional judgment, experimentation, or community governance. The analytical requirement is to make the selection architecture visible.

20.9.7 Participation Access and Standing Scarcity

Participation scarcity concerns the possibility that abundant goods, services, information, or generated outputs coexist with limited pathways through which subjects and collectives can contribute to, learn within, influence, or reshape consequential economic processes. Section 20.6 distinguished productive, epistemic, care, institutional, community, and post-employment participation. The present subsection asks how abundance changes the relative scarcity of these participatory positions.

Automation provides a clear example. If fewer human labor hours are required for a given level of output, material production can become less scarce while employment-mediated pathways to income, professional learning, recognition, social connection, and organizational standing become more selective. The appropriate response cannot be inferred from the productivity gain alone. Income support can address material security; education can support capability; public or community institutions can create alternative participation pathways; ownership or governance reform can affect standing. These mechanisms address different dimensions.

Symbolic abundance can produce a similar structure. Many people may be able to generate publishable-looking artifacts while editorial attention, recognized expertise, institutional affiliation, audience access, or decision standing remain scarce. Knowledge abundance can widen information access while research participation remains constrained by laboratories, credentials, funding, mentorship, or institutional permissions. Abundance therefore does not automatically democratize consequential participation.

Definition 20.146 (Participation-scarcity profile). *A participation-scarcity profile specifies the consequential roles available within an abundant economic configuration, the access and conversion conditions governing entry, the contribution and learning opportunities attached to those roles, the recognition and standing they confer, the burdens and dependencies they create, and the pathways through which participants can influence or revise the configuration.*

Participation scarcity is not solved by maximizing the number of roles. Some participation can be extractive, compulsory, unsafe, or responsibility-bearing without authority. The relevant issue is the distribution of consequential and capability-supporting pathways together with practical exit.

Proposition 20.147 (Abundance–participation divergence). *Productive abundance can coexist with narrowing economic participation where output growth or automation reduces the number, diversity, or accessibility of roles through which relevant subjects acquire capability, recognition, standing, or influence over future economic formation.*

The proposition also allows the opposite possibility. Abundance can free time, lower entry costs, reduce survival pressure, and enable wider participation in research, care, culture, community stewardship, entrepreneurship, or public life. Whether such expansion occurs depends on participatory infrastructure rather than on abundance alone.

20.9.8 Generative Opportunity and Future-Formation Scarcity

Generative opportunity scarcity is the deepest scarcity considered in this section. It concerns practical access to the resources, capabilities, relations, infrastructures, in-

stitutional standing, time, and option structures through which new economically consequential trajectories can be originated, sustained, revised, and realized. An economy can contain abundant consumption goods, abundant symbolic artifacts, and abundant candidate knowledge while access to future formation remains highly concentrated.

The distinction is visible when the cost of generating an artifact falls but the cost of making a consequential project durable remains high. A person may generate a business plan while lacking finance, legal standing, distribution, infrastructure, or time. A researcher may generate hypotheses while lacking experimental access. A community may formulate a development proposal while lacking land rights, administrative standing, or public investment. A creator may generate media while lacking audience pathways or cultural institutions. A small organization may build software while depending on proprietary compute, identity, payment, or platform infrastructures that determine whether the project can survive.

Generative opportunity therefore combines several scarcities already analyzed: material complements, epistemic capability, attention, trust, orientation, participation, infrastructure, and institutional access. It also has a temporal dimension. Some opportunities require durable investment before benefits become visible. Others depend on option preservation, succession, maintenance, or the ability to survive early failure. A configuration that funds only already legible and immediately measurable projects can appear efficient while narrowing the range of later alternatives.

Definition 20.148 (Generative-opportunity profile). *A generative-opportunity profile specifies the practical pathways through which a subject or collective can originate, develop, sustain, revise, and realize a consequential new trajectory, including relevant time, material resources, knowledge, infrastructure, finance, recognition, institutional standing, collaboration, attention, risk absorption, and exit or recovery conditions.*

This profile differs from a static opportunity count. Ten nominal opportunities can be less generative than two practically reachable pathways if the former lack conversion conditions. It also differs from entrepreneurial opportunity in a narrow market sense. Generative opportunities include scientific, institutional, ecological, cultural, care, public, technological, and community trajectories whose value may remain heterogeneous and only partly monetizable.

Proposition 20.149 (Generative-opportunity scarcity condition). *An abundant economic order remains generatively scarce where the capacity to originate, sustain, revise, and realize consequential new trajectories is persistently concentrated in a narrow set of positions because complementary time, capability, infrastructure, finance, standing, attention, or institutional access remain practically unavailable elsewhere.*

The proposition connects abundance to the book's wider concern with generative participation and generative foreclosure. Abundant artifacts do not by themselves preserve plural future formation. An order can supply cheap consumption, rapid answers, and extensive symbolic production while progressively narrowing who can shape institutions, build durable alternatives, conduct consequential inquiry, maintain communities, or regenerate ecological and public capacities. Conversely, abundance can become deeply generative where it lowers entry barriers while relational infrastructure, capability formation, contestability, and participatory standing keep future-forming pathways broadly reachable.

Section 20.9 therefore reframes abundance as a problem of scarcity architecture.

Material, symbolic, and epistemic abundance can relax important constraints, yet their economic-order significance depends on the complementary scarcities they transform. Attention, trust, orientation, participation, and generative opportunity become especially important where productive capacity expands faster than the social and institutional capacities required to direct, verify, distribute, and convert that capacity. This conclusion prepares the next economic-order problem: persistent capability asymmetry can determine who controls the infrastructures and bottlenecks through which abundance becomes consequential.

20.10 Radical Capability Asymmetry in Economic Order

The role of this section is to examine the architecture of economic order when capability differences become persistent, multidimensional, weakly substitutable, or recursively reinforcing across economically consequential positions. Its objective is to extend the capability-asymmetry analysis of Chapter 18 from the specific human–AI field to the wider organization of economic relations. The section develops eight dimensions: persistent capability-asymmetry profiles, dependency-based power conversion, access and capability conversion, infrastructure control, human action-space preservation, generative participation, contestability and counter-power, and long-horizon coexistence. The method is relational and historical. Capability asymmetry is evaluated through the mechanisms by which it is reproduced, converted into dependence or power, mediated by institutions, and made more or less revisable over time.

Chapter 18 established three disciplines that remain binding here. First, capability is typed and task-relative, so superiority on one dimension does not establish a universal ordering. Second, capability asymmetry does not become power merely because the difference is large; a conversion mechanism involving dependence, control, mediation, or constrained alternatives must be identified. Third, governance under radical asymmetry cannot be reduced to capability equalization because some differences may remain technically, institutionally, or economically durable. Section 20.10 carries these disciplines into economic-order analysis, where capability differences can arise among persons, organizations, public institutions, communities, jurisdictions, infrastructures, and artificial systems.

The economic-order problem is broader than the distribution of productive skill. A position can possess weak direct productive capability while controlling infrastructure on which more capable positions depend. A community can possess rich local knowledge while lacking finance, legal standing, or access to complementary institutions. A public authority can possess formal mandate while relying on external technical systems that it cannot audit or replace quickly. A firm can possess frontier computational capacity while depending on public infrastructure, skilled labor, energy systems, or legal protections. Capability asymmetry is therefore a configuration of profiles, complements, access conditions, bottlenecks, temporal reserves, and institutional standing.

Definition 20.150 (Radical capability-asymmetry order profile). A *radical capability-asymmetry order profile* specifies, for a bounded economic configuration and historical horizon, the materially relevant typed capabilities of participating positions; the

Table 20.10: Dimensions of radical capability asymmetry in generative relational economic order.

Dimension	Primary order-level object	Generative question	Characteristic analytical failure
Persistent asymmetry	Reproduced capability differences across positions and time	Which mechanisms make a capability gap durable, cumulative, or self-reinforcing?	Treating a present performance gap as a stable order-level relation
Dependency-based power conversion	Reliance, control, withdrawal capacity, and constrained substitution	Through which relation does capability difference condition another position's feasible action?	Equating capability superiority with power by definition
Access conversion	Admission, affordability, permissions, complements, learning, and practical use	Does wider formal access become usable capability, or mainly deeper dependence on an external position?	Treating availability as effective capability equalization
Infrastructure control	Compute, networks, energy, data, standards, identity, finance, logistics, legal and administrative systems	Which bottlenecks determine whether otherwise capable positions can operate, substitute, or exit?	Focusing on visible actors while ignoring infrastructural chokepoints
Human action space	Reachable alternatives and alternative-forming capacities retained by human positions and collectives	Which human and collective capacities remain practically exercisable, reorganizable, and institutionally consequential?	Preserving nominal choice while alternative-forming capacity erodes
Generative participation	Pathways into knowledge, institutions, care, communities, production, culture, and future formation	Can less capable positions still contribute to and reshape consequential collective processes?	Equating income support or service access with participation
Contestability and counter-power	Challenge, review, substitution, counter-capacity, organization, and correction	Can affected positions contest or reorganize capability-dependent relations without requiring capability symmetry?	Treating either transparency or equal capability as sufficient governance
Long-horizon coexistence	Durable coordination among heterogeneous capability profiles	Can asymmetry remain compatible with plural standing, regenerative participation, revisability, and future openness?	Treating coexistence as either equality or passive accommodation to dominance

mechanisms reproducing their differences; the complementary resources and infrastructures required to exercise those capabilities; the dependencies, access conditions, and bottlenecks connecting the positions; the pathways through which capability differences become power-relevant; and the counter-capacities, contestability, substitution, and revision mechanisms available within the order.

Definition 20.150 makes radicality an order-level relational claim. Large capability differences can remain weakly consequential where alternatives, interoperability, counter-capacity, or institutional protection are strong. More modest differences can become structurally important where one position controls a critical interface or where repeated dependence compounds over time. Table 20.10 summarizes the eight dimensions developed below.

Proposition 20.151 (Order-level asymmetry condition). *A capability asymmetry becomes an order-level generative concern when its persistence and conversion mechanisms materially shape the distribution of feasible action, dependency, institutional standing, participation, or future-forming capacity across positions, especially where affected positions possess weak substitution, contestation, or rebuilding pathways.*

Proposition 20.151 keeps evaluation mechanism-specific. Capability equality is neither the baseline nor the automatic objective. Economic coordination routinely depends on specialization, differentiated expertise, delegated authority, and heterogeneous infrastructures. The stronger question is how capability difference is organized and whether the resulting relations remain practically governable, contestable, and generative for the positions whose later possibilities are affected.

20.10.1 Persistent Capability-Asymmetry Profiles

Persistent capability asymmetry concerns the historical reproduction of capability differences rather than their observation at one moment. Chapter 18 defined persistence through repeated interactions, reinforcing complementarities, and weak substitution. At the level of economic order, the reproduction mechanisms become wider. Education, finance, data, infrastructure, reputation, legal standing, organizational learning, network access, standards, ownership, procurement, and accumulated institutional memory can all reinforce a capability position across time.

Persistence can arise through cumulative advantage. A position with superior capability can generate greater income, data, reputation, political access, or learning opportunities, which then increase later capability. Persistence can also arise through complementarity. A model provider can be replaceable in principle while an organization has invested so deeply in one surrounding workflow, identity system, data schema, and technical standard that substitution becomes costly. A jurisdiction can possess many skilled participants while lacking complementary infrastructure needed to mobilize their skills at scale. The relevant unit is therefore the capability configuration rather than the isolated actor.

Some persistence is socially useful. Professional expertise, institutional memory, public infrastructure, scientific competence, and trusted maintenance capability often require accumulation over long periods. The generative problem appears where persistence becomes difficult to challenge, reproduce elsewhere, transmit, or rebuild, especially when it controls access to consequential economic processes. Stability and concentration therefore require separate evaluation.

Definition 20.152 (Persistent capability-asymmetry profile). *A persistent capability-asymmetry profile specifies the capability differences that remain consequential across repeated interactions or historical extensions, the mechanisms that reproduce or compound those differences, the rate and cost at which alternative positions can learn or rebuild relevant capacities, and the institutional conditions that accelerate, stabilize, or weaken the asymmetry.*

This profile distinguishes durable specialization from self-reinforcing closure. A specialist institution can remain highly capable while training successors, publishing standards, supporting interoperability, and preserving alternative providers. Another institution can retain similar capability while enclosing knowledge, controlling complements, and weakening replacement capacity. The observed capability gap can be similar while the order-level consequences differ substantially.

Proposition 20.153 (Asymmetry-reproduction condition). *A persistent capability asymmetry warrants stronger order-level concern where the mechanisms that reproduce the asymmetry also reduce the practical capacity of affected positions to learn, substitute, organize counter-capacity, retain independent judgment, or construct alternative institutional pathways.*

The proposition connects capability persistence to generative foreclosure. A durable difference can remain compatible with a generative order where the surrounding configuration retains learning, succession, portability, counter-capacity, and entry pathways. The deeper concern is a reproduction process that weakens the mechanisms through which later alternatives could emerge.

20.10.2 Dependency-Based Power Conversion

Capability asymmetry becomes power-relevant through relational conversion. Section 18.3 showed that dependency, infrastructure control, access control, epistemic authority, decision mediation, and institutional stabilization can connect capability differences to another position's feasible action. Economic-order analysis retains this discipline and adds a wider question: how do multiple dependencies combine across sectors, institutions, and infrastructures so that one capability position gains durable influence over later economic possibilities?

Dependency is not inherently pathological. Complex economies depend on division of labor, public systems, technical standards, expertise, logistics, finance, care, and institutional specialization. A dependency can enlarge capability when the supplying position is reliable, accountable, substitutable, and embedded in reciprocal or legally protected relations. The power question emerges when withdrawal, repricing, rule change, withholding, or technical modification by one position systematically conditions another position's feasible action and when alternatives are costly, slow, or institutionally blocked.

Order-level dependency is frequently layered. A firm can appear to depend on an AI provider while both depend on cloud infrastructure, specialized hardware, energy, payment systems, identity services, legal permissions, and public networks. A community can depend on a platform for market access while the platform depends on public law and communication infrastructure. A public agency can formally govern a service while operationally depending on proprietary technical expertise. Power analysis therefore requires tracing dependency chains rather than stopping at the visible contractual relation.

Definition 20.154 (Dependency-based power-conversion pathway). A *dependency-based power-conversion pathway* is the identifiable sequence of capability reliance, complementary-resource control, constrained substitution, institutional mediation, and practical consequence through which a capability advantage or control position becomes able to condition another position's feasible action, timing, cost, continuity, or access to future alternatives.

The definition leaves room for reciprocal dependence. Two positions can rely heavily on one another while possessing different withdrawal capacities, temporal reserves, legal protections, or alternative partners. Power therefore depends on the structure of dependency, not on the existence of interdependence alone.

Proposition 20.155 (Dependency-conversion condition). A *capability asymmetry supports a stronger order-level power claim when the dependency-based power-conversion pathway is historically persistent, materially consequential, weakly substitutable over the relevant horizon, and supported by control over interfaces or complements that affect another position's practical alternatives.*

This condition prevents a general capability hierarchy from substituting for power analysis. It also prepares later governance analysis: weakening power concentration can involve substitution, interoperability, public alternatives, counter-capacity, temporal reserves, rights, or changes in the institutional conversion mechanism without eliminating the underlying capability difference.

20.10.3 Capability-Access Conversion

Access is one route through which capability asymmetry can be reduced, reproduced, or transformed. Shared tools, education, public infrastructure, open knowledge, affordable services, and institutional permissions can widen practical capability. Yet formal access does not establish effective capability equalization. Section 20.5 showed that infrastructure becomes economically useful only through practical conversion; the same principle applies to advanced capability.

An organization can receive access to a powerful model while lacking data governance, domain expertise, verification procedures, integration capability, or legal permission needed for reliable use. A learner can access abundant educational tools while lacking time, guidance, or institutional recognition. A small firm can access cloud services while remaining unable to bear switching costs or negotiate terms. A public institution can procure an advanced system while losing internal capability to audit, maintain, or replace it. Access can therefore enlarge practical capability and deepen dependency at the same time.

The relevant question is not whether a resource is open or available in the abstract. It is whether affected positions can convert access into durable and revisable capability without losing the complementary capacities required for independent judgment, substitution, or institutional self-direction. In some configurations, broad access can support substantial equalization. In others, the capability frontier can move faster than diffusion, preserving a large asymmetry even while absolute capability rises for many participants.

Definition 20.156 (Asymmetry-conditioned access). An *asymmetry-conditioned access profile* specifies the capability resource made available, the terms and continuity of access, the complementary knowledge, infrastructure, permissions, time, and organizational capacity required for use, the degree of practical capability gained, the dependencies created or reduced, and the retention of verification, substitution, and exit capacity.

The profile also distinguishes access to output from access to capability formation. A person can receive high-quality generated results while gaining little ability to reproduce, verify, or revise the process. A firm can purchase a service while remaining unable to internalize relevant expertise. The economic-order consequence depends on whether access changes the distribution of durable capability or mainly changes who can consume capability supplied elsewhere.

Proposition 20.157 (Access-conversion condition). *Widened access weakens a capability asymmetry more durably where affected positions can convert the accessed resource into practically retained capability, verification, complementary infrastructure, organizational learning, and credible substitution or exit rather than relying exclusively on continuing permission from the advantaged position.*

The proposition does not imply that every capability should be internalized. Specialization remains valuable. Its purpose is to separate capability-enhancing access from access that leaves the deeper asymmetry and its dependency structure largely unchanged.

20.10.4 Critical Infrastructure Control

Capability is exercised through infrastructure. Compute, energy, data systems, communication networks, identity, finance, payment systems, transport, logistics, legal registries, professional standards, public administration, and institutional knowledge can determine whether nominal capability becomes economically effective. Section 20.5 treated such systems as relational infrastructure. Under radical asymmetry, infrastructure also becomes a possible bottleneck through which capability differences are amplified or governed.

Infrastructure control differs from infrastructure ownership. A public infrastructure can be formally public while technical dependence on one contractor gives another position substantial operational control. A privately owned network can remain heavily regulated, interoperable, and contestable. A distributed technical ecosystem can still depend on one standard, identity layer, data format, or payment channel. The analytical question is who can alter, withhold, price, prioritize, or redesign an infrastructural function that other positions require.

Criticality is also relational. An infrastructure becomes critical relative to the operations that depend on it, the time available for substitution, and the consequences of interruption. A provider with modest market share can occupy a critical position if it controls a specialized complement with no rapid replacement. Conversely, a large provider can have limited power relevance where interoperability, redundancy, and credible alternatives are strong.

Definition 20.158 (Critical infrastructure-control profile). A *critical infrastructure-control profile* specifies the infrastructural function required by economically consequential positions, the actors capable of modifying or withholding that function, the concentration and substitutability of relevant complements, the time and cost of transition, the dependencies propagated through connected systems, and the legal, public, technical, or organizational mechanisms that constrain or counterbalance control.

This profile prevents visible model or firm capability from obscuring lower-layer bottlenecks. It also supports multiscale governance. Some concentration can be addressed through interoperability; some through public capacity or common infrastructure; some through redundancy, portability, reserves, or legal obligations. The appropriate mechanism depends on the infrastructure and failure mode.

Proposition 20.159 (Infrastructure-bottleneck condition). *Infrastructure control becomes a stronger amplifier of radical capability asymmetry where economically important positions depend on the controlled function, practical substitutes cannot be activated within the relevant horizon, and the controlling position can alter access, continuity, price, standards, or operating conditions in ways that materially reshape downstream feasible action.*

The proposition connects infrastructure to power without treating concentration as sufficient evidence of abuse. A critical infrastructure can support large collective gains while remaining strongly governed. The order-level issue is the combination of criticality, control, substitutability, contestability, and public or collective capacity.

20.10.5 Human Action-Space Preservation

Radical capability asymmetry raises a question that cannot be answered by access or income alone: what practical space of action remains available to human partici-

pants and human-governed collectives when more capable systems or organizations mediate consequential economic processes? Chapter 18 defined human action space through reachable alternatives and the means of generating additional alternatives. At the level of economic order, this action space spans work, knowledge, care, institutions, communities, culture, entrepreneurship, public reasoning, and the formation of new organizations and practices.

Action-space preservation does not require that humans remain the most capable position in every task. Such a requirement would confuse capability ranking with standing and generativity. A human participant can rely on highly capable systems while retaining authority to frame objectives, interpret context, challenge outputs, organize alternatives, and participate in institutional change. Conversely, nominal human authority can coexist with a very narrow action space when technical systems determine feasible options, institutional knowledge has been outsourced, or alternative infrastructures have disappeared.

The action-space question is therefore both current and intertemporal. A configuration can preserve current choice while weakening the capacity to generate later alternatives. For example, users can select among many AI-mediated services while lacking the knowledge, data portability, institutional standing, or infrastructure needed to build alternatives. Professionals can retain formal responsibility while losing the practical capability to inspect or revise automated workflows. Communities can retain platform access while losing independent spaces or institutions through which collective action could be reorganized.

Definition 20.160 (Order-level human action-space profile). *An order-level human action-space profile specifies the practically reachable economic, epistemic, institutional, care, community, cultural, and organizational actions available to human participants and human-governed collectives, together with the capabilities, rights, infrastructures, records, time, resources, standing, and alternative-forming mechanisms required to sustain or expand that space across changing conditions.*

The profile makes action space relational. Formal legal permission can coexist with weak practical reachability. Material support can coexist with weak institutional standing. Rich technological assistance can coexist with declining independent verification. The relevant question is the ensemble of conditions through which human action remains consequential and revisable.

Proposition 20.161 (Action-space preservation condition). *An economic order preserves a stronger human action space where capability asymmetry does not materially eliminate the practical capacities, rights, infrastructures, records, standing, and organizational pathways through which human participants and human-governed collectives can initiate, contest, reorganize, and institutionalize consequential alternatives.*

This criterion does not privilege unaided action as such. Human action space can be deeply technologically mediated. What matters is whether mediation expands or contracts the practical capacity to shape later relational configurations rather than leaving humans only as recipients of outputs selected elsewhere.

20.10.6 Generative Participation Architecture

Section 20.6 established economic participation as a differentiated architecture of productive, epistemic, care, institutional, community, and post-employment positions. Radical capability asymmetry changes the participation question because

contribution can remain meaningful even where one position performs many operations more effectively. The central issue becomes whether participation pathways are organized around residual productive necessity or around the wider capacity to enter future-forming processes.

A highly capable economic order can distribute abundant services while concentrating agenda formation, interpretation, investment, institution building, and governance in a narrow set of positions. Material security can coexist with weak generative participation. Conversely, extensive asymmetry can coexist with meaningful participation where institutions preserve roles in problem formation, verification, care, stewardship, community organization, cultural generation, scientific inquiry, public reasoning, and institutional revision.

Participation requires more than symbolic inclusion. It needs time, infrastructure, education, recognition, standing, access to decision interfaces, and the capacity to sustain projects long enough for contributions to become consequential. Under asymmetry, the value of participation may also shift. Human participation can be economically important because of contextual knowledge, responsibility, care, legitimacy, situated judgment, relationship formation, or value articulation even where direct productive throughput is lower.

Definition 20.162 (Asymmetry-resilient participation architecture). An *asymmetry-resilient participation architecture* is a configuration of material support, capability pathways, rights, institutional roles, infrastructures, recognition practices, decision interfaces, and collective organizations through which less capable or differently capable positions can continue to make consequential contributions to knowledge, care, institutions, communities, culture, production, and future economic formation despite persistent capability differences.

The definition does not require preserving every historical role. Some roles can disappear legitimately as technologies and institutions change. Resilience concerns whether new pathways can be generated and whether participation remains capable of shaping the order rather than being confined to ceremonial or residual functions.

Proposition 20.163 (Generative-participation condition under asymmetry). *Persistent capability asymmetry is more compatible with a generative economic order where less advantaged positions retain practical pathways to capability formation, consequential contribution, institutional standing, organization, contestation, and creation of new participation forms that do not depend solely on their labor remaining scarce.*

This proposition connects Chapter 18's anti-foreclosure criterion to economic-order design. Income redistribution can support the material basis of participation, yet participation itself requires institutions and infrastructures through which supported positions can enter collective generation.

20.10.7 Contestability and Counter-Power Architecture

Capability asymmetry becomes more dangerous when affected positions cannot challenge the decisions, representations, rules, or infrastructures through which that asymmetry is converted into practical consequence. Contestability therefore concerns more than transparency. It includes explanation, evidence access, review, appeal, counter-expertise, representation, organization, substitution, correction, and the practical possibility of changing the governing relation.

Counter-power should also be distinguished from capability equality. Section 18.13 showed that governance can rely on counter-capacities even where the primary capability gap remains large. Public institutions can regulate a technically superior provider; professional bodies can establish standards; communities can organize collectively; shared infrastructure can reduce dependence; independent auditors can provide counter-expertise; interoperability can preserve exit. These mechanisms do not make capabilities equal. They alter the relational consequences of asymmetry.

Counter-power itself can create dependency. An organization established to discipline one dominant infrastructure can become a new gatekeeper. A public regulator can lack technical capacity and rely on the firms it supervises. A shared alternative can remain financially dependent on one sponsor. The relevant architecture therefore includes counter-capacity reproduction and contestability of the countervailing institutions themselves.

Definition 20.164 (Asymmetry contestability architecture). An *asymmetry contestability architecture* specifies the practical mechanisms through which capability-dependent decisions, access conditions, representations, standards, and infrastructural controls can be questioned, reviewed, countered, corrected, substituted, or reorganized, together with the capabilities, independence, standing, and resources required to sustain those mechanisms over time.

Contestability can be distributed. Different mechanisms can address different conversion sites: legal review for rights, technical audit for system behavior, public alternatives for infrastructure, collective bargaining for organizational dependency, professional standards for epistemic authority, and interoperability for exit. No single mechanism needs to carry the entire governance burden.

Proposition 20.165 (Counter-power adequacy condition). *Counter-power has stronger generative adequacy where it changes the practical conversion of capability asymmetry into constraint or dependence, remains sufficiently independent of the advantaged position, preserves its own learning and replacement capacity, and is itself subject to contestability and revision.*

The proposition avoids two opposite simplifications. Transparency without counter-capacity can leave an asymmetry intact, while concentrated counter-authority without review can reproduce the same structural problem in another form. A generative order requires an ecology of contestability appropriate to the relevant conversion mechanisms.

20.10.8 Long-Horizon Coexistence Architecture

The final economic-order problem is coexistence among persistently heterogeneous capability positions. Coexistence does not mean capability equality, passive tolerance of domination, or permanent assignment of fixed roles. It concerns whether an order can coordinate deeply unequal capabilities while preserving plural standing, generative participation, value heterogeneity, institutional learning, practical contestability, and future possibility.

Long-horizon coexistence is especially demanding because capability profiles evolve. Artificial systems can improve rapidly; institutions can accumulate or lose competence; communities can develop shared capacity; public infrastructure can expand or decay; education can alter distribution; standards can change which capabilities matter. An order that is stable for one capability configuration can

become brittle when the configuration changes. Coexistence therefore depends on trajectories rather than one equilibrium arrangement.

The analysis also returns to plural value. A more capable position does not acquire normative authority merely because it can predict, optimize, generate, or coordinate more effectively on selected dimensions. Economic order still requires standing, rights, procedural accommodation, domain-specific value structures, and open normative closure as developed in Section 20.8. Capability can inform decisions without exhausting the values by which decisions are judged.

Coexistence also requires a treatment of dependence that avoids a universal independence ideal. Human societies are constituted through interdependence. The generative criterion is stronger where critical dependencies remain visible, sufficiently governable, supported by transition capacity, and prevented from becoming mechanisms of irreversible foreclosure. Some dependencies can be accepted because they enlarge capability substantially; others may warrant redundancy or public alternatives because failure would remove basic participation or institutional standing.

Definition 20.166 (Asymmetry-compatible coexistence architecture). An *asymmetry-compatible coexistence architecture* is a long-horizon economic configuration in which persistent capability differences can support coordination and specialization while materially relevant dependencies, infrastructural controls, standing relations, participation pathways, value conflicts, counter-capacities, and revision mechanisms remain sufficiently visible and governable to preserve plural future formation.

The definition treats coexistence as a continuing institutional achievement. It can require education, public capacity, interoperability, rights, welfare, commons, professional institutions, technical standards, organizational diversity, archives, care systems, and other mechanisms developed throughout Chapters 19 and 20. Their combination will vary across domains.

Proposition 20.167 (Long-horizon coexistence condition). *Radical capability asymmetry is more compatible with a generative relational economic order where changing capability differences remain separated from automatic claims to normative authority, critical dependencies remain contestable and sufficiently substitutable or protected, human and collective action spaces remain capable of renewal, and institutions preserve practical pathways for participation, counter-capacity, learning, and reorganization as the asymmetry evolves.*

Section 20.10 therefore reframes radical capability asymmetry as an economic-order architecture rather than a problem of equalization alone. Persistent capability differences matter through their reproduction, access conditions, infrastructural bottlenecks, dependency-based conversion into power, effects on action space, and organization of participation and contestability. The resulting order can remain highly asymmetric while preserving substantial generativity, or it can become increasingly closed even while absolute capability and material abundance rise. The next section turns to the governance problem implied by this conclusion. Section 20.11 develops adaptive economic governance as the architecture through which monitoring, feedback, experimentation, reversibility, institutional learning, rule evolution, historical re-evaluation, and co-evolution can respond to changing configurations without presuming that present arrangements should remain fixed.

20.11 Adaptive Economic Governance

Sections 20.1–20.10 developed an economic-order architecture spanning evaluation, policy, institutions, infrastructure, participation, value recirculation, plural values, abundance, and radical capability asymmetry. The present section addresses the temporal governance problem created by that architecture. Economic orders operate while technologies, ecological conditions, capabilities, dependencies, institutions, values, and the evidence used to justify governing arrangements continue to change. The section's role is to specify how an economic order can monitor such change, translate observations into governed response, learn across institutions, revise rules, and reconsider earlier settlements while preserving continuity, accountability, standing, and practical action space. Its objective is therefore broader than adaptive policy in Section 20.3: the analytical object is the coupled governance architecture of an economic order rather than one policy instrument or programme. The method is synthetic and historical, drawing on the adaptive decision architecture of Chapter 11, the governance analysis of Chapter 16, and the evaluation and institutional architectures already developed in this chapter.

Adaptive governance at economic-order scale should be distinguished from institutional volatility. Predictable rights, stable expectations, professional routines, infrastructures, and long-horizon commitments can themselves be generative. Adaptation concerns the organized capacity to reconsider arrangements when materially relevant evidence or conditions change. Evolution concerns slower transformation in rules, institutional carriers, interfaces, classifications, and authority structures. Neither process establishes improvement by itself. A governing arrangement can adapt in a harmful direction, and an evolving order can accumulate dependencies or exclusions while appearing responsive. The evaluative profile of Section 20.2 therefore remains necessary throughout adaptation.

Definition 20.168 (Adaptive economic-governance architecture). An *adaptive economic-governance architecture* is a versioned configuration of monitoring, feedback, bounded experimentation, reversibility and repair, distributed institutional learning, rule-change procedures, historical re-evaluation, and co-evolutionary review through which an economic order can revise governing arrangements as relevant conditions and consequences change while preserving identifiable authority, accountability, standing, and continuity.

The definition places *versioning* at the centre of adaptation. A sequence of changing decisions becomes governable when the relevant evidence, assumptions, authorities, rules, affected positions, expected consequences, and reasons for revision remain historically reconstructable. Versioning also matters for justice. Later participants need to know which commitments created current dependencies, which burdens were anticipated, which protections were promised, and which evidence supported earlier closure.

Table 20.11 summarizes the eight dimensions developed below.

20.11.1 Economic-Order Monitoring Architecture

Monitoring provides the observational infrastructure of adaptive economic governance. At economic-order scale, the monitoring object extends beyond target outcomes. Section 20.2 established that evaluation can concern relational incidence,

Table 20.11: Dimensions of adaptive economic governance in generative relational economic order.

Dimension	Primary object	Characteristic governance question
Monitoring	Changes in outcomes, relations, capabilities, dependencies, infrastructures, and assumptions	What should remain observable, at which boundary and cadence, with what provenance and burden?
Feedback	Pathways from observation to interpretation and governed response	How do signals travel through institutions, delays, authority, strategic reaction, and correction?
Experimentation	Bounded variation introduced partly for learning	Which changes can be tested, with what exposure, safeguards, spillover control, and stopping conditions?
Reversibility and repair	Capacity to alter commitments and address residual effects	What can be rolled back, repaired, compensated, substituted, or transferred to a successor arrangement?
Distributed learning	Learning across multiple institutions and knowledge sites	How are local findings retained, compared, translated, and incorporated without erasing domain-specific remainder?
Rule evolution	Change in rules and meta-rules governing economic relations	Who may revise rules, through which procedures, and how are rights, expectations, and path dependence handled?
Historical re-evaluation	Reconsideration of earlier warrant in light of later evidence and values	How should previous decisions be re-epistemized without projecting present knowledge backward?
Co-evolution	Reciprocal change between governance and governed economic configurations	How do rules, actors, technologies, infrastructures, capabilities, and strategies alter one another over time?

propagation, delayed effects, capability regeneration, constraint transformation, option spaces, generative return, and history-space effects. Section 20.10 added capability asymmetry, dependency, infrastructure control, action space, participation, and counter-power. An adaptive economic order therefore requires monitoring architectures capable of observing changes in these structures where they are materially relevant.

The requirement does not imply comprehensive surveillance. Economic orders contain more potentially observable relations than any institution can monitor, and monitoring itself consumes resources, can alter behaviour, and can create new privacy or power concerns. The analytical task is to specify a proportionate monitoring boundary. High-consequence, rapidly changing, difficult-to-reverse processes can warrant shorter observation intervals and broader escalation channels. Stable, low-consequence arrangements can often tolerate slower review. Monitoring cadence should therefore relate to process speed, evidence latency, reversibility, consequence, and observation cost.

Monitoring also needs plural evidence. Administrative indicators can reveal utilization or expenditure while missing practical access. Aggregate productivity can rise while maintenance capability declines. Employment statistics can miss care burdens or non-employment participation. System-uptime metrics can miss exclusion produced by authentication or documentation. A governance architecture should therefore preserve pathways for anomaly reports, qualitative evidence, affected-position testimony, expert judgment, audit, and evidence that the monitoring system itself is distorting behaviour.

Definition 20.169 (Economic-order monitoring profile). An *economic-order monitoring profile* specifies the economic objects and relations under observation, the relevant spatial and institutional boundary, indicators and qualitative evidence, provenance, cadence, temporal horizon, affected positions, uncertainty, observation burdens, responsible monitors, escalation conditions, and the authority through which monitoring can trigger review.

Monitoring should also make its omissions visible where those omissions are materially important. A monitoring system cannot observe everything, yet it can record which dimensions are outside its scope, which proxies are used, and which affected positions lack reliable representation. This prevents an operational dashboard from being mistaken for a complete representation of the economic field.

Proposition 20.170 (Monitoring-adequacy condition). *Adaptive economic governance has stronger monitoring adequacy where the monitoring boundary, evidence types, cadence, provenance, uncertainty, affected positions, observation burdens, and escalation pathways are specified in relation to the consequences and reversibility of the governed processes rather than inferred from indicator availability alone.*

The proposition treats monitoring as selective epistemic infrastructure. Its purpose is to support later judgment, including judgment about whether the selected monitoring architecture remains adequate.

20.11.2 Feedback and Response Pathways

Observation becomes adaptive governance only when materially relevant signals can alter interpretation or action. A feedback pathway therefore includes more than data transmission. It contains selection of signals, interpretation, authority, response rules, delay, implementation capacity, and later observation of the response. At economic-order scale, these steps frequently cross institutional boundaries. A financial signal can alter firm behaviour before regulatory review is complete; a welfare access failure can be visible to frontline organizations while budget authority sits elsewhere; an ecological threshold can be monitored scientifically while land-use authority is fragmented across jurisdictions.

Feedback can be delayed or amplified. A governing response based on stale evidence can arrive after the relevant relation has changed. A small policy adjustment can become large through markets, expectations, platform rankings, organizational routines, or financial leverage. Conversely, strong formal feedback can be absorbed by institutions with weak implementation capacity and produce little practical change. Adaptive governance therefore needs to track both the informational pathway and the conversion pathway through which response becomes effective.

Actors can also respond strategically to governance. Firms reorganize around rules, households change eligibility behaviour, platforms modify interfaces, professional communities develop workarounds, and regulated organizations may shift activity across classifications or jurisdictions. Feedback is consequently reflexive. The response to a rule changes the field on which the next observation is based.

Definition 20.171 (Governance feedback pathway). An *economic-governance feedback pathway* is the sequence through which an observed change is selected, interpreted, assigned to an authority or decision process, converted into a governing response, implemented through relevant institutions or infrastructures, and re-observed together with the strategic and systemic reactions generated by that

response.

Feedback design should preserve differentiation among signal, interpretation, and authority. The same evidence can support different interpretations under different causal models or value judgments. An automated trigger can be useful for bounded technical conditions while remaining inappropriate for value-laden or rights-sensitive decisions. Where interpretation remains contested, a feedback pathway can include multiple evidential channels and explicit review rather than compressing disagreement into a single trigger.

Proposition 20.172 (Feedback-conversion condition). *A feedback pathway has stronger adaptive adequacy where it makes visible the interpretation, authority, delay, implementation capacity, strategic response, and re-observation through which a signal is converted into economic-governance change, especially where cross-institutional transmission or high leverage can amplify error.*

This condition links adaptive governance to the conversion logic used throughout GRE. Information alone does not govern. It becomes consequential through relations, authority, capability, and institutional execution.

20.11.3 Bounded Governance Experimentation

Economic governance sometimes changes arrangements partly to learn. Pilot programmes, phased implementation, regulatory sandboxes, alternative service models, temporary standards, local trials, procurement variants, or institutional prototypes can generate evidence that observation of an unchanged system cannot supply. Experimentation can therefore support adaptation where causal uncertainty is substantial and the relevant change can be bounded.

Experimentation also redistributes exposure. A pilot is experienced by actual participants, organizations, communities, or environments. Learning benefits can accrue broadly while burdens concentrate locally. Spillovers can cross the formal experimental boundary through prices, labour markets, data systems, infrastructure, reputation, or ecological processes. Experimental governance therefore requires an incidence analysis similar to Section 20.2: who bears uncertainty, who gains information, which rights or protections remain in force, and what happens when the experiment stops.

Some governance objects are difficult to experiment on. Constitutional rights, irreversible ecological loss, basic legal standing, macroeconomic stability, long-lived infrastructure, and highly networked systems can resist small-scale isolation. A generative approach therefore treats experimentation as one learning mode among others. Historical comparison, simulation, scenario analysis, institutional comparison, qualitative inquiry, and carefully staged implementation can become more appropriate where direct experimentation would create disproportionate exposure or provide weak external validity.

Definition 20.173 (Bounded governance experiment). *A bounded governance experiment is a deliberately limited variation in an economic-governance arrangement introduced partly to generate learning, with specified scope, affected positions, comparison logic, safeguards, authority, spillover assessment, observation plan, stopping conditions, transition provisions, and limits on the claims that may be generalized from the resulting evidence.*

Experimentation should also preserve the possibility of negative learning. A trial that reveals weak conversion, unexpected dependency, administrative burden, or value conflict can justify withdrawal or redesign. Institutional incentives that reward only successful pilots can suppress precisely the evidence experimentation was intended to generate.

Proposition 20.174 (Experimentation-warrant condition). *Governance experimentation has stronger warrant where the expected learning value is material, exposure and spillovers are proportionate to that value, basic standing and safeguards remain protected, stopping and transition conditions are practicable, and the experiment's evidential scope is kept distinct from broader normative or institutional authorization.*

The proposition preserves a difference between learning that an arrangement can work under selected conditions and deciding that the arrangement should govern a wider population or domain.

20.11.4 Reversibility, Repair, and Successor Capacity

Adaptive governance depends partly on the ability to revise commitments, yet economic reversibility is rarely binary. A rule can be repealed while contracts, infrastructure, expectations, skills, debts, data, environmental effects, organizational structures, or dependency remain. Section 20.3 therefore treated policy exit as a configuration-level problem. At economic-order scale, reversibility must similarly distinguish formal rollback from practical recoverability.

Several forms of response should remain separate. *Rollback* restores an earlier rule where that state remains reachable. *Repair* addresses damage or capability loss that survives rule change. *Compensation* responds to burdens that cannot be physically reversed. *Substitution* creates an alternative infrastructure or relation. *Succession* transfers obligations, records, capabilities, and standing into a new arrangement. These mechanisms can be combined when a simple return to the previous configuration is unavailable.

Reversibility can also decay with time. A small pilot can be easy to stop before organizations restructure around it, while later reversal can become expensive after investments, skills, and expectations adapt. Critical data dependencies or technical standards can become harder to replace as complementary systems accumulate. Ecological or cultural losses can become only partly reparable. Adaptive governance therefore benefits from observing the temporal profile of reversibility rather than treating a nominal sunset clause as sufficient.

Definition 20.175 (Governance recoverability profile). *A governance recoverability profile records the practical capacity to roll back, repair, compensate, substitute, or succeed a governing arrangement across time, together with residual effects, dependency, sunk commitments, rights and obligations, retained records, transition costs, and domains in which recovery is partial or unavailable.*

A recoverability profile can justify stronger caution where uncertainty and irreversibility coincide. It can also reveal cases where deliberate commitment is appropriate. Some infrastructures, rights, or ecological protections require durability to become effective. Reversibility is therefore a design variable rather than a universal objective.

Proposition 20.176 (Recoverability condition). *Where an economic-governance ar-*

rangement can create durable dependency, path dependence, or difficult-to-repair loss, adaptive design should identify the feasible modes and temporal limits of rollback, repair, compensation, substitution, and succession before treating formal revision authority as practical reversibility.

This condition connects governance to the history-space analysis of Chapter 15: revision capacity depends on which later configurations remain reachable after the governing intervention has altered the path itself.

20.11.5 Distributed Institutional Learning

An economic order learns through many sites. Ministries, firms, courts, schools, hospitals, communities, regulators, professional bodies, research institutions, infrastructures, and platform operators can each observe different parts of the same economic process. Section 20.4 developed institutional learning within one institutional configuration. Economic-order learning adds the problem of translation among distributed institutions whose evidence, vocabularies, mandates, time horizons, and standing differ.

Centralization of all learning is neither feasible nor necessarily desirable. Local institutions often possess situated knowledge, while central institutions can compare patterns across regions or sectors. Professional communities can identify technical failures that aggregate data miss. Affected communities can reveal burden or meaning that administrative indicators fail to represent. Research institutions can test mechanisms beyond the operational capacity of frontline organizations. The order-level challenge is to preserve these differentiated epistemic positions while creating interfaces through which material findings can travel.

Learning across institutions can fail in several ways. Evidence can be trapped locally, stripped of provenance during aggregation, generalized beyond its domain, delayed until the governing condition has changed, or filtered by institutional incentives. Organizational turnover can erase memory. Successful practices can be copied without the relational or infrastructural conditions that made them effective. Section 19.1's domain-translation discipline therefore remains relevant inside governance itself: transfer requires correspondence, adaptation, and visibility of remainder.

Definition 20.177 (Distributed governance-learning architecture). *A distributed governance-learning architecture is the configuration through which heterogeneous institutions generate, preserve, compare, translate, contest, and incorporate evidence about governing arrangements while retaining provenance, domain conditions, institutional memory, affected-position knowledge, and the authority pathways required for later revision.*

Learning also requires capacity to act on what has been learned. An institution can recognize a problem yet lack budget, legal authority, technical expertise, coordination, or political standing to change it. Order-level learning therefore includes the distribution of revision capability, not only the circulation of knowledge.

Proposition 20.178 (Distributed-learning condition). *Adaptive economic governance has stronger learning capacity where differentiated knowledge sites can retain local evidence and provenance, exchange materially relevant findings through explicit translation interfaces, preserve unresolved disagreement, and connect learning to institutions with practical authority and capability to revise the relevant arrangements.*

The proposition links epistemic pluralism to institutional capacity. Knowledge that cannot enter a consequential review pathway remains informative without becoming governance learning.

20.11.6 Rule Evolution and Meta-Governance

Adaptation can alter the application of a rule while leaving the rule architecture intact. Longer-horizon change often reaches further: eligibility categories change, standards are recombined, institutions gain or lose authority, digital interfaces begin to execute rules automatically, professional discretion is redistributed, or new forms of participation and review are created. These changes constitute rule evolution because they modify the architecture through which later decisions are generated.

Rule evolution raises a meta-governance question: who may alter the rules of alteration. Amendment thresholds, delegated authority, emergency powers, judicial interpretation, technical standards bodies, platform governance, administrative guidance, collective bargaining, and community rule-making each allocate authority differently. A generative economic order therefore needs to observe both first-order rules and the meta-rules that determine how first-order rules may be revised.

Evolution can emerge without one deliberate designer. Repeated exceptions can become practice; technical standards can migrate across sectors; temporary procedures can become permanent; platform interfaces can normalize classifications before legislation catches up; institutional mergers can relocate authority. Historical reconstruction is therefore needed to distinguish explicit amendment from cumulative drift.

Definition 20.179 (Economic rule-evolution profile). An *economic rule-evolution profile* records the historical changes in substantive rules, classifications, authority, implementation interfaces, exceptions, interpretive practices, and meta-rules of revision, together with the institutions and affected positions through which those changes were generated, stabilized, contested, or displaced.

Meta-governance should preserve differentiated stability. Basic rights, legal standing, or safety protections can require high thresholds for change, while technical parameters can warrant faster revision. A uniform amendment cadence across all rule types would ignore their different functions and consequences.

Proposition 20.180 (Rule-evolution governance condition). *Rule evolution has stronger generative adequacy where the authority and procedures for changing different classes of rules are explicit, historical drift and exceptional practice remain reconstructable, affected positions retain proportionate standing, and meta-rules can themselves be reviewed when accumulated change alters the distribution of power, dependency, capability, or value.*

The condition preserves institutional continuity while allowing rule architectures to evolve when the economic relations they govern have materially changed.

20.11.7 Historical Re-Evaluation and Warrant Revision

Adaptive governance should be capable of revisiting earlier decisions without treating earlier decision makers as if they possessed later knowledge. Chapter 11 distinguished ex ante warrant from retrospective assessment, and Section 20.2 carried

that distinction into economic-order evaluation. Historical re-evaluation develops the same discipline for governing arrangements whose evidence, values, causal understanding, and affected positions have changed over time.

A governing decision can remain reasonable relative to the evidence and alternatives available at the time even if later consequences reveal that it should now be revised. Conversely, a favourable later outcome does not automatically validate a poorly warranted original process. Re-evaluation therefore needs two temporal perspectives: reconstruction of the earlier warrant and assessment of the current warrant for continuation, modification, repair, or closure.

Historical re-evaluation can also expose excluded positions. Some affected groups may have lacked standing, data may have omitted informal or ecological burdens, and values treated as secondary may later become institutionally salient. Incorporating such evidence can revise current judgment while preserving an accurate record of the earlier institutional field.

Definition 20.181 (Historical governance re-evaluation record). *A historical governance re-evaluation record reconstructs the problem formulation, evidence, assumptions, value judgments, affected positions, alternatives, authority, uncertainty, and expected consequences supporting an earlier governing arrangement, then records later evidence, newly represented positions, revised causal understanding, changed conditions, and the resulting revision of present warrant.*

The record also supports responsibility. It can distinguish foreseeable harm ignored at the time from consequences that became intelligible only later. It can separate institutional negligence from reasonable uncertainty. Such distinctions matter for repair, compensation, accountability, and institutional learning.

Proposition 20.182 (Historical re-evaluation condition). *A governing arrangement has stronger historical revisability where present re-evaluation preserves the evidential and normative context of earlier decisions, incorporates later evidence and newly represented positions without projecting them backward, and makes explicit how the current warrant for continuation, repair, transformation, or closure differs from the earlier warrant.*

Historical re-evaluation therefore supports re-epistemization at the level of economic order. The past remains fixed as history while the interpretation and warrant attached to inherited arrangements can change.

20.11.8 Governance–Economy Co-Evolution

Economic governance and economic order change one another. Rules alter investment, technology, organizational form, participation, and dependency. Those changes create new capabilities, constituencies, infrastructures, data, expectations, and power relations that can later alter governance. Adaptive governance therefore cannot be represented adequately as an external controller responding to an otherwise independent economy. The governing architecture is part of the field it governs.

Co-evolution is visible throughout the preceding sections. Public infrastructure changes reachability and later political demand. Platform regulation can alter technical architecture, which changes the object of later regulation. Welfare systems can stabilize life trajectories while generating administrative categories and institutional

capacities. AI governance can change incentives for model development, deployment, verification, and public capability. Ecological regulation can redirect technology and land use while ecological responses alter later policy options. These reciprocal pathways can be generative, stabilizing, exclusionary, or destabilizing depending on their configuration.

The co-evolutionary perspective also changes the meaning of policy success. A rule can solve its initial problem and simultaneously transform the field so that a different problem becomes salient. A governance architecture should therefore retain the capacity to redefine its object rather than monitoring the original target indefinitely after the target has ceased to represent the material economic relation.

Definition 20.183 (Governance–economy co-evolution profile). A *governance–economy co-evolution profile* records reciprocal changes among governing rules, institutions, infrastructures, capabilities, technologies, participant strategies, value structures, dependencies, and practical option spaces, together with the feedback pathways through which changes in one part of the configuration alter the later conditions of governance in another.

Co-evolution can also transform governance boundaries. Activities previously treated as private coordination can become infrastructural; technical standards can acquire public significance; community practices can become formal institutions; public functions can migrate into platform interfaces; transnational dependencies can exceed one jurisdiction's capacity. Adaptive governance therefore needs mechanisms for reconsidering where governance responsibility is located.

Proposition 20.184 (Co-evolutionary governance condition). *Adaptive economic governance has stronger long-horizon adequacy where it can observe reciprocal change between governing arrangements and governed configurations, revise the definition and boundary of the governance problem when those relations materially change, and preserve learning, standing, contestability, and transition capacity as governance responsibilities themselves evolve.*

Section 20.11 therefore treats adaptation as a property of economic-order governance rather than a demand for continuous policy change. Monitoring provides selective observation; feedback creates response pathways; experimentation generates bounded learning; reversibility and repair preserve recoverability; distributed institutions retain and translate knowledge; rule evolution governs changing rule architectures; historical re-evaluation revises warrant without rewriting history; and co-evolution keeps governance inside the changing economic field it helps constitute. The resulting architecture preserves continuity while maintaining the capacity for revision where evidence, capabilities, dependencies, values, or historical conditions materially alter the warrant for existing arrangements. Section 20.12 turns from adaptive governance to economic futures and examines the plurality of trajectories, path creation, option preservation, intergenerational possibility, long-horizon risk, radical uncertainty, and premature closure through which economic order remains open to later formation.

20.12 Economic Future Formation

Sections 20.1–20.11 developed an economic-order architecture concerned with evaluation, policy, institutions, infrastructure, participation, value recirculation, plural

values, scarcity relocation, radical capability asymmetry, and adaptive governance. The present section addresses the future-facing problem created by that architecture. Economic orders do not merely allocate present resources or govern present relations. They also shape which later configurations remain imaginable, reachable, supportable, repairable, and institutionally admissible. The role of this section is therefore to specify how Generative Relational Economics can analyze economic future formation without treating the future as one forecastable path or reducing openness to an unlimited number of nominal options. Its objective is to connect plural trajectories, path creation, reachability, intergenerational standing, long-horizon risk, radical uncertainty, and closure discipline within one bounded economic-order framework. The method is historical and configurational, drawing on the generative-spacetime architecture of Chapter 15, the long-horizon asymmetry analysis of Chapter 18, and the evaluation and governance architectures of Sections 20.2 and 20.11.

Future formation should be distinguished from prediction. Prediction asks which event or state is likely to occur under specified assumptions. Future formation asks how present relations, institutions, infrastructures, capabilities, rules, values, and decisions change the practical field from which later paths can be generated. The distinction matters because an economic order can alter future possibility even where precise forecasting is weak. Infrastructure can create new reachable regions; professional training can preserve capabilities that later become useful in unexpected settings; ecological depletion can remove possibilities before their later value is known; standards can make some technical trajectories interoperable and others inaccessible; concentrated control of knowledge or compute can narrow who is able to initiate consequential alternatives. GRE therefore treats future possibility as a historically generated economic object.

Definition 20.185 (Future-formation profile). An *economic future-formation profile* records, for a bounded economic configuration, the currently represented and practically reachable future possibilities, the capabilities and infrastructures required to generate additional paths, the dependencies and constraints that condition transition, the distributions of standing over future-forming decisions, the temporal horizons of risk and maintenance, and the mechanisms through which later participants can reinterpret, revise, extend, or close inherited pathways.

The definition preserves several distinctions developed earlier in the book. Represented futures are not identical to admissible futures; admissible futures are not identical to practically reachable futures; and present reachability does not exhaust later path creation. The profile therefore treats future possibility as dynamic and historically conditional rather than as a fixed choice set.

Table 20.12 summarizes the eight dimensions developed below.

20.12.1 Future-Possibility Architecture

Economic analysis often represents the future through expected states, projected variables, or scenarios. These representations are useful, yet they do not exhaust the future-facing structure of an economic order. A configuration also contains legal permissions, infrastructure, skills, knowledge, organizational capacity, social relations, ecological conditions, standards, financial access, and institutional standing that determine whether a represented possibility can be reached or sustained. Future possibility is therefore partly relational and infrastructural.

Table 20.12: Dimensions of economic future formation in generative relational economic order.

Dimension	Primary object	Characteristic future-formation question
Future possibility	Represented, admissible, and reachable future configurations	Which futures remain practically open, for whom, and through which relational and institutional conditions?
Multiple trajectories	Coexisting economic paths with heterogeneous temporal and value structures	Which trajectories can coexist, diverge, reconnect, or become mutually exclusive without being collapsed into one forecast?
Path creation	Emergence of later trajectories not contained in the initial represented option set	Which capabilities, experiments, infrastructures, and forms of participation allow genuinely new paths to be generated?
Option preservation	Retention of meaningful later reachability	Which options warrant continued accessibility, and what maintenance, interoperability, reserves, or modularity make that accessibility practical?
Intergenerational possibility	Possibility structures inherited by later participants	Which capabilities, burdens, institutions, resources, records, and option structures are transferred across generations?
Long-horizon risk	Delayed, cumulative, systemic, and difficult-to-repair future effects	Which risks accumulate beyond ordinary planning horizons, and how should reversibility, monitoring, and protective capacity respond?
Radical uncertainty	Material uncertainty not reducible to stable probabilities or known scenarios	How should economic judgment proceed when future states, values, mechanisms, or model boundaries remain partly unknown?
Closure discipline	Commitments that narrow, stabilize, or foreclose later possibilities	Which forms of closure are warranted, how durable should they be, and what records and revision pathways should accompany them?

A useful distinction can be made among *represented possibility*, *admissible possibility*, and *practical reachability*. A possibility is represented when it enters the analytic or institutional field as an identifiable alternative. It is admissible when relevant legal, technical, normative, or institutional rules permit it. It is practically reachable when actors or collectives possess sufficient capability, access, coordination, time, resources, and transition pathways to move toward it. An option can exist at one level while being absent at another. Formal permission to form a cooperative, for example, does not establish practical reachability where finance, premises, legal knowledge, or organizational capability are missing.

Future possibility is also position-specific. A technological transition that expands one firm’s feasible set can narrow workers’ occupational options. A new transport link can widen regional opportunity while displacing communities with weak standing. A digital public service can create access for some while making participation more difficult for people lacking identity documents or recoverable digital credentials. Future possibility should therefore be profiled across affected positions rather than inferred from an aggregate count of available alternatives.

Definition 20.186 (Future-possibility architecture). A *future-possibility architecture* is the configuration of represented, admissible, and practically reachable future states and trajectories together with the capabilities, infrastructures, rules, value conditions, dependencies, standing relations, and transition pathways that make those possibilities differently available across economic positions and time horizons.

A future-possibility architecture can expand without becoming universally preferable. Some possibilities should be constrained by safety, justice, ecological limits, or rights. Conversely, a smaller set of highly supported and revisable options can provide greater practical freedom than a large catalogue of nominal alternatives. GRE therefore evaluates the quality, distribution, reachability, and revisability of future possibilities rather than maximizing option count.

Proposition 20.187 (Future-possibility adequacy condition). *Future-facing economic analysis has stronger generative adequacy where represented alternatives are distinguished from admissible and practically reachable alternatives, where reachability is profiled across affected positions, and where the capability, infrastructure, dependency, standing, and transition conditions of later action remain explicit.*

The condition provides the base layer for the remaining subsections. Economic futures are shaped not only by which destinations are visible, but also by who can travel toward them and by whether additional destinations can later be generated.

20.12.2 Multiple Economic Trajectories

Economic orders frequently contain several trajectories at once. Technologies diffuse unevenly; institutions change at different speeds; regional economies follow distinct paths; households, firms, communities, ecosystems, and public systems operate on heterogeneous temporal scales. A single aggregate forecast can therefore conceal divergent trajectories whose interaction matters for later order.

Multiple trajectories need not converge. A platform ecosystem can expand while public administrative capacity weakens. Material productivity can rise while ecological regeneration declines. Scientific capability can grow while participation in research narrows. Some trajectories can be complementary, some competitive, and some conditionally incompatible. Their future importance can also change when previously peripheral relations become critical.

Trajectory plurality matters for governance because intervention in one path can alter another. Subsidizing one technical standard can create complements that make alternative standards harder to adopt. Urban investment can increase land values and alter community continuity. Long-term contracts can stabilize supply while reducing later substitution. GRE therefore treats trajectory comparison as a relational problem involving interaction, coupling, divergence, and possible reconnection.

Definition 20.188 (Multiple-trajectory profile). *A multiple-trajectory profile records the coexisting economic trajectories relevant to a bounded inquiry, their temporal scales, principal carriers, dependencies, value structures, points of coupling or conflict, transition conditions, and the ways in which change along one trajectory can expand, redirect, stabilize, or foreclose another.*

The profile does not require one common metric. A public-capacity trajectory can be compared with an ecological trajectory through identified interfaces without assuming that administrative capability and ecological regeneration share a scalar value unit. This preserves the plural-value architecture of Section 20.8 while enabling future-facing coordination.

Proposition 20.189 (Trajectory-plurality condition). *Where economically consequential processes follow heterogeneous and interacting trajectories, future analysis should preserve their distinct temporal and value structures while identifying the interfaces*

through which one trajectory alters the later reachability, burden, dependency, or generativity of another.

This condition limits the temptation to infer economic future from one dominant trend. A high-growth trajectory can coexist with generative depletion elsewhere in the order, and a slow-moving institutional trajectory can become decisive when faster technological change reaches an institutional boundary.

20.12.3 Economic Path Creation

The future cannot be represented only as selection among alternatives already visible in the present. Economic actors and institutions can create new paths through experimentation, invention, organization, learning, reinterpretation, coalition, institutional redesign, and recombination of existing resources. Future formation therefore includes the capacity to generate later trajectories that were not present in the initial option set.

Path creation depends on more than creativity or technology. A new cooperative form can require legal standing, finance, accounting capability, collective trust, and institutional recognition. A scientific field can require instrumentation, preservation, training, and research time. A new care arrangement can require changes in public finance, labor rules, professional practice, and community participation. An ecological restoration pathway can require land access, stewardship knowledge, multi-jurisdictional coordination, and long temporal commitments. Generative opportunity therefore depends on the configuration described in Section 20.9, not merely on the production of ideas.

Path creation can also redistribute power. Actors that control standards, infrastructure, finance, data, or institutional authorization can influence which nascent paths become viable. Path creation should therefore be examined together with capability asymmetry and counter-power rather than romanticized as spontaneous innovation.

Definition 20.190 (Economic path-creation capacity). *Economic path-creation capacity* is the practical capability of subjects or collectives to originate, assemble, institutionalize, sustain, and revise consequential economic trajectories that are not exhausted by the currently represented option set, using available knowledge, relations, infrastructure, resources, standing, and recovery capacity.

Path-creation capacity is partly collective. No single participant may possess the legal, technical, financial, epistemic, and organizational capacities required to generate a new path. Institutions that support combination across heterogeneous capabilities can therefore be future-forming even when they do not directly produce the final innovation or organization.

Proposition 20.191 (Path-creation condition). *Economic future formation is more generative where relevant subjects and collectives retain practical pathways for experimentation, recombination, organization, institutionalization, and recovery through which additional trajectories can be created rather than limiting later action to selection among presently represented alternatives.*

The proposition does not imply that every new path should be supported. Path creation remains subject to evaluation, affected-position standing, ecological and safety constraints, and plural-value governance. Its role is to preserve the possibility of later formation where uncertainty makes the complete future option set unknowable in

advance.

20.12.4 Option Preservation and Reachability

Preserving an option differs from merely refraining from prohibition. An option can remain legally permitted while its practical substrate disappears. Skills can atrophy, infrastructure can be dismantled, archives can become unreadable, ecosystems can cross thresholds, alternative suppliers can exit, public expertise can be outsourced away, or interoperable standards can be replaced by closed systems. Option preservation therefore concerns the maintenance of conditions that keep later transition practically possible.

Section 20.3 treated option-space preservation as a policy design problem. At economic-order scale, preservation is distributed across institutions and time. Redundant infrastructure, modular design, reserves, interoperability, professional succession, public archives, ecological conservation, portability, and diversified supply can all preserve later reachability. These arrangements often impose present costs. Their value lies partly in maintaining future transition capacity that may never be exercised.

Option preservation should remain selective. Some paths warrant closure because they violate rights, generate unacceptable hazard, or create irreversible burdens without sufficient justification. Other options can be too costly to maintain indefinitely. The analytical task is to make the preservation decision explicit: which future transitions matter, for whom, over what horizon, and through which maintenance burden.

Definition 20.192 (Option-preservation profile). *An option-preservation profile specifies the future transitions judged materially important to keep practically reachable, the capabilities, infrastructures, knowledge, ecological conditions, legal standing, interoperability, reserves, and maintenance required for that reachability, the positions benefiting from or bearing the preservation burden, and the conditions under which continued preservation should be reviewed.*

Option preservation is therefore compatible with commitment. A society can commit strongly to decarbonization while preserving several technological or institutional transition paths within that constraint. A public system can adopt a digital infrastructure while retaining recoverable non-digital fallback for critical functions. Commitment and option preservation operate at different levels.

Proposition 20.193 (Option-preservation condition). *Where uncertainty, irreversibility, dependency, or long replacement times make later transition materially consequential, economic-order design should identify which options warrant practical preservation and should distinguish nominal permissibility from the maintained capabilities and infrastructures required to keep those options reachable.*

This condition also clarifies the relationship between efficiency and resilience. Removal of apparently unused capacity can improve current efficiency while narrowing future recovery or substitution. GRE evaluates that tradeoff explicitly rather than treating unused capacity as waste by definition.

20.12.5 Intergenerational Possibility Structures

Economic orders transfer more than assets across generations. Later participants inherit infrastructures, institutions, ecological conditions, public debt, technical standards, legal categories, archives, capabilities, maintenance obligations, social relations, cultural memory, unresolved disputes, and a structured field of possible action. Intergenerational analysis should therefore examine inherited possibility structures rather than only inherited wealth.

Future participants cannot fully specify their values in advance. Present institutions nevertheless make decisions that shape what later participants can know, revise, restore, or create. The challenge is to provide meaningful standing to future possibility without pretending to speak conclusively for future preferences. Preservation of records, repair capacity, ecological function, institutional revisability, and plural option structures can serve as procedural safeguards where substantive future values remain uncertain.

Intergenerational possibility also involves burden distribution. A project can create current benefit by transferring maintenance, waste, debt, ecological restoration, institutional complexity, or technical dependency forward. Conversely, present investment in infrastructure, education, knowledge preservation, ecological regeneration, or public capability can enlarge later action space. These effects should be traced even when market prices incompletely represent them.

Definition 20.194 (Intergenerational possibility inheritance). An *intergenerational possibility inheritance* is the configuration of capabilities, infrastructures, ecological conditions, institutions, records, obligations, dependencies, maintenance requirements, unresolved burdens, and reachable future paths transferred from earlier economic arrangements to later participants.

The definition shifts attention from one intergenerational balance to a heterogeneous inheritance. Later participants can inherit greater material wealth while receiving narrower ecological options, weaker public institutions, or more concentrated infrastructural dependency. Intergenerational evaluation should therefore preserve plural dimensions.

Proposition 20.195 (Intergenerational possibility condition). *Long-horizon economic evaluation has stronger intergenerational adequacy where present decisions identify the material, institutional, ecological, epistemic, and relational conditions they transfer forward, make deferred obligations and difficult-to-repair burdens visible, and preserve sufficient records and revision capacity for later participants to reinterpret and reshape inherited arrangements.*

This condition avoids claiming that present actors can determine the good of future generations. It requires instead that present action remain accountable for the possibility structures it knowingly or foreseeably creates.

20.12.6 Long-Horizon Risk Architecture

Long-horizon risk differs from ordinary short-horizon uncertainty because consequences can accumulate after current institutions, decision makers, technologies, and evidence standards have changed. Climate effects, demographic shifts, infrastructure degradation, debt dynamics, skill erosion, ecological thresholds, institutional dependence, and technical lock-in can develop through mechanisms whose early signals

are weak and whose later repair is expensive.

Risk at these horizons is often relational. The same disturbance can produce different consequences depending on infrastructure, public capacity, social protection, ecological condition, geographic position, access to finance, and substitution pathways. Aggregate probability and expected loss therefore provide only part of the relevant profile. GRE also asks which positions bear exposure, which capabilities absorb disturbance, which dependencies amplify failure, and which losses alter later path creation.

Long-horizon governance should distinguish risk reduction, resilience, recoverability, and transformation. Reducing the probability of one failure differs from creating capacity to absorb it. Recoverability concerns repair or substitution after disturbance. Transformation becomes relevant where the previous configuration should not or cannot be restored. These strategies can require different institutions and can redistribute burden differently.

Definition 20.196 (Long-horizon economic-risk profile). A *long-horizon economic-risk profile* records delayed and cumulative hazards, affected positions, exposure pathways, dependency amplification, capability buffers, thresholds and irreversibilities, evidence latency, monitoring horizons, recovery or transformation options, and the ways in which realized loss could alter later possibility and path-creation capacity.

Long horizons also intensify the problem of discounting and representation. A low present probability can coexist with severe irreversible consequence. Some harms are difficult to monetize, and some future values are not yet represented. GRE therefore avoids making one numerical reduction procedure the sole criterion of long-horizon adequacy.

Proposition 20.197 (Long-horizon risk condition). *Where economic decisions can generate delayed, cumulative, systemic, or difficult-to-repair effects, risk analysis should combine probabilistic information where warranted with profiles of exposure, dependency, threshold, irreversibility, capability buffering, recovery, transformation, and later possibility loss.*

The proposition is compatible with quantitative risk analysis. It specifies the wider relational architecture in which quantitative estimates acquire economic meaning.

20.12.7 Radical Uncertainty and Decision Scope

Some future-facing decisions confront uncertainty that cannot be reduced to a stable probability distribution. Relevant future states may be unknown; causal mechanisms may change; participant values may evolve; institutional boundaries may shift; technological categories may become obsolete; and the act of intervention can change the system being modeled. Chapter 15 treated generative spacetime as historically open, while Section 20.11 showed that governance and economy co-evolve. These conditions limit the authority of forecasts that assume a stable future state space.

Radical uncertainty does not remove the need for decision. It changes the appropriate scope of decision claims. A forecast can be treated as one conditional representation rather than as exhaustive description. Scenario sets can expose different mechanism assumptions without implying that the set is complete. Robustness analysis can identify options that perform acceptably across several represented conditions while

leaving unrepresented remainder visible. Reversibility, modularity, monitoring, and staged commitment can become more important where confidence in the state space itself is weak.

Judgment also becomes explicit. Decisions can depend on historical analogy, professional experience, normative commitments, aesthetic or strategic orientation, and interpretation of incomplete evidence. Such judgment should remain attributable and revisable rather than disguised as model output.

Definition 20.198 (Radical-uncertainty decision profile). A *radical-uncertainty decision profile* records the represented future states and scenarios, the acknowledged incompleteness of that representation, unstable or unknown mechanisms, evolving value and institutional conditions, model-boundary uncertainty, consequential judgment inputs, reversibility and staging options, monitoring requirements, and the scope of claims warranted by the available evidence.

The profile prevents uncertainty language from becoming either false precision or paralysis. It asks what can reasonably be claimed, what remains open, which consequences demand protection despite uncertainty, and how later evidence can revise the decision.

Proposition 20.199 (Radical-uncertainty scope condition). *Where the relevant future state space, mechanisms, values, or institutional boundaries are materially unstable or incomplete, economic decision making should proportion claims to the represented uncertainty, retain explicit judgment and remainder, and use staged commitment, monitoring, reversibility, robustness, or option preservation where these mechanisms are proportionate to the consequences of being wrong.*

This condition complements the adaptive-governance architecture of Section 20.11. Radical uncertainty makes later learning part of present decision design.

20.12.8 Closure Discipline in Future Formation

Economic order requires closure. Budgets must be adopted, infrastructures built, legal standards chosen, institutions created, contracts honored, and safety or ecological limits enforced. Future openness therefore cannot mean indefinite deferral or permanent reversibility. The relevant question is how closure is made when its consequences extend into a future that remains partly unknown.

Closure can operate at several levels. A decision can close one instrument while keeping the objective revisable. A standard can stabilize an interface while allowing competing implementations. A right can be durably protected while administrative procedures evolve. An ecological prohibition can close destructive pathways while preserving plural forms of compatible activity. Conversely, a narrow technical or organizational choice can unintentionally close wider future pathways through dependency, complement accumulation, or loss of alternative capability.

The key distinction is between *warranted commitment* and *premature closure*. Prematurity cannot be determined by duration alone. A rapid closure can be warranted when delay creates severe harm and evidence is sufficient. A slowly accumulated closure can remain premature where alternatives disappear through path dependence without explicit assessment of consequences, standing, and revision. Closure discipline therefore concerns the relation among evidence, consequence, reversibility, affected positions, alternative pathways, and the level at which commitment is imposed.

Definition 20.200 (Future-closure profile). A *future-closure profile* specifies the future possibilities constrained or stabilized by an economic commitment, the level and duration of closure, evidential and normative warrant, affected positions and standing, alternatives considered, reversibility or repair pathways, dependency and path-creation effects, review conditions, and the records through which later participants can reconstruct and reconsider the commitment.

Closure discipline also preserves institutional memory. Later actors should be able to distinguish deliberate closure from accidental lock-in, justified commitment from legacy dependence, and unavoidable irreversibility from avoidable loss of alternative capacity. This requirement connects future formation to the historical re-evaluation architecture of Section 20.11.7.

Proposition 20.201 (Future-closure discipline). *Economic closure has stronger generative adequacy where the level, scope, duration, warrant, affected standing, alternative pathways, dependency effects, and recoverability of the commitment are explicit, and where durable closure is accompanied by sufficient records, maintenance, review, repair, or successor capacity for later participants to understand and, where materially possible, revise inherited consequences.*

The proposition completes the section by linking openness and commitment. A generative economic order is neither one that maximizes all future options nor one that fixes a preferred future in advance. It is an order capable of making consequential commitments while preserving the capabilities, records, institutions, plural standing, and path-creation capacity through which future participants can continue forming economic futures of their own.

Section 20.12 therefore treats economic future formation as an economic-order problem in its own right. Future-possibility architecture distinguishes representation from practical reachability; multiple trajectories preserve heterogeneous temporal and value structures; path creation keeps later novelty inside the economic field; option preservation maintains selected transition capacity; intergenerational possibility makes inherited action structures visible; long-horizon risk traces delayed and difficult-to-repair consequences; radical uncertainty disciplines the scope of present claims; and closure discipline permits commitment without silently converting current judgment into permanent normative authority. Section 20.13 turns next to the limits of GRE and asks where the programme's domain, ontology, epistemology, methodology, normativity, formalization, historical reach, and generalization remain bounded.

20.13 Economic-Order Scope and Validity Boundaries

The role of this section is to state the scope and validity boundaries that accompany the economic-order synthesis developed in this chapter. Its objective is to identify where Generative Relational Economics (GRE) currently has analytical warrant, where its claims require additional assumptions or domain translation, and where its vocabulary should yield to other disciplinary, empirical, normative, or formal frameworks. The section develops eight boundary dimensions: domain scope, ontological commitment, epistemic access and warrant, methodological adequacy, normative authority, formalization and model scope, historical transfer, and programme-level generalization. The method is reflexive and claim-indexed. A boundary attaches to a

particular object, proposition, representation, intervention, or generalization rather than functioning as a global verdict on the usefulness of the programme.

The need for explicit boundaries follows from GRE's own architecture. Chapters 4 and 5 separate ontological suspension from epistemic reconstruction. Chapters 6–9 preserve methodological plurality and treat research practice as part of the evidential architecture. Chapters 14–16 extend analysis toward heterogeneous value, generative spacetime, power, justice, and governance, where empirical and normative questions cannot be collapsed into one register. Chapter 19 further shows that domain translation can require decomposition, reinterpretation, local substitution, or withdrawal of GRE concepts. The present section therefore treats boundary specification as part of analytical adequacy.

This section is intentionally compact relative to the dedicated treatment of limits, open problems, and failure modes later in the book. Its purpose here is to place validity conditions around the economic-order claims of Sections 20.1–20.12 before the future research programme is stated. Detailed questions concerning representation error, relational reduction, closure, value conversion, power, justice, applied praxis, empirical identification, and falsification remain research objects in their own right. Section 20.13 supplies the boundary map needed to keep those later inquiries open.

Definition 20.202 (GRE validity-boundary profile). *A GRE validity-boundary profile specifies, for a stated GRE claim or analytical construction, the domain and scale to which it applies, the ontological commitments it assumes or suspends, the evidential access and uncertainty supporting it, the methods through which it is investigated, the normative authority it possesses, the status and scope of any formal representation, the historical conditions relevant to transfer, and the level at which generalization is warranted.*

Definition 20.202 makes scope explicit at the level of individual claims. A qualitative interpretation, a formal representation, an empirical regularity, and a normative proposal can all belong to GRE while carrying different kinds of warrant. Table 20.13 summarizes the eight dimensions developed below.

Proposition 20.203 (Boundary-explicit adequacy condition). *A GRE claim has stronger analytical adequacy when its domain, ontology, evidential access, method, normative standing, formal status, historical conditions, and generalization scope are sufficiently explicit for a reader to identify both what the claim supports and what remains outside its warranted reach.*

Proposition 20.203 treats boundary statements as substantive content. A narrow but well-specified claim can carry more research value than a broader statement whose domain, evidence, or normative authority remains ambiguous.

20.13.1 Domain Scope Boundaries

GRE is principally an economic research programme. Its relational vocabulary can illuminate interfaces with law, political theory, history, education, ecology, culture, artificial intelligence, and other domains, yet such illumination does not confer disciplinary jurisdiction. Chapter 19 demonstrates this through domain translation: economic concepts acquire domain-specific meaning only after subjects, relations, mechanisms, values, temporal scales, evidence, and institutional boundaries are respecified.

Table 20.13: Scope and validity boundaries of Generative Relational Economics.

Boundary dimension	Scope question	Required discipline	Characteristic overreach
Domain scope	Which economic object, domain, scale, and interface does the claim address?	Preserve domain-specific objects, mechanisms, and remainders	Treating an economic translation as authority over another discipline
Ontological commitment	Which entities or relations are assumed, represented, or ontologically suspended?	Separate useful representation from ultimate ontological claim	Reifying relational, field, spacetime, or subject representations
Epistemic access and warrant	What can be observed, inferred, reconstructed, or only hypothesized?	Track provenance, uncertainty, identifiability, and model dependence	Treating partial manifestation as complete access to the target
Methodological adequacy	Which method is adequate to the local research question?	Combine or separate interpretive, empirical, formal, and computational modes as warranted	Treating one method as universally sufficient
Normative authority	Which values, standing relations, and evaluative premises authorize the conclusion?	Keep normative premises, conflicts, and unresolved remainder visible	Deriving justice or goodness directly from generativity or efficiency
Formalization and model scope	What analytical work does the formal representation perform?	State assumptions, semantics, identification conditions, and empirical interfaces	Treating formal elegance or analogy as empirical or ontological proof
Historical transfer	Which categories and mechanisms depend on a historical configuration?	Index claims to time, institutions, technologies, and category change	Projecting historically situated mechanisms as timeless laws
Generalization scope	At what level may the result travel beyond the case or domain?	Distinguish local, cross-domain, and programme-level claims	Converting recurring vocabulary into universal theory

The first boundary therefore concerns domain containment. Economic analysis can examine how legal standing affects access, how educational arrangements reproduce capability, how ecological processes condition production, or how cultural recognition shapes value realization. These interfaces remain economic objects insofar as the research question concerns allocation, conversion, capability, dependency, infrastructure, value processes, participation, or economic-order formation. Questions internal to jurisprudence, pedagogy, ecology, aesthetics, or other disciplines may require concepts and standards of adequacy that GRE does not supply.

Domain scope also depends on scale. A concept that works at the level of an organization may become misleading at the level of a jurisdiction, transnational system, household, or ecosystem. Likewise, a relation identified at one boundary can disappear or change type after the analytical boundary is expanded. Domain adequacy therefore requires explicit specification of the unit and interface being studied.

Definition 20.204 (GRE domain-containment profile). A *GRE domain-containment profile* records the economic object of inquiry, the relevant domain interface, analytical boundary and scale, the GRE concepts transferred into the inquiry, the domain-specific concepts retained, and any remainder that requires reinterpretation, local substitution, or withdrawal of the transferred concept.

The profile keeps interdisciplinary work reciprocal. A domain can revise GRE when economic vocabulary fails to represent an important mechanism, standing relation, temporal structure, or evidential object.

Proposition 20.205 (Domain-containment condition). A *GRE analysis crossing disciplinary boundaries should preserve the receiving domain's independent objects, standards of evidence, normative questions, and conceptual remainders wherever those elements materially affect the economic claim being made.*

This condition supports interdisciplinary dialogue while containing economic over-

reach. It also preserves the possibility that a useful economic relation is only one partial representation of a wider domain object.

20.13.2 Ontological Commitment Boundaries

GRE uses relational beings, fields, configurations, histories, spacetime representations, capability profiles, and institutional structures as analytical objects. Their usefulness does not establish an ultimate ontology. Chapter 4 adopts ontological suspension precisely so that relational analysis can proceed without requiring premature settlement of metaphysical questions that the economic research task does not need to decide.

This restraint is especially important where formal or physical language is imported. A field representation can capture distributed influence without implying that social reality literally consists of a physical field. A 2-complex can provide a representation of history-bearing relational structure without establishing that the economic world is fundamentally a 2-complex. Dynamical, topological, operator-algebraic, or amplitude-like formalisms can reveal structural possibilities while their ontological status remains open.

The same boundary applies to economic subjects. Persons, organizations, communities, artificial systems, institutions, and represented non-human positions can possess economically consequential standing in different senses. Operational agency, relational subjecthood, legal status, moral standing, phenomenological experience, and ultimate ontology remain separate questions. GRE can analyze their economic interfaces without resolving all of them within economics.

Definition 20.206 (Ontological-commitment profile). An *ontological-commitment profile* records which entities, relations, processes, or structures a GRE analysis treats as empirically or analytically real for the local inquiry; which are representational devices; which stronger ontological interpretations remain optional; and which ontological questions are suspended because the argument does not require their resolution.

Proposition 20.207 (Ontological-restraint condition). *A GRE representation should not acquire stronger ontological authority than is required by its analytical role, evidential support, and explicit assumptions; where several ontological interpretations support the same economic analysis, the stronger commitment should remain open unless additional argument establishes it.*

Ontological restraint does not weaken relational analysis. It clarifies what the analysis depends on and permits later theories to revise the metaphysical interpretation without automatically invalidating every economic result obtained through the representation.

20.13.3 Epistemic Access and Warrant Boundaries

GRE often studies relations, capabilities, dependencies, value processes, future possibilities, and institutional effects that are only partially observable. Chapter 5 therefore treats manifestation and representation as mediated access rather than transparent disclosure. The relevant epistemic boundary concerns what can be directly observed, what can be inferred from traces, what requires reconstruction, and what remains hypothetical or underidentified.

Partial access is especially consequential in long-horizon and generative analysis. A present increase in capability can be observed more readily than the later possibilities it enables. A dependency can remain latent until an attempted exit occurs. Institutional learning can be difficult to distinguish from temporary performance improvement. Value capture can operate through several conversion interfaces whose contribution is not directly separable. Future-option loss can be inferred from disappearing capabilities or infrastructures while the counterfactual future itself remains unobservable.

The epistemic problem is therefore wider than data scarcity. It includes non-invertibility, hidden relations, measurement error, model dependence, selection effects, changing categories, performative indicators, and weak counterfactual identification. Negative evidence also requires care: absence of an observed relation supports absence of the target only where trace generation, detection, coverage, and preservation are sufficiently warranted.

Definition 20.208 (Epistemic-warrant boundary). An *epistemic-warrant boundary* specifies, for a GRE claim, the observable traces and manifestations available, the inferential or reconstructive steps connecting them to the target, uncertainty and missingness, identifiability conditions, model dependence, counterfactual assumptions, and the strongest claim supported by the resulting evidential architecture.

Proposition 20.209 (Epistemic-scope condition). *Where a GRE target is only partially observed or reconstructed, the strength and scope of the conclusion should track the stability, specificity, independence, historical adequacy, and uncertainty of the evidential pathways through which the target is inferred.*

This condition is especially important for claims about generativity. Generativity can be investigated through later capability, reuse, regeneration, path creation, and option-space effects, yet a present indicator cannot by itself provide complete evidence of all later consequences.

20.13.4 Methodological Adequacy Boundaries

GRE is methodologically plural because its objects are heterogeneous. Historical reconstruction, interpretive inquiry, ethnography, institutional analysis, causal inference, experiments, network analysis, simulation, formal modeling, computational methods, and comparative case research can each provide relevant access to different aspects of relational economic configurations. None receives universal priority from the GRE framework itself.

Methodological adequacy is local to the research question. A randomized design can identify an average effect for a bounded intervention while leaving long-horizon institutional evolution outside its design. An ethnography can reveal tacit coordination and meaning while providing limited support for prevalence claims. A simulation can clarify consequences of specified mechanisms while remaining conditional on model closure. Historical comparison can illuminate path dependence while facing incomplete archives and changing categories. Formal analysis can expose structural consistency without establishing empirical magnitude.

Mixed methods can strengthen inquiry when the methods address complementary evidential problems. Their combination also requires care because evidence from different methods may concern different targets, populations, scales, or historical moments. Triangulation is strongest when the relation among those evidential objects is

itself specified.

Definition 20.210 (Method-adequacy profile). A *method-adequacy profile* identifies the research question and target, the method or combination of methods used, the evidential role assigned to each method, the assumptions and exclusions introduced by the design, the scales and populations to which the result applies, and the claims that remain unsupported by that methodological configuration.

Proposition 20.211 (Methodological-pluralism condition). A *GRE research design* should select methods according to the evidential and interpretive requirements of the local question and should preserve the distinct warrant of heterogeneous methods when their outputs cannot be validly merged into one evidential scale.

Methodological pluralism also bounds practical decision analysis. Under urgency or incomplete information, the feasible evidence base can be narrower than ideal research design. Such decisions can still be warranted when evidential limitation, judgment, monitoring, and later re-evaluation are explicit.

20.13.5 Normative Authority Boundaries

GRE contains normative vocabulary concerning justice, participation, standing, value, dependency, future possibilities, and generative adequacy. These concepts support normative inquiry, yet generativity alone does not determine goodness. A process can generate extensive future capability while distributing burdens unjustly. Stability can preserve a valuable institution or an oppressive relation. Option expansion can benefit one position while imposing ecological or care burdens elsewhere. Efficient conversion can intensify domination if control over the conversion interface is concentrated.

The normative boundary therefore concerns authority. Descriptive findings about dependency, conversion, power, capability, or future-option structure can reveal normatively relevant facts. Moving from those facts to judgments of legitimacy, justice, priority, rights, or obligation requires normative premises concerning standing, value, burden, responsibility, entitlement, or acceptable procedure. GRE can organize those premises and show where they interact, but it does not make every normative conflict commensurable.

Plural-value analysis in Sections 20.8 and value recirculation in Section 20.7 reinforce this point. An order can require operational decisions while normative remainders remain unresolved. Normative adequacy therefore includes procedural standing, explanation, contestability, and revision where substantive agreement is incomplete.

Definition 20.212 (Normative-authority profile). A *normative-authority profile* records the evaluative object, affected positions and standing, values and rights invoked, normative premises, conflicts and incommensurabilities, procedural basis of decision, distribution of burden and benefit, unresolved normative remainder, and the scope within which the resulting normative conclusion is claimed to apply.

Proposition 20.213 (Normative-underdetermination condition). Where several normatively relevant values, rights, or standing relations remain incompletely commensurable, GRE analysis should preserve the premises and unresolved remainder of the decision rather than treating generativity, capability, efficiency, stability, or any other single economic property as sufficient normative authority.

The proposition leaves space for stronger normative theories. Political philosophy, jurisprudence, ethics, democratic theory, ecological ethics, and domain-specific normative frameworks can supply commitments whose economic consequences GRE then analyzes relationally.

20.13.6 Formalization and Model-Scope Boundaries

Formalization has several legitimate roles in GRE. It can sharpen definitions, expose assumptions, distinguish mechanisms, represent partial orders, analyze conversion interfaces, model dynamic trajectories, identify invariants, or test internal consistency. The same formal language can also invite overreach when symbols acquire a precision that the underlying empirical or semantic objects do not support.

The formal boundary begins with model type. A schematic formalism organizes concepts. A structural model represents relations among typed objects. An analogical model imports selected structure from another field. A parameterized model connects variables to empirical quantities. A predictive model additionally requires a warranted relation to future observations. These forms carry different evidential obligations.

Closure is another boundary. Economic configurations are open, reflexive, historically changing, and partly constituted by the categories through which participants act. A formal model can close selected mechanisms for analysis while leaving an explicit remainder. Model usefulness depends partly on whether the excluded relations are small for the research purpose or materially capable of changing the conclusion.

The same discipline applies to mathematical imports from geometry, field theory, operator algebra, category theory, dynamical systems, or physics. Structural similarity can support inquiry without establishing identity of mechanism, semantics, or ontology.

Definition 20.214 (Formalization-scope profile). *A formalization-scope profile states the role of a GRE formalism, the semantics of its objects and operations, assumptions and closure conditions, empirical or interpretive correspondence, parameter-identification requirements where applicable, excluded relations, sensitivity to those exclusions, and the level of claim that the formal result can support.*

Proposition 20.215 (Formal-transfer condition). *A formal structure transferred into GRE has stronger warrant when the preserved relations, altered semantics, closure assumptions, empirical correspondences, and domain-specific remainders are explicit; formal resemblance alone does not establish shared mechanism, ontology, or empirical validity.*

Formalization can therefore remain ambitious while epistemically disciplined. A formal object earns its place by clarifying an analytical problem and by keeping the route back to interpretation or evidence visible.

20.13.7 Historical Transfer Boundaries

GRE emerged from historically specific economic conditions and repeatedly treats institutions, categories, technologies, and value forms as historically generated. Its claims therefore require temporal indexing. Concepts such as employment, platform, corporation, public service, intellectual property, citizenship, data, artificial intelli-

gence, or professional expertise can change their institutional meaning across periods and places.

Historical transfer presents at least three problems. First, categories can be anachronistic: a contemporary term can obscure how earlier actors understood their own relations. Second, mechanisms can change while labels remain stable. Third, similar mechanisms can operate through different institutional forms. A dependency relation in one historical configuration may rely on land tenure, while another relies on identity infrastructure, finance, data, or technical standards.

Historical analysis also faces incomplete archives and unequal preservation. Powerful institutions often leave denser records than informal communities, care relations, marginalized groups, or tacit maintenance practices. Apparent absence in the archive can therefore reflect preservation structure rather than absence in the historical economy.

Definition 20.216 (Historical-transfer profile). A *historical-transfer profile* specifies the period and institutional configuration in which a GRE concept or mechanism is identified, the historical meaning of its categories, relevant changes in technology and institutions, archival and evidential asymmetries, comparison criteria used across periods, and the aspects of the claim that remain portable after those differences are taken into account.

Proposition 20.217 (Historical-portability condition). A GRE mechanism should be generalized across historical contexts only to the extent that the relevant relational structure, category meaning, institutional mediation, evidence, and causal pathway remain sufficiently comparable for the stated analytical purpose.

This condition is consistent with recurrent economic structures. Dependency, allocation, maintenance, power, value conversion, or capability formation can recur historically while being realized through different institutional architectures. Historical recurrence should therefore be demonstrated at the level of mechanism relevant to the claim.

20.13.8 Generalization Scope and Programme Containment

The final boundary concerns the level at which GRE findings can travel. Chapter 19 distinguished domain-local, cross-domain, and programme-level generalization. Section 20.13 adds a further containment discipline: repeated success of GRE within economics would still not by itself establish a general theory of every social, legal, ecological, political, or cultural process.

Generalization should therefore preserve the route by which a claim travels. A finding may remain case-specific. Several cases can support a domain-level mechanism. Repeated domain correspondences can support a cross-domain structural proposition. A programme-level concept can organize many inquiries while still carrying substantial empirical and normative variation. Movement among these levels requires evidence of correspondence, not recurrence of terminology alone.

Programme containment also protects GRE from conceptual inflation. If relation, generativity, capability, value, power, infrastructure, or possibility are defined so broadly that every observation confirms them, the concepts lose discriminating capacity. A productive programme requires conditions under which its distinctions fail, require decomposition, or are outperformed by rival explanations.

The relation between GRE and a future Generative Relational Theory (GRT) is therefore one of contribution rather than automatic elevation. GRE can provide domain-specific successes, failures, formalisms, counterexamples, and candidate invariants. Whether any of these support a broader theory depends on comparative work across independently constituted domains and on identification of what remains stable after economic assumptions are removed.

Definition 20.218 (GRE generalization-scope profile). *A GRE generalization-scope profile records the evidential base of a finding, the cases and domains represented, the structural correspondence claimed across them, the assumptions preserved in transfer, counterexamples and transfer failures, rival explanations, and the level at which the resulting claim is warranted: case-local, domain-level, cross-domain, programme-level, or candidate input to a broader theory.*

Proposition 20.219 (Programme-containment condition). *GRE has stronger cumulative warrant where successful explanations, failed transfers, rival accounts, boundary conditions, and required conceptual revisions remain visible, and where broader theoretical generalization is deferred until the relevant cross-domain invariants and non-transferable assumptions have been independently established.*

Programme containment completes the boundary architecture of this section. Domain specificity prevents economics from absorbing adjacent disciplines. Ontological suspension prevents analytical representations from becoming premature metaphysics. Epistemic boundaries calibrate claims to mediated access. Methodological boundaries preserve local adequacy and plural evidence. Normative boundaries keep evaluative premises and unresolved conflicts visible. Formalization boundaries preserve the distinction between structural insight and empirical or ontological proof. Historical boundaries limit anachronistic transfer. Generalization boundaries preserve the difference between a productive economic research programme and a completed general theory.

These boundaries are not a residual disclaimer added after GRE's positive claims. They specify how those claims remain testable, revisable, interpretable, and capable of cumulative refinement. Section 20.14 therefore turns next to the future research programme: empirical testing, formal development, comparative inquiry, institutional experimentation, longitudinal research, cross-cultural work, AI-era research, and theoretical revision can be organized around the boundaries identified here without presuming in advance which of them will narrow, extend, or substantially revise the present framework.

20.14 GRE Economic-Order Research Agenda

The role of this section is to convert the economic-order synthesis of this chapter into a bounded research agenda. Its objective is to identify the empirical, formal, comparative, experimental, longitudinal, cross-cultural, AI-era, and theory-revision tasks required to test and refine the claims developed in Sections 20.1–20.13. The section does not attempt to replace the dedicated GRE research programme developed later in the book. Its scope is narrower: it specifies what the economic-order architecture constructed in Chapter 20 now requires from subsequent research. The method is claim-linked and revision-oriented. Each research family is connected to identifiable objects, mechanisms, evidence, failure conditions, and possible consequences for the

framework.

Section 20.13 established that GRE claims carry explicit validity boundaries. A future research agenda should therefore do more than accumulate supportive examples. It should distinguish descriptive reconstruction from mechanism identification, compare GRE explanations with rival accounts, investigate transfer failures, test whether formal distinctions correspond to observable structures, and preserve negative results as programme-level evidence. The relevant question is not whether every inquiry confirms GRE vocabulary. It is whether GRE distinctions improve explanation, measurement, intervention design, comparative understanding, or theoretical revision within the scope claimed.

The research agenda also inherits an important asymmetry from the book's architecture. Some claims are already conceptually developed but empirically underidentified. Others have empirical analogues but incomplete formalization. Still others concern long-horizon or counterfactual structures that cannot be validated through one method or one dataset. Research design should therefore follow the status of the claim rather than impose one universal evidential template.

Definition 20.220 (Economic-order research-agenda profile). An *economic-order research-agenda profile* specifies, for a GRE economic-order claim, the research object, claim status, relevant mechanism, evidential requirement, appropriate methods, comparison or counterfactual structure, temporal horizon, principal uncertainty, plausible disconfirming result, and the conceptual or formal revision that such a result would trigger.

Definition 20.220 links future research to programme revision rather than treating research topics as independent additions. Table 20.14 summarizes the eight research families developed below.

Proposition 20.221 (Research-revision linkage condition). A GRE economic-order research programme is stronger when major empirical, formal, comparative, and applied inquiries specify in advance which findings would strengthen, narrow, decompose, reinterpret, or withdraw the claim being investigated.

Proposition 20.221 makes revision conditions part of research design. The result is a programme that can accumulate knowledge through support, failure, and boundary discovery alike.

20.14.1 Empirical Identification and Testing

The first research family concerns empirical identification. Many Chapter 20 concepts are structurally explicit but require empirical operationalization. Relational infrastructure, participation conversion, generative return, dependency-based power conversion, option preservation, institutional learning, and future-formation capacity cannot be tested adequately by attaching one indicator to each term. They are configurations whose observable traces may be distributed across institutions, time periods, administrative records, organizational practices, surveys, qualitative evidence, networks, and historical sequences.

Empirical research should therefore begin with the mechanism and claim level. A claim that documentation barriers reduce practical access requires different evidence from a claim that a platform's infrastructural control produces durable dependency, or that a public institution reproduces capability across personnel turnover.

Table 20.14: Research families for the GRE economic-order agenda.

Research family	Primary object	Research task	Revision signal
Empirical identification and testing	Relational mechanisms and economic-order profiles	Operationalize claims, identify mechanisms, compare rival explanations, and estimate scope	Repeated non-identification, contradictory mechanism evidence, or superior rival explanation
Formal development and model comparison	Typed relations, trajectories, conversion, power, value, and option structures	Clarify semantics, derive implications, compare model classes, and connect formalisms to evidence	Formal inconsistency, empirical non-correspondence, or excessive dependence on closure assumptions
Comparative economic-order studies	Institutional configurations across domains and jurisdictions	Compare recurrent structures, differentiated mechanisms, and transfer boundaries	Failed structural correspondence or domain-specific remainder that changes the GRE object
Institutional experimentation and intervention	Policies, institutions, infrastructures, and governance arrangements	Test bounded changes with safeguards, monitoring, learning, and repair pathways	Burden displacement, unanticipated dependency, failure of conversion, or weak external validity
Longitudinal and historical tracking	Capability, dependency, infrastructure, value, and possibility trajectories	Observe cumulative change, delayed effects, path dependence, and re-epistemization	Short-run findings reverse, disappear, or change mechanism over longer horizons
Cross-cultural and cross-jurisdictional comparison	Category meaning, standing, value, institutions, and conversion conditions	Test portability without erasing local semantics and institutional differences	Apparent recurrence depends on imposed categories or incomparable institutional functions
AI-era economic-order research	Capability asymmetry, abundance, scarcity relocation, participation, and infrastructure control	Track rapid changes in productive and epistemic systems and their institutional mediation	Capabilities, dependencies, or participation pathways evolve faster than the framework's categories
Theory revision and cumulative programme learning	GRE concepts, boundaries, and claim hierarchy	Integrate positive, negative, and boundary evidence into explicit conceptual revision	Persistent anomalies, failed transfers, conceptual inflation, or stronger alternative architecture

Some questions invite causal inference. Others require descriptive mapping, process tracing, comparative case reconstruction, relational measurement, or mixed-method triangulation.

Operationalization also creates measurement effects. Indicators can redirect organizational behavior, change participant incentives, or privilege what is easiest to record. GRE research should therefore preserve the distinction between the target relation and the indicator used to approximate it. Where measurement becomes part of governance, the measurement system itself becomes an economic-order object.

Definition 20.222 (Empirical-identification profile). A *GRE empirical-identification profile* records the target relation or mechanism, observational unit, relevant positions, proposed indicators and their provenance, identification assumptions, comparison structure, missing or latent dimensions, likely measurement effects, rival explanations, and the evidential pattern that would count against the stated mechanism.

Proposition 20.223 (Mechanism-indexed empirical condition). *Empirical support for a GRE concept is stronger when evidence identifies the proposed relational mechanism and its boundary conditions, rather than only showing correlation between outcomes that are compatible with several competing explanations.*

A priority for future work is therefore the construction of reusable empirical protocols for relation-indexed access, capability regeneration, typed dependency, conversion pathways, standing, value return, and option-space change. These protocols need not impose one metric across domains. Their purpose is to make mechanism claims more comparable while preserving domain-specific semantics.

20.14.2 Formal Development and Model Comparison

The second research family concerns formal development. The book has used partial orders, networks, fields, dynamical representations, operator-like transformations, spacetime language, typed relations, and other formal devices to clarify selected structures. Future work should determine which formalisms provide genuine explanatory or computational gain for particular economic questions and which remain primarily conceptual scaffolds.

Formal development should proceed through model comparison rather than symbolic accumulation. A network representation may be adequate for one dependency architecture while a temporal event structure is required for another. Agent-based models may illuminate adaptive coordination where closed-form models obscure heterogeneity. Algebraic or category-theoretic representations may clarify conversion and composition without supplying empirical prediction. No single model class should be presumed to dominate simply because it accommodates the vocabulary of the programme.

The most important formal task is semantic discipline. Every formal object should correspond to a stated economic object or operation, and assumptions introduced for tractability should remain distinguishable from claims about the target system. Model closure, observability, parameter identification, and sensitivity to omitted relations should be explicit.

Definition 20.224 (GRE model-comparison programme). *A GRE model-comparison programme compares alternative formal representations of the same economic-order problem by specifying their semantics, preserved relations, closure assumptions, empirical interfaces, computational properties, identifiable implications, failure conditions, and the domain-specific remainder left outside each representation.*

Proposition 20.225 (Formal-plurality research condition). *GRE formal development has stronger cumulative value when competing model classes are compared against a shared economic question and evidential interface, and when formal sophistication is separated from empirical adequacy or ontological authority.*

This agenda leaves room for ambitious formalisms while demanding that they earn analytical scope. The dedicated research programme later in the book can extend these model families systematically; the present chapter supplies the economic-order problems against which such extensions should be tested.

20.14.3 Comparative Economic-Order Studies

Chapter 19 demonstrated that recurrent GRE structures can appear across heterogeneous domains while retaining different mechanisms and remainders. Future comparative work should extend this discipline from domains to economic orders and institutional configurations. The research object is not a ranking of entire economies

by one GRE score. It is the comparison of specific relational architectures across cases that differ in institutions, histories, technologies, value structures, and scales.

Useful comparisons might examine alternative welfare-access architectures, different forms of public or cooperative infrastructure, platform governance regimes, research systems, care infrastructures, migration-status arrangements, or arrangements for value recirculation. Comparative design should identify which functions are genuinely comparable and which institutional forms perform different roles despite similar labels.

Negative comparison is as important as positive correspondence. A concept that transfers successfully across several cases may fail in a case where category meaning, causal mechanism, or institutional scale differs. Such failure can identify a hidden assumption in the original GRE formulation.

Definition 20.226 (Comparative economic-order correspondence). A *comparative economic-order correspondence* specifies the economic function or mechanism being compared, the cases and boundaries selected, relevant institutional and historical differences, the GRE structure hypothesized to recur, domain- or case-specific remainders, and the evidence required to distinguish structural correspondence from terminological similarity.

Proposition 20.227 (Comparative-revision condition). A *comparative GRE study* should treat failed correspondence as evidence about the scope of the concept being compared, including the possibility that the concept requires decomposition, narrower semantics, or case-specific replacement.

Comparative work is therefore one route through which economic diversity disciplines theoretical abstraction. It can reveal recurrent structures without converting institutional variety into noise.

20.14.4 Institutional Experimentation and Intervention

The fourth research family concerns institutional experimentation. Sections 20.3 and 20.11 established that policies and governance arrangements can be designed with monitoring, staged commitment, reversibility, learning, and exit-sensitive closure. Research should test how these architectures perform in practice while recognizing that participants in institutional experiments bear real costs and dependencies.

Relevant experiments may include new access pathways, portability rules, participatory mechanisms, interoperability standards, value-return arrangements, maintenance regimes, public-service interfaces, community governance procedures, or AI-assisted administrative systems. The research question should extend beyond whether the intervention changes one target metric. It should examine conversion, burden distribution, capability formation, dependency, institutional learning, and the possibility that the experiment changes the field in which later evaluation occurs.

Ethical and institutional constraints are part of the research object. Reversibility may be limited, participants may have unequal exit capacity, and experimental benefits can be concentrated while burdens are dispersed. Institutional experimentation therefore requires standing, remedy, data governance, monitoring of externalities, and transition planning alongside causal learning.

Definition 20.228 (Generative institutional experiment profile). A *generative insti-*

tutional experiment profile specifies the institutional mechanism being changed, affected positions, expected conversion pathway, monitoring and evidential design, exposure and burden, safeguards, participation and standing, stopping and revision conditions, reversibility or repair limits, externalities, and the scope within which experimental findings may be generalized.

Proposition 20.229 (Experimentation-burden condition). *Institutional experimentation has stronger research and governance warrant when learning benefits are evaluated together with participant burdens, dependency effects, externalities, correction pathways, and the practical recoverability of the affected configuration.*

Institutional experimentation can thus serve theory development without treating society as a frictionless laboratory. The experiment itself becomes part of the relational configuration whose consequences must be studied.

20.14.5 Longitudinal and Historical Tracking

Many GRE claims concern reproduction and transformation across time. Capability regeneration, institutional learning, generative depletion, path dependence, value recirculation, infrastructure maintenance, participation trajectories, and future-option effects can be misidentified by short observation windows. Longitudinal research is therefore central to the economic-order agenda.

Longitudinal design should track not only outcomes but changing mechanisms and categories. A policy can initially expand access and later generate administrative dependency. A platform can initially widen participation and later concentrate infrastructural control. An institution can appear efficient while succession capacity gradually erodes. An educational or research system can produce strong short-run outputs while losing the capabilities needed for future problem formation.

Historical research extends this temporal depth where prospective datasets are unavailable or categories themselves have changed. Archival reconstruction, institutional histories, oral histories, legal change, technical standards, and organizational records can reveal how present structures were generated and which alternatives were previously available but later closed.

Definition 20.230 (Longitudinal generative-trajectory record). *A longitudinal generative-trajectory record tracks, across a stated period, changes in outcomes, relations, capabilities, dependencies, infrastructures, institutional rules, value-return pathways, participation positions, option structures, category meanings, and the evidential revisions required as the configuration changes.*

Proposition 20.231 (Temporal-depth condition). *A GRE claim about regeneration, depletion, path dependence, institutional learning, or future possibility requires a temporal window sufficient to distinguish transient performance from changes in the mechanisms and capacities that reproduce the economic configuration.*

This condition makes temporal mismatch itself an empirical problem. Different components of an economic order can evolve on different clocks, and research designs should be capable of detecting those differences rather than forcing all effects into one horizon.

20.14.6 Cross-Cultural and Cross-Jurisdictional Comparison

Cross-cultural and cross-jurisdictional research tests whether GRE categories retain meaning when social practices, legal structures, institutional histories, linguistic systems, and normative traditions differ. This task is not reducible to adding country fixed effects to a common model. The categories through which economic standing, care, community, ownership, contribution, legitimacy, or obligation are understood can themselves differ across contexts.

Research design should therefore separate structural comparison from semantic imposition. A relation described as dependency in one context may be understood through kinship, public obligation, professional hierarchy, community stewardship, or contractual authority in another. Similar institutional labels can also conceal different rights, enforcement structures, or practical access conditions.

Translation is therefore substantive. Multilingual inquiry, local conceptual history, legal interpretation, ethnographic work, and co-designed measurement can reveal whether the GRE object survives translation or whether a local concept identifies a relation that the original framework missed.

Definition 20.232 (Cross-context translation profile). A *cross-context translation profile* records the GRE concept being compared, local categories and languages through which the relation is expressed, institutional and legal context, relevant historical formation, translation choices, measurement correspondence, normative differences, and the remainder that resists or revises the transferred concept.

Proposition 20.233 (Cross-context validity condition). A *GRE concept has stronger cross-cultural or cross-jurisdictional warrant when structural correspondence is established without requiring local categories, values, or institutions to be redescribed as imperfect versions of the original analytical case.*

Cross-context research can consequently expand GRE by discovering missing categories, not merely by testing an unchanged framework in additional locations.

20.14.7 AI-Era Economic-Order Research

The seventh research family concerns rapid AI-mediated transformation. Chapters 17 and 18, together with Sections 20.9 and 20.10, identify a moving research frontier in which productive and symbolic abundance, epistemic mediation, capability asymmetry, infrastructure control, and participation can change faster than conventional institutional data are updated.

AI-era research should therefore track configurations rather than model benchmarks alone. Relevant objects include organizational workflow, verification burden, retained human capability, professional judgment, ownership and access to productive intelligence, infrastructure dependency, participation pathways, value capture, public capacity, and the reallocation of attention and orientation. The same nominal technology can have different economic effects when embedded in different institutional architectures.

Measurement will also need versioning. Model capability, platform policy, access conditions, interfaces, pricing, data practices, and organizational adaptation can change during the research period. A study that records only a product name or model class can quickly lose interpretive precision. AI-era research therefore requires provenance for technical and institutional conditions together with economic

outcomes.

Definition 20.234 (AI-era economic-order research profile). An *AI-era economic-order research profile* records the artificial capability being used, model or system version where relevant, access and infrastructure conditions, organizational embedding, affected human and collective capabilities, verification architecture, dependency and control positions, participation and standing effects, value-capture pathways, and the temporal validity of the resulting claim.

Proposition 20.235 (AI-configuration research condition). *Research on AI-mediated economic order has stronger explanatory value when capability changes are studied together with institutional embedding, infrastructure control, verification, dependency, participation, and retained human or collective capability, rather than inferred from model performance alone.*

Rapid change also makes negative and obsolete findings valuable. A mechanism that disappears after technical or institutional change can reveal which part of the previous configuration carried the effect.

20.14.8 Theory Revision and Cumulative Programme Learning

The final research family concerns the programme's capacity to learn from its own investigations. A research programme can become self-sealing if every supportive case is counted as confirmation while failures are redescribed as additional complexity. GRE should instead preserve a versioned architecture of claims, evidence, counterexamples, competing explanations, domain failures, and conceptual changes.

Theory revision can take several forms. A concept may be narrowed because its original domain was too broad. A relation may be decomposed into several typed mechanisms. A formal representation may be replaced because its closure assumptions distort the target. A normative claim may be separated from an empirical mechanism. A domain remainder may become a new GRE concept. Repeated failure may justify withdrawal of a claim rather than indefinite repair.

Cumulative learning also requires claim genealogy. Later formulations should preserve enough history to reconstruct why earlier versions were adopted, which evidence challenged them, and what problem the revision was intended to solve. This prevents theoretical change from erasing the record needed to evaluate whether the programme is genuinely learning.

Definition 20.236 (GRE programme-revision record). A *GRE programme-revision record* is a versioned account of a GRE claim or concept that preserves its previous formulation, evidential basis, formal or interpretive assumptions, counterevidence, rival explanations, transfer failures, boundary changes, revised formulation, unresolved remainder, and the conditions under which further revision or withdrawal would be warranted.

Proposition 20.237 (Cumulative-revision condition). *GRE functions as an open cumulative research programme only where supportive findings, negative results, boundary evidence, rival explanations, and conceptual withdrawals can all alter the status and scope of its claims through an explicit revision record.*

This condition closes the Chapter 20 research agenda without exhausting the larger programme. Empirical identification can test whether proposed mechanisms are present. Formal work can sharpen and compare representations. Comparative stud-

ies can expose hidden assumptions. Experiments can test bounded institutional alternatives. Longitudinal work can distinguish reproduction from temporary performance. Cross-context research can reveal missing categories. AI-era inquiry can track rapidly moving configurations. Theory revision can integrate all of these results without treating the framework as fixed.

The dedicated research-programme chapter in Part VIII can develop these families into a substantially wider agenda covering GRE's concepts, formal methods, historical and interpretive research, measurement, falsification, negative results, intervention, and comparative theory. The present section has a narrower role: it identifies the research obligations generated by the economic-order synthesis of Chapter 20. Section 20.15 turns next to a different boundary question: what the economic-domain development of GRE may contribute to the future development of Generative Relational Theory, and what should remain domain-specific.

20.15 GRE Contributions to Future Generative Relational Theory

The role of this section is to clarify the relation between Generative Relational Economics (GRE) and the possible future development of a more general Generative Relational Theory (GRT). Its objective is to specify what the economic-domain work developed in this book can contribute to broader theory formation, which results remain specific to economics, and what evidential and comparative conditions would be required before a recurrent GRE structure could receive wider theoretical scope. The section proceeds through domain instantiation, explanatory gain, boundary evidence, cross-domain comparison, candidate invariants, domain-bound assumptions, generalization warrant, and general-theory formation discipline. The method is comparative and programme-theoretic: success, failure, non-transfer, and unresolved remainder are treated as evidence about scope rather than as stages in an assumed progression toward unification.

GRE has been developed throughout this book as a domain-specific research programme. Its central objects include economic subjects, allocation and conversion, value processes, institutions, infrastructures, productive and reproductive relations, power, participation, knowledge, artificial capability, and economic future formation. Many of the relational and generative distinctions used to study these objects may have analogues elsewhere, but an analogy does not establish a domain-independent structure. Chapter 19 already showed, within the economic programme, that recurrence across education, research, work, welfare, commons, platforms, public institutions, migration, ecology, and culture can coexist with different mechanisms, evidential requirements, temporalities, and normative remainders. Section 20.13 then made explicit that every GRE claim carries validity boundaries, while Section 20.14 linked those boundaries to a revision-oriented research agenda. The present section extends that discipline to generalization beyond economics.

A future GRT would require more than the removal of economic vocabulary from GRE. It would require independently developed domain programmes, explicit translation between their objects and methods, negative cases in which proposed structures fail to transfer, and evidence that any candidate invariant retains explanatory work after domain-specific assumptions are removed. GRE can therefore contribute cases,

Table 20.15: GRE contributions and restraints in future GRT development.

Dimension	GRE contribution	Possible broader-theory use	Required restraint
Domain instantiation	Economically specified relational and generative objects	Test case for domain realization of GR vocabulary	Preserve economic semantics and institutional specificity
Explanatory gain	Distinctions that improve reconstruction, explanation, measurement, or intervention	Evidence that a relational distinction can do substantive work	Do not convert local usefulness into universal validity
Boundary evidence	Failed transfer, weak identification, rival explanation, and conceptual remainder	Information about where a candidate structure changes or disappears	Preserve negative cases rather than absorb them as complexity
Cross-domain comparison	Explicit mapping of objects, mechanisms, scales, and evidence	Test of structural recurrence across independently developed domains	Compare structure rather than terminology alone
Candidate invariants	Recurrent patterns such as configuration, conversion, dependency, regeneration, and path formation	Hypotheses for broader relational theory	Treat recurrence as candidate status until counterdomains are examined
Domain-bound assumptions	Prices, property, economic institutions, production, allocation, and other economic closures	Clarification of what should remain domain-specific	Avoid exporting economic assumptions through abstract vocabulary
Generalization warrant	Comparative support, rival testing, boundary mapping, and formal correspondence	Justification for carefully scoped expansion of claim domain	Require evidence across domains and methods
Theory-formation discipline	Versioning, branching, deferred unification, and withdrawal	Architecture for cumulative GRT development	Permit plural GR formulations and failed generalization

distinctions, formal experiments, boundary evidence, and candidate structures. It cannot, by itself, establish the scope of a general relational theory.

Definition 20.238 (Economic-domain contribution profile). An *economic-domain contribution profile* records a GRE concept or claim, its economic object and mechanism, evidential and formal support, known boundary conditions, domain-specific assumptions, observed failures or remainders, candidate cross-domain structure, and the additional comparative evidence required before a broader theoretical interpretation would be warranted.

Definition 20.238 treats generalization as a claim requiring its own warrant. Table 20.15 summarizes the eight dimensions developed below.

Proposition 20.239 (Domain-contribution condition). *GRE contributes most strongly to future GRT development when economic-domain results are transferred as scoped evidence, candidate structures, and boundary records whose broader validity remains open to independent cross-domain testing.*

Proposition 20.239 establishes the governing relation for the section. General theory, if it becomes warranted, should be reconstructed through domain comparison rather than obtained by abstraction from one successful domain programme.

20.15.1 Economic-Domain Instantiation of GR Inquiry

GRE can be understood as an economic-domain instantiation of a broader generative relational orientation. The word *instantiation* requires care. It does not mean that a complete GRT already exists and GRE merely substitutes economic nouns into a

finished general schema. The direction of learning can run both ways. A domain programme may inherit provisional relational distinctions while also discovering objects, failures, and formal requirements that later reshape the more general vocabulary.

Economic inquiry gives relational concepts unusually concrete institutional carriers. Dependency can be mediated through employment, debt, infrastructure, property, platforms, welfare administration, legal status, or access to artificial systems. Conversion can involve resources, rights, money, data, knowledge, status, institutional standing, or productive capability. Generativity can appear through capability formation, maintenance, institutional reproduction, knowledge creation, ecological regeneration, or path creation. These cases give relational vocabulary observable and historically reconstructable economic forms.

At the same time, their economic specification matters. A price is not merely a generic relation. Property is not only a relation among abstract nodes. Employment, public infrastructure, monetary systems, welfare rights, contractual obligations, and productive organizations carry legal, historical, institutional, and normative structures that may have no direct equivalent in another domain. GRE therefore tests a generative relational orientation through economic specificity rather than escaping that specificity.

Definition 20.240 (Economic-domain instantiation profile). An *economic-domain instantiation profile* specifies the shared generative or relational concept being used, its economic objects and carriers, the mechanisms through which it is realized, the economic institutions or constraints that shape it, the evidence through which it becomes accessible, and the domain-specific remainder that should remain visible if the concept is compared beyond economics.

Proposition 20.241 (Instantiation-specificity condition). A GRE concept is a stronger candidate for later cross-domain comparison when its economic realization is specified precisely enough that shared structure can be separated from the economic institutions, semantics, and closure assumptions through which the structure became observable.

This condition also prevents abstract vocabulary from concealing economic assumptions. A future GRT should learn from how generative relations become institutionally realized in economics while retaining the possibility that other domains realize related structures through materially different objects.

20.15.2 Economic-Domain Explanatory Gains

The second contribution concerns domain-specific explanatory gain. A broader theory should not inherit a GRE distinction simply because it is conceptually appealing. The more relevant evidence is whether the distinction improves economic inquiry relative to available alternatives. Improvement can take several forms: a relation may reveal a mechanism obscured by object-centered description; a conversion analysis may explain why formal allocation produces unequal practical capability; a typed dependency may distinguish beneficial coordination from power-producing reliance; or a generative-trajectory analysis may reveal long-horizon depletion behind strong current performance.

Such gains remain claim-specific. GRE need not outperform existing economics as a whole in order to contribute useful concepts. A relational reconstruction may be valuable for one class of institutional problems while a conventional price model remains sufficient for another. A generative analysis may add information about ca-

pability reproduction without improving short-run forecasting. The evidential unit should therefore be the local explanatory or analytical task.

The same discipline applies to formal work. A 2-complex, network, field, partial-order, dynamical, or operator-like representation provides evidence for broader theory only where it clarifies a structure that simpler representations leave obscure and where its semantics remain identifiable. Formal richness alone cannot establish a general invariant.

Definition 20.242 (Economic-domain explanatory-gain profile). An *economic-domain explanatory-gain profile* records the target economic question, baseline descriptions or rival explanations, the GRE distinction or model applied, the mechanism or structure made visible, the evidential improvement obtained, remaining ambiguity, and the scope within which the gain has been established.

Proposition 20.243 (Explanatory-gain transfer condition). *A domain-specific GRE success supplies stronger evidence for future generalization when the source of its explanatory gain can be identified independently of the specifically economic assumptions that produced the case.*

Domain success therefore produces a candidate for comparison, not an automatic component of GRT. The distinction matters because a concept can be highly productive in economics precisely because it aligns with historically specific economic institutions.

20.15.3 Economic-Domain Boundary Evidence

Domain-specific failure is equally important for future theory formation. GRE may fail to identify a mechanism in a case, add little beyond a simpler account, require assumptions that cannot be defended, or encounter an economic object whose structure is poorly captured by its current vocabulary. Such results should not be treated merely as defects awaiting reinterpretation. They can reveal where a candidate general concept changes type, where a domain assumption was hidden inside the abstraction, or where an alternative theory provides a better account.

Boundary evidence can arise at several levels. An empirical mechanism may fail to appear. A formal representation may depend on closure assumptions that remove the relevant economic relation. A value-conversion analysis may not distinguish competing interpretations. A generativity concept may become too elastic to discriminate among cases. A cross-domain translation may produce a large remainder. Each failure has different implications for programme revision.

A future GRT would be especially vulnerable to self-sealing if domain failures were automatically redescribed as additional relational complexity. General theory requires the capacity to say that a proposed invariant does not travel, that a category is economics-specific, or that a concept should be divided into several domain-sensitive types.

Definition 20.244 (Economic-domain boundary-evidence record). An *economic-domain boundary-evidence record* preserves the GRE claim tested, case and boundary, expected mechanism, observed discrepancy or failure, rival explanation, domain-specific condition implicated, theoretical level affected, and whether the result warrants narrowing, decomposition, reinterpretation, local replacement, or withdrawal.

Proposition 20.245 (Boundary-evidence contribution condition). *Negative or boundary evidence from GRE contributes to future GRT when it changes the proposed scope or structure of a generalization rather than being absorbed automatically into a more permissive version of the same claim.*

A mature general theory would therefore need an archive of failed transfers alongside successful ones. GRE can contribute such records before broader theory is attempted.

20.15.4 Cross-Domain Comparative Architecture

Cross-domain comparison is the principal bridge through which GRE results could later become evidence about GRT. The relevant comparison is structural rather than lexical. Two domains may use words such as *relation*, *constraint*, *capacity*, *conversion*, or *generation* while referring to different objects, mechanisms, temporalities, and evidential practices. Conversely, structurally related mechanisms may be expressed through entirely different domain vocabularies.

Comparison should therefore begin from independently specified domain objects. A candidate structure can then be tested for correspondence across subject types, relation types, transformations, scales, histories, evidence, and practical consequences. This approach permits partial correspondence. One component may transfer while another remains domain-bound. A shared formal pattern may survive while its normative interpretation changes. A temporal architecture may recur while the relevant causal mechanism does not.

Chapter 19 provided an internal rehearsal of this discipline across heterogeneous economic domains. A future cross-domain comparison would require a stronger test because the receiving domain would not be economically constituted in the same way. The comparison must therefore preserve the receiving domain's own categories and standards of evidence.

Definition 20.246 (Cross-domain structural-correspondence profile). *A cross-domain structural-correspondence profile records the source and receiving domains, independently defined objects, proposed shared relation or transformation, semantic translation, relevant scales and temporalities, evidential interfaces, formal correspondence where used, mismatches, domain-specific remainders, and plausible counterexamples.*

Proposition 20.247 (Cross-domain correspondence condition). *Cross-domain recurrence supplies evidence for broader theory only when structural correspondence survives explicit comparison of semantics, mechanisms, scale, evidence, and domain-specific remainder.*

This condition makes non-translation informative. A general theory need not require every domain to instantiate every concept. Its credibility may instead depend on knowing which structures recur, which branch into typed variants, and which remain local.

20.15.5 Candidate Cross-Domain Invariants

GRE suggests several structures that may merit cross-domain testing. Their status in this section is strictly candidate. They are research hypotheses about possible invari-

ance, not established universal properties.

One candidate is the *history-bearing configuration*: an analytical object whose present state depends on relations, prior transformations, and inherited constraints. A second is *generative transformation*: a process whose consequences include changes in later capabilities, relations, constraints, or possibility structures. Additional candidates include typed dependency, conversion interfaces, multiscale temporal coupling, maintenance and regeneration, differentiated standing, path creation, and the distinction between represented alternatives and practically reachable possibilities.

These structures have proved useful across many economic questions in this book. Their recurrence within GRE is meaningful because the economic cases differ substantially. Yet Chapter 19 remains inside an economic research programme. Repeated usefulness across economic domains therefore demonstrates internal portability more strongly than general-theory invariance.

Definition 20.248 (Candidate cross-domain invariant profile). A *candidate cross-domain invariant profile* specifies the proposed invariant structure, the economic cases in which it recurs, the transformation under which it is claimed to remain structurally recognizable, domain-specific realizations, known counterexamples or failures, competing abstractions, and the independent domains required for further testing.

Proposition 20.249 (Invariant-warrant condition). *A recurrent GRE structure should remain a candidate invariant until its proposed invariance has been tested across independently constituted domains and against plausible competing abstractions that explain the same recurrence.*

The phrase *candidate invariant* therefore carries a methodological burden. It requires specifying what is preserved through translation, not merely observing that several domains can be redescribed using the same general word.

20.15.6 Domain-Bound Assumptions and Remainders

Generalization also requires active identification of what should remain economic. GRE relies on concepts and closures that are powerful precisely because the economic domain contains institutions such as markets, money, property, firms, labor relations, public budgets, contracts, platforms, productive infrastructure, welfare systems, and legal-economic standing. Even where another domain has analogous coordination or exchange, the economic semantics and institutional history should not be presumed to transfer.

Some assumptions enter through measurement. Monetary valuation, prices, productivity, income, cost, ownership, or formal access can provide economically meaningful observations while having no domain-general status. Other assumptions enter through normative or institutional roles. Scarcity, allocation, participation, standing, and return have economic meanings shaped by rights, obligations, institutional rules, and historical organization.

Domain-specific remainder is therefore constructive. It identifies what a broader GRT should leave to economics rather than absorb into abstract vocabulary. A general theory that explains every economic object only by redescribing it at a higher level may lose the institutional specificity that made the explanation useful.

Definition 20.250 (Domain-bound assumption and remainder profile). A *domain-bound assumption and remainder profile* records the economic concept or closure being used, the institutional or historical conditions that give it meaning, which components may support cross-domain comparison, which components lack justified analogues elsewhere, and what explanatory loss would follow if the economic remainder were removed.

Proposition 20.251 (Domain-containment condition). *Future GRT development should preserve economically specific assumptions and remainders whenever abstraction would erase mechanisms, institutional meanings, or evidential structures needed to explain the economic case.*

Domain containment is therefore part of successful generalization. A broader theory gains credibility by specifying what it does not absorb.

20.15.7 Generalization-Warrant Conditions

The seventh subsection states a provisional standard for future generalization. No single checklist can guarantee theoretical validity, yet several conditions can make a broader claim more defensible. The candidate structure should first be stated with semantics clear enough to survive domain translation. Independent domain programmes should then reconstruct their own objects without importing the conclusion. Structural correspondence should be supported by appropriate evidence within each domain. Rival explanations and counterdomains should be considered. Domain-specific remainder should remain visible. The generalization should also specify the level at which recurrence is claimed: descriptive pattern, mechanism, formal relation, generative transformation, normative implication, or some combination of these.

Methodological plurality matters because one mode of evidence can make a pattern appear more general than it is. A formal isomorphism may coexist with different causal mechanisms. Similar historical trajectories may arise through distinct relations. Comparable qualitative descriptions may conceal different scale structures. Cross-domain warrant is therefore stronger where several methods converge on the relevant structure while preserving their separate epistemic limits.

Generalization also needs a stopping rule. If the candidate concept must be broadened repeatedly to encompass every counterexample, the result can lose discriminative value. A useful general theory should permit some proposed generalizations to fail.

Definition 20.252 (Generalization-warrant profile). A *generalization-warrant profile* records the candidate shared structure, source domains, independent domain specifications, semantic and formal correspondences, supporting and negative evidence, rival abstractions, methodological diversity, known remainders, counterdomains, proposed scope, and the findings that would require narrowing or withdrawal of the generalized claim.

Proposition 20.253 (Cross-domain generalization condition). *A GRE-derived structure acquires stronger warrant for inclusion in future GRT when independently constituted domains support the proposed correspondence, relevant counterexamples and rivals have been examined, domain-specific remainders remain explicit, and the generalized claim retains conditions under which it can be narrowed or withdrawn.*

This standard is intentionally demanding. General theory has value only if its wider scope adds explanatory organization without purchasing that scope through conceptual vagueness.

20.15.8 General-Theory Formation Discipline

The final subsection concerns the discipline of theory formation itself. A future GRT may develop through accumulation, branching, competing formulations, partial unification, and the abandonment of unsuccessful generalizations. GRE should contribute to that process without treating generalization as the predetermined endpoint of domain inquiry.

One implication is that deferred generalization can be a positive theoretical state. If economics, law, ecology, education, history, governance, or other domains share some structures but diverge on others, a family of related domain theories may be more informative than a single maximally abstract formulation. General theory can remain layered: some invariants may be broad, some transformations typed by domain, and some concepts intentionally local.

A second implication concerns versioning. Candidate GRT concepts should preserve their domain sources, revision history, failed correspondences, and alternative formulations. Later unification should remain reconstructable rather than retroactively presenting the final vocabulary as if it had been implicit from the beginning.

A third implication concerns normative authority. Even if a relational or generative structure generalizes descriptively, normative conclusions need independent warrant. A general account of generativity would not by itself establish that generativity has overriding normative priority in every domain.

Definition 20.254 (General-theory formation record). A *general-theory formation record* is a versioned account of a candidate GRT concept or structure that preserves its domain sources, semantics, evidential support, formal representations, successful and failed transfers, competing formulations, domain remainders, revisions, current scope, and unresolved conditions for further generalization.

Proposition 20.255 (General-theory formation discipline). *Future GRT development is more robust when domain specificity, failed transfer, branching formulations, deferred unification, normative remainder, and claim withdrawal remain legitimate outcomes of theory formation.*

This discipline states the contribution of Chapter 20 without attempting to complete GRT. GRE supplies a developed economic instantiation, a record of internal cross-domain translation, a set of candidate structures, formal experiments, empirical obligations, and explicit validity boundaries. Its successes can identify promising candidates for wider inquiry; its failures can identify the conditions under which those candidates should change or remain economic. The chapter's closing section can therefore provide provisional closure at the economic level while leaving general-theory development contingent on future domain evidence, comparison, criticism, and revision.

Table 20.16: Functions of provisional closure for the economic-order synthesis

Closure function	Primary object	Required discipline	Handoff consequence
Scoped establishment	Economic-order contributions developed in Chapter 20	Preserve claim status, assumptions, domain, evidence, and normative limits	Makes the synthesis reusable without universalizing it
Remainder preservation	Unresolved economic-order tensions, mechanisms, and domain-specific remainders	Record what remains unresolved and why it matters	Converts incompleteness into explicit research objects
Inquiry handoff	Claims requiring comparison, testing, translation, or failure analysis	Identify the next evidential, theoretical, or disciplinary interface	Prevents Chapter 20 from duplicating later programme architecture
Open future formation	Economic-order possibilities not settled by the present synthesis	Preserve plurality, path dependence, reversibility, and revision conditions	Leaves economic futures open while allowing the chapter to close

20.16 Provisional Closure of Economic-Order Synthesis

The role of this section is to close the economic-order synthesis developed in Chapter 20 without converting that synthesis into a closure of the GRE research programme as a whole. Sections 20.1–20.12 assembled an economic-order analysis of evaluation, policy, institutions, infrastructure, participation, value recirculation, plural value, changing scarcity, radical capability asymmetry, adaptive governance, and future formation. Sections 20.13–20.15 then stated the validity boundaries, research obligations, and general-theory interface associated with that synthesis. The present task is narrower: to identify what has become sufficiently explicit for reuse, preserve unresolved economic-order remainders, and specify the handoff to the theoretical dialogue, research-programme, cross-domain, limitation, and programme-identity work that follows in Chapters 21–25.

This chapter therefore distinguishes *closure of an analytical cycle* from *closure of a theory*. Economic-order synthesis can be provisionally complete when its objects, relations, scope conditions, unresolved tensions, and research interfaces are explicit enough to support criticism and continued inquiry. That state does not settle the identity of GRE, the governance of programme revision, the admissibility of future formulations, or the final architecture of open research. Those programme-level questions belong to the later chapters designed to address them directly.

Definition 20.256 (Economic-order synthesis closure profile). An *economic-order synthesis closure profile* records the principal economic-order claims stabilized in a bounded GRE synthesis, their scope and present status, unresolved economic-order questions and remainders, the empirical or formal interfaces capable of revising them, and the downstream chapters or research programmes to which those questions are handed.

Definition 20.256 makes closure a scoped analytical state. The profile does not require consensus that the represented economic order is normatively desirable, empirically universal, or theoretically complete. It requires enough explicit structure that subsequent inquiry can distinguish what Chapter 20 has argued from what it has left open.

Table 20.16 summarizes the four functions of this chapter-level closure.

20.16.1 Established Architecture and Scoped Contributions

The first closure function is to state what the economic-order synthesis has made available at its present level of warrant. The contribution is not a preferred constitutional blueprint. It is an integrated analytical architecture in which economic order can be examined as a history-bearing configuration of subjects, relations, institutions, infrastructures, capabilities, value processes, dependencies, power relations, and future possibility structures.

Several elements of that architecture are now sufficiently explicit for criticism and reuse. Allocation has been separated from realized access by attention to conversion conditions. Value has been treated as heterogeneous and relational, with distinct processes of generation, propagation, conversion, circulation, return, dissipation, and extraction. Generative spacetime has introduced sequence, delay, accessibility, path dependence, and historical inheritance into economic-order analysis. Power has been distinguished from asymmetry while remaining traceable through dependency, infrastructure, recognition, access, and conversion. Knowledge, artificial intelligence, maintenance, participation, and regeneration have been integrated without being reduced to a single scalar objective.

These contributions remain bounded by the disciplines stated throughout the book. Generativity does not establish goodness. Relational representation does not settle ultimate ontology. Formal tractability does not supply empirical warrant. Cross-domain recurrence does not establish theoretical identity. Economic-order analysis does not select one universally preferred institutional arrangement.

Proposition 20.257 (Scoped-establishment condition). *A contribution of the Chapter 20 synthesis is provisionally established only at the level supported by its stated semantics, assumptions, evidence, formal role, domain scope, and validity boundaries; completion of the chapter does not enlarge that warrant.*

Proposition 20.257 permits a concept to become stable enough for cumulative use while remaining open to narrower semantics, better measurement, rival formalization, or empirical defeat. The achieved object is therefore a scoped economic-order architecture rather than a terminal doctrine.

20.16.2 Unresolved Economic-Order Remainders

The second closure function is to preserve unresolved structure. A polished synthesis can become misleading when open mechanisms, normative disagreements, or domain-specific remainders disappear from its closing account. Chapter 20 therefore retains them as part of the state of inquiry.

Empirically, many mechanisms proposed in the chapter require identification across institutions, jurisdictions, and historical settings. Formally, several representations remain exploratory and can admit competing model families. Normatively, plural value, differentiated standing, ecological and intergenerational claims, AI-mediated participation, and the relation between distributive and generative justice cannot be settled by economic description alone. Institutionally, contestability, interoperability, counter-power, maintenance, and value return remain design problems whose workable forms depend on local history and governance. Historically, categories that are coherent in contemporary economies may change as technologies, institutions, ecological conditions, and political orders change.

Chapter 19 also leaves domain-specific remainders that constrain economic-order generalization. Education adds processes of judgment and capability formation; care makes dependency and social reproduction unusually visible; ecology introduces biophysical conditions and non-human affectedness; migration introduces multi-jurisdictional standing; culture adds interpretation and symbolic inheritance; platforms make executable institutional architecture especially salient. Such remainders can require revision of GRE categories rather than assimilation into them.

Definition 20.258 (Economic-order remainder register). An *economic-order remainder register* records an unresolved mechanism, normative remainder, model limitation, domain-specific structure, evidential gap, or serious counterexample together with the Chapter 20 claim it qualifies, the reason it remains unresolved, and the form of inquiry capable of materially changing its status.

Proposition 20.259 (Remainder-preservation condition). *Provisional closure of an economic-order synthesis is stronger when material unresolved remainders remain explicit components of the research state rather than becoming implicit assumptions of framework completeness.*

The remainder register therefore serves as an interface to subsequent work. Some entries become problems for theoretical dialogue in Chapter 21; some become research streams in Chapter 22; some require neighboring-domain translation in Chapter 23; and some become limitation or failure questions in Chapter 24.

20.16.3 Handoff Conditions for Continued Inquiry

The third closure function specifies how the economic-order synthesis is handed forward. Chapter 20 should not reproduce the programme-level revision architecture developed later in the book. It should instead state which kinds of downstream work are required before its economic-order claims can acquire broader warrant.

Four handoff routes are especially important. The first is *theoretical comparison*: concepts such as value, scarcity, agency, power, institution, and economic order must remain comparable with alternative economic theories rather than being insulated by GRE vocabulary. Chapter 21 supplies that dialogical test. The second is *research operationalization*: proposed mechanisms require research objects, measurements, historical reconstructions, formal models, interventions, counterevidence, and replication practices. Chapter 22 develops that programme. The third is *disciplinary translation*: some economic-order questions cross into law, political theory, education, ecology, history, aesthetics, or AI studies and require domain-specific semantics and standards of warrant. Chapter 23 specifies those interfaces. The fourth is *failure analysis*: the synthesis must remain vulnerable to representational error, empirical non-identification, failed translation, normative underdetermination, and framework-level revision. Chapter 24 makes those vulnerabilities explicit.

Definition 20.260 (Economic-order handoff record). An *economic-order handoff record* specifies a Chapter 20 claim or unresolved remainder, the downstream inquiry required to evaluate or extend it, the evidence or comparison relevant to that inquiry, and the later chapter or research interface responsible for carrying the question forward.

Proposition 20.261 (Non-duplication handoff condition). *Chapter-level closure is architecturally stronger when it preserves the questions required by later inquiry while leaving programme identity, revision governance, cross-domain adjudication, and*

framework-level failure analysis to the chapters that undertake those tasks directly.

This handoff condition preserves continuity without repetition. It also makes disagreement productive. A later chapter may narrow, qualify, or reject a Chapter 20 construction without treating that change as a failure of book coherence; the architecture is designed to expose such revision paths.

20.16.4 Open Economic-Order Futures

The final closure function concerns the object of Chapter 20 itself: economic-order formation remains historically open. The chapter has argued that infrastructures, institutions, value processes, capability distributions, knowledge systems, ecological conditions, and power relations shape future possibility. No conclusion reached here establishes a unique terminal economic order.

Open future formation does not imply that every pathway is equally desirable or that institutions should maximize optionality without limit. Some closures are ethically, ecologically, technically, or legally justified; some redundancies are costly; some trajectories become infeasible because the material world changes. The analytical requirement is narrower: where a present order materially shapes later possibility, the affected capacities, dependencies, path-creation mechanisms, reversibility conditions, and distribution of foreclosure should remain available for evaluation.

Definition 20.262 (Open economic-order future profile). An *open economic-order future profile* records the consequential future pathways made more or less accessible by a present economic-order configuration, the capacities and infrastructures on which those pathways depend, the positions bearing major foreclosure or transition costs, and the conditions under which later revision remains possible.

Proposition 20.263 (Non-terminal economic-order closure). *Provisional closure of the Chapter 20 synthesis does not identify a terminal economic order; it identifies a sufficiently explicit present architecture from which competing future formations can be compared, investigated, and revised.*

Chapter 20 can therefore close without closing GRE and without closing the economic future it studies. Its specific contribution is the integrated economic-order frame. Chapter 21 now subjects that frame to dialogue with alternative economic theories, beginning the book's transition from substantive synthesis to comparative testing, explicit research-programme construction, cross-domain interfaces, limitation analysis, and final programme-level closure.

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Chapter 21

Relational Dialogue among Economic Theories

Theoretical Dialogue and Disciplinary Return

Chapter 21 opens Part VIII by returning Generative Relational Economics (GRE) to the wider theoretical ecology from which it emerged. Parts I–VII developed GRE progressively through historical reconstruction, disciplinary constitution, ontological and epistemological discipline, research and application praxis, substantive economic architecture, power and knowledge, artificial intelligence, domain translation, and economic-order synthesis. That sequence necessarily foregrounded GRE's own conceptual vocabulary. The present chapter changes the direction of inquiry. Its task is to place GRE in sustained dialogue with economic traditions that organize economic reality through different objects, subjects, causal mechanisms, temporalities, value concepts, methods, and standards of evidence.

The chapter does not treat theoretical dialogue as a preliminary contest whose purpose is to identify one final winner. Economic traditions often illuminate different mechanisms, scales, historical formations, or dimensions of the same process. Some disagreements can be clarified through translation; some arise from different evidential regimes; some reflect distinct normative commitments; and some remain genuinely irreducible. A relational dialogue is useful when it makes these differences more precise while preserving the possibility that one theory may explain a local mechanism better than GRE. Theoretical plurality consequently becomes a source of correction as well as comparison.

This chapter also adopts a reflexive premise: economics itself has a history. The objects recognized as economic, the problems treated as central, the institutions through which research is organized, and the methods accepted as evidentially authoritative have changed over time. Classical political economy organized inquiry around wealth, production, distribution, class, accumulation, trade, and public revenue; marginalist and neoclassical traditions reformulated value and choice; twentieth-century formalization and econometrics altered the representational and evidential architecture of the field; institutional, historical, behavioral, feminist, ecological, complexity, capability, and relational traditions widened or redrew economic

boundaries in other directions. These changes do not imply that economics lacks an object. They indicate that the practical and disciplinary constitution of that object is historically mediated.

Chapter 2 already reconstructed many of the traditions considered in Sections 21.12–21.24 as components of GRE's intellectual genealogy. The present chapter treats those reconstructions as historical baselines rather than reopening them. Where Chapter 2 provides a dedicated genealogical treatment, the theory-specific sections below reintroduce historical detail only when it is required to identify a mechanism, establish a domain of adequacy, preserve an evidential practice, or mark a translation boundary. Their principal object is the relation between a mature GRE and an independently developed neighboring theory. The relevant question is therefore not primarily how a tradition developed, but what its analytical architecture makes visible, where it remains especially effective, what it reveals that GRE may obscure, and which parts resist translation. This dialogue is reciprocal: neighboring theories may constrain GRE's claims, expose missing distinctions, provide better local models, and identify domains in which generative-relational abstraction should recede.

The chapter therefore proceeds in four movements. Sections 21.1–21.11 establish the comparative architecture. They examine economics as a relationally generated discipline, theories as relational configurations, a common but non-reductive vocabulary for dialogue, heterogeneous units of analysis and subjects, relations and structures, value and commensuration, scarcity and distribution, time and history, power and coordination, and evidential regimes. This movement supplies questions that can be asked across theories without assuming that the answers are equivalent.

Sections 21.12–21.24 then place major traditions into theory-specific dialogue through that comparative architecture. Classical political economy, neoclassical economics, Marxian political economy, Keynesian and Post-Keynesian economics, institutional and historical economics, behavioral and experimental economics, evolutionary and complexity economics, feminist and care economics, capability and human-development approaches, ecological economics, commons and solidarity traditions, economic sociology and relational economics, and digital or platform-centered analysis are examined for the mechanisms and objects they make visible. Where Chapter 2 already provides the genealogy, these sections treat it as a baseline; where no equivalent dedicated treatment exists, additional historical exposition is retained. In both cases, each tradition should preserve its conceptual commitments, evidential warrants, and domain of adequacy before any GRE translation is attempted.

Sections 21.25–21.28 address translation directly. They distinguish conceptual, functional, structural, historical, scalar, and value-regime translation; develop several forms of equivalence without identity; preserve irreducible disagreement; and examine conditions for multi-theoretical explanation. The chapter therefore treats translation loss and non-equivalence as substantive outcomes rather than defects to be hidden.

The final movement, Sections 21.29–21.31, turns criticism back toward GRE. Existing theories may specify mechanisms more sharply, measure important phenomena more reliably, preserve historical specificity more effectively, or articulate normative distinctions that GRE currently handles only schematically. The chapter consequently asks what GRE should learn, where generative-relational translation overreaches,

and which new research problems theoretical dialogue creates for Chapter 22.

Three restraints govern the chapter. First, a common relational vocabulary is an instrument of comparison, not evidence that every theory is secretly relational in the same sense. Second, explanatory usefulness remains local to claims, mechanisms, scales, and evidential settings. A theory that is limited in one domain may remain highly effective in another. Third, dialogue is reciprocal. GRE can reconstruct other theories only if it also permits those theories to revise GRE's objects, boundaries, formalizations, and normative assumptions.

Chapter 21 therefore treats economic theory as a plural and historically generated field of inquiry. Its purpose is neither synthesis by absorption nor eclectic combination without criteria. The aim is to construct a disciplined theoretical ecology in which comparison can reveal both correspondence and resistance. Section 21.1 begins that task by examining how economics itself is historically and relationally constituted as a discipline.

21.1 Economics as a Relationally Generated Discipline

The role of this section is to establish the reflexive starting point for Chapter 21: before economic theories are compared, the discipline within which those theories become intelligible should itself be treated as historically and relationally constituted. The objective is to explain how economic problems, categories, methods, evidential standards, institutions, and disciplinary boundaries are generated and stabilized without reducing economics to the sociology of economists or denying the reality of economic phenomena. The discussion proceeds through eight dimensions: historical formation, problem generation, disciplinary institutions, methods and evidential regimes, economic categories, disciplinary boundaries, boundary transformation, and the relational reality of economics. The method is historical, interpretive, and reflexive. It uses established episodes and disciplinary formulations as evidence of changing economic problem-spaces while preserving the distinction between changes in economic reality and changes in how economics represents that reality.

This reflexive stance matters for theoretical dialogue because theories do not enter comparison as timeless packages. A concept such as wealth, utility, capital, unemployment, capability, care, information, platform, or ecological constraint becomes analytically consequential within particular historical, institutional, and methodological arrangements. The same term can change meaning as its institutional carrier changes, while new economic conditions can make previously peripheral objects central to inquiry. Economics therefore requires both object-level analysis and a second-order account of how its objects become recognizable as economic. Table 21.1 summarizes the eight dimensions developed in this section.

Definition 21.1 (Relationally generated discipline). A *relationally generated discipline* is a history-bearing configuration of problems, categories, methods, evidential standards, institutions, research communities, professional practices, and boundary rules through which a field of inquiry stabilizes objects, produces warranted claims, reproduces expertise, and revises the conditions of its own inquiry.

The definition does not imply that a discipline constructs its object without constraint. Economic events, material processes, ecological conditions, institutions,

Table 21.1: Dimensions through which economics is generated and reproduced as a discipline.

Dimension	Generative mechanism	Reflexive question
Historical formation	Changing production, institutions, political order, technologies, and intellectual lineages	Which historical conditions make particular economic objects and explanations salient?
Problem generation	Events, classifications, institutions, measurements, and practical contradictions	How does a condition become formulated as an economic problem?
Disciplinary institutions	Universities, journals, professional communities, statistical systems, public agencies, and research infrastructures	Which institutions reproduce categories, methods, standards, and research agendas?
Methods and evidence	Formal models, statistics, econometrics, experiments, history, institutional analysis, qualitative inquiry, and computation	Which manifestations of economic reality become legible through each evidential regime?
Economic categories	Concepts, classifications, units, indicators, and institutional representations	Which relations become visible or compressed when an economic category stabilizes?
Disciplinary boundaries	Conventions governing what is treated as economically relevant	Which objects enter economic inquiry, and which remain delegated to neighboring disciplines?
Boundary transformation	New technologies, institutions, crises, social movements, and cross-disciplinary borrowing	How do new phenomena or methods alter the practical scope of economics?
Relational reality	Persistent networks of concepts, institutions, practices, records, and authority	How does economics become causally consequential while remaining historically revisable?

prices, labor relations, technologies, and distributions can constrain economic claims regardless of prevailing disciplinary preference. The definition instead identifies the mediating architecture through which heterogeneous phenomena become recognized, measured, modeled, debated, and acted upon as economic.

Table 21.1 summarizes the dimensions through which this disciplinary configuration is historically generated and reproduced.

21.1.1 Historical Formation of Economic Inquiry

Economic inquiry has repeatedly reorganized its central objects. Smith’s treatment of wealth connected division of labor, exchange, prices, wages, profits, rent, accumulation, trade, and public revenue within a broad political-economic problem-space (A. Smith 1776). Nineteenth-century marginalism redirected important parts of value theory toward marginal utility and exchange, while Marshall integrated demand, supply, production, distribution, exchange, and consumption within a reorganized analytical architecture (Jevons 1871; Marshall 1890). Robbins later offered an influential disciplinary formulation centered on scarce means with alternative uses, thereby giving scarcity a constitutive role in defining the field (Robbins 1932). Samuelson’s formal synthesis further consolidated maximizing behavior, equilibrium systems, comparative statics, production, and welfare analysis within a common mathematical framework (Samuelson 1947).

These developments matter here as evidence of disciplinary transformation, not as a linear progression toward one correct definition of economics. Classical political economy, marginalism, neoclassical theory, institutional economics, Keynesian traditions, Marxian political economy, feminist economics, ecological economics, capability approaches, behavioral research, complexity economics, and economic soci-

ology retain different objects and explanatory priorities. The historical field therefore contains branching lineages, partial inheritances, reformulations, and persistent disagreements.

The economic world also changes alongside the discipline. Industrial organization, corporate forms, monetary institutions, welfare systems, mass statistics, global production networks, digital platforms, data infrastructures, ecological constraints, and artificial intelligence create relations whose economic significance cannot be inferred solely from older categories. A discipline can therefore face two distinct historical problems at once: inherited theories may remain useful within their domains, while new configurations generate objects that require different combinations of concepts and methods.

Polanyi's historical treatment of market society provides one influential example of this reflexive relation between economic categories and institutional formation (Polanyi 1944). His later formulation of the economy as an instituted process likewise emphasizes that reciprocity, redistribution, and exchange operate through historically constituted institutional arrangements rather than through one invariant organizational form (Polanyi 1957). GRE does not adopt Polanyi's framework as a complete definition of economics. It takes from this lineage the discipline of asking which institutional relations make a particular economic category historically operative.

Proposition 21.2 (Historical-formation condition for economic inquiry). *An account of economics as a discipline is historically adequate only where changes in its central problems, categories, methods, and boundaries are interpreted together with changes in the economic institutions and material relations that make those transformations intelligible.*

The proposition prevents two reductions. Intellectual history alone cannot explain every disciplinary transformation, because changes in production, institutions, technology, and political order alter the problems presented to inquiry. Social change alone cannot explain theoretical development either, because concepts, methods, schools, and research institutions mediate how such changes become economically intelligible.

21.1.2 Historical Generation of Economic Problems

An economic condition becomes a disciplinary problem through processes of selection, representation, and institutional attention. Material hardship can exist before a statistical category stabilizes it; unpaid care can sustain production while remaining weakly represented in national accounting; information can become economically consequential before theories specify its unusual production and appropriation properties; platform dependence can become widespread before standard firm or market categories represent its architecture adequately. Economic problems therefore have both object-level existence and problem-form histories.

This distinction does not imply that problems are arbitrary constructions. The absence of a category can obscure a real burden, while the creation of a category can improve observation without creating the underlying condition. The relevant analytical question is how a dispersed set of events, relations, experiences, measurements, and institutional demands becomes organized into a problem that supports research and intervention.

Kuhn's account of normal science is useful at this level because it emphasizes that

research communities do not choose puzzles from an unconstrained universe; problems become salient within historically organized fields of concepts, exemplars, and standards (Kuhn 1962). The analogy should remain bounded. Economics contains multiple traditions rather than one unified paradigm, and practical economic crises can force questions into the field that established theories initially represent poorly. Still, the broader discipline is valuable: problem selection is structured.

GRE adds a generative question to this process. A problem-form does more than describe a condition. It can influence what data are collected, which populations become visible, what causal mechanisms are investigated, which interventions are considered, and which future capacities are funded. Defining unemployment, productivity, inflation, poverty, human capital, market concentration, unpaid care, systemic risk, digital access, or ecological damage in one way rather than another can redirect institutional attention and resources even when the definition is introduced for analytical purposes.

Definition 21.3 (Economic problem-form). An *economic problem-form* is a historically situated representation that organizes selected economic conditions, affected positions, mechanisms, evidence, boundaries, and intervention possibilities into a researchable or governable object.

A problem-form can be more or less adequate to the relations it represents. It can also coexist with rival formulations. The discipline therefore benefits from preserving the lineage of problem definitions rather than allowing the currently dominant formulation to appear natural or inevitable.

21.1.3 Disciplinary Institutions and Knowledge Reproduction

Economic knowledge is reproduced through institutions. Universities train researchers; journals and publishers stabilize channels of evaluation and dissemination; professional communities reproduce vocabularies and standards; statistical agencies and public institutions construct recurring data infrastructures; central banks, ministries, firms, international organizations, research institutes, and civil-society organizations generate problems, records, and forms of expertise. These institutions differ in purpose and authority, yet together they influence which forms of economic knowledge remain available for cumulative inquiry.

The institutional relation has two directions. Research institutions shape economics by allocating time, training, funding, publication opportunities, data access, and professional recognition. Economics also shapes institutions by supplying categories, forecasts, metrics, policy evaluations, and organizational representations that can alter practical decision making. The discipline is therefore neither external observer nor simple instrument of institutional interests. It occupies multiple positions inside the economic field it studies.

Institutional reproduction also creates path dependence. A method can remain influential partly because training, software, datasets, publication conventions, and accumulated expertise make it inexpensive to reuse. A neglected method can become difficult to employ because the required archives, languages, field networks, or professional skills deteriorate. Institutional history consequently shapes not only what researchers prefer but what forms of inquiry remain practically feasible.

This point connects Chapter 17's epistemic economy to disciplinary self-analysis. Economic inquiry depends on preservation, provenance, verification, interpretation,

mentoring, criticism, and research infrastructure. A discipline can expand its output while weakening its capacity to reproduce some of the skills required to interpret older evidence, maintain long-run datasets, conduct difficult fieldwork, or reconstruct theories outside current methodological conventions.

Proposition 21.4 (Disciplinary-reproduction condition). *A disciplinary account of economics should include the institutional conditions through which economic questions, methods, records, expertise, criticism, and professional standing are reproduced, because those conditions affect which economic realities remain practically researchable.*

The proposition does not make institutional explanation sufficient for evaluating a theory. A model remains answerable to its assumptions, logic, evidence, and explanatory performance. Institutional analysis adds a second question: which relations made the production, persistence, and correction of that model possible?

21.1.4 Methods and Evidential Regimes

Economics contains multiple evidential regimes. Formal theory can isolate logical implications under explicit assumptions; econometrics can identify or estimate relationships under specified designs; experiments can investigate behavior under controlled or quasi-controlled conditions; historical inquiry can reconstruct sequences and institutional transformation; institutional analysis can study rules, positions, and governance arrangements; qualitative and ethnographic approaches can recover meanings, tacit practices, and mechanisms that standardized datasets represent weakly; computational models can explore interacting heterogeneous agents or complex dynamics.

These methods disclose different manifestations of economic reality. Samuelson's formal programme illustrates the power of mathematical unification for deriving implications across several domains of economic analysis (Samuelson 1947). Contemporary causal econometrics, by contrast, places strong emphasis on research designs that support identification of causal effects from observed variation (Angrist and Pischke 2009). Institutional research such as Ostrom's work on governance demonstrates the importance of rules, participant positions, local knowledge, and institutional diversity for problems that resist a simple market-versus-state representation (Ostrom 1990; Ostrom 2005).

A relational account of disciplinary method does not require methodological relativism. Methods can be inappropriate to a target, poorly executed, underidentified, formally inconsistent, historically insensitive, or normatively confused. The point is that methodological adequacy is indexed to the claim being made. A randomized design may identify a local treatment effect while saying little about historical emergence; an archive may reconstruct institutional sequence without identifying a general causal magnitude; an equilibrium model may clarify compatibility conditions without establishing the stability of a real economy; an ethnography may reveal a mechanism whose prevalence remains quantitatively uncertain.

Theoretical dialogue therefore requires evidential translation as well as conceptual translation. Disagreement can arise because two traditions ask different questions of different evidence. Before treating one conclusion as a contradiction of another, the analyst should ask whether the claims share an object, population, temporal scale, mechanism, and evidential burden.

Definition 21.5 (Disciplinary evidential regime). A *disciplinary evidential regime* is a structured relation among research questions, admissible evidence, methods of inference, standards of justification, representational practices, and communities of criticism through which a class of economic claims acquires or loses warrant.

This definition will matter later in Section 21.11, where methodological translation across theories becomes a direct object of analysis.

21.1.5 Economic Categories and Analytical Visibility

Economic categories perform two connected functions. They compress heterogeneous relations into tractable analytical objects, and they make some relations visible enough for measurement, comparison, law, administration, or theory. Categories such as household, firm, worker, capital, property, unemployment, income, productivity, human capital, market, public good, platform, or capability can therefore be both epistemic representations and institutionally consequential classifications.

Compression is necessary. Research cannot represent every relation simultaneously. A firm boundary supports accounting and legal responsibility; a household category supports demographic and income analysis; an employment category makes labor-force statistics possible. Yet the category can conceal relations outside its boundary. Productive capacity attributed to a firm may depend on public infrastructure, unpaid care, supplier knowledge, ecological conditions, and social trust. Household income can conceal unequal control within the household. Employment statistics can omit economically consequential unpaid work. A category gains analytical power by selecting, and selection always has a remainder.

Several economic traditions have expanded visibility by altering category systems. Human-capital analysis represented education and training as investments in productive capacity (Becker 1964). Capability approaches shifted evaluative attention from commodities and utility toward what persons are substantively able to do or be (Sen 1985). Economic sociology emphasized that economic action is embedded in ongoing social relations, challenging strongly atomized representations (Granovetter 1985). Feminist economic work made care, unpaid labor, and social provisioning more visible as economically consequential processes. These moves differ substantially, yet each demonstrates that disciplinary categories help determine which relations enter economic explanation.

GRE consequently treats categories as revisable interfaces between economic reality and economic inquiry. Revision is warranted when an inherited category ceases to preserve mechanisms material to the question, when new institutions alter its constitutive relations, or when excluded positions become necessary to explanation. Category expansion should remain disciplined, because making every social phenomenon economic would dissolve the field's explanatory boundaries.

Proposition 21.6 (Category-visibility condition). *An economic category is analytically adequate only relative to the relations it is intended to preserve, the relations it compresses, and the claim for which that compression is being used.*

This condition allows economics to use operational categories without mistaking them for exhaustive ontologies of the entities they represent.

21.1.6 Disciplinary Boundaries of Economics

The boundary of economics has never been given by one permanent object definition. Smith's inquiry into wealth included production, exchange, distribution, public finance, institutional arrangements, and moral-political questions associated with commercial society (A. Smith 1776). Robbins's scarcity formulation provided a much more formal boundary centered on the relation between ends and scarce means with alternative uses (Robbins 1932). Later economic work has analyzed education, information, institutions, households, health, environment, networks, platforms, and other objects that complicate any simple substantive boundary.

Boundary expansion can occur through at least four pathways. First, a previously external condition can become recognized as causally necessary to economic explanation. Second, a new institution or technology can create economically consequential relations that inherited categories represent weakly. Third, a method can make a previously inaccessible object measurable or formally tractable. Fourth, normative or political contestation can expose omitted burdens, forms of labor, affected positions, or ecological dependencies.

Yet disciplinary openness requires containment. GRE already adopted this discipline in Chapters 3 and 20: legal, psychological, ecological, political, cultural, or ethical questions can intersect economic inquiry without becoming reducible to economics. An economic analysis of legal standing examines how legal categories affect access, obligation, property, labor, or capability; it does not replace jurisprudence. An economic analysis of care can examine time, capability, dependence, and social reproduction while leaving dimensions of intimacy or moral relation to other forms of inquiry.

Definition 21.7 (Economic disciplinary-boundary profile). An *economic disciplinary-boundary profile* specifies the objects treated as economically consequential for a given inquiry, the relations through which that consequence is established, the neighboring domains required for adequate interpretation, and the remainder that should remain outside economic reduction.

This profile makes disciplinary boundaries claim-relative without making them arbitrary. The relevant question is whether including or excluding an object materially changes economic explanation, evaluation, or intervention.

21.1.7 Boundary Transformation and New Economic Objects

Disciplinary boundaries transform when economic reality creates new interfaces among previously separated categories. Information provides an instructive example. Arrow's analysis of invention emphasized uncertainty and appropriation problems that distinguish knowledge production from ordinary commodity production (Arrow 1962). Digital platforms later coupled information, matching, ranking, attention, reputation, data extraction, labor, and infrastructure control inside organizational forms that cannot be represented fully through a simple seller-buyer transaction. Artificial intelligence further couples productive capability with epistemic infrastructure, symbolic generation, delegation, verification, and organizational dependence.

Similar transformations occur outside digital economies. Care economics reveals relations through which households, employment, public services, embodiment, and

social reproduction interact. Ecological economics makes material and energetic dependence visible where conventional monetary boundaries can externalize biophysical change. Migration connects labor markets, legal status, households, care, remittances, and multiple jurisdictions. Knowledge economies connect research institutions, intellectual property, public funding, firms, education, and information infrastructures.

A new economic object therefore need not be a newly existing entity. It can be a newly consequential relation, a newly measurable process, or a configuration whose economic effects become too large to remain analytically peripheral. Boundary transformation can also move in the opposite direction: a category may lose usefulness when its historical mechanism disappears or becomes better represented through a different framework.

This process creates a reflexive danger. Once a discipline acquires an expanding vocabulary, it can redescribe almost any phenomenon as economic. Chapter 20's validity-boundary discipline therefore carries directly into the present chapter. Expansion is warranted only where the economic mechanism, evidence, and explanatory gain can be stated. A relational language should enlarge analytical reach where necessary while preserving neighboring domains and domain-specific remainders.

Proposition 21.8 (Boundary-transformation condition). *A transformation of economics' disciplinary boundary is warranted where changed economic relations, institutions, technologies, or evidential capacities create an object whose inclusion materially improves economic explanation, while the object's non-economic dimensions and disciplinary remainders remain explicit.*

This proposition will later constrain GRE's dialogue with established traditions. A concept should enter the common comparative language because it performs identifiable analytical work, not because GRE can relabel it relationally.

21.1.8 Economics as Relational Reality

The preceding analysis supports a final distinction between economics as an intellectual abstraction and economics as a relationally real discipline. Economics has persistent institutions, publications, classifications, educational pathways, professional roles, datasets, policy interfaces, models, and public authority. These structures can shape investment, regulation, measurement, organizational behavior, and public interpretation. They therefore possess causal efficacy within the social world even though their boundaries, categories, and internal standards remain historically revisable.

This is the sense in which economics can be treated as a *relational reality*. The claim does not assert that "economics" is a single entity with one intention, nor that disciplinary consensus exists. It identifies a sufficiently persistent configuration of relations through which heterogeneous economic inquiries are reproduced, recognized, criticized, and made consequential. Competing schools can inhabit the same disciplinary field while disagreeing about its central objects and methods.

The relational-reality formulation also makes reflexivity tractable. Economic theories can influence the economic systems they describe through policy, organizational design, measurement, expectations, professional training, and institutional categories. Merton's self-fulfilling-prophecy mechanism provides a general social-theoretical example of how socially consequential definitions can contribute to

producing the conditions they anticipate (Merton 1948). GRE should use such mechanisms selectively rather than infer that every economic representation is performative. Still, the possibility matters: the discipline can enter the causal field of its own objects.

Definition 21.9 (Disciplinary relational reality). A *disciplinary relational reality* is a sufficiently persistent and causally consequential configuration of concepts, institutions, communities, records, methods, classifications, and practices through which a field of inquiry is reproduced and through which its representations can affect the domain it studies.

Economics therefore occupies two positions simultaneously. It studies historically changing economic realities, and it participates in institutions through which some of those realities are classified, measured, governed, and transformed. The relation does not erase the distinction between theory and world. It makes that distinction historically mediated and empirically researchable.

Proposition 21.10 (Disciplinary-reflexivity condition). *Economic theory should be treated as reflexively consequential where its classifications, models, measurements, or institutional uses materially alter the behavior, rules, expectations, or resource flows of the economic configuration being studied.*

The proposition establishes the bridge to Section 21.2. If economics is itself a relationally generated and occasionally causally operative discipline, then individual economic theories can be examined as relational configurations connected to historical contexts, research communities, institutional locations, methods, and manifestations. That analysis does not relativize theoretical truth. It adds the conditions under which theoretical claims are produced, sustained, challenged, and revised to the comparative architecture of Chapter 21.

21.2 Economic Theories as Relational Configurations

The role of this section is to establish the unit through which Chapter 21 will compare economic theories. The objective is to treat a theory neither as an isolated set of propositions nor as a mere expression of its social environment, but as a history-bearing configuration connecting analytical objects, observer positions, research communities, institutional locations, methods, evidential access, representations, and revision practices. The discussion proceeds through eight dimensions: theory-object-observer configuration, historical context, research-community reproduction, institutional location, method-theory coupling, manifestational access, generative effects, and theoretical revisability. The method is reflexive and comparative. It preserves the logical and evidential content of theories while adding the conditions through which their objects become visible, their claims become reproducible, and their categories become economically consequential.

This approach extends the disciplinary analysis in Section 21.1. Economics can contain multiple theoretical configurations at the same time because shared disciplinary institutions do not require one object, one method, or one explanatory ontology. A general-equilibrium model, a historical account of accumulation, a capability analysis, a care-economy reconstruction, and an institutional study can inhabit the same disciplinary field while selecting different units, causal relations, manifestations, and evidential standards. Their coexistence therefore cannot be understood adequately

Table 21.2: Dimensions of an economic theory treated as a relational configuration.

Dimension	Relational object	Comparative risk
Object–observer	Objects selected together with positions from which they are represented	Treating object selection as neutral or purely subjective
Historical context	Problems, institutions, technologies, and events conditioning theoretical formation	Projecting historically specific categories across unlike contexts
Research community	Shared concepts, training, criticism, publication, and reproduction practices	Equating community reproduction with theoretical validity
Institutional location	Universities, states, firms, international organizations, foundations, professional bodies, and other carriers	Ignoring how access, incentives, and authority shape feasible inquiry
Method–theory coupling	Methods through which theoretical objects become tractable and claims become testable	Treating one method as the theory’s complete object
Manifestational access	Observations, measurements, models, narratives, cases, and traces through which objects appear	Treating representation as exhaustive access to the economic object
Generative effects	Effects of theory on classification, policy, organization, measurement, expectations, and design	Inferring performativity from intellectual influence alone
Revisability	Procedures through which concepts, assumptions, scope, and claims are altered or withdrawn	Preserving a theory by absorbing every counterexample into elastic reinterpretation

by listing doctrines alone. Comparison requires a representation of the configuration within which a theoretical claim acquires meaning and warrant.

Definition 21.11 (Economic theoretical configuration). An *economic theoretical configuration* is a history-bearing arrangement of analytical objects, observer positions, concepts, assumptions, methods, evidential interfaces, research communities, institutional locations, representations, and revision practices through which a body of economic claims is formulated, evaluated, reproduced, and made consequential.

The definition is intentionally broader than a formal model and narrower than the discipline as a whole. A theoretical configuration can include mathematical models, verbal mechanisms, historical interpretations, classificatory systems, measurement conventions, and practical institutional uses. It can also contain internal disagreement. The relevant condition is sufficient coherence for claims, objects, methods, and evidential practices to remain mutually intelligible over some period.

Table 21.2 summarizes the eight dimensions developed below.

21.2.1 Theory–Object–Observer Configuration

Economic theories begin by differentiating an object-space. A theory may foreground individual choice, production relations, institutions, capabilities, aggregate demand, care, ecological throughput, networks, or innovation. Such selection does not mean that excluded relations cease to exist. It defines which distinctions become analytically operative and which are temporarily compressed. The observer enters this process through the questions posed, categories used, scales selected, and manifestations treated as evidentially accessible.

The term *observer* here is broader than an individual researcher. It can denote a modeling position, measurement regime, institutional role, disciplinary tradition, policy vantage point, or historically available problem-form. A national statistical office and a household ethnography can observe the same economy through different classificatory infrastructures. A firm-level productivity study and a social-reproduction

analysis can share empirical events while constructing different units and relations as analytically central.

Definition 21.12 (Theory–object–observer profile). A *theory–object–observer profile* specifies the economic objects selected by a theory, the relations through which those objects are constituted, the observer positions from which they become representable, the scales and boundaries of observation, and the consequential exclusions introduced by that configuration.

The profile avoids two opposite reductions. Object selection is not arbitrary, because economic conditions can resist inadequate representation and generate counterevidence. Observer position is also not eliminable, because data categories, model boundaries, units of analysis, and research questions mediate what can be claimed. The relational problem is therefore to specify how object and observer are connected without collapsing one into the other.

A theory of unemployment, for example, can define its object through labor-market status, aggregate demand, search frictions, institutional classifications, household constraints, or combinations of these. Each representation permits different questions and can support different interventions. Their difference cannot be adjudicated solely by asking which vocabulary is more comprehensive. Adequacy depends on the target claim, mechanism, evidence, and scale.

Proposition 21.13 (Object-selection condition). *Comparison among economic theories requires the objects, observer positions, scales, and excluded relations relevant to each theory to be specified before substantive claims are treated as directly commensurable.*

This condition will matter throughout the chapter. The same word can refer to different configured objects, while different words can sometimes refer to partially corresponding structures. A relational comparison must therefore precede any assertion of theoretical equivalence.

21.2.2 Historical Context of Theoretical Formation

Theoretical configurations form within historical problem-spaces. Industrialization, financial crises, mass unemployment, welfare-state development, decolonization, globalization, ecological degradation, digital platforms, and artificial intelligence can alter both economic reality and the questions that appear urgent or tractable. A theory can therefore be historically situated without its claims being reducible to historical circumstance.

Classical political economy developed around problems of production, distribution, trade, accumulation, and class formation in historically changing commercial and industrial societies. Marginal and neoclassical frameworks reorganized important parts of economic analysis around choice, exchange, scarcity, and equilibrium. Keynesian traditions made aggregate instability, money, expectations, and unemployment central under conditions in which coordination through price adjustment alone appeared analytically insufficient. Later institutional, capability, behavioral, ecological, care, complexity, and platform-centered approaches responded to different empirical and theoretical problem-spaces. These lineages overlap, contest, and recombine rather than succeeding one another in a single sequence.

Kuhn's analysis of scientific communities provides one influential language for ex-

aming how problem selection, exemplars, and disciplinary standards can stabilize historically (Kuhn 1962). The present argument uses this insight cautiously. Economics contains persistent pluralism, methodological diversity, and institutional heterogeneity, so its theoretical configurations need not fit one paradigm structure. Historical context is better treated as a conditioning relation whose relevance must be established for the theory under examination.

Definition 21.14 (Theoretical historical-context profile). *A theoretical historical-context profile records the economic conditions, institutional structures, technologies, political problems, intellectual inheritances, available evidence, and practical controversies materially connected to the formation or transformation of a theoretical configuration.*

The profile also supports historical transfer discipline. A theory developed for one institutional order may travel successfully to another, but the warrant for transfer depends on the persistence of relevant mechanisms and semantics. Historical origin alone neither validates nor invalidates later use.

Proposition 21.15 (Historical-context condition). *Historical explanation of a theory becomes analytically relevant where changes in economic conditions, institutional arrangements, available evidence, or problem-forms help explain the theory's object selection, assumptions, scope, or revision without substituting genealogy for evaluation of the theory's claims.*

This distinction permits Chapter 21 to place theories historically while still asking whether their mechanisms, formalizations, and empirical implications remain adequate beyond their contexts of formation.

21.2.3 Research-Community Reproduction of Theory

A theoretical configuration persists through communities capable of reproducing its language and standards. Textbooks, graduate training, seminars, journals, conferences, replication practices, data infrastructures, citation networks, professional associations, and informal intellectual lineages transmit what counts as a recognized problem, acceptable proof, convincing evidence, or technically competent contribution.

Research-community reproduction is analytically distinct from consensus. Communities contain disputes over assumptions, identification strategies, formal techniques, evidence, normative premises, and scope. A community can preserve a shared theoretical vocabulary precisely through structured disagreement over its use. Conversely, a theory can diffuse across several communities that reinterpret it differently.

Definition 21.16 (Theoretical reproduction profile). *A theoretical reproduction profile specifies the training, communication, criticism, publication, data, replication, and succession relations through which a theoretical configuration remains intelligible and capable of cumulative development across researchers and generations.*

This profile makes tacit knowledge visible. Competence in a theory often requires more than possession of its published propositions. Researchers learn how to simplify, which anomalies to treat as important, which approximations are acceptable, how to diagnose a failed model, and which empirical designs carry evidential weight. Such practical knowledge is part of theoretical reproduction even when it is weakly

codified.

The existence of a strong research community does not establish truth. Community reproduction can stabilize fruitful knowledge, but it can also reproduce blind spots, inaccessible technical conventions, path dependence, or narrow problem selection. The proper analytical relation is therefore reflexive rather than dismissive.

Proposition 21.17 (Research-community condition). *Theoretical persistence should be analyzed through the community relations that reproduce competence and criticism while theoretical adequacy remains separately accountable to argument, evidence, rival explanation, and domain performance.*

This separation will be important when established schools are reconstructed later in the chapter. Their institutional persistence is neither evidence against them nor sufficient evidence for them.

21.2.4 Institutional Location of Theoretical Production

Economic theory is produced within institutions that provide resources, permissions, incentives, data access, career structures, practical problems, and channels of application. Universities, central banks, statistical agencies, governments, international organizations, firms, foundations, research institutes, professional associations, and civil-society organizations can occupy different positions in this theoretical field.

Institutional location affects feasible inquiry through access to time, computation, administrative records, field sites, proprietary data, policy processes, and professional networks. It can also shape which problems carry practical urgency. Central-bank research may develop especially detailed representations of monetary transmission or financial stability; development organizations can generate categories centered on poverty, capability, institutions, or programme evaluation; firms may possess high-resolution operational data unavailable to public researchers.

These relations should not be converted into simple claims of institutional bias. Institutional location can generate distinctive knowledge as well as distinctive blind spots. The relevant analytical question is which dependencies, accesses, incentives, and authority relations condition the theory's production and use.

Definition 21.18 (Institutional-location profile). *A theoretical institutional-location profile records the institutions that materially support, constrain, apply, or authorize a theoretical configuration together with relevant resource access, data access, professional incentives, dependencies, practical responsibilities, and channels of public or organizational influence.*

Institutional use can also alter the theory itself. A concept adopted into regulation, accounting, welfare administration, organizational design, or statistical classification may acquire operational definitions and data infrastructures that feed back into research. Theory, institution, and measurement can therefore become historically coupled.

Proposition 21.19 (Institutional-location condition). *Institutional location is theoretically consequential where it materially shapes feasible evidence, object definition, research incentives, channels of implementation, or feedback from practical use into subsequent theoretical development.*

The proposition remains narrower than a sociology of knowledge claim about all theoretical content. It specifies a mechanism that can be investigated rather than

presumed.

21.2.5 Method–Theory Coupling

Economic theories and methods often co-develop. Formal optimization can make preference and constraint structures precise; econometrics can connect theoretical mechanisms to statistical variation; experiments can isolate local behavioral responses; historical analysis can reconstruct institutional transformation; ethnography can reveal tacit practices and categories; simulations can explore interaction among heterogeneous agents; network methods can represent relational position and propagation.

A method does more than test a pre-existing theory when its representational affordances make some theoretical objects easier to formulate. Samuelson's formal synthesis illustrates how mathematical representation can reorganize the architecture of theoretical economics rather than merely restate it (Samuelson 1947). Similar relations occur when new datasets, computing capacities, experiments, or measurement systems make previously weakly tractable objects available to inquiry.

Method–theory coupling can generate blind spots when the feasible method becomes mistaken for the complete object. A phenomenon difficult to quantify can be economically consequential; a formally tractable mechanism can be empirically minor; a rich historical reconstruction can lack identification for a specific causal claim. Methodological pluralism therefore requires local adequacy rather than indiscriminate accumulation of methods.

Definition 21.20 (Method–theory coupling profile). *A method–theory coupling profile specifies how a theory's objects, assumptions, mechanisms, and evidential claims are enabled, transformed, constrained, or tested by the methods through which the theory is developed and evaluated.*

Proposition 21.21 (Method–theory adequacy condition). *Methodological comparison among theories should distinguish the objects made tractable by a method from the broader economic object, and should evaluate method adequacy relative to the local claim, mechanism, scale, and evidential requirement.*

This condition prevents methodological translation from becoming a hierarchy in which one evidential regime automatically absorbs the others.

21.2.6 Manifestational Access in Theoretical Representation

Economic theories encounter their objects through manifestations. Prices, quantities, transactions, surveys, administrative records, balance sheets, interviews, institutional texts, experiments, historical archives, network traces, and observed practices provide partial access to economic relations. The same underlying configuration can generate different manifestations at different scales or through different institutional interfaces.

GRE's distinction between relational and manifestational reality is useful here because it prevents evidence from being equated with the total object. A wage record manifests one part of a labor relation; it does not by itself represent bargaining, care obligations, professional identity, tacit knowledge, workplace power, or household conversion. A market price can convey scarcity and exchange conditions while re-

maintaining incomplete for ecological degradation or unpaid care. An aggregate indicator can track consequential change while compressing distributional heterogeneity.

Definition 21.22 (Theoretical manifestation profile). *A theoretical manifestation profile identifies the observable or reconstructable traces through which a theory accesses its object, the transformations connecting those traces to theoretical categories, and the relevant relations that remain latent, compressed, or inaccessible within that representation.*

The profile creates a common language for comparing theories that use unlike evidence. One theory can rely on aggregate time series, another on institutional records, and another on qualitative reconstruction. Their evidence cannot be made equivalent merely by translating vocabulary. Comparison requires attention to what each manifestation can warrant.

Proposition 21.23 (Manifestational-adequacy condition). *A theoretical representation is evidentially adequate relative to a claim where the manifestation through which the object is accessed preserves the relations required for that claim and where material latent or compressed relations remain explicit in the stated scope.*

The condition also clarifies disagreement. Two theories can conflict because they make incompatible claims about the same manifestation, because they explain different manifestations of one configuration, or because they construct different objects from partially overlapping evidence.

21.2.7 Generative Effects of Economic Theory

Economic theory can become part of the economic configurations it describes. Concepts can enter policy rules, organizational routines, accounting systems, market design, measurement conventions, professional education, expectations, and public reasoning. Their use can alter incentives, classifications, institutions, or resource flows, creating a reflexive relation between theoretical representation and economic reality.

Merton's analysis of self-fulfilling processes provides one general mechanism through which socially consequential expectations can contribute to the conditions they anticipate (Merton 1948). Economic theory can enter similar processes through more specific institutional pathways. A regulatory model can change reporting behavior; a performance metric can reorganize organizational priorities; a market-design theory can be instantiated in an actual allocation mechanism; a statistical classification can determine eligibility or visibility.

The present argument therefore uses *generative effect* in a bounded sense. Intellectual influence alone is insufficient. A theoretical configuration becomes economically generative when identifiable transmission mechanisms connect its representation to changed rules, expectations, infrastructures, practices, categories, or capabilities.

Definition 21.24 (Theoretical generativity profile). *A theoretical generativity profile specifies the institutional, organizational, educational, classificatory, technological, or policy pathways through which an economic theory contributes to changing the economic configuration that it subsequently observes or evaluates.*

These effects can strengthen or weaken the theory's later empirical fit. A theory instantiated through policy can create conditions closer to its modeled assumptions. It can also produce unforeseen responses that expose missing relations. Reflexivity

therefore does not protect a theory from criticism. It creates additional causal pathways that require analysis.

Proposition 21.25 (Theory-generativity condition). *An economic theory should be treated as a generative object where identifiable transmission pathways connect its concepts, models, classifications, or recommendations to later changes in economic behavior, institutions, measurements, capabilities, or resource flows.*

The proposition also constrains claims of performativity. A theory can remain descriptively influential without becoming causally decisive, and economic actors can appropriate theoretical categories in heterogeneous or resistant ways.

21.2.8 Theoretical Revisability across Configuration Change

Treating theories as relational configurations makes theoretical revision more precise. A theory can change through alteration of concepts, assumptions, model closure, measurement, method, institutional location, empirical scope, normative premises, or problem definition. Several of these can change while the theory retains enough continuity to remain recognizable; sufficiently extensive change can instead produce a successor configuration.

Revision should therefore be recorded at the level at which it occurs. A revised parameter estimate is different from a changed causal mechanism. Extension to a new domain is different from semantic redefinition. Addition of an auxiliary condition is different from decomposition of an earlier theoretical object. A research programme becomes difficult to criticize when every adverse result can be redescribed as already compatible with its core language.

Definition 21.26 (Theoretical configuration revision record). *A theoretical configuration revision record preserves changes in a theory's objects, semantics, assumptions, methods, evidential base, formalization, institutional uses, empirical scope, rival explanations, boundary conditions, and unresolved remainder together with the reasons for those changes.*

This record parallels the claim-version discipline developed for GRE in Chapter 20. It also supports fair historical comparison. A contemporary theory should not be attributed unchanged to an earlier formulation when later researchers have altered its semantics or evidential architecture. Conversely, an earlier criticism may remain relevant if the mechanism it identifies persists beneath revised vocabulary.

Proposition 21.27 (Theoretical-revisability condition). *A theoretical configuration remains cumulatively revisable where empirical failure, formal inconsistency, rival explanation, historical change, domain transfer, and methodological criticism can produce identifiable narrowing, decomposition, reinterpretation, replacement, or withdrawal of claims rather than only expansion of protective auxiliary language.*

The eight dimensions developed in this section establish the unit of theoretical dialogue used in the remainder of Chapter 21. A theory enters comparison as a configured relation among object, observer, history, community, institution, method, manifestation, generative effect, and revision pathway. This representation preserves both theoretical content and the conditions through which that content becomes intelligible and consequential.

Section 21.3 now develops the next layer of the dialogue: a common relational vocabulary for objects, subjects, relations, resources, capacities, constraints, value, his-

tory, power, evidence, method, and generativity. That vocabulary can support comparison only if the configuration-specific meanings established here remain visible. Relational translation will therefore function as an interface among theories rather than as a procedure for dissolving their differences.

21.3 Common Relational Coordinates for Theoretical Dialogue

The role of this section is to establish a common language through which heterogeneous economic theories can be compared without being treated as semantically or structurally identical. The objective is not to replace the vocabulary of classical, neo-classical, Marxian, Keynesian, institutional, behavioral, capability, feminist, ecological, complexity, commons, relational, or digital-economic traditions. It is to define a set of *comparison coordinates* that can record what each theoretical configuration treats as an object, subject, relation, resource, capacity, constraint, value, historical process, power relation, evidential warrant, and generative effect. The section proceeds through eleven such coordinates. Its method is explicitly non-reductive: each coordinate is a question posed to a theory, not a claim that the theory already contains the GRE concept in the same sense.

Section 21.2 established that economic theories enter dialogue as history-bearing configurations rather than isolated propositions. A common vocabulary is useful only after those configuration-specific meanings remain visible. Otherwise translation can create false equivalence: a “resource” in one theory can be a produced input, a legal entitlement, a capability-enabling condition, an ecological stock, or a socially recognized asset; a “subject” can be a preference bearer, class-positioned agent, household member, institutional actor, collective, or artificial system. Similar words can therefore mask different theoretical objects, while unlike words can sometimes denote partially corresponding structures.

Definition 21.28 (Relational dialogue coordinate system). *A relational dialogue coordinate system is a structured set of comparative questions concerning analytical objects, subject positions, relations, resources, capacities, constraints, value forms, temporal and historical organization, power, evidence and method, and generativity, used to map economic theories while preserving their local semantics, mechanisms, scope conditions, and unresolved remainder.*

The coordinate system is intentionally weaker than a unified meta-theory. It does not require every theory to populate every coordinate, and an empty coordinate can itself be informative. A theory centered on price coordination may say relatively little about care relations; a historical theory may resist a compact capacity representation; an experimental framework may bracket long-run generativity. The comparative task is to record such absences and asymmetries rather than fill them automatically with GRE vocabulary.

Table 21.3 summarizes the eleven coordinates and the reduction risk attached to each one.

Proposition 21.29 (Non-reductive coordinate condition). *A common comparison language remains theoretically legitimate only where each coordinate preserves the theory-specific semantics, mechanism, scale, evidential basis, and remainder required for the claim being compared.*

Table 21.3: Common relational coordinates for non-reductive dialogue among economic theories.

Coordinate	Comparative question	Reduction risk
Objects	What entities, processes, configurations, or units are made analytically primary?	Treating unlike units as instances of one universal object
Subjects	Which positions can act, choose, experience, contribute, represent, or be affected?	Equating agency, standing, preference, and subjecthood
Relations	Which exchange, production, institutional, care, network, ecological, or power relations are constitutive?	Reducing structure to pairwise interaction
Resources	What material, financial, informational, institutional, ecological, or symbolic means are relevant, and how are they accessed?	Equating possession with practical usability
Capacities	What can positions or configurations actually do, reproduce, or transform?	Treating observed performance as durable capability
Constraints	Which material, legal, institutional, social, cognitive, ecological, or historical limits shape feasible action?	Treating every constraint as a removable friction
Value	What counts as valuable, for whom, through which realization and comparison processes?	Presuming scalar commensurability
Time/history	How are sequence, duration, path dependence, reproduction, crisis, and future possibility represented?	Projecting static relations across historical change
Power	Through which dependencies, controls, positions, or institutions can differences become consequential influence?	Equating asymmetry with power
Evidence/method	Through which manifestations and methods are claims warranted?	Converting methodological difference into evidential equivalence
Generativity	How do present relations alter later capabilities, institutions, values, paths, and possibilities?	Treating novelty or growth as generativity

This condition governs the remainder of the chapter. Sections 21.4–21.11 will deepen several of these coordinates before the chapter turns to individual traditions.

21.3.1 Analytical Objects and Unit Boundaries

The first coordinate concerns what a theory treats as an economic object. The object can be an individual choice, household, firm, class relation, market, institution, network, ecological process, platform, flow, stock, aggregate, historical regime, or relational configuration. These objects are not merely labels for the same underlying unit. They carry different boundary assumptions about what belongs inside the explanation and what can remain external.

A theory that begins with individuals can reconstruct organizations through aggregation or strategic interaction. A theory that begins with class, institution, or production relation can treat the individual as a position within a wider structure. A macroeconomic model can represent sectors or aggregates that intentionally suppress micro-level heterogeneity. An ecological account can extend the object boundary beyond human transactions to material-energy throughput and biophysical regeneration. The common coordinate must therefore record *object formation* before asking whether theories agree.

Definition 21.30 (Analytical-object profile). An *analytical-object profile* specifies a theory’s primary units, their boundaries, internal structure, relevant scales, admissible aggregation or decomposition relations, and the economically consequential relations excluded from the local object definition.

Object comparison is especially important where the same term hides different in-

ternal structure. “Firm” can denote a production function, nexus of contracts, governance institution, organizational capability, legal person, or power-bearing hierarchy. Treating these as automatically equivalent would make later comparison incoherent.

Proposition 21.31 (Object-boundary comparison condition). *Theories should be compared at the object level only after their units, boundaries, scales, and decomposition or aggregation rules have been specified sufficiently to determine whether apparent correspondence concerns the same economic object, a nested object, or only a functional analogy.*

Section 21.4 will develop this coordinate in greater detail across individuals, households, firms, classes, institutions, markets, networks, communities, ecologies, and relational configurations.

21.3.2 Subject Positions and Agency Profiles

The second coordinate asks which positions count as subjects and what forms of agency, standing, experience, responsibility, or affectedness those positions possess. A preference-bearing consumer, worker located in a production relation, capability-bearing person, household member, institutionally embedded actor, collective organization, ecological stakeholder, and artificial agent should not be placed into one subject category merely because each can appear on the left-hand side of a model equation.

Agency itself is multidimensional. A position can choose among represented alternatives without possessing authority to change the rules that generate those alternatives. A household can act collectively while containing internal conflict. A firm can have legal standing and strategic capability without experience in the human sense. A future generation can be economically affected without present agency. The common coordinate therefore separates analytical subjecthood from moral standing, legal personhood, decision authority, contribution, representation, and exposure to consequences.

Definition 21.32 (Subject-position profile). *A subject-position profile identifies the positions recognized by a theory together with their modeled forms of agency, choice, standing, contribution, experience, responsibility, representation, and affectedness.*

This profile prevents one theory’s subject assumptions from silently entering another. Behavioral modification of rational choice, for example, does not automatically produce the same subject as a capability or care framework; collective or artificial agency also requires separate reconstruction.

Proposition 21.33 (Subject-translation condition). *Translation between theoretical subjects requires the dimensions of agency and standing relevant to each theory to be mapped separately, with residual non-equivalence preserved where one theory attributes capacities or statuses absent from the other.*

Section 21.5 will use this coordinate to compare several major subject architectures directly.

21.3.3 Relational Structure and Interaction Mechanisms

Economic theories differ not only in their units but in the relations treated as constitutive. Exchange, production, ownership, labor, credit, care, contract, hierarchy,

network connection, institutional rule, ecological dependency, class relation, and platform intermediation organize economic objects differently. A price-mediated exchange relation is not simply a generic tie with a numerical weight, just as a care relation cannot be reconstructed fully as bilateral transfer.

The common coordinate therefore distinguishes *interaction* from *relational constitution*. Some theories treat already constituted actors as interacting; others treat identities, capabilities, preferences, institutions, or positions as partly produced through relations. The distinction matters for explanation because changing a relation can either alter outcomes among stable actors or alter the actors and feasible actions themselves.

Definition 21.34 (Relational-mechanism profile). A *relational-mechanism profile* specifies the relations recognized by a theory, their directionality and symmetry, the objects they connect or constitute, the mechanisms through which they transmit effects, and the extent to which relational change transforms the participating positions themselves.

A common relational language should therefore avoid reducing all structure to pairwise edges. Institutions, norms, class positions, ecological systems, and markets can contain higher-order, rule-mediated, or field-like relations whose effects are not recoverable from isolated dyads.

Proposition 21.35 (Relational-structure preservation condition). *Cross-theoretical translation of relations is warranted only where the relevant directionality, mediation, constitutive role, scale, and mechanism are preserved; similarity of connected units alone does not establish relational equivalence.*

Section 21.6 will expand this coordinate across the major relational structures used in economic theory.

21.3.4 Resource Forms and Access Pathways

The resource coordinate asks what means of action a theory recognizes and how those means become usable. Material inputs, land, labor time, money, credit, information, knowledge, infrastructure, institutional rights, ecological functions, reputation, data, attention, and social support can all operate as resources in different theoretical configurations. Their economic significance depends on more than possession.

A formal entitlement can fail to become practical access; information can be available but unintelligible; finance can exist without eligible borrowers; data can be stored without rights to use it; infrastructure can be present but unreachable. Resource comparison therefore needs an access and conversion layer. This also prevents a resource language from flattening distinctions among stocks, flows, rights, services, and relational conditions.

Definition 21.36 (Resource-access profile). A *resource-access profile* specifies the resource forms recognized by a theory, their ownership or control conditions, access pathways, complementary requirements, conversion conditions, substitutability, depletion or renewal properties, and the positions able to mobilize them.

The resource coordinate is therefore compatible with scarcity analysis without presuming that every scarcity is material or market-priced. Institutional standing, care time, verification capacity, ecological regeneration, and platform access can become economically consequential scarcities through different mechanisms.

Proposition 21.37 (Resource-usability condition). *Comparison of resources across theories should distinguish nominal availability, authorized access, practical usability, conversion into valued function, and subsequent depletion or regeneration before quantities are treated as directly comparable.*

Section 21.8 will later connect this coordinate to scarcity, distribution, allocation, and generative opportunity.

21.3.5 Capacity and Conversion Profiles

Capacity concerns what subjects, collectives, organizations, institutions, or configurations can actually do. Economic theories encode capacity through productivity, skill, human capital, capability, technology, organizational competence, bargaining strength, institutional capacity, learning, or adaptive potential. These representations can overlap while remaining non-equivalent.

Observed performance is an especially poor universal proxy for capacity. High output under extensive external support can coexist with weak independent capability; unused capacity can remain latent because complementary resources are missing; a collective can possess a capability no member possesses alone. The coordinate therefore separates capacity from current realization and includes the conversion conditions through which resources become practicable function.

Definition 21.38 (Capacity-conversion profile). *A capacity-conversion profile identifies the functions a position or configuration can perform, the resources and relations required for those functions, the conversion pathways connecting resources to realized activity, the conditions of capability reproduction, and the distinction between individual, collective, institutional, and infrastructural capacity where relevant.*

This profile allows productivity, human capital, capability, and organizational competence to enter dialogue without being collapsed into one scalar variable.

Proposition 21.39 (Capacity-performance distinction). *Cross-theoretical comparison should distinguish observed performance from retained and regenerative capacity, and should identify the complementary relations through which a measured performance becomes possible.*

The distinction will become especially important when the chapter compares capability approaches, evolutionary economics, care economics, institutional analysis, and AI-mediated economic theories.

21.3.6 Constraint Architecture and Conditionality

Constraints define and transform feasible action. They can be material, financial, legal, institutional, informational, cognitive, ecological, temporal, organizational, social, or historical. Some constraints operate as scarcity; others protect rights, stabilize expectations, coordinate behavior, preserve ecological functions, or make collective action possible. A common language should therefore avoid identifying constraint with inefficiency.

Theories also differ in whether constraints are treated as fixed parameters, endogenous outcomes, institutional rules, historically accumulated structures, or objects of political contestation. A budget constraint and a legal prohibition may both delimit action while operating through very different mechanisms. Path dependence can cre-

ate historically inherited constraints that are absent from a static representation of the same current resources.

Definition 21.40 (Constraint-architecture profile). A *constraint-architecture profile* specifies the constraints relevant to a theory, their sources, carriers, scales, temporal persistence, transformability, protective or coordinative functions, and the mechanisms through which they alter feasible actions or relational positions.

Constraint translation is therefore partly a question of conditionality. A theory can predict an effect under a constraint structure that another theory treats as institutionally mutable. Their disagreement may concern the mechanism, the boundary condition, or the level at which the constraint is considered endogenous.

Proposition 21.41 (Constraint-type distinction). A *common theoretical dialogue* should preserve distinctions among enabling, protective, coordinative, restrictive, and historically inherited constraints, and should state whether each constraint is treated as exogenous, endogenous, or institutionally revisable within the theory under examination.

This condition will also prevent later value and policy comparisons from equating “constraint relaxation” with improvement by definition.

21.3.7 Value Forms and Evaluation Interfaces

Economic theories attach value to different objects through different processes. Utility, willingness to pay, price, labor, surplus, capability, care, ecological function, relational goods, dignity, public value, and generative value do not occupy one semantic layer. Some are descriptive representations, some are evaluative criteria, some are institutional outcomes, and some combine positive and normative content.

The common coordinate must therefore record both the *value form* and the *evaluation interface*. A market price can function as an exchange ratio without exhausting welfare. A capability can be an evaluative space without being a scalar measure. Care can be economically consequential while resisting monetization. Ecological processes can matter through both instrumental and non-instrumental valuation. Translation becomes misleading when one value form is treated as the numeraire for all others without explicit warrant.

Definition 21.42 (Value-form profile). A *value-form profile* specifies what a theory treats as valuable or value-relevant, the subject or position to which the value is attributed, the mechanism through which it is realized or represented, the comparison or aggregation rule employed, and any remainder that resists translation into that rule.

Proposition 21.43 (Value-translation condition). *Translation among theoretical value concepts requires value carrier, realization mechanism, evaluative purpose, comparison rule, and residual incommensurability to be specified separately before numerical or conceptual correspondence is asserted.*

Section 21.7 will develop this coordinate through utility, labor, price, capability, care, ecological, relational, and generative value.

21.3.8 Temporal Structure and Historical Pathways

Time enters economic theory in heterogeneous forms: comparative statics, equilibrium adjustment, discounting, expectations, historical time, path dependence, evolutionary change, crisis, institutional reproduction, learning, technological transition, and irreversibility. A common temporal vocabulary must preserve these differences rather than placing every theory on one homogeneous clock.

Sequence matters when earlier events transform later feasible states. Duration matters when institutional learning or capability formation requires time. Timing matters in liquidity, coordination, care, and crisis. Historical inheritance matters where rules, infrastructures, ecological conditions, or social relations persist after the originating decision. Some theories foreground such processes; others deliberately compress them to isolate a local relation.

Definition 21.44 (Temporal-historical profile). A *temporal-historical profile* specifies the time structure used by a theory, including sequence, duration, anticipation, memory, path dependence, reproduction, irreversibility, crisis, transition, and the conditions under which earlier states alter later possibility structures.

A theory with an equilibrium concept is not thereby “ahistorical” in every use, and a historical theory need not reject local equilibrium reasoning. The dialogue should identify the temporal role of each representation relative to the claim.

Proposition 21.45 (Temporal-translation condition). *Temporal translation among theories is warranted only where the relevant ordering, duration, memory, irreversibility, and transition assumptions are made explicit; correspondence of static states does not establish equivalence of historical processes.*

Section 21.9 will compare these temporal structures directly.

21.3.9 Power Conversion and Control Positions

Power is often present in economic theory even when it is not named directly. Bargaining position, ownership, class relation, monopoly, hierarchy, agenda control, institutional authority, network centrality, platform gatekeeping, asymmetric information, legal standing, and capability asymmetry can all create differentiated influence. A common language must identify the conversion mechanism rather than treat every inequality as power.

The relevant question is how an asymmetry becomes consequential for another position’s feasible action, access, value realization, or future possibilities. Control over infrastructure, standards, finance, data, employment, or institutional rules can mediate this conversion. Counter-power and credible exit can alter the relation without eliminating the underlying asymmetry.

Definition 21.46 (Power-conversion profile). A *power-conversion profile* specifies the relevant asymmetry, dependency or exposure, control position, institutional or infrastructural mediation, consequences for feasible action, persistence mechanism, counter-capacity, and contestability through which differentiated capability becomes economically consequential influence.

Proposition 21.47 (Power-mechanism condition). *Cross-theoretical claims about power should identify the mechanism converting asymmetry or position into consequential influence, and should distinguish that mechanism from the underlying difference in resources, capability, or status.*

Section 21.10 will use this coordinate to compare price coordination, hierarchy, class power, institutional power, bargaining, networks, capability asymmetry, care dependency, platform power, and relational power.

21.3.10 Evidence, Method, and Warrant

Theories differ in what counts as evidence and in how observations warrant claims. Deduction, econometrics, experiments, historical records, institutional comparison, ethnography, simulation, formal proof, case reconstruction, and mixed methods access different manifestations of economic reality. A common theoretical language must therefore include an evidential coordinate rather than compare theories only at the conceptual level.

Evidence does not enter theory without transformation. Administrative categories, survey instruments, experimental protocols, archival survival, model identification, coding rules, and qualitative interpretation all mediate the relation between observed trace and theoretical claim. Methodological difference can therefore produce genuine disagreement about what has been observed, not only how the observation should be explained.

Definition 21.48 (Evidence–method–warrant profile). *An evidence–method–warrant profile specifies the manifestations used as evidence, the methods through which those manifestations are produced or interpreted, the inferential link connecting them to a theoretical claim, the uncertainty and exclusions involved, and the scope of warrant thereby supported.*

This profile also preserves asymmetry among evidential regimes. A randomized intervention can identify a local causal effect without reconstructing its historical formation; an archival account can establish sequence and institutional context without identifying a counterfactual effect in the same way. Their contributions can be complementary without being interchangeable.

Proposition 21.49 (Evidential-translation condition). *Methods and evidence can enter common theoretical dialogue only where the inferential warrant of each evidential regime remains explicit; methodological plurality does not authorize treating unlike forms of evidence as equivalent support for the same claim.*

Section 21.11 will develop the methodological implications of this coordinate in detail.

21.3.11 Generativity and Future-Formation Effects

The final coordinate concerns how a theory represents the production of later possibilities. Growth, accumulation, innovation, learning, capability formation, reproduction, institutional change, ecological regeneration, path creation, and cultural or epistemic formation can all describe processes through which the future differs from the present. They should not be collapsed into one generic notion of generativity.

GRE uses generativity to ask how present relations alter later capacities, institutions, values, option structures, and paths. In theoretical dialogue this concept should function as a comparative question: *what does the theory allow to be generated, by whom or what, through which mechanism, over what horizon, and with what depletion or closure risks?* A theory may contain a strong account of innovation but a weak ac-

count of institutional reproduction; another may explain reproduction while leaving path creation underdeveloped.

Definition 21.50 (Theoretical generativity coordinate). *A theoretical generativity coordinate specifies the processes through which a theory represents the creation, reproduction, transformation, depletion, or closure of later capabilities, relations, institutions, value forms, knowledge, infrastructures, and practical possibility structures.*

The coordinate must also distinguish generativity from normative desirability. A process can generate new options while producing domination, ecological depletion, or exclusion. Conversely, maintenance can be generative when it preserves the substrate from which future activity remains possible.

Proposition 21.51 (Generativity-translation condition). *Cross-theoretical comparison of generative processes requires the generated object, generating mechanism, temporal horizon, reproduction conditions, depletion effects, affected positions, and normative status to remain separately specified.*

The eleven coordinates developed in this section provide a common interface for the remainder of Chapter 21. They do not assert that every economic theory contains the same relational ontology. They make explicit the questions required to test correspondence, partial translation, functional analogy, or irreducible difference.

Sections 21.4–21.11 now deepen the comparative architecture by examining units of analysis, subjects and agency, relations and structures, value and commensuration, scarcity and distribution, time and change, power and coordination, and evidence and method. The common language introduced here should therefore be read as a disciplined coordinate system whose legitimacy depends on preserving theoretical specificity at every subsequent stage of dialogue.

21.4 Economic Objects across Analytical Units

This section develops the object-level coordinate introduced in Section 21.3 by distinguishing the *unit of analysis* from the *economic object* represented at that unit. Its role is to provide a disciplined basis for comparing theories that begin with individuals, households, firms, classes, institutions, markets, networks, communities, ecologies, or wider relational configurations. The objective is not to select a privileged unit. It is to specify how a unit acquires analytical boundaries, which relations are internalized or externalized, how aggregation and decomposition are performed, and when a change of scale changes the economic object itself. The discussion proceeds from relatively familiar units toward increasingly composite configurations and concludes with a multi-level relational object capable of preserving cross-scale dependence without treating every scale as analytically interchangeable.

A unit of analysis is the locus at which attributes, events, relations, or outcomes are indexed for a particular claim. An economic object is the bounded configuration whose properties or transformations the claim seeks to explain. The two can coincide, but they need not. A person can be the unit at which income is measured while the relevant object is a household distribution system, labor relation, or institutional entitlement. A firm can be the unit in administrative data while the explanatory object is a supply network or regulatory field. Conversely, an aggregate can be the unit of observation while the object of interest remains a distribution of heterogeneous positions within it.

Definition 21.52 (Analytical-unit and economic-object profile). An *analytical-unit and economic-object profile* specifies, for a given claim, the unit at which evidence or attributes are indexed, the economic object whose mechanism is being represented, the boundary that separates internal from external relations, the relevant scale, admissible aggregation and decomposition rules, and the relations whose exclusion may alter the interpretation of the claim.

The distinction is important for theoretical dialogue because apparent disagreements can arise from different object boundaries rather than incompatible causal claims. The same empirical event can be represented as individual choice, household adaptation, firm restructuring, class redistribution, institutional change, network propagation, market adjustment, or ecological pressure. These descriptions can conflict, nest, or illuminate different mechanisms. Comparison therefore requires boundary reconstruction before adjudication.

Proposition 21.53 (Unit–object separation condition). *A theoretical comparison is well specified only where the unit at which evidence is indexed is distinguished from the economic object whose mechanism is being explained whenever those two structures differ.*

Table 21.4 summarizes the ten object architectures developed in this section. The table is not a hierarchy. Each unit is analytically useful where its boundary preserves the relations relevant to the local claim.

21.4.1 Individual Analytical Unit

The individual remains one of the most important analytical units in economics because many consequential variables and decisions are person-indexed: consumption, labor supply, education, income, health, preference expression, capability, and exposure to policy can all be measured or represented at this level. The analytical usefulness of the individual, however, depends on what the claim attributes to the person and which relations are treated as constitutive of the observed state.

An individual can be represented as a preference bearer, decision maker, worker, capability-bearing person, rights holder, debtor, caregiver, learner, platform user, or historically situated participant. These representations are not equivalent. A person-level choice can depend on household bargaining, employer authority, legal status, infrastructure, social expectation, algorithmic mediation, or ecological conditions. Individual indexing therefore does not establish individual causal sufficiency.

Definition 21.54 (Individual-unit profile). An *individual-unit profile* specifies the person-indexed attributes or events relevant to a claim together with the relational, institutional, historical, and material conditions required to interpret those attributes or events.

The individual unit is strongest where the mechanism genuinely operates through person-level variation or where normative standing requires person-sensitive incidence. It becomes weaker when aggregation silently converts relationally generated states into intrinsic personal properties. Income, employability, productivity, or observed preference may partly reflect positions and opportunities produced elsewhere in the configuration.

Proposition 21.55 (Individual-boundary adequacy condition). *Person-level analysis is adequate for a claim only where relations externalized from the individual boundary*

Table 21.4: Analytical units and characteristic economic-object boundaries

Unit	Characteristic object boundary	Principal boundary risk
Individual	Person-level choice, capability, income, labor, or experience	Externalizing constitutive social and institutional relations
Household	Resource pooling, care, reproduction, joint constraint, intra-household allocation	Treating internal distribution and conflict as homogeneous
Firm	Production, governance, contracts, capability, hierarchy, or organizational memory	Treating the legal or accounting boundary as the causal boundary
Class	Relational position in production, ownership, distribution, or reproduction	Reifying a relational position into a fixed homogeneous group
Institution	Rule-bearing and role-bearing configuration with enforcement and interpretation	Equating formal rule text with operational institution
Market	Price, exchange, matching, competition, coordination, and participation architecture	Treating market boundary and participation conditions as exogenous
Network	Positional structure of ties, flows, dependencies, and propagation	Reducing typed relations to generic edges
Community	Collective relation, shared infrastructure, norms, memory, and mutual support	Romanticizing cohesion or suppressing internal heterogeneity
Ecology	Material-energy relations, regenerative processes, thresholds, and human–nonhuman dependence	Treating biophysical conditions as external constraints only
Relational configuration	Multi-level history-bearing arrangement of objects and relations	Expanding the object until local mechanisms lose identification

do not contain mechanisms necessary to interpret the person-level state or where those mechanisms are represented explicitly as conditioning structures.

21.4.2 Household Economic Configuration

The household is frequently used as a unit for consumption, saving, poverty, labor allocation, fertility, care, housing, and welfare analysis. Its analytical significance arises from resource pooling, shared constraints, interdependent decisions, care obligations, reproduction, and the conversion of market and public resources into daily life. These mechanisms make the household more than a simple aggregation of individuals.

Household boundaries are nevertheless heterogeneous. Legal household, dwelling unit, family, care network, tax household, consumption unit, and remittance network can differ. Resources entering the household need not be distributed equally, and a common budget does not imply common preferences or symmetric bargaining power. Household-level welfare indicators can therefore conceal person-level deprivation or dependence.

Definition 21.56 (Household economic-object profile). A *household economic-object profile* identifies the membership rule, resource-pooling structure, internal allocation processes, care and reproduction relations, authority or bargaining structure, external dependencies, and temporal continuity through which a household becomes an economic object for a given claim.

The profile allows household analysis to remain useful without presuming a unitary actor. It also permits cross-theoretical comparison between models that treat the household as a decision unit and approaches that emphasize intra-household power, unpaid labor, care, or intergenerational reproduction.

Proposition 21.57 (Household-composition condition). *Household-level explanation should preserve internal allocation, dependency, and standing whenever those relations can alter person-level outcomes or the household's external economic behavior.*

21.4.3 Firm Organizational Configuration

The firm can be represented as a production unit, legal person, nexus of contracts, governance arrangement, hierarchy, capability repository, employer, innovating organization, platform, or node within a supply network. These representations often share an empirical name while assigning different causal boundaries to the object.

Accounting and legal boundaries provide important information, but they need not coincide with the boundary of production or control. Outsourcing can move workers outside a firm's payroll while leaving operational dependence intact. Intellectual property and platform rules can extend control beyond ownership of productive assets. Supplier relations can make capabilities distributed across organizations. Conversely, a legally integrated corporation can contain semi-autonomous divisions with different technologies and decision structures.

Definition 21.58 (Firm organizational-object profile). A *firm organizational-object profile* specifies the organizational boundary relevant to a claim, including production relations, control rights, contractual interfaces, internal hierarchy, capability and knowledge distribution, external dependencies, and the relation between legal, accounting, operational, and causal boundaries.

This formulation permits theories of production, transaction, governance, capability, labor, and power to be compared without presuming that they describe the same firm object. It also makes boundary change itself analytically visible when merger, outsourcing, franchising, platformization, automation, or financial restructuring alters the organization.

Proposition 21.59 (Firm-boundary correspondence condition). *Claims about firms should identify which organizational boundary carries the proposed mechanism; correspondence between theories cannot be inferred solely from their use of the term "firm."*

21.4.4 Class Position and Reproduction

Class differs from the preceding units because it is principally relational. A class position is constituted through patterned relations to production, ownership, labor, surplus, authority, or distribution rather than by spatial membership or legal incorporation alone. Class analysis therefore changes the object of explanation: individual and organizational attributes can be interpreted partly as effects of recurrent structural

positions.

A class object can be specified at different resolutions. Broad relations between owners and workers may be analytically useful for some historical processes, while occupational fractions, managerial positions, financial claims, informal labor, status, geography, or care responsibilities may matter for others. The unit should remain sufficiently differentiated to preserve the mechanism being studied.

Definition 21.60 (Class-position profile). A *class-position profile* specifies the relational criteria through which positions are constituted, the resources or claims attached to those positions, their reproduction mechanisms, internal heterogeneity, mobility pathways, and the scale at which common interests or constraints are analytically attributed.

Class therefore should not be treated as a demographic label detached from the relation that constitutes it. Nor should relational constitution imply perfect homogeneity among occupants of a class position. Historical institutions, gender, race, citizenship, skill, geography, sector, and organizational authority can mediate how the position is experienced and reproduced.

Proposition 21.61 (Relational-class condition). *Class functions as a coherent economic object only where the relation constituting the class position and the mechanism reproducing or transforming that position are specified separately from the empirical characteristics of current position holders.*

21.4.5 Institutional Economic Configuration

Institutions enter economic explanation through rules, roles, expectations, enforcement, interpretation, routines, rights, obligations, and organizational carriers. The institution is therefore rarely exhausted by a written rule. A property regime, labor standard, monetary arrangement, welfare entitlement, procurement system, professional norm, or platform governance rule becomes economically effective through enactment and reproduction across multiple positions.

Institutional boundaries can cut across organizations. The same rule may be administered by several agencies, interpreted by courts, operationalized by firms, and navigated by households. Informal practices can supplement or displace formal requirements. Institutional change can occur through formal amendment, reinterpretation, implementation drift, technological substitution, or changes in the subjects capable of invoking a rule.

Definition 21.62 (Institutional economic-object profile). An *institutional economic-object profile* specifies the rule or norm complex, recognized positions, enforcement and interpretation mechanisms, organizational carriers, practical enactment, historical reproduction, and interfaces through which the institution alters economic possibilities and obligations.

This profile distinguishes the institution from both a single organization and a pure rule statement. It also permits institutional effects to be investigated across scales, including cases where local implementation transforms the practical institution without changing its formal text.

Proposition 21.63 (Institutional-enactment condition). *Institutional analysis is complete for a local claim only where the operative relation between formal rule, interpretation, enforcement, organizational carrier, and practical enactment is represented at*

the scale relevant to the claimed effect.

21.4.6 Market Coordination Configuration

A market can be modeled as a set of exchanges, a price-formation mechanism, a matching process, a competitive field, an institutionally constituted arena, or a historically embedded coordination configuration. These descriptions differ in what they treat as endogenous. Participation rights, product definitions, information, payment systems, property rules, contract enforcement, standards, infrastructure, and market-making institutions can all be conditions of the market rather than external background.

Market boundaries also vary by purpose. A geographic market used in competition analysis can differ from a technological ecosystem, labor market, financial market, platform marketplace, or informal exchange network. The relevant object can further change as substitution, regulation, infrastructure, or digital intermediation alters who can participate and what counts as a comparable good or service.

Definition 21.64 (Market-configuration profile). *A market-configuration profile specifies the exchanged or matched objects, participant-entry conditions, coordination mechanism, price or non-price signals, institutional supports, information structure, substitution relations, spatial and temporal boundary, and dependencies through which the market is reproduced.*

The profile avoids treating “the market” as a boundary-free mechanism. It also allows theories to disagree productively about whether specific institutional conditions are constitutive of market coordination or merely affect outcomes within an already defined market.

Proposition 21.65 (Market-boundary endogeneity condition). *Where participation, product definition, information, infrastructure, or institutional support materially alters the coordination mechanism, those conditions should be treated as part of the market object or explicitly modeled boundary conditions rather than presumed exogenous.*

21.4.7 Network Positional Structure

Network analysis shifts attention from isolated attributes toward positional structure. Firms, households, banks, workers, communities, technologies, or institutions can acquire economic significance through connectivity, centrality, brokerage, dependency, clustering, multiplex relations, and paths through which resources or disturbances propagate.

A network object is not defined by connectivity alone. Edge type matters. Credit exposure, ownership, information exchange, friendship, supply dependence, migration, care, and platform interaction transmit different effects. Direction, weight, timing, contractual status, substitutability, and higher-order group structure can also change the meaning of a network position.

Definition 21.66 (Economic-network object profile). *An economic-network object profile specifies nodes, typed relations, directionality, intensity, temporal structure, positional measures, propagation mechanisms, boundary rules, and the higher-order structures required to interpret economic dependence or coordination within the network.*

Network boundaries deserve special care because observed data often include only a subset of relations. A measured network can therefore be a manifestation of a wider relational structure rather than the object in full. Positional inference should remain indexed to the sampled or institutionally visible network.

Proposition 21.67 (Typed-network condition). *Network comparison across theories preserves economic meaning only where relation type, direction, propagation mechanism, temporal scope, and boundary construction remain explicit; generic connectivity alone is insufficient to establish structural equivalence.*

21.4.8 Community Economic Configuration

Community becomes economically relevant where repeated social relations, shared infrastructures, collective memory, norms, mutual support, common resources, identity, or localized knowledge alter production, care, exchange, resilience, or distribution. The community object can therefore capture relations that remain difficult to represent through household, firm, or market units alone.

Community boundaries are rarely simple. Residence, kinship, language, occupation, religion, digital participation, shared resource use, or political membership can produce overlapping communities. Internal disagreement and hierarchy can coexist with solidarity. Community analysis therefore requires attention to membership, exit, voice, exclusion, internal distribution, and the institutions through which collective capacity is maintained.

Definition 21.68 (Community economic-object profile). *A community economic-object profile specifies the basis of membership, shared relations and infrastructures, collective capacities, internal differentiation, boundary and exclusion practices, memory and reproduction mechanisms, and external interfaces through which community structure becomes economically consequential.*

This formulation permits community to enter economic analysis without romanticizing cohesion or reducing collective relations to individual social capital. A community can support generativity while also containing exclusion, dependency, or unequal authority.

Proposition 21.69 (Community-heterogeneity condition). *Community-level economic explanation should preserve internal differentiation and boundary processes whenever cohesion, exclusion, authority, or unequal access materially affects the collective mechanism being analyzed.*

21.4.9 Ecological Economic Configuration

Ecological analysis expands the economic object beyond human institutional and transactional boundaries. Energy, material throughput, land, water, biodiversity, climate, ecosystem functions, regenerative rates, pollution sinks, and threshold processes can be constitutive of production and reproduction rather than external conditions appended after an economic model is specified.

The relevant ecological boundary depends on the process. A supply chain can depend on watershed conditions far from the point of sale; a local production system can contribute to cumulative atmospheric effects; an ecosystem can regenerate on a timescale different from investment or policy cycles. Economic and ecological units

therefore frequently fail to align spatially or temporally.

Definition 21.70 (Ecological economic-object profile). An *ecological economic-object profile* specifies the biophysical processes, material and energy flows, regenerative capacities, thresholds, affected human and nonhuman systems, spatial extent, temporal scale, and economic interfaces required to represent a claim about economic dependence on ecological conditions.

This profile does not imply that every economic claim requires full ecological reconstruction. It establishes the narrower requirement that ecological relations become internal to the economic object when excluding them would change the mechanism, feasible set, reproduction condition, or long-run interpretation of the claim.

Proposition 21.71 (Ecological-boundary inclusion condition). *Biophysical processes belong within an economic object's explanatory boundary where they materially condition the creation, maintenance, depletion, or regeneration of the economic relations or capacities at issue.*

21.4.10 Multi-Level Relational Configuration

The final object architecture treats economic phenomena as potentially distributed across several units at once. Individuals act within households and organizations; firms participate in markets and networks; institutions shape all of these positions; communities reproduce capabilities and norms; ecological systems condition material possibility. A multi-level relational configuration provides a way to represent such coupling without declaring one scale universally fundamental.

The usefulness of this object depends on disciplined containment. Enlarging the boundary can reveal cross-scale mechanisms, but an indefinitely expanding configuration can make explanation unfalsifiable and local identification impossible. Multi-level analysis therefore requires explicit rules for which units and relations are included, how states at one level are generated from or constrain another, and which remainder stays outside the local model.

Definition 21.72 (Multi-level relational economic object). A *multi-level relational economic object* is a bounded history-bearing configuration in which two or more analytical units are connected through specified cross-level relations, with explicit rules for aggregation, decomposition, conditioning, feedback, and temporal propagation.

The object is particularly useful when causal direction crosses levels. Household decisions can affect labor markets while labor-market institutions alter household possibilities; firm strategies can reshape networks while network structure changes firm capability; ecological degradation can alter production while production changes ecological regeneration. These are coupled processes rather than independent levels stacked beside one another.

Proposition 21.73 (Cross-level mechanism condition). *A multi-level relational configuration is warranted only where the cross-level relations add identifiable explanatory content beyond separate single-unit analyses and where aggregation, decomposition, feedback, and boundary assumptions remain explicit.*

The analysis of units and economic objects therefore yields a plural but disciplined object architecture. Individuals, households, firms, classes, institutions, markets, networks, communities, and ecologies can each be legitimate analytical units, while the economic object relevant to a claim may coincide with, contain, cut across, or be con-

stituted through relations among them. Theoretical dialogue should consequently compare object boundaries before comparing results produced within those boundaries.

This object-level clarification prepares Section 21.5. Once the unit and object boundary are specified, the next question concerns which positions within or across those objects possess agency, standing, experience, responsibility, contribution, representation, or affectedness. Subject architecture can then be compared without conflating the entity selected for analysis with the subject recognized by a theory.

21.5 Economic Agency across Subject Architectures

This section develops the subject-position coordinate introduced in Section 21.3 and follows the object-level analysis of Section 21.4. Its role is to distinguish the *economic object* represented by a theory from the *subject positions* to which that theory attributes choice, initiative, capability, responsibility, representation, standing, or exposure to consequences. The objective is not to identify one canonical economic subject. It is to reconstruct several recurrent subject architectures and to specify the dimensions along which they can be compared without treating preference, class position, institutional embeddedness, bounded rationality, capability, relational constitution, collective action, or artificial agency as equivalent descriptions of the same actor. The discussion therefore moves from relatively familiar individual subject forms toward relational, collective, and artificial agency, and closes by specifying the boundaries of subject translation.

A subject position is not defined merely by occupying a unit of analysis. A household can be an economic object while individual members remain differentiated subjects; a corporation can be an organizational object to which strategic actions are attributed even though experience and responsibility are distributed among persons and institutional procedures; a future generation can be affected by present decisions without possessing present decision authority. Likewise, agency is multidimensional. Choosing among available alternatives, initiating a new course of action, negotiating, refusing, coordinating, revising rules, representing others, and sustaining collective action can depend on different capacities and institutional permissions.

Definition 21.74 (Economic subject-agency profile). An *economic subject-agency profile* specifies, for a theory or claim, the positions recognized as subjects together with their attributed forms of choice, initiative, capability, rule-changing authority, representation, responsibility, legal standing, experiential status, and affectedness, including the relations and institutions that enable or constrain those attributes.

The profile deliberately separates analytical subjecthood from moral or legal conclusions. A model can attribute decision capability to a firm without establishing that the firm has human experience; an institution can represent a community without exhausting the standing of its members; an artificial system can execute economically consequential actions without resolving questions of consciousness, moral status, or ultimate responsibility. These distinctions are necessary for both theoretical comparison and economic governance.

Proposition 21.75 (Subject-agency separation condition). *Cross-theoretical comparison of economic subjects is adequate only where the dimensions of agency, standing, responsibility, representation, and affectedness relevant to the local claim are distin-*

Table 21.5: Subject architectures and characteristic agency questions in economic theory

Subject architecture	Principal agency emphasis	Characteristic translation risk
Preference-bearing	Choice over represented alternatives and preference ordering	Equating observed choice with complete welfare or autonomous preference formation
Class-positioned	Action conditioned by relational position in production, ownership, and distribution	Inferring common agency directly from common structural position
Institutionally embedded	Role-mediated permission, obligation, interpretation, and rule use	Treating institutions only as external constraints on otherwise unchanged actors
Bounded-rationality	Procedural choice under limited information, cognition, and attention	Treating cognitive limitation as absence of agency or as a purely individual defect
Capability-bearing	Substantive possibility to realize valued doings and beings	Equating resources, formal permission, achieved functioning, and capability
Relationally constituted	Subject properties partly generated through recurrent relations and histories	Dissolving attributable agency into structure or treating relations as incidental context
Collective	Coordinated action through procedures, roles, representation, and shared capacity	Treating organizational action as unanimous member preference
Artificial	Delegated or system-mediated action through computational and institutional interfaces	Inferring moral standing, experience, or autonomous responsibility from functional performance
Translation boundary	Dimension-by-dimension correspondence among heterogeneous subject forms	Forcing equivalence where theories distribute agency and standing differently

guished rather than inferred from a single generic category of actor.

Table 21.5 summarizes the subject architectures developed in this section. The rows should be read as comparative profiles rather than mutually exclusive ontological classes. The same person or organization can occupy several subject positions simultaneously, and a theory can combine more than one architecture.

21.5.1 Preference-Bearing Economic Subjects

A preference-bearing subject is represented through an ordering, valuation, or choice relation over available alternatives. This architecture is powerful when the relevant economic problem concerns trade-offs among represented options, demand, allocation, response to incentives, or welfare analysis under an explicit preference structure. Its analytical economy also makes clear which aspects of subjecthood are being bracketed: the origin of preferences, the constitution of the feasible set, interpersonal relations, institutional permissions, and the capacity to alter the choice architecture can remain outside the local representation unless modeled separately.

Choice therefore should not be treated as a complete synonym for agency. A per-

son can choose among menu items without having the authority to define the menu, alter prices, change participation rules, or develop the capacities required to use an option. Observed choice can also be shaped by information, habit, social expectation, bargaining position, adaptive response, or institutional design. These conditions do not invalidate preference-based analysis; they determine the scope within which the inferred subject architecture is adequate.

Definition 21.76 (Preference-choice agency profile). A *preference-choice agency profile* specifies the alternatives represented to a subject, the preference or valuation relation used to order them, the information and constraints relevant to choice, the stability or formation assumptions attached to preferences, and the authority the subject possesses to modify the choice environment itself.

The last element is important for translation. Two theories can both describe a person as choosing while assigning very different significance to that choice. One can treat the ordering as a sufficient representation of the local decision; another can regard the ordering as historically or socially formed and therefore as one manifestation of a wider subject configuration.

Proposition 21.77 (Choice-domain adequacy condition). *Preference-based subject representation is adequate for a local claim where the relevant mechanism is carried by choice among represented alternatives and where omitted processes of preference formation, feasible-set construction, or rule revision do not materially change the interpretation of that claim.*

21.5.2 Class-Positioned Economic Subjects

Class-positioned subjecthood begins from a different analytical premise. The subject is located in recurrent relations of production, ownership, labor, authority, surplus, or distribution that condition incentives, vulnerabilities, resources, and possible forms of action. The subject is therefore neither reducible to personal attributes nor fully determined by structural position. A class position can shape action without producing a homogeneous consciousness, identical interest, or automatic capacity for collective coordination.

This distinction separates *position* from *agency through the position*. Workers exposed to a common labor relation can differ in contract status, citizenship, care responsibilities, skill, geography, organizational membership, or access to exit. Owners and managers can occupy distinct control positions even where both receive income connected to the same organization. A class theory must therefore specify which relation constitutes the position and which mechanisms translate that position into behavior, interests, organization, or historical change.

Definition 21.78 (Class-position agency profile). A *class-position agency profile* specifies the relation constituting a class position, the resources and constraints attached to that position, the mechanisms through which occupants interpret or act from it, the conditions of coordination among similarly positioned subjects, and the sources of internal differentiation that can modify common action.

A class-positioned subject can therefore be compared with a preference-bearing subject without translating class into a fixed preference type. The former makes relational location part of subject constitution; the latter can remain useful for particular decisions within that position.

Proposition 21.79 (Position-action mediation condition). *A structural position supports an agency claim only where a mechanism connecting the position to interpretation, capacity, coordination, or action is specified; common position alone does not establish common agency.*

21.5.3 Institutionally Embedded Economic Actors

Institutionally embedded actors act through positions whose permissions, obligations, categories, procedures, and expectations are partly supplied by institutions. A central-bank official, corporate director, welfare claimant, licensed professional, contract holder, public servant, or platform participant can possess forms of agency that depend on recognized roles rather than on private resources alone. Institutions can constrain action, but they can also enable actions that would otherwise be unavailable by establishing authority, enforceable claims, recognized procedures, and common expectations.

Institutional embeddedness therefore changes both feasible action and the meaning of action. Signing a document can create an obligation only where the signer occupies an authorized position and the surrounding institutional configuration recognizes the act. Voting inside an organization, invoking an entitlement, exercising fiduciary authority, or enforcing a contract similarly depends on rule-mediated standing. At the same time, actors interpret, reproduce, contest, and sometimes transform the institutions through which they act.

Definition 21.80 (Institutionally embedded agency profile). *An institutionally embedded agency profile specifies the role occupied by an actor, the permissions and obligations attached to that role, the institutional resources available through it, the interpretive and discretionary space within the role, and the pathways through which role enactment can reproduce, contest, or modify the institution.*

This profile prevents institutional analysis from treating rules as an environment external to otherwise unchanged actors. It also prevents the opposite reduction in which the role exhausts the person or organization occupying it. Institutional positions mediate agency while leaving room for heterogeneous interpretation, competence, resistance, and interaction with other positions.

Proposition 21.81 (Institutional-mediation condition). *Where an action depends on role-specific authority, entitlement, obligation, or procedure, the institutional mediation of agency should be represented as part of the subject architecture rather than as an external constraint alone.*

21.5.4 Bounded-Rationality Agency Profiles

Bounded-rationality approaches alter the subject architecture by making decision procedures, limited information, finite cognition, search cost, attention, heuristics, satisficing, and learning analytically relevant. The subject remains capable of purposeful action, but the process through which action is selected can no longer be represented solely by a fully specified optimization problem with costless access to all relevant information.

Boundedness should not be interpreted as a purely personal deficiency. The information environment is partly designed through institutions, interfaces, organizations, professions, and technologies. An actor can appear poorly informed

because crucial information is inaccessible, badly classified, strategically withheld, or too costly to verify. Organizational routines and social knowledge can also expand practical rationality beyond what an isolated individual could calculate. The boundary of the cognitive subject therefore interacts with the surrounding epistemic configuration.

Definition 21.82 (Bounded-rationality agency profile). *A bounded-rationality agency profile specifies the decision task, information available to the actor, cognitive and attentional limits, search and verification costs, decision procedures or heuristics, learning opportunities, environmental supports, and the consequences of those bounds for attainable action.*

This profile provides a translation bridge between choice-oriented and institutionally or relationally embedded theories. The bridge remains partial: introducing cognitive limits does not by itself establish that preferences, identities, or capabilities are relationally constituted.

Proposition 21.83 (Procedural-agency condition). *Where decision procedures and information-processing limits materially affect behavior, theoretical comparison should represent those procedures and their environmental supports rather than inferring agency solely from the observed outcome of choice.*

21.5.5 Capability-Bearing Persons

Capability-oriented subject architecture shifts attention from resources or chosen outcomes toward the substantive possibilities available to persons. A person can possess income or a formal entitlement while lacking the practical ability to convert it into mobility, education, health, participation, communication, or other valued functionings. Conversely, two persons with similar observed achievements can possess different opportunity structures because one outcome is freely chosen while the other results from severe constraint.

This architecture requires several distinctions. Resource possession differs from conversion capacity. Achieved functioning differs from the capability set from which it could have been chosen. Capability differs from expressed preference because adaptation to deprivation can alter what a person reports or seeks. Agency also extends beyond personal welfare when persons pursue commitments, relationships, or collective goals that they value independently of their own achieved functioning.

Definition 21.84 (Capability-bearing subject profile). *A capability-bearing subject profile specifies the resources and entitlements available to a person, relevant personal and relational conversion conditions, substantive attainable functionings, constraints on selection among those possibilities, and the person's practical capacity to pursue valued individual or collective purposes.*

Capability therefore provides a richer account of practical possibility without eliminating the need to specify institutions, relations, or power. The same nominal capability can be fragile where it depends on discretionary support, inaccessible infrastructure, hidden dependency, or a gatekeeper whose cooperation is uncertain.

Proposition 21.85 (Capability-agency correspondence condition). *A capability claim supports an agency interpretation only where practical attainability and relevant conversion conditions are represented; nominal resources, formal permission, or observed functioning alone do not establish the corresponding substantive agency.*

21.5.6 Relationally Constituted Subject Positions

Relationally constituted subjecthood treats some economically consequential properties of subjects as generated or stabilized through recurrent relations. Preferences can be socially formed, skills can depend on institutions and collaborators, identities can be attached to roles, bargaining capacity can emerge from organization, and expectations can be shaped through repeated interaction. A subject can therefore remain identifiable while some of the attributes relevant to economic action are historically produced through the configuration in which the subject participates.

Relational constitution should be stated with restraint. It does not require the claim that the subject has no continuity apart from any particular relation, nor that every attribute is socially generated. The analytical burden is to identify which property is relation-dependent, through what mechanism, over what timescale, and with what degree of persistence after the relation changes. This preserves attributable agency while allowing agency itself to be historically formed.

Definition 21.86 (Relationally constituted subject profile). *A relationally constituted subject profile identifies the subject properties relevant to a claim, the relations through which those properties are generated, maintained, or transformed, the historical duration of that dependence, and the extent to which the subject retains continuity and actionable capacity across relational change.*

The profile is particularly important for theoretical translation because a theory of fixed actors interacting can reproduce the same observed pattern as a theory in which interaction changes the actors themselves. Their predictions may overlap locally while their accounts of intervention, learning, and historical change differ substantially.

Proposition 21.87 (Relational-constitution identification condition). *A claim that an economic subject is relationally constituted is warranted only where the relation-dependent property and the mechanism generating or reproducing that property are identified separately from ordinary interaction among otherwise stable subjects.*

21.5.7 Collective Economic Agency

Economic action is frequently attributed to collectives: firms invest, unions bargain, governments tax, cooperatives allocate, communities maintain infrastructure, and professional associations establish standards. Such language can be analytically legitimate when collective action is produced through procedures that coordinate differentiated participants across time. Collective agency does not require unanimous preference, identical experience, or complete internal cohesion.

The relevant question is how action becomes attributable to the collective. Decision rules, delegated authority, representation, routines, information systems, memory, enforcement, resource pooling, and recognized external standing can transform many individual contributions into a persistent action-capable configuration. Internal disagreement remains relevant because representation can be incomplete and collective actions can distribute benefits, burdens, or responsibility unevenly among members.

Definition 21.88 (Collective agency profile). *A collective agency profile specifies the membership or constituency relevant to a claim, decision and coordination procedures, representative or delegated roles, collective resources and memory, persis-*

tence across member turnover, external standing, internal contestability, and the allocation of responsibility for collective action.

This definition separates collective agency from aggregation. A statistical group can exhibit correlated behavior without possessing any procedure for common action. Conversely, a legally or organizationally constituted body can act despite disagreement among its members because authorized procedures generate decisions attributable to the collective.

Proposition 21.89 (Collective-attribution condition). *Economic action should be attributed to a collective only where a coordination, authorization, or reproduction mechanism connects differentiated participants to the action in a way that persists beyond coincident individual behavior.*

21.5.8 Artificial Economic Agency

Artificial systems increasingly mediate economically consequential activities such as recommendation, pricing, matching, forecasting, scheduling, trading, screening, contracting, content generation, and resource allocation. The language of agency becomes useful when such systems select or initiate actions within an operational environment, yet the attribution requires careful typing. Functional action, delegated authority, institutional authorization, legal standing, moral standing, experiential status, and ultimate responsibility are distinct questions.

An artificial system can therefore be analyzed as an economic agent for a bounded operational claim without presuming consciousness or independent moral personhood. The economically relevant configuration includes the system's action space, objective or instruction structure, training and input dependencies, delegated permissions, human and organizational oversight, infrastructure, update pathway, auditability, and the parties who bear consequences. Agency can also be distributed: a human–AI workflow may generate actions that cannot be explained adequately by either the software or the nominal human operator in isolation.

Definition 21.90 (Artificial economic-agency profile). *An artificial economic-agency profile specifies the actions an artificial system can select or execute, the information and computational processes supporting those actions, the authority delegated to the system, operational dependencies, oversight and override pathways, persistence and update conditions, affected positions, and the institutional allocation of responsibility for resulting actions.*

The profile is designed to prevent capability from silently becoming status. Greater forecasting, generation, or operational autonomy can alter dependency and control relations without determining whether the system possesses experience, moral standing, or legal personhood. Those questions require separate premises and forms of evidence.

Proposition 21.91 (Artificial-agency attribution condition). *Attributing economic agency to an artificial system is analytically warranted for a local claim where the system has a specified action space, a mechanism connecting inputs to consequential action, and an identifiable authorization and responsibility architecture; functional agency alone does not establish experiential or moral status.*

21.5.9 Subject-Translation Boundaries

The preceding architectures show why theoretical dialogue should not begin by replacing every subject with a generic “actor.” Preference-bearing, class-positioned, institutionally embedded, bounded-rationality, capability-bearing, relationally constituted, collective, and artificial subjects distribute agency across different dimensions. Some theories emphasize selection among alternatives; others emphasize the formation of those alternatives, the positional structure conditioning action, the capability to convert resources into function, or the procedures through which many participants act collectively.

A subject translation should therefore be dimension-by-dimension. Choice can correspond without capability; legal standing can correspond without experiential status; collective decision authority can correspond without unanimity; affectedness can exist without present agency; responsibility can remain with human or institutional principals even where an artificial system performs the proximate action. Translation is strongest where these dimensions align through identifiable mechanisms and weakest where the same label conceals different architectures.

Definition 21.92 (Subject-translation profile). A *subject-translation profile* maps two or more theoretical subject positions across choice, initiative, capability, institutional authority, relational constitution, representation, responsibility, legal standing, experiential status, and affectedness, while recording dimensions for which correspondence is partial, absent, or presently indeterminate.

This profile operationalizes the broader non-reductive translation discipline of Section 21.3. It also anticipates the relational analysis of Section 21.6: subject properties and agency claims often depend on the relations and structures through which positions are constituted. Later theoretical comparison can therefore ask whether two traditions disagree about the subject itself, about the relations producing the subject’s action space, or about the normative standing attributed to positions affected by economic change.

Proposition 21.93 (Subject-translation boundary condition). *Cross-theoretical subject translation is adequate only where correspondence is established separately for the dimensions relevant to the claim and where non-equivalence in agency, standing, representation, responsibility, or affectedness remains explicit rather than being absorbed into a generic actor category.*

The section therefore yields a plural subject architecture for theoretical dialogue. Economic theories can remain comparable without sharing a single subject ontology. The next analytical task is to examine the relations and structures through which those subjects interact, acquire positions, reproduce capabilities, coordinate action, and transform one another.

21.6 Economic Relations and Structural Configurations

The role of this section is to specify the relational and structural coordinates through which economic theories can be compared after their objects and subject architectures have been separated in Sections 21.4 and 21.5. Its objective is to distinguish a local relation between economic positions from a more persistent structure com-

posed of patterned relations, and to show how different theoretical traditions assign explanatory weight to exchange, production, ownership, labor, institutions, care, networks, ecology, and power-bearing configurations. The section proceeds comparatively rather than by proposing that one relation is fundamental in every domain. Its method is to identify the positions connected by a relation, the mechanism carried by that relation, the temporal and institutional conditions of its reproduction, and the structural effects that arise when relations become patterned across multiple positions or periods.

Economic analysis often uses relational language while assigning different meanings to the relation itself. A market transaction can be represented as an exchange between already constituted agents, as an institutionally organized transfer of rights, as an event embedded in a continuing social relation, or as one moment in a wider structure of production and distribution. A firm can be represented through contracts, authority, routines, ownership, production relations, or network position. Care can appear as household allocation, unpaid labor, capability support, interdependence, or social reproduction. These descriptions are not interchangeable merely because each is relational. The analytical task is to identify what the relation connects, what passes through or is generated by it, which positions it creates or reproduces, and what remains outside the representation.

Definition 21.94 (Economic relational-structural profile). An *economic relational-structural profile* specifies the positions connected within an economic configuration, the type and direction of relations among them, the resources, rights, information, obligations, capabilities, values, or dependencies mediated by those relations, their temporal persistence and institutional conditions, the larger pattern formed across relations, and the mechanisms through which that pattern affects subsequent action or position formation.

The definition distinguishes relation from structure without making them independent objects. A relation is a typed connection or process between positions. A structure is a sufficiently persistent and patterned organization of multiple relations such that the pattern itself becomes relevant to the opportunities, constraints, expectations, dependencies, or positions generated within the configuration. Structural explanation therefore requires more than naming a pattern. It should identify how the pattern is reproduced and how it enters a mechanism relevant to the claim.

Proposition 21.95 (Relational-structural identification condition). An *economic relation or structure has explanatory content only where the relevant positions, relational mechanism, persistence conditions, and consequences for action, capability, distribution, or subsequent position formation can be identified with sufficient specificity for the local claim.*

Table 21.6 summarizes the ten relational coordinates developed below. The table is comparative rather than exhaustive: a concrete economic configuration can contain several of these relations simultaneously, and the analytical problem is often their coupling rather than the isolation of one relation.

21.6.1 Exchange Relations and Transfer Architecture

Exchange is among the most familiar relational objects in economics, yet theories differ over what an exchange relation contains. A minimal representation can connect two parties through quantities and prices. Broader representations can include prop-

Table 21.6: Relational and structural coordinates for cross-theoretical economic comparison.

Coordinate	Primary relational question	Characteristic reduction risk
Exchange	What is transferred, by whom, through which rights and terms?	Reducing continuing relations to isolated transactions
Production	How are heterogeneous inputs and contributions transformed into outputs and capacities?	Treating production as a technical mapping alone
Ownership	Which rights, control capacities, residual claims, and exclusion powers attach to positions?	Treating legal title as complete practical control
Labor	How are work, authority, remuneration, capability, and dependence organized?	Treating labor only as a priced input
Institution	How do rules, roles, procedures, and enforcement organize interaction?	Reifying rules apart from enactment and interpretation
Care	How are maintenance, dependence, capability support, and social reproduction organized?	Treating care as residual household activity
Network	How do topology and position condition access, mediation, diffusion, and dependence?	Treating edges as homogeneous connections
Ecology	How do economic processes depend on and transform biophysical relations?	Treating environment as an external stock
Power-bearing structure	Which relations convert asymmetry or dependence into durable control over relevant possibilities?	Inferring power directly from difference or centrality
Translation boundary	Which relational mechanisms correspond across theories, and which remain irreducible?	Equating shared vocabulary with structural identity

erty rights, contractual terms, information, bargaining position, institutional enforcement, reputation, repeated interaction, and the histories through which the objects of exchange became transferable. Smith’s analysis of exchange and specialization situated market exchange within a wider architecture of production and social coordination (A. Smith 1776). Polanyi’s historical account, by contrast, emphasizes that exchange operates through instituted economic arrangements whose social organization can vary substantially (Polanyi 1944; Polanyi 1957).

For theoretical dialogue, the key issue is therefore the *transfer architecture*. What is transferred can include a physical good, a service, a claim, access, risk, information, a right of use, or a future obligation. Payment does not always exhaust the relation: warranties, employment obligations, platform dependence, continuing service provision, data extraction, or credit relationships can persist after the transaction event. Exchange can consequently be modeled as an event nested within a longer relation.

Definition 21.96 (Exchange-relation profile). An *exchange-relation profile* specifies the parties and positions participating in a transfer, the object or entitlement transferred, reciprocal or nonreciprocal consideration, relevant rights and obligations,

pricing or valuation mechanism, information and bargaining conditions, enforcement architecture, temporal continuation, and dependencies that remain after the transfer event.

This profile allows price-centered and institution-centered accounts to be compared without demanding that they answer the same question. A spot-market model may be adequate for a claim about local price response while leaving continuing dependence outside its scope. A relational or institutional account may be required where the economic consequence depends on repeated exchange, locked-in infrastructure, incomplete contracting, or asymmetric exit capacity.

Proposition 21.97 (Exchange-scope condition). *An exchange representation is adequate to the extent that the transfer event and its retained obligations, dependencies, and institutional conditions include the relations causally relevant to the claim being evaluated.*

21.6.2 Production Relations and Cooperative Transformation

Production links heterogeneous contributions through processes that transform materials, knowledge, labor, energy, organization, infrastructure, and time. Treating production only as a technical mapping from inputs to outputs can be useful for some questions, but it can omit the relations through which inputs become available, coordinated, maintained, and renewed. Marx's analysis placed relations of production at the center of a broader account of class and accumulation (Marx 1867). Coase's theory of the firm, from a different analytical tradition, asked why some transactions are coordinated within firms rather than through market contracting (Coase 1937). The theories differ substantially, yet each makes the organization of production analytically consequential.

A relational comparison should distinguish technical complementarity from organizational cooperation, authority, ownership, contractual dependence, and capability reproduction. The same observed output can arise through different configurations: vertically integrated firms, decentralized contracting, cooperatives, platform-mediated work, public production, household production, or commons-based arrangements. These configurations can distribute learning, risk, control, maintenance burdens, and future productive capacity differently even when short-run output is similar.

Definition 21.98 (Production-relational profile). *A production-relational profile identifies the contributing positions, materials and capabilities mobilized, transformation process, coordination and authority mechanisms, allocation of risk and returns, maintenance and learning requirements, temporal sequencing, and the effects of production on the future capacities of participating positions and infrastructures.*

Production is therefore both transformative and potentially generative or depletive. It can produce goods while eroding ecological stocks, increase output while degrading worker capability, or generate learning that expands later productive possibilities. These effects need not be included in every production model, but theoretical translation should record whether they are represented or bracketed.

Proposition 21.99 (Production-configuration condition). *Two theories represent corresponding production relations only where their relevant transformation, coordination, contribution, and reproduction mechanisms can be mapped without treating equal output measures as sufficient evidence of structural equivalence.*

21.6.3 Ownership and Control Relations

Ownership organizes economically consequential relations through bundles of rights and recognized positions. Legal title can carry rights to use, exclude, transfer, receive income, modify, collateralize, or dispose of an asset, yet practical control can diverge from formal ownership. Creditors, managers, regulators, platform operators, technical administrators, communities, licensors, or infrastructure providers can possess forms of control that matter even where they lack title. Institutional economics has long emphasized that property is constituted through rules and enforceable claims rather than being a purely physical relation between a person and an object (Commons 1931; North 1990).

The distinction between ownership and control is especially important for contemporary intangible and infrastructural assets. A person can nominally own data while lacking practical capacity to move, interpret, or delete it; a firm can own equipment while depending on proprietary software or cloud infrastructure controlled elsewhere; shareholders can possess residual claims while managers exercise operational authority. Cross-theoretical comparison should therefore decompose the rights and capacities bundled into ownership.

Definition 21.100 (Ownership-control profile). *An ownership-control profile specifies the asset or relation governed, legal title, use rights, exclusion rights, transfer rights, income and residual claims, decision and modification authority, collateral or encumbrance relations, enforcement conditions, and practical dependencies that qualify the exercise of those rights.*

This profile prevents ownership from serving as a single scalar variable where the local mechanism depends on one component of the bundle. It also permits analysis of divided or layered control across jurisdictions, organizations, technical systems, and contractual relations.

Proposition 21.101 (Ownership-control decomposition condition). *Where an economic claim depends on control, access, exclusion, income, or transferability, ownership should be decomposed into the rights and practical capacities relevant to that mechanism rather than inferred solely from formal title.*

21.6.4 Labor Relations and Organizational Position

Labor relations connect productive contribution to remuneration, authority, time, skill formation, risk, identity, dependency, and organizational position. A wage can be represented as the price of labor services for some analytical purposes, yet employment frequently includes continuing relations that exceed the wage transaction: supervision, scheduling, evaluation, promotion, training, occupational closure, benefits, legal protections, and dependence on organizational infrastructure. The economic object is therefore often a labor relation rather than a sequence of isolated labor-market exchanges.

Theories also differ over whether labor power, human capital, capability, class position, bargaining relation, care responsibility, or organizational membership provides the relevant explanatory object. These differences matter because identical wages can coexist with very different autonomy, security, learning, exposure, and future capacity. Labor relations can generate capabilities through training and collaboration or deplete them through deskilling, overwork, hazardous conditions, or

unstable scheduling.

Definition 21.102 (Labor-relational profile). *A labor-relational profile specifies the work contributed, remuneration and claims received, authority and scheduling relations, bargaining and exit conditions, legal and organizational standing, capability formation or depletion, risk allocation, temporal dependence, and the position of the worker within wider production and reproduction structures.*

This definition also permits unpaid, informal, dependent, and hybrid forms of labor to enter comparison where they are economically consequential. The presence of remuneration can be one coordinate without serving as the sole criterion of economic contribution.

Proposition 21.103 (Labor-relation adequacy condition). *A labor representation is adequate for a given claim only where the dimensions of remuneration, authority, dependence, capability, and organizational position that transmit the relevant economic effect are included or explicitly bracketed.*

21.6.5 Institutional Relations and Rule-Structured Interaction

Institutions organize economic relations by stabilizing rules, roles, procedures, expectations, sanctions, entitlements, and recognized categories. Institutional relations therefore differ from ordinary repeated interaction: a role can carry authority or obligation because a rule system recognizes it. Commons, firms, markets, courts, public agencies, professional bodies, and payment systems all contain such rule-structured relations. Ostrom's work on commons governance demonstrates how positions, rules, monitoring, sanctions, and collective-choice arrangements can produce institutional diversity beyond a simple market-state dichotomy (Ostrom 1990; Ostrom 2005).

Rules, however, do not operate independently of interpretation and enactment. Written provisions can be weakly enforced, selectively applied, supplemented by informal norms, or transformed through precedent and administrative practice. The economic relation is therefore generated through the coupling of rule text, recognized roles, implementation capacity, interpretation, and participant expectations.

Definition 21.104 (Institutional-relation profile). *An institutional-relation profile specifies the relevant rules, recognized positions, rights and duties, decision procedures, interpretation and enforcement mechanisms, informal complements, monitoring and sanction pathways, revision procedures, and the historically reproduced expectations through which rule-structured interaction becomes economically consequential.*

The profile makes institutions comparable without treating them as fixed containers. Institutional structure is reproduced through action and can change through reinterpretation, noncompliance, legal revision, organizational learning, or shifts in practical capacity.

Proposition 21.105 (Institutional-enactment condition). *An institutional explanation should connect formal or informal rules to the enactment, interpretation, enforcement, and expectation mechanisms through which those rules shape economic relations in practice.*

21.6.6 Care Relations and Reproductive Dependence

Care relations make visible forms of economic dependence that are easily obscured when analysis begins with self-sufficient actors. Children, older persons, disabled persons, patients, and temporarily dependent adults can require continuing care, while almost every economic subject depends at some stages of life on forms of maintenance, education, health support, emotional work, and social reproduction. Feminist economic analysis has emphasized that these activities are economically consequential even when they occur outside market exchange or formal employment (Folbre 1994; Folbre 2001).

Care is relational in a stronger sense than the transfer of a service. The quality and continuity of care can depend on knowledge of a particular person, trust, temporal presence, emotional relation, and responsibility that are only partially substitutable. Care providers can simultaneously hold capabilities and burdens, and the organization of care can redistribute time, income, labor-market participation, health, and future capability across households, communities, firms, and public institutions.

Definition 21.106 (Care-relation profile). A *care-relation profile* identifies the care recipient and provider positions, dependency or support need, material and relational forms of provision, temporal continuity, substitutability, knowledge and trust requirements, compensation and recognition, burden distribution, institutional support, and effects on the capabilities of both recipient and provider.

The purpose is not to assume that all care relations share one normative status. Some are voluntary, familial, professional, public, communal, or coercively allocated. Comparative analysis should preserve those differences while recognizing maintenance and reproduction as economic relations where they affect capability, participation, distribution, or institutional sustainability.

Proposition 21.107 (Care-reproduction condition). *Care enters economic structural analysis where its organization materially conditions the maintenance or reproduction of capabilities, participation, labor, health, or social continuity, with the distribution of care burdens and benefits kept analytically visible.*

21.6.7 Network Relations and Positional Topology

Network analysis emphasizes that economic consequences can depend on patterns of connection rather than attributes of isolated positions. Buyers and sellers, firms and suppliers, lenders and borrowers, researchers and collaborators, workers and referral contacts, or platforms and complementors can occupy positions whose significance arises from topology. Granovetter's account of embedded economic action illustrates how ongoing social relations can shape economic behavior beyond atomized transaction representations (Granovetter 1985).

A relational comparison should nevertheless resist treating every edge as equivalent. Connections can differ in direction, strength, frequency, content, substitutability, exclusivity, trust, contract, information quality, or control. Network centrality can improve access in one configuration while increasing exposure or mediation burden in another. A network representation is therefore informative only where the meaning of its nodes and edges remains tied to the economic mechanism under study.

Definition 21.108 (Economic network-structure profile). An *economic network-structure profile* specifies the economically meaningful nodes or positions, typed

and directed relations among them, topology, concentration and redundancy, flows or transformations carried by relations, entry and exit conditions, temporal persistence, and the mechanisms through which network position affects access, diffusion, mediation, dependency, or resilience.

This profile also distinguishes topology from structure in the broader sense. A graph can represent patterned connectivity while omitting legal rules, organizational authority, or value processes that are constitutive of the economic relation. Network structure is therefore one representation of relational organization rather than a universal substitute for institutional analysis.

Proposition 21.109 (Network-semantic condition). *A network representation has explanatory force only where node and edge semantics, relevant flow or transformation mechanisms, and the economic consequences of topology are specified rather than inferred from connectivity measures alone.*

21.6.8 Ecological Relations and Biophysical Dependence

Economic configurations are embedded in biophysical processes that provide energy, materials, ecological services, waste absorption, climatic conditions, and regenerative capacities. Ecological economics has emphasized that economic production cannot be treated as materially closed because transformation is constrained by biophysical throughput and irreversibility (Georgescu-Roegen 1971; Daly 1990). Social-ecological research likewise shows that resource systems, users, governance arrangements, and ecological processes can be dynamically coupled (Ostrom 2009).

The relational issue is therefore more specific than adding an environmental variable to an otherwise unchanged economic model. Ecological relations can constitute the feasible production set, determine regeneration rates, create threshold effects, transmit risks across places and generations, and alter the distribution of economic opportunities. Economic actors can also transform the ecological relations on which their later activity depends.

Definition 21.110 (Ecological-economic relation profile). *An ecological-economic relation profile specifies the biophysical system or process relevant to an economic claim, the economic positions dependent on or transforming it, material and energy flows, regeneration and depletion dynamics, spatial and temporal boundaries, thresholds or irreversibilities, governance relations, and the distribution of resulting benefits, burdens, and future constraints.*

This profile avoids treating ecology as an external stock while also avoiding the claim that every ecological process should be absorbed into economics. The economic relevance must be established through identifiable dependence, transformation, valuation, distribution, or institutional mechanism.

Proposition 21.111 (Ecological-embedding condition). *An ecological relation should enter an economic explanation where biophysical dependence or transformation materially alters the mechanism, feasible trajectories, distribution, or regenerative conditions relevant to the economic claim.*

21.6.9 Power-Bearing Relational Structures

Relations can carry asymmetries in resources, capabilities, information, legal authority, infrastructure access, exit options, or control over consequential interfaces. Such asymmetries can become power-bearing when the relational structure allows one position to alter another's practical possibilities, terms of participation, exposure, or capacity to contest. Section 21.5 distinguished subject agency from standing and affectedness. The present subsection identifies the structural carrier through which asymmetry can matter, while Section 21.10 will later compare theories of coordination and power in greater depth.

Power should not be inferred directly from difference. A large firm and a small firm can differ greatly in scale without the larger firm controlling a relation relevant to the smaller one. Network centrality, ownership, expertise, legal authority, or technological capability can likewise fail to convert into power where dependence is low, alternatives are available, or effective counter-capacity exists. The relational mechanism is therefore the conversion of a difference or positional advantage through dependency, control, mediation, or restricted alternatives.

Definition 21.112 (Power-bearing structural profile). *A power-bearing structural profile identifies the positions in an asymmetric relation, the resource, capability, rule, infrastructure, information channel, or interface through which asymmetry can be converted, the dependence and substitutability conditions of affected positions, the decisions or possibilities subject to alteration, temporal persistence, and available counter-capacity or contestation pathways.*

The profile is deliberately narrower than a general theory of power. Its purpose in theoretical dialogue is to distinguish relations that merely differ from relations whose structure transmits durable control over economically consequential possibilities.

Proposition 21.113 (Power-conversion condition). *A relational asymmetry should be interpreted as economically consequential power only where an identifiable dependence, control, or mediation pathway converts that asymmetry into altered possibilities, burdens, terms, or capacities for another position.*

21.6.10 Structure–Relation Translation Boundaries

The preceding analyses show why relation and structure require their own translation discipline. Two theories can describe the same observed event while locating its causal significance in different relations. A wage payment can be represented as exchange, as part of a labor relation, as a class relation, as an institutional entitlement, as a node in household reproduction, or as one component of a production network. These representations can overlap without becoming interchangeable.

Translation should therefore proceed at the mechanism level. The comparison should ask whether the theories identify corresponding positions, whether the relation has the same directionality and temporality, whether it carries the same rights, obligations, resources, or dependencies, whether the surrounding structural pattern plays a causal role, and whether relation-induced changes in the positions themselves are represented. A shared relational vocabulary can organize these questions while preserving irreducible differences.

Definition 21.114 (Structure–relation translation profile). *A structure–relation translation profile maps theoretical representations across position definitions, relation*

type, directionality, relational content, temporal persistence, institutional embedding, topology, constitutive effects, structural reproduction, and associated dependence or control, while recording dimensions for which correspondence remains partial or absent.

This profile also separates structural correspondence from equivalence. A network theory and an institutional theory can identify a similar concentration pattern while disagreeing about why it persists. A Marxian and a contractual account can both analyze the firm while assigning different causal roles to ownership, production, authority, class, and exchange. A care-economic and capability approach can overlap on dependence and capability maintenance while retaining different normative and explanatory commitments. The comparative gain lies in locating these correspondences and disagreements precisely.

Proposition 21.115 (Structure–relation translation condition). *Cross-theoretical relational translation is adequate only where correspondence is established for the mechanisms relevant to the claim and where differences in relation type, structural reproduction, constitutive effect, temporal scope, or power-bearing capacity remain explicit rather than being absorbed into a generic concept of connection.*

Economic theories can therefore share a relational coordinate system without sharing one structural ontology. Exchange, production, ownership, labor, institutions, care, networks, ecology, and power-bearing relations can intersect within the same economic configuration while retaining different explanatory roles. Section 21.7 next applies the same non-reductive dialogue method to value and commensuration, where structural translation becomes especially demanding because theories differ not only over relations but also over what can legitimately be compared, aggregated, priced, or left incommensurable.

21.7 Economic Value and Commensuration Architectures

The role of this section is to provide a comparative architecture for theories that use the language of value while assigning different objects, mechanisms, evidential roles, and evaluative purposes to that language. Its objective is to distinguish value carrier, value formation or realization, measurement, comparison, commensuration, aggregation, conversion, normative ranking, and unresolved remainder. The discussion proceeds through utility, labor-based value, price, capability, care, ecological, relational, and generative approaches before examining commensuration and incommensurability directly. The method is comparative and non-reductive. Each approach is reconstructed through the problem it addresses and the information it treats as relevant, while translation is limited to dimensions for which correspondence can be established without converting heterogeneous value claims into one presumed common metric.

Economic theories often appear to disagree over “value” while addressing different analytical questions. A utility representation can organize preference-based choice without claiming to describe labor contribution. A labor theory can analyze social production without supplying a complete welfare metric. A price can coordinate exchange without measuring every relevant form of worth. Capability evaluation can assess substantive opportunity without reducing opportunity to willingness to

pay. Care, ecological, relational, and generative approaches can identify contributions or conditions that remain only partially represented in conventional monetary accounts. Theoretical dialogue therefore requires more than asking which theory has the correct quantity of value. It requires identifying what is being valued, by whom or through which process, for which purpose, through what evidence, and with what comparison rule.

Definition 21.116 (Economic value-architecture profile). An *economic value-architecture profile* specifies the value carrier or evaluative object, the subject or process through which value is attributed, formed, realized, or recognized, the mechanism connecting the carrier to the evaluative claim, the informational basis, the available measurement or ordering procedure, the relevant scale and time horizon, the institutions or interfaces through which value becomes consequential, the permitted forms of comparison or aggregation, and any value remainder that the representation leaves unresolved.

The profile separates analytical operations that are often compressed into one vocabulary. Measurement assigns observations according to a rule. Comparison establishes some relation among alternatives. Commensuration expresses heterogeneous entities through a common metric. Aggregation combines values across units according to an explicit procedure. Conversion transforms one value-bearing condition into another form or representation. Normative ranking specifies which states, distributions, or relations count as better according to a criterion. One operation can occur without the others.

Proposition 21.117 (Value-operation separation condition). *Cross-theoretical value comparison is adequate only where measurement, comparison, commensuration, aggregation, conversion, and normative ranking are distinguished whenever their identification would alter the interpretation, evidential warrant, or practical consequence of the claim.*

Table 21.7 summarizes the eleven comparative coordinates developed below. The categories are neither mutually exclusive nor exhaustive. Their purpose is to preserve the distinctive analytical work performed by different value architectures while making points of partial correspondence visible.

21.7.1 Utility-Based Valuation

Utility has performed several different roles across economic theory: a language of satisfaction, a representation of preference ordering, an argument about welfare, and a formal device for representing choice. Historical marginalism did not contain one uniform theory of utility. Jevons treated marginal utility as central to exchange, while Pareto and later ordinal approaches reduced the dependence of consumer theory on measurable cardinal pleasure (Jevons 1871; Pareto 1971; Hicks 1939b). The comparative task therefore begins by identifying what status utility has in the theory being examined.

In an ordinal choice representation, a utility function can encode the ordering of alternatives without implying that differences in utility have interpersonal or even intrapersonal cardinal meaning. In other applications, expected utility or welfare analysis can assign additional structure. These uses should remain separated because a mathematical representation adequate for predicting choice need not provide a complete account of well-being, justice, or social value. Sen's critique of informationally

Table 21.7: Value and commensuration coordinates for cross-theoretical economic dialogue.

Coordinate	Primary evaluative question	Characteristic reduction risk
Utility	How are alternatives ordered relative to preferences or welfare representations?	Treating preference representation as complete value theory
Labor-based value	How does socially organized labor enter value formation and distribution?	Treating labor magnitude as a universal welfare metric
Price	How are exchange ratios and monetary valuations formed and used?	Treating price as exhaustive social worth
Capability	What substantive opportunities are practically available to persons?	Treating observed functioning as complete capability
Care	How are maintenance, dependence, and reproductive contribution valued?	Treating care as a homogeneous service quantity
Ecological value	Which biophysical stocks, functions, relations, and regenerative conditions matter?	Treating ecological value as fully substitutable monetary capital
Relational value	What value arises through the quality or form of relations?	Treating relations as attributes of isolated goods
Generative value	How do present processes alter later capacities and value-producing conditions?	Treating future production of possibility as automatically good
Commensuration	Which entities can be represented through a common metric, for which purpose?	Treating a common metric as proof of substantive equivalence
Value remainder	Which evaluative differences remain outside a justified common scale?	Treating incomplete comparison as decision impossibility
Translation	Which value dimensions correspond across theories without erasing remainder?	Treating partial correspondence as theoretical identity

narrow welfare evaluation is especially relevant: satisfaction or preference can adapt to persistent deprivation, while substantive freedom can remain constrained (Sen 1992; Sen 1999).

Definition 21.118 (Utility-valuation profile). A *utility-valuation profile* specifies whether utility represents experienced satisfaction, preference ordering, choice consistency, expected evaluation under uncertainty, welfare, or another object; whether the representation is ordinal or cardinal; the domain over which preferences are defined; the information excluded from the representation; and the comparison or aggregation operations for which the utility representation is claimed to be valid.

Utility therefore supplies a highly productive coordinate for theoretical dialogue when its informational role remains explicit. A preference ordering can be compared with capability or relational approaches at the point where each asks how alternatives are evaluated, while disagreement remains visible over whether the evaluative basis should include adaptation, social relations, rights, capability, or future generative effects.

Proposition 21.119 (Utility-scope condition). *A utility representation supports a broader value claim only to the extent that the informational interpretation, interpersonal-comparison assumptions, and normative role required by that broader claim are independently specified and justified.*

21.7.2 Labor-Based Value Formation

Labor-based theories of value address a different problem. Classical political economy connected value to production, labor, cost, exchange, and distribution, while Marx located the value form within historically specific relations of commodity production and socially necessary labor (A. Smith 1776; Marx 1867). These accounts cannot be translated into utility language simply by treating labor as another preference-bearing attribute. Their principal analytical object concerns the social organization through which production and exchange acquire determinate value relations.

For theoretical comparison, several dimensions should be separated: embodied or expended labor, socially necessary labor time, labor contribution, labor cost, bargaining power, remuneration, and moral claims about deservingness. These dimensions can overlap in historical debates but need not coincide. A claim that labor participates in value formation is distinct from a claim that wage income measures labor's full social contribution, and both differ from a normative claim that distribution should track labor contribution.

Definition 21.120 (Labor-value formation profile). *A labor-value formation profile specifies the relevant form of labor, the social and technical organization of production, the mechanism connecting labor to the value claim, the treatment of productivity and heterogeneity, the relation between value and exchange magnitude, the institutional conditions of realization, and the distributional or normative conclusions, if any, that are claimed to follow.*

This profile makes labor-based and other theories comparable without requiring a common scalar representation. A capability analysis can ask what labor arrangements do to substantive opportunities; a care analysis can identify socially necessary reproductive labor omitted from market accounts; a price theory can examine monetary remuneration. These are intersecting questions whose answers can diverge because they refer to different value objects.

Proposition 21.121 (Labor-value translation condition). *A labor-based value claim should be translated into another value architecture only where the labor object, production mechanism, social form, and relevant realization conditions survive the translation rather than being replaced by a different evaluative object carrying the same word "value."*

21.7.3 Price-Based Valuation Signals

Price is among the most observable and institutionally consequential forms through which economic valuation appears. Prices can coordinate exchange, transmit information, structure incentives, establish accounting values, determine eligibility or affordability, and influence investment. They arise through specific market and institutional configurations involving supply, demand, bargaining, regulation, market power, conventions, and monetary arrangements. Marshall's treatment of market

value through interacting demand and supply conditions already illustrates why price should not be identified with a one-sided theory of value (Marshall 1890).

A price can nevertheless perform several distinct functions. It can be an exchange ratio, an administered rule, an accounting convention, an auction outcome, a regulated tariff, a shadow price, or a willingness-to-pay estimate. These objects possess different evidential and normative meanings. Market price can reveal a consequential relation among participants under existing conditions while remaining silent about people excluded from the market, future generations, nonmarket care, ecological thresholds, rights, or values deliberately withheld from sale.

Definition 21.122 (Price-valuation profile). A *price-valuation profile* specifies the priced object or entitlement, the institution through which the price is formed, participating and excluded positions, the information and bargaining conditions, monetary unit and time horizon, relevant constraints on exchange, the behavioral or accounting function of the price, and the scope of any inference from price to welfare or social value.

Price therefore offers a commensurating interface without establishing substantive equivalence. Two goods can receive the same monetary price while differing in ecological consequence, care burden, capability effect, symbolic meaning, or future generativity. Conversely, an unpriced good can remain economically consequential through institutions, dependence, maintenance, or foregone alternatives.

Proposition 21.123 (Price-warrant condition). A *monetary price warrants a claim about exchange valuation within the relevant institutional configuration; any extension from that price to comprehensive welfare, social worth, ecological value, or normative priority requires additional assumptions and evidence.*

21.7.4 Capability-Based Evaluation

Capability-oriented evaluation shifts the informational basis from resources or utility alone toward the substantive opportunities persons possess to achieve valuable beings and doings (Sen 1985; Sen 1992; Robeyns 2005). The relevant value carrier is therefore neither a commodity bundle nor a reported satisfaction level. It is an opportunity structure whose practical availability depends on personal, social, institutional, and environmental conversion conditions.

This architecture complicates commensuration. Capabilities are multidimensional, partly counterfactual, and sensitive to the purpose of evaluation. Two persons can display the same achieved functioning while possessing different opportunity sets; two persons with the same resources can possess different capabilities. Operationalization can use indicators and explicit weights, but the existence of a multidimensional index does not demonstrate that the underlying capabilities are intrinsically commensurable or that the chosen weights are normatively neutral.

Definition 21.124 (Capability-evaluation profile). A *capability-evaluation profile* specifies the persons or positions evaluated, relevant capabilities and functionings, resources and conversion conditions, substantive alternatives, evidence used to infer opportunity, weighting or comparison procedures, participatory or normative basis for selecting dimensions, and the remainder between observed achievement and practical freedom.

For GRE dialogue, capability analysis provides a particularly important bridge to

access, conversion, action space, and future possibility. The relationship remains non-identical. GRE generativity concerns how present processes alter later value-producing and capability-producing conditions, while capability evaluation can assess substantive opportunities without adopting a generative ontology or temporal architecture.

Proposition 21.125 (Capability-comparison condition). *A capability comparison is adequate only where the relevant dimensions, conversion conditions, informational proxies, weighting procedure, and distinction between achieved functioning and substantive opportunity are sufficiently explicit for the evaluative purpose.*

21.7.5 Care Value in Reproductive Relations

Care-economic traditions draw attention to activities and relations that maintain persons, households, communities, and social reproduction while being incompletely represented by wages, national accounts, or market prices. Feminist economic work has shown how unpaid household and care labor can disappear from conventional accounting despite its economic indispensability (Waring 1988; Folbre 1994). Care work can also occur in paid markets, where its valuation is shaped by gendered institutions, public-good characteristics, emotional relations, and constraints on substitution (England 2005).

Care value is especially resistant to simple unitization because the service output can depend on continuity, trust, attentiveness, relational knowledge, responsibility, and the condition of the recipient. Time-use measures can make labor visible, wages can record remuneration, and replacement-cost estimates can construct monetary proxies. Each representation answers a different question. None automatically exhausts the value of sustaining capability, reducing vulnerability, or preserving a relationship through which care can be effectively delivered.

Definition 21.126 (Care-value profile). *A care-value profile specifies the care relation, recipient and provider positions, maintenance or capability function, paid or unpaid institutional setting, time and intensity, relational continuity, substitutability, burdens and opportunity costs, remuneration or accounting representation, and evaluative remainder not captured by the selected measure.*

Care therefore illustrates why recognition and commensuration should be separated. Making unpaid care visible through a monetary estimate can correct one accounting omission while still leaving relational and qualitative dimensions outside the metric. A translation is analytically useful where it makes a hidden burden or contribution comparable for a defined purpose, provided the comparison does not redefine the original relation as merely a priced service.

Proposition 21.127 (Care-valuation remainder condition). *A care valuation should preserve a remainder whenever the chosen time, wage, replacement-cost, capability, or outcome measure omits relational continuity, dependency, quality, responsibility, or another dimension material to the claim being evaluated.*

21.7.6 Ecological Value in Biophysical Reproduction

Ecological value architectures address stocks, processes, functions, relations, regenerative capacities, and thresholds that condition economic possibility. Ecological economics has emphasized the material and energetic irreversibility of economic

processes and the importance of maintaining regenerative conditions (Georgescu-Roegen 1971; Daly 1990). Environmental valuation can use monetary estimates for particular decisions, while other approaches emphasize intrinsic, relational, ecological, or sustainability-based reasons for preservation.

The comparative problem concerns what exactly becomes commensurated. A monetary estimate of an ecosystem service can support a policy comparison without establishing that the ecosystem is exhaustively represented by the estimate. Natural-capital measures can make depletion visible while embedding assumptions about substitutability. Thresholds, irreversibility, species loss, identity, stewardship, and future ecological function can remain only partially represented by present willingness to pay.

Definition 21.128 (Ecological-value profile). *An ecological-value profile specifies the ecological entity, process, relation, or regenerative condition evaluated; the affected human and nonhuman positions where relevant; spatial and temporal scale; biophysical dependencies and thresholds; measurement indicators; monetary or nonmonetary valuation procedure; substitutability assumptions; uncertainty; and dimensions intentionally retained outside the chosen metric.*

Ecological value can therefore interact with price, capability, relational, and generative value without becoming reducible to any one of them. A wetland can carry market-related service values, support capabilities, participate in cultural and relational values, and preserve future regenerative capacity. These dimensions can inform one decision while requiring different forms of evidence and comparison.

Proposition 21.129 (Ecological-commensuration scope condition). *An ecological commensuration procedure is warranted only for the decision dimensions it validly represents; biophysical thresholds, irreversibilities, non-substitutable relations, and long-horizon regenerative conditions should remain explicit where their omission would change the decision or interpretation.*

21.7.7 Relational Value Formation

Relational value identifies cases in which the quality, form, or appropriateness of a relation contributes to what is valuable. Environmental scholarship has used relational value to describe values grounded in relationships, responsibilities, identities, and ways of living with human and nonhuman others (Chan et al. 2016). Relational-goods traditions similarly examine goods whose value depends on interpersonal interaction and cannot be produced or consumed entirely by isolated individuals (Uhlener 1989; Gui 2000).

A relational-value architecture differs from attaching an ordinary attribute to a good. Trust, reciprocity, recognition, belonging, mutuality, or shared participation can depend on how interaction occurs. Replacing a relationship with an apparently equivalent monetary transfer can therefore alter the value-bearing object itself. This does not imply that relational values are inherently nonmarket or normatively superior. Market exchange can sustain relationships, and relational forms can reproduce exclusion or domination. The analytical requirement is to identify the relation that carries the value and the mechanism through which that value is realized.

Definition 21.130 (Relational-value profile). *A relational-value profile specifies the participating positions, the relation or mode of association carrying evaluative significance, the practice or condition through which the value is realized, temporal per-*

sistence, dependence on reciprocity or recognition, possible institutional mediation, substitutability, and the extent to which monetary or scalar representations preserve or alter the value-bearing relation.

Relational value can be compared with utility where participants value the relation, with capability where relations expand substantive opportunity, and with care where relational continuity matters. Those correspondences remain partial because the explanatory object can differ: experienced satisfaction, substantive freedom, care contribution, and the value of the relationship itself should remain distinguishable.

Proposition 21.131 (Relational-value preservation condition). *A translation of relational value is adequate only where the representation preserves the economically relevant properties of the relation whose form or quality carries the value, rather than retaining only an outcome associated with that relation.*

21.7.8 Generative Value Formation

Generative value directs attention toward processes that create or regenerate conditions through which later value, capability, knowledge, participation, or economic possibility can arise. GRE inherits important precedents from work on generative value while developing a broader architecture of heterogeneous value generation, conversion, circulation, capture, return, dissipation, and regeneration (Eglash 2016). Within the present chapter, generative value is included as one value architecture among others rather than as a common metric into which the other architectures should be translated.

The distinctive temporal object is a change in later possibility. Education can contribute to future capability; research can generate knowledge whose applications are initially unknown; infrastructure can alter future coordination; ecological restoration can regenerate future material possibility; institutions can reproduce trust or procedural capacity. These processes differ materially. Their common feature is only that part of their economic significance concerns the conditions they generate for subsequent value-bearing activity.

Definition 21.132 (Generative-value profile). *A generative-value profile specifies the present process, the later value-bearing capacities or conditions whose formation is claimed, the transmission or reproduction mechanism, affected positions, temporal horizon, dependencies and complementary conditions, evidence connecting present action to later possibility, distribution of generative benefits and burdens, and any depletion or foreclosure produced alongside generation.*

Generative value is descriptively compatible with normatively adverse outcomes. A process can generate durable extractive capacity, dependency, or exclusion. Normative evaluation therefore requires further criteria concerning whose capabilities or possibilities are generated, which values are served, which burdens are imposed, and what alternatives are foreclosed.

Proposition 21.133 (Generative-value separation condition). *Evidence that a process generates future value-producing capacity or possibility establishes a generative effect within the specified domain; normative desirability, distributive justice, and equivalence with other value forms require additional evaluative premises.*

21.7.9 Commensuration Procedures

Commensuration converts qualities or entities that differ in kind into a representation through which they can be compared using a common metric. Espeland and Stevens emphasize that commensuration is a social process with cognitive and political consequences rather than a purely technical act (Espeland and Stevens 1998). Monetary valuation is one important form, but scores, rankings, indexes, quality-adjusted units, standardized tests, ratings, and composite indicators can perform similar comparative work.

Commensuration can generate substantial analytical and institutional benefits. A common unit can make trade-offs visible, coordinate decentralized decisions, support budgeting, identify disparities, or permit statistical analysis across heterogeneous cases. The same operation can also suppress distinctions that matter to the decision. The relevant question is therefore neither whether commensuration is intrinsically valid nor whether qualitative difference forbids quantification. It is whether the selected metric preserves the distinctions required by the purpose for which comparison is undertaken.

Definition 21.134 (Commensuration procedure profile). A *commensuration procedure profile* specifies the heterogeneous entities being compared, the common metric or ordering rule, transformation from source attributes into the metric, weighting or normalization procedure, institutional purpose, included and excluded positions, sensitivity to scale and time, uncertainty, and the substantive distinctions lost or altered through commensuration.

A common metric can itself reshape the objects being measured. Rankings, scores, or monetary valuations can influence organizational priorities, participant behavior, and resource allocation, thereby making valuation performative in some settings (Espeland and Sauder 2007). The consequences of commensuration are therefore part of its economic analysis where the measure enters incentives or institutional decisions.

Proposition 21.135 (Purpose-indexed commensuration condition). A *commensuration rule is adequate only relative to a stated evaluative or decision purpose and only where the transformations, weights, exclusions, and resulting loss of distinction remain acceptable for that purpose.*

21.7.10 Incommensurable Value Remainders

Value plurality does not guarantee complete comparability. Philosophical work on incommensurability and incomparability distinguishes cases in which alternatives cannot be represented adequately by one common measure or complete ranking (Raz 1986; Chang 1997). Economic decision, however, often still has to proceed. The analytical problem is therefore to preserve the unresolved value relation while identifying the procedural or institutional basis on which action is nevertheless chosen.

Several forms of remainder should be distinguished. A *measurement remainder* exists where a valued dimension is recognized but poorly observed. A *metric remainder* exists where a dimension can be observed but does not translate appropriately into the selected common unit. A *normative remainder* exists where disagreement concerns the legitimate criterion or weighting. A *relational remainder* exists where the mode of valuation changes the relation being valued. A *temporal remainder* exists where future or irreversible consequences resist stable present comparison. These

remainders differ from mere data scarcity.

Definition 21.136 (Incommensurable value-remainder profile). An *incommensurable value-remainder profile* records value dimensions recognized as material to an economic decision but not adequately represented within the selected common metric or ordering, the reason for the non-representation, affected positions, decision consequences, available partial comparisons, and the procedure through which unresolved plurality is carried into judgment or governance.

Incommensurability therefore need not imply paralysis. Rights can function as side constraints, thresholds can protect ecological or capability minima, deliberation can address plural values, and decisions can preserve options where uncertainty is high. Such procedures do not manufacture a latent common metric. They provide ways to act while acknowledging incomplete evaluative closure.

Proposition 21.137 (Remainder-preservation condition). *Where a materially relevant value dimension lacks a justified common metric, an economic decision procedure should preserve that remainder explicitly rather than treating its absence from the metric as evidence of zero value or complete comparability.*

21.7.11 Translation across Value Architectures

The preceding architectures can overlap without becoming interchangeable. Utility and price can be linked through demand while remaining distinct. Labor can affect price without price becoming a complete representation of labor-based value. Capability can be supported by care, ecological conditions, income, or relational goods without being reducible to any of those inputs. Generative value can arise through capability formation, ecological regeneration, institutional learning, or relational reproduction while retaining a distinct temporal question. Cross-theoretical dialogue therefore requires translation across structured differences rather than a search for one master unit.

A useful translation begins by identifying the value carrier in each theory, the mechanism of realization, the informational basis, the subject or position whose evaluation matters, the scale and time horizon, and the comparison operation the theory permits. Correspondence can then be stated dimension by dimension. One theory can supply information omitted by another; two theories can provide alternative representations of the same process; or they can address different evaluative objects despite using the same term.

Definition 21.138 (Cross-theoretical value-translation profile). A *cross-theoretical value-translation profile* maps two or more value architectures across carrier, valuer or affected position, formation or realization mechanism, informational basis, measurement, comparison rule, commensuration status, aggregation, temporal scope, institutional interface, normative role, and unresolved remainder, while distinguishing correspondence, complementarity, conflict, and absent translation.

The profile also clarifies the place of conversion. A market can convert labor, access, information, or ecological use rights into monetary value; an institution can convert credentials into employment eligibility; a social process can convert recognition into trust or participation. Conversion demonstrates an operative interface between value forms. It does not establish that the source and target values are identical, conserved, or fully reversible. This distinction connects the theoretical dialogue of the present section to GRE's earlier treatment of typed value conversion and conversion

remainder.

Proposition 21.139 (Value-translation non-reduction condition). *Cross-theoretical value translation is adequate only where correspondence is asserted at the level actually supported by shared mechanism or evaluative function, and where differences in carrier, information, commensuration, aggregation, temporal scope, normative role, or remainder remain available for subsequent analysis.*

Economic value can therefore be plural without becoming analytically unstructured. Utility, labor-based value, price, capability, care, ecological value, relational value, and generative value provide different coordinates for economic inquiry, and commensuration can create useful common representations for defined purposes. Theoretical dialogue becomes more rigorous when a common metric is treated as an instrument with a domain of validity rather than as evidence that heterogeneous value forms have become identical. Section 21.8 next extends this discipline to scarcity, resources, distribution, and allocation, where the meaning of scarcity itself depends on which value-bearing objects, access relations, and future possibilities are recognized.

21.8 Economic Scarcity–Access–Distribution Architecture

The role of this section is to provide a common comparative architecture for theories that organize economic analysis around scarcity, resources, access, distribution, and allocation while assigning different meanings to those terms. Its objective is to distinguish physical limitation from positional rivalry, institutional exclusion, attention constraint, knowledge access, capability limitation, generative opportunity, distributional incidence, and allocation authority. The discussion proceeds from resource conditions to institutional and cognitive forms of scarcity, then to distribution and allocation, and finally to the relational consequences through which scarcity can be reproduced, relocated, intensified, or relaxed. The method is comparative and mechanism-sensitive. A condition counts as scarce only relative to a specified subject, use, time horizon, institutional arrangement, and conversion pathway; the existence of scarcity therefore does not by itself identify either its cause or the appropriate allocation rule.

Scarcity is among the most influential organizing concepts in economics. Robbins famously characterized economic analysis around relations between ends and scarce means with alternative uses (Robbins 1932). Yet the word can refer to substantially different economic conditions. A material input can be physically limited; access to an abundant resource can be institutionally restricted; a position can be valuable because only a few participants can occupy it; information can be abundant while attention becomes scarce; knowledge can be costly to produce but inexpensive to reproduce; and nominal resources can coexist with severe capability deprivation when persons lack the conversion conditions required to use them. Treating these situations as one undifferentiated scarcity problem obscures the mechanisms through which economic constraints are produced and reproduced.

Definition 21.140 (Economic scarcity–access–distribution profile). An *economic scarcity–access–distribution profile* specifies the resource, position, capability, information, or opportunity at issue; the subjects for whom it is scarce or abundant; the

physical, institutional, cognitive, relational, or temporal mechanism producing the constraint; the access and conversion conditions; the allocation authority or process; the resulting distribution; the relevant time horizon; and the pathways through which the arrangement reproduces, relaxes, transfers, or relocates scarcity.

This profile separates three analytical questions. A *resource condition* concerns what is available and reproducible. An *access condition* concerns which positions can command or practically use what is available. A *distributional condition* concerns how resources, burdens, positions, capabilities, and opportunities are arranged across subjects. These dimensions can move independently. Aggregate abundance can coexist with restricted access, while equal nominal distribution can coexist with unequal conversion into substantive capability.

Proposition 21.141 (Scarcity-mechanism identification condition). *A scarcity claim supports an explanatory or policy conclusion only where the relevant scarcity mechanism, affected subjects, access conditions, conversion pathways, allocation process, and temporal horizon are specified at the level required by that conclusion.*

Table 21.8 summarizes the ten coordinates developed below. The table treats scarcity as a family of mechanisms rather than a single scalar condition.

21.8.1 Material Resource Scarcity

Material resource scarcity concerns physical stocks, flows, capacities, and regenerative processes that constrain feasible economic activity. Land, energy, minerals, water, biomass, housing space, transport capacity, and ecological sinks can become scarce through limited stocks, bounded flow rates, spatial concentration, depletion, congestion, or slow regeneration. This form of scarcity is closest to the intuitive image of “not enough” material means, yet even here the relevant boundary is relational. A resource can be abundant for one use and scarce for another, locally accessible but globally plentiful, or physically present while unavailable within the time horizon required by an economic process.

Economic analysis therefore benefits from separating absolute physical limits from scarcity generated by technology, infrastructure, substitution possibilities, quality requirements, and temporal mismatch. A mineral deposit that exists geologically may remain economically inaccessible. Electricity generation capacity may be sufficient annually while peak-load capacity is scarce hourly. Ecological systems can provide renewable flows while becoming scarce when extraction exceeds regeneration. Social-ecological analysis consequently links resource units, resource systems, users, and governance rather than treating biophysical quantity as the complete economic object (Ostrom 2009).

Definition 21.142 (Material resource-scarcity profile). *A material resource-scarcity profile specifies the physical stock or flow, spatial boundary, quality requirements, extraction or access technology, rate of use, regeneration or replenishment dynamics, substitutability, critical thresholds, and time horizon through which material availability constrains an economic process.*

Material scarcity can therefore change without a change in aggregate physical stock. Infrastructure can enlarge practical availability; degradation can reduce usable quality; substitution can move demand to another resource; and conservation can preserve future flows. Conversely, a technological increase in extraction capacity can relax near-term scarcity while accelerating later depletion.

Table 21.8: Scarcity, access, and distribution coordinates for cross-theoretical economic dialogue.

Coordinate	Comparative question	Characteristic reduction risk
Material scarcity	Which physical stocks, flows, regenerative processes, and substitutable inputs constrain feasible activity?	Treating every constraint as a fixed natural limit
Relative scarcity	Which positions or goods are scarce because their value depends on relative location, rank, congestion, or exclusivity?	Treating positional rivalry as material shortage
Institutional scarcity	Which rules, rights, classifications, or control arrangements restrict practical access?	Treating institutionally produced exclusion as natural scarcity
Attention	How is finite cognitive and organizational attention allocated among abundant signals and claims?	Treating information provision as equivalent to attention
Knowledge access	How are knowledge production, reproducibility, exclusion, verification, and absorptive capacity organized?	Treating inexpensive copying as universal practical abundance
Capability constraint	Which conversion conditions limit the use of available resources and formal opportunities?	Treating resource possession as substantive capability
Generative opportunity	Which present arrangements preserve or deplete future capacity to create options, relations, and value?	Treating current abundance as sufficient future opportunity
Distribution	How are resources, burdens, claims, positions, capabilities, and risks distributed across subjects?	Treating aggregate totals as distributionally sufficient
Allocation	Through which mechanisms and authorities are scarce or contested items assigned among uses and subjects?	Treating one allocation mechanism as universally adequate
Relational reproduction	How do allocation and distribution reshape later scarcity, access, dependency, and generativity?	Treating allocation as a terminal rather than history-producing event

Proposition 21.143 (Material-scarcity temporality condition). *A material-scarcity claim is incomplete where current availability is assessed independently of the extraction, replenishment, substitution, degradation, and threshold processes that determine availability over the relevant economic horizon.*

21.8.2 Positional and Relative Scarcity

Some economic goods or positions remain scarce even when their material substrate becomes abundant because their value depends on relative position, exclusivity, congestion, status, or limited occupancy. Central urban locations, elite credentials, high-ranking offices, spectrum slots, queue priority, exclusive memberships, and certain attention-generating positions have this structure. Additional material production can sometimes relax the constraint, but it cannot automatically reproduce the relational position being sought.

Relative scarcity is therefore generated by a comparison relation or occupancy

structure. The relevant object is not merely the good but the relation between a position and the surrounding distribution. A larger supply of credentials, for example, can increase educational attainment while leaving scarcity of high-status differentiation intact if the relevant evaluative hierarchy moves with the distribution. A larger number of communication channels can expand expression while intensifying competition for visibility.

Definition 21.144 (Relative-scarcity profile). *A relative-scarcity profile specifies the scarce position or comparative advantage, the reference population, the ordering or congestion relation that generates scarcity, the number or proportion of positions practically available, the conditions of entry and exit, and the mechanisms through which expansion, substitution, or reclassification changes the relational value of the position.*

This distinction matters because policies directed at material supply can fail when the binding constraint is positional. Building more physical space can relieve congestion but may leave prestige-based location scarcity intact. Expanding formal credentials can increase knowledge while also creating new differentiating credentials. The theoretical task is to identify which relation is scarce before assuming that greater quantity relaxes it.

Proposition 21.145 (Relative-scarcity non-substitution condition). *An increase in the material quantity associated with a positional good relaxes the relevant scarcity only where the comparative, congestion, rank, or exclusivity relation generating that scarcity is correspondingly altered.*

21.8.3 Institutionally Produced Scarcity

Scarcity can also be produced by rules, rights, classifications, contracts, administrative procedures, intellectual-property regimes, zoning, licensing, platform access conditions, or control over infrastructure. In such cases, a resource may be materially available while practical access is restricted. Polanyi's treatment of economies as instituted processes is useful here because exchange and distribution occur through historically specific institutional arrangements rather than through a mechanism detached from law and social organization (Polanyi 1957).

Property-rights analysis similarly shows why ownership should not be represented as a single binary relation. Access, withdrawal, management, exclusion, and alienation can be distributed among different positions (Schlager and Ostrom 1992). Scarcity for a particular subject may therefore arise because that subject lacks one right in a differentiated bundle, even when another subject can use the same underlying resource. Sen's entitlement analysis makes a related point in the context of famine: aggregate availability and individual command over food can diverge because access depends on production, exchange, and institutional entitlements (Sen 1981).

Definition 21.146 (Institutionally produced scarcity profile). *An institutionally produced scarcity profile specifies the materially available resource or opportunity, the rule or rights architecture governing it, the positions authorized to access or control it, the procedures and costs of qualification, the enforcement mechanism, the available substitutes, and the revision pathways through which the institutional restriction can change.*

Institutionally produced scarcity is not inherently inefficient or illegitimate. Safety

standards, conservation rules, professional licensing, privacy protections, and ecological restrictions can deliberately limit access in order to preserve other values or future capacities. The analytical requirement is therefore to distinguish the existence of an institutional restriction from the evaluation of its purpose and effects.

Proposition 21.147 (Institutional-scarcity attribution condition). *Where material availability exceeds practical access, an explanation of scarcity should identify the institutional mechanism governing qualification, authorization, exclusion, control, or enforcement before attributing the constraint to physical shortage alone.*

21.8.4 Attention Allocation under Informational Abundance

Information-rich environments illustrate a different scarcity architecture. Simon observed that an abundance of information consumes the attention of its recipients and therefore creates a need to allocate scarce attention among abundant information sources (Simon 1971). Digital networks, scientific publishing, financial information systems, organizational dashboards, and AI-generated content intensify this structure: storage and transmission can become inexpensive while human or organizational capacity to inspect, verify, interpret, and act remains bounded.

Attention scarcity is not simply a psychological property of isolated individuals. Interfaces, ranking systems, workflows, notification architectures, organizational roles, deadlines, and incentive structures distribute attention. A platform can increase informational abundance while concentrating visibility. An organization can collect more indicators while reducing the time available for interpreting each one. AI can lower the cost of producing analyses while increasing the verification burden placed on decision makers.

Definition 21.148 (Attention-allocation profile). *An attention-allocation profile specifies the available information streams, the subjects or organizations receiving them, finite inspection and interpretation capacity, ranking and filtering mechanisms, interruption costs, verification burden, decision deadlines, and the institutional or technical rules through which some signals obtain priority over others.*

The economic object is therefore the allocation of cognitive and organizational processing capacity. More information can improve decisions when it increases relevant accessible evidence, yet additional signals can also worsen selection, increase noise, or crowd out slower forms of judgment. Information abundance and epistemic capacity must remain distinct.

Proposition 21.149 (Attention-bottleneck condition). *An increase in available information enlarges effective knowledge only where selection, interpretation, verification, memory, and decision capacities expand sufficiently to prevent attention from becoming the binding constraint.*

21.8.5 Knowledge Access and Reproducibility

Knowledge has an unusual scarcity profile because the costs of producing, verifying, transmitting, reproducing, and applying it can differ sharply. Hayek emphasized that economically relevant knowledge is dispersed and incompletely possessed by separate individuals (Hayek 1945). Arrow, from another direction, emphasized uncertainty and appropriation problems surrounding inventive activity and information (Arrow 1962). Digital reproduction can greatly reduce the marginal cost of copying

some knowledge without eliminating scarcity in discovery, validation, interpretation, tacit skill, infrastructure, or access rights.

Knowledge can therefore be abundant as encoded information while scarce as trusted, usable, context-sensitive capability. A research article may be freely downloadable while the instrumentation, mathematical preparation, language ability, tacit laboratory skill, or institutional access required to use it remains scarce. Conversely, enclosure through intellectual property, secrecy, paywalls, proprietary data, or platform control can produce access scarcity for an informational good whose technical reproduction is inexpensive. Commons-oriented work on knowledge highlights precisely these governance questions of access, preservation, enclosure, and collective production (Hess and Ostrom 2007).

Definition 21.150 (Knowledge-access profile). A *knowledge-access profile* specifies the knowledge object, production and verification costs, reproducibility, codifiability, tacit components, legal and technical access conditions, required absorptive or interpretive capacity, infrastructure dependencies, provenance, and the institutions through which knowledge is maintained, transmitted, revised, or enclosed.

This profile prevents two opposite reductions. Knowledge should not be treated as conventionally scarce merely because its creation is costly, nor as universally abundant merely because its digital copy has near-zero marginal cost. Scarcity can move from reproduction to validation, attention, trust, computation, specialized skill, or institutional access.

Proposition 21.151 (Knowledge-scarcity relocation condition). *When reproduction costs fall substantially, the economically binding scarcity of knowledge may relocate to discovery, verification, interpretation, attention, absorptive capability, infrastructure, provenance, or authorized access; analysis should identify that relocation rather than infer practical abundance from copying cost alone.*

21.8.6 Capability Constraint and Conversion

Resource abundance does not imply that persons possess the substantive capability to convert resources into valued activities or states. Capability-oriented analysis therefore changes the scarcity question. The relevant issue is not only whether a resource exists or is formally distributed, but whether conversion factors, social arrangements, bodily conditions, public services, infrastructure, and institutional standing permit a person to use that resource in practice (Sen 1999).

This distinction applies beyond personal welfare. Firms can possess capital while lacking organizational capability; public agencies can receive budgets while lacking implementation capacity; communities can have formal rights without the collective infrastructure required to exercise them. Capability scarcity is consequently relational to a task, subject, conversion environment, and temporal horizon.

Definition 21.152 (Capability-constraint profile). A *capability-constraint profile* specifies the subject, valued or required functioning, available resources and formal entitlements, personal, social, institutional, and infrastructural conversion conditions, practical alternatives, dependency relations, retained capability after action, and the mechanisms through which capability can be maintained, regenerated, or depleted.

The same nominal allocation can therefore generate different substantive opportunity. Equality of money, formal rights, information, or equipment may leave substan-

tial differences in mobility, care support, health, language, organizational authority, network access, or technical skill. The economic comparison must match the level of scarcity to the object being evaluated.

Proposition 21.153 (Resource–capability separation condition). *A resource distribution supports a claim about substantive opportunity only where the relevant conversion conditions and practical alternatives are sufficiently specified to connect resource command to the capability being evaluated.*

21.8.7 Generative Opportunity Availability

The preceding distinctions concern existing resources, positions, information, and capabilities. GRE adds a further comparative coordinate: whether an economic arrangement preserves the practical ability to generate new options, relations, capabilities, institutions, knowledge, and value processes. This coordinate was developed throughout Part VII and is especially important when present abundance is produced by consuming the infrastructures or capabilities required for later creation.

Generative opportunity is therefore distinct from the number of presently available choices. A household can have many consumption options while lacking time, security, education, or social infrastructure for future capability formation. A firm can operate efficiently while allowing maintenance capability to decay. A society can enjoy abundant digital outputs while becoming dependent on a narrow technical infrastructure that reduces future substitutability. The relevant scarcity is scarcity of practical future formation.

Definition 21.154 (Generative-opportunity profile). *A generative-opportunity profile specifies the subject or collective, the capacities and infrastructures from which new options can be formed, access to learning and experimentation, relational and institutional support, option-preserving reserves, dependencies and lock-ins, maintenance and regeneration requirements, and the horizon over which present arrangements enlarge or contract later reachable possibilities.*

Generative opportunity should not be treated as a universal scalar good. Some future options may be harmful, rights-violating, or ecologically destructive. The coordinate is analytical before it is normative: it identifies which capacities for future formation are being created or lost so that normative evaluation can address them explicitly.

Proposition 21.155 (Present-abundance separation condition). *Present resource or output abundance implies generative abundance only where the arrangement also preserves the capacities, infrastructures, maintenance pathways, and practical option-formation processes required for future creation and revision.*

21.8.8 Distributional Position and Incidence

Distribution concerns the arrangement of economically consequential resources, claims, burdens, risks, positions, capabilities, and opportunities across subjects. Different theories select different distributive objects. Classical political economy emphasized distribution among social classes; welfare economics can focus on income or utility; capability approaches evaluate substantive opportunities; feminist and care economics draw attention to unpaid work, time, dependency, and reproductive burdens; ecological analysis can include exposure to environmental harms

and access to regenerative resources. The theoretical disagreement can therefore concern the object of distribution before it concerns the preferred distribution.

A distributive statement also requires an incidence boundary. Income received by a household may conceal internal allocation. A subsidy received by a firm may ultimately benefit workers, owners, consumers, or suppliers depending on market and institutional conditions. A pollution burden can be spatially displaced or deferred across generations. Distribution is therefore a relational and temporal object rather than merely a cross-sectional vector.

Definition 21.156 (Distributional-incidence profile). A *distributional-incidence profile* specifies what is distributed, the subjects or positions among which it is distributed, the unit and scale of observation, direct and indirect incidence, temporal incidence, intra-unit distribution where relevant, the mechanisms producing the distribution, and the capabilities or dependencies through which nominal receipt becomes practically consequential.

This profile separates descriptive distribution from normative judgment. A theory can identify concentration or burden without yet specifying the distributive principle by which the pattern should be evaluated. Conversely, a normative distributive criterion requires a sufficiently precise object and incidence structure to avoid evaluating the wrong distribution.

Proposition 21.157 (Distribution-object specification condition). *Cross-theoretical claims about distribution are comparable only where the distributed object, subject boundary, incidence mechanism, temporal horizon, and aggregation level are sufficiently aligned or their differences are retained explicitly.*

21.8.9 Allocation Mechanisms and Decision Rights

Allocation concerns the processes through which resources, positions, burdens, attention, or opportunities are assigned among uses and subjects. Markets, prices, administrative rules, queues, lotteries, bargaining, household decisions, professional judgment, commons governance, political budgeting, algorithms, and hybrid institutions can all perform allocative functions. The existence of scarcity therefore does not identify one necessary allocation mechanism.

Allocation should also be distinguished from distribution. An allocation rule is a process; distribution is one pattern of incidence produced through that process together with initial conditions, feedback, strategic behavior, and institutional structure. Market allocation can generate different distributions under different endowments and power relations. Administrative allocation can generate different outcomes under different eligibility rules and implementation capacities. Commons governance can allocate use rights through collective rules that do not fit a simple market–state binary (Ostrom 2010).

Definition 21.158 (Allocation-mechanism profile). An *allocation-mechanism profile* specifies the item being allocated, eligible subjects and uses, decision rights, information available to decision makers, selection or priority rule, prices or other signals where relevant, enforcement, appeal and revision procedures, strategic incentives, transaction and coordination costs, and the distributional and generative consequences produced over time.

A mechanism can be effective for one allocative problem and poorly suited to an-

other. Prices can coordinate decentralized exchange where relevant claims are represented through effective demand; administrative rules can protect rights or pursue collective objectives; professional judgment can incorporate contextual information; lotteries can distribute equally qualified scarce slots; and polycentric arrangements can distribute authority across multiple decision centers. Comparative analysis should therefore identify mechanism-specific conditions rather than treating allocation as synonymous with one institutional form.

Proposition 21.159 (Allocation–distribution separation condition). *The evaluation of an allocation mechanism should distinguish its decision process from the distribution it produces and should include the initial positions, information structure, decision rights, strategic responses, and feedback processes through which allocative rules generate distributive outcomes.*

21.8.10 Relational Reproduction and Scarcity Relocation

Allocation and distribution are history-producing processes. They alter ownership, capability, knowledge, network position, bargaining power, infrastructure, expectations, maintenance, and future access. A solution to one scarcity can therefore create another. Automation can reduce scarcity of routine production while increasing scarcity of trusted judgment or specialized infrastructure. Digital abundance can reduce copying costs while concentrating attention or control. Expanded educational access can relax knowledge scarcity while leaving positional scarcity in elite credentials. Resource extraction can relax current material scarcity while creating future ecological scarcity.

This dynamic is best described as *scarcity relocation*. The concept does not imply that every scarcity is conserved or merely moved. Innovation, institutional reform, cooperation, substitution, and regeneration can genuinely relax constraints. The analytical point is that relaxation at one coordinate should not be inferred to constitute overall abundance until its effects on other coordinates and future periods have been examined.

Definition 21.160 (Scarcity-relocation record). *A scarcity-relocation record identifies an initial scarcity, the intervention or economic process that relaxes or transforms it, the resources and relations mobilized by that process, new or intensified constraints appearing elsewhere, the subjects bearing those constraints, the temporal displacement involved, and the mechanisms through which the new scarcity can be mitigated, reproduced, or further transformed.*

The relational consequence of distribution is similarly cumulative. Distribution can alter future bargaining positions, learning capacity, health, political voice, access to credit, network centrality, and the ability to absorb shocks. Allocation can therefore reproduce scarcity by shaping the conditions under which future claims are made. Conversely, social investment, public infrastructure, open knowledge, capability formation, maintenance, and institutional redesign can convert a distributive intervention into a reduction of later scarcity.

Proposition 21.161 (Scarcity-relocation visibility condition). *A claim that an economic arrangement reduces scarcity is stronger where the analysis traces whether the constraint is eliminated, relaxed, deferred, redistributed among subjects, transferred across scales, or transformed into another scarcity coordinate.*

The comparative result of this section is therefore a change in the unit of theo-

retical dialogue. Scarcity is not a single background fact to which theories merely offer different solutions. It is a typed, historically situated relation among resources, subjects, institutions, conversion conditions, attention, knowledge, capabilities, and future possibilities. Distribution identifies where economically consequential objects and burdens are located; allocation identifies the mechanisms and decision rights through which they are assigned; and relational reproduction identifies how those arrangements change the scarcity conditions faced later. This architecture prepares Section 21.9, where the temporal forms assumed by economic theories—equilibrium time, historical time, path dependence, crisis, structural transformation, irreversibility, and open futures—become the next object of comparison.

21.9 Economic Temporalities and Historical Change

Section 21.8 compared scarcity, access, allocation, and distribution by separating resource conditions from the relational mechanisms through which scarcity is produced, relaxed, or relocated. The present section adds the temporal coordinate required for theoretical dialogue. Its role is to compare how economic theories represent sequence, duration, recurrence, expectation, reproduction, cumulative change, discontinuity, and future possibility. The objective is neither to privilege historical description over abstraction nor to treat dynamic language as inherently superior to static analysis. The relevant question is whether a theory's temporal representation preserves the mechanisms necessary for the claim being made. The section therefore moves through equilibrium and comparative-static time, historical sequence, path dependence, evolutionary change, crisis, structural transformation, multiple timescales, irreversibility, and open futures. Table 21.9 summarizes the resulting comparative coordinates.

Definition 21.162 (Economic temporal architecture). An *economic temporal architecture* specifies the economically relevant events or states, their ordering and duration, the mechanisms connecting earlier and later configurations, the role of expectation and memory, the rates and scales of change, the conditions of recurrence or persistence, the degree of reversibility, and the structure of future possibilities represented by an economic theory or model.

A temporal architecture is therefore more than a time index attached to variables. Two theories can use the same calendar time while making different claims about what persists, what can change, which earlier events remain causally active, and whether the future is a known continuation of an existing state space or a domain in which new objects and relations may emerge. A relational comparison should preserve these differences before asking whether theories can be translated into a shared dynamic vocabulary.

Proposition 21.163 (Temporal-adequacy condition). A *temporal representation is adequate to an economic claim when the representation preserves the sequence, persistence, feedback, expectation, irreversibility, and scale relations that materially affect the mechanism under analysis; greater temporal detail does not by itself imply greater explanatory adequacy.*

Table 21.9: Temporal architectures for theoretical dialogue in economics

Coordinate	Primary analytical question	Characteristic reduction risk
Equilibrium time	Which adjustments or state comparisons are represented while the relevant structure is held fixed?	Treating a useful analytical closure as a complete history
Historical sequence	Which events, institutions, or expectations depend on their order and timing?	Treating temporal order as interchangeable
Path dependence	Through which mechanism do earlier events alter later reachable configurations?	Using path dependence as a synonym for any historical influence
Evolutionary time	How do routines, variation, learning, innovation, and selection alter populations or organizations?	Treating change as movement toward a predetermined optimum
Crisis	Which relations change mode, activate rapidly, or cross thresholds?	Treating every large disturbance as one common crisis mechanism
Structural transformation	Which economic objects, relations, or rules are reconfigured rather than merely resized?	Equating quantitative growth or decline with structural change
Multiple timescales	Which processes operate at different rates and how are the rates coupled?	Comparing observations across incompatible temporal scales
Irreversibility	Which consequences, capabilities, or histories cannot be restored by reversing the initiating action?	Treating formal policy reversal as practical restoration
Open futures	Which future objects, options, and trajectories can be generated beyond the currently represented state space?	Treating uncertainty as variation within a fixed catalogue of outcomes

21.9.1 Equilibrium and Comparative-Static Time

Equilibrium and comparative-static analysis provide a powerful temporal compression. They can ask how an economic system is characterized when specified adjustment conditions are satisfied, or how the represented equilibrium changes when a parameter changes while the underlying model structure is held fixed. Hicks's treatment of equilibrium and expectations and Samuelson's formal consolidation of comparative statics illustrate the analytical productivity of such closure (Hicks 1939b; Samuelson 1947). The temporal question is therefore not whether equilibrium analysis contains literal clock time, but which historical and adjustment processes have been compressed into the relation among states.

The compression can be adequate when the research question concerns local incidence, comparative responses, feasibility, or a sufficiently stable institutional envi-

ronment. Its interpretation becomes more demanding when the process of adjustment itself changes preferences, capabilities, technologies, institutions, expectations, or the available set of economic objects. In such cases, the before-and-after states can remain informative while failing to represent the mechanism that connects them.

Definition 21.164 (Comparative-static temporal profile). *A comparative-static temporal profile specifies the state variables being compared, the parameters or conditions allowed to change, the relations treated as fixed during comparison, the adjustment process left implicit, the stability assumptions that support the comparison, and the historical mechanisms excluded from the represented transition.*

Equilibrium time should therefore be interpreted as one possible analytical resolution. A price adjustment, for example, may be represented without reconstructing the institutional history of the market if that history is locally irrelevant. A labor-market transition involving deskilling, migration, credential change, or organizational restructuring may require a richer temporal representation because the adjustment changes the subjects and relations being compared.

Proposition 21.165 (Comparative-static scope condition). *A comparative-static result supports a claim about historical transition only to the extent that the omitted adjustment processes do not materially transform the objects, relations, constraints, or expectations on which the compared states depend.*

21.9.2 Historical Sequence and Event Dependence

Historical time becomes analytically important when sequence and timing affect the meaning or consequence of economic events. The establishment of a payment standard before a platform becomes dominant can have different consequences from introducing the same standard after network dependence has formed. A subsidy implemented before productive capability has disappeared can operate differently from the same subsidy introduced after organizational knowledge has been lost. The economic relevance lies in the dependence of later relations on the order and temporal placement of earlier events.

Historical sequence also changes what actors know and expect. An event that was unforeseeable at one moment can become a precedent at another. Institutions acquire records, reputations, routines, legal interpretations, and expectations through sequences of implementation. North's treatment of institutional change emphasizes the historical persistence of institutional structures and their consequences for incentives and economic performance (North 1990). A temporal comparison should therefore distinguish chronology from causal sequence: events can occur in order without that order being economically consequential, while some ordering relations are central to the mechanism.

Definition 21.166 (Historical-sequence profile). *A historical-sequence profile specifies the economically relevant events, their partial or chronological ordering, the relations whose state is altered by each event, the information and expectations available at each stage, the mechanisms through which earlier events condition later ones, and the counterfactual reorderings relevant to the claim.*

This profile supports historical comparison without requiring every economic explanation to become a complete narrative. The analyst can isolate a consequential sequence—for example, investment, standardization, skill formation, market concentration, and regulatory response—while retaining only those historical details needed

to establish the mechanism.

Proposition 21.167 (Sequence-relevance condition). *Temporal order is economically explanatory when changing the order or timing of relevant events would alter the mechanism, feasible continuation, distributional incidence, or interpretation of later states under the assumptions of the analysis.*

21.9.3 Path-Dependent Economic Development

Path dependence gives a more specific meaning to historical dependence. David's discussion of QWERTY and Arthur's analysis of increasing returns in competing technologies provide influential economic formulations in which early events can affect later adoption through mechanisms such as technical interrelatedness, increasing returns, learning, coordination, or quasi-irreversibility (David 1985; Arthur 1989). The general lesson is narrower than the statement that history matters. A path-dependent account should identify how an earlier event changes the transition possibilities or relative attractiveness of later alternatives.

The same analytical form can appear in institutions, infrastructures, skills, standards, settlement patterns, and organizational routines. Yet path dependence should not imply permanent lock-in. A path can weaken when complementary investments depreciate, substitutes improve, coordination changes, political coalitions shift, or deliberate transition policy creates new infrastructure. Path dependence is consequently a mechanism-dependent modification of reachability rather than a metaphysical claim that the past determines the future.

Definition 21.168 (Path-dependence profile). *A path-dependence profile specifies the historically contingent event or sequence, the self-reinforcing or persistence mechanism, the economic objects whose later state is affected, the alternatives whose relative reachability changes, the strength and duration of persistence, and the conditions under which the path can branch, decay, or be deliberately reconfigured.*

This definition also separates path dependence from ordinary state dependence. Current capital stock may affect future output because capital persists physically; a path-dependent claim requires an additional mechanism through which a historically realized route changes later possibilities relative to relevant alternatives.

Proposition 21.169 (Path-mechanism condition). *A historical sequence warrants a path-dependence interpretation when an identifiable persistence or reinforcement mechanism makes later reachable configurations depend materially on the realized path rather than only on the contemporaneous state variables represented in the comparison.*

21.9.4 Evolutionary Adaptation and Selection

Evolutionary economic time emphasizes populations of heterogeneous agents, organizations, routines, technologies, and practices whose composition changes through variation, search, learning, innovation, replication, retention, and selection. Nelson and Winter developed an evolutionary theory in which routines, search, and competitive processes help explain changing firm and industry behavior over time (Nelson and Winter 1982). Schumpeter's analysis of development likewise foregrounded innovation and new combinations as mechanisms through which an established economic configuration can be disrupted (Schumpeter 1934).

Evolutionary language does not by itself imply biological identity or convergence toward an optimum. Economic selection environments are institutionally produced, strategically contested, and capable of changing through the activities of the entities being selected. Firms can influence standards and regulation; technologies can create complementary infrastructures; users can learn; governments can subsidize alternatives; and successful practices can alter the environment in which later selection occurs. Economic evolution is therefore often co-evolutionary.

Definition 21.170 (Evolutionary economic-time profile). *An evolutionary economic-time profile specifies the heterogeneous population or repertoire, sources of variation and novelty, mechanisms of learning or search, retention and reproduction processes, selection conditions, feedback from selected configurations to the selection environment, and the temporal horizon over which composition and capability change.*

The profile permits theoretical comparison between evolutionary, institutional, technological, and organizational accounts without presuming that they share one selection mechanism. It also helps distinguish adaptation within an existing regime from the generation of new economic objects or rules.

Proposition 21.171 (Evolutionary-openness condition). *An evolutionary economic explanation should specify both the mechanisms that retain and select existing variants and the mechanisms through which the relevant population, routines, technologies, or selection environment can themselves change over time.*

21.9.5 Crisis and Regime Discontinuity

Crisis compresses several possible temporal phenomena: rapid loss of coordination, liquidity interruption, cascading default, institutional legitimacy failure, supply disruption, political-economic rupture, or a threshold transition in which a previously stabilizing relation changes mode. The comparative task is to identify the mechanism rather than treat crisis as a self-explanatory category. A large decline in output, for example, can accompany several distinct histories whose propagation structures, affected positions, and recovery possibilities differ.

A crisis also changes the temporal relevance of relations. Emergency credit lines, inventories, mutual-aid networks, legal powers, maintenance reserves, and administrative capacities that appear secondary during ordinary periods can become decisive. Conversely, routines optimized for stable operation can become liabilities when assumptions about demand, settlement, supply, or information fail. Work on critical transitions in complex systems provides one formal vocabulary for threshold-sensitive change, while its transfer to economic settings requires domain-specific identification of the relevant state variables, feedbacks, and thresholds (Scheffer et al. 2009).

Definition 21.172 (Economic crisis-transition profile). *An economic crisis-transition profile specifies the initiating disturbance or endogenous instability, propagation relations, amplifying and damping mechanisms, activation of latent dependencies, affected positions, speed of change, threshold or regime features where relevant, emergency responses, recovery capacities, and persistent residues after the acute phase.*

This profile allows crisis to be compared with ordinary fluctuation without assuming a universal threshold. Some crises are abrupt; others accumulate slowly and become visible only when a buffer fails. Some restore a previous configuration after intervention; others reorganize institutions, balance sheets, technologies, or political

expectations.

Proposition 21.173 (Crisis-mechanism differentiation condition). *A crisis classification supports theoretical comparison only when the analysis identifies the propagation, amplification, response, and recovery mechanisms that distinguish the relevant episode from ordinary variation and from other forms of crisis.*

21.9.6 Structural Transformation and Reconfiguration

Structural transformation concerns change in the organization of economic relations rather than a change only in the magnitude of existing variables. Sectoral composition can shift; technologies can alter production architecture; ownership and coordination forms can change; labor can move among occupations; infrastructure can create new geographical relations; and legal or institutional revision can redefine economically recognized objects. Dosi's distinction between technological trajectories and discontinuities associated with new technological paradigms provides one influential account of how technical change can combine cumulative development with reorientation (Dosi 1982).

A structural account should therefore identify what structure means locally. It may refer to sectoral composition, class relations, network topology, institutional rules, technological architecture, spatial organization, or the set of feasible economic roles. Quantitative growth can occur with limited structural transformation, while substantial structural change can occur during periods of modest aggregate growth.

Definition 21.174 (Structural-transformation profile). *A structural-transformation profile specifies the economic relations or organizational components being reconfigured, the mechanism of transformation, the old and emerging position structures, the redistribution of capabilities and dependencies, the infrastructures and institutions supporting the transition, and the criteria by which the change counts as structural rather than merely scalar.*

Structural transformation is especially relevant to theoretical dialogue because different traditions can identify different structures in the same historical episode. One theory may emphasize sectoral composition, another class relations, another institutional rules, and another technological networks. Translation should preserve these object differences before seeking a common narrative.

Proposition 21.175 (Structural-change identification condition). *A claim of structural transformation requires an explicit account of which relations, positions, rules, or organizational components have changed and why the change alters subsequent economic mechanisms rather than only the measured scale of activity.*

21.9.7 Multiple Economic Timescales

Economic processes rarely operate at a single rate. Prices can adjust within seconds, inventories within days, contracts over months, skills over years, infrastructures over decades, and ecological regeneration over still longer horizons. Institutional legitimacy, demographic structure, technological standards, and scientific capability can follow yet other temporal patterns. A theory that aggregates these processes into one time step can be useful, but the aggregation becomes problematic when fast and slow processes interact materially.

Fast adjustment can consume slow capacity. A firm can meet quarterly targets by deferring maintenance; a government can stabilize an immediate crisis while creating long-lived debt or institutional precedent; a platform can expand rapidly while standards and regulatory capacity adapt slowly. Conversely, slow infrastructures can stabilize fast activity by providing reliable coordination, storage, energy, communication, or legal expectation. The relevant temporal structure is consequently relational among rates.

Definition 21.176 (Multi-timescale economic profile). *A multi-timescale economic profile specifies the processes operating at materially different rates, their characteristic horizons, the variables or relations each process changes, the coupling among fast and slow dynamics, the observation intervals used in evidence, and the mechanisms through which changes at one timescale accumulate into or constrain another.*

Timescale selection also affects empirical interpretation. A policy can appear successful over one year and capability-depleting over a decade. A technological transition can look discontinuous at annual resolution and gradual at monthly resolution. A relational comparison should therefore specify the timescale at which a claim is expected to hold.

Proposition 21.177 (Timescale-matching condition). *Evidence and theoretical claims should be matched to the timescale of the mechanism being evaluated, especially where short-run adjustment can accumulate into long-run capability, institutional, infrastructural, or ecological change.*

21.9.8 Irreversibility and Hysteresis

Irreversibility concerns histories in which reversing an initiating action or parameter does not restore the previous practical configuration. The source may be physical destruction, sunk investment, lost skill, institutional precedent, ecological threshold crossing, migration, network reorganization, reputation, legal obligation, or expectation formation. Hysteresis is a more specific dynamic form in which the state reached depends on the prior path and exhibits persistence when a driving condition is reversed. Economic analysis should keep the broad practical concept of irreversibility distinct from any particular formal hysteresis model.

Path dependence and irreversibility are related but separable. A path can influence later choice while remaining practically reversible at moderate cost. An irreversible loss can occur without a self-reinforcing selection mechanism. The distinction matters for policy because formal repeal or price reversal can leave capabilities, infrastructures, debts, environmental damage, or organizational arrangements unchanged.

Definition 21.178 (Economic irreversibility profile). *An economic irreversibility profile specifies the action or event, the economic state or capability altered, the mechanism preventing or raising the cost of restoration, the temporal decay or persistence of that mechanism, the available repair, compensation, substitution, or successor pathways, and the degree to which return to the prior configuration remains practically reachable.*

This profile permits graded rather than categorical analysis. Some losses are technically reversible but institutionally difficult; others are financially recoverable but ecologically persistent; still others can be repaired only by constructing a successor arrangement rather than recreating the previous state.

Proposition 21.179 (Practical-return condition). *A claim of economic reversibility requires more than reversal of the initiating policy, price, or control variable; it requires a credible pathway through which the relevant capabilities, relations, infrastructures, obligations, and affected positions can be restored or functionally replaced.*

21.9.9 Open Futures and Endogenous Novelty

Some economic theories represent uncertainty within a fixed state space: future prices, outputs, shocks, or preferences are unknown while the catalogue of possible variables and outcomes is given. Other forms of change can alter that catalogue itself. Innovation can create a new product category; institutional reform can create a new right or organizational form; scientific discovery can make previously infeasible production possible; social movements can alter recognized claims; and artificial systems can generate new forms of coordination or dependency. Schumpeter's treatment of new combinations and evolutionary approaches to novelty provide important precedents for analyzing economic change in which the future is not exhausted by recombination within a fixed equilibrium system (Schumpeter 1934; Nelson and Winter 1982).

Open futures do not imply unrestricted possibility. Economic futures remain conditioned by existing capabilities, resources, institutions, ecological constraints, inherited infrastructures, and power relations. Openness refers to the possibility that new economically relevant objects, relations, rules, and options can emerge through processes represented only incompletely in the present state description.

Definition 21.180 (Open-future economic profile). *An open-future economic profile specifies the presently represented state and option space, the mechanisms capable of generating new economic objects, relations, rules, or capabilities, inherited constraints on novelty, path-dependent reachability, processes that preserve or foreclose future formation, and the evidential limits on claims about trajectories whose relevant categories may themselves change.*

This coordinate clarifies the relation between uncertainty and generativity. Probabilistic uncertainty can concern which member of a represented outcome set will occur. Generative uncertainty can concern which economically relevant possibilities will become formable at all. The latter requires greater caution in long-horizon prediction and greater attention to option preservation, learning, and revision.

Proposition 21.181 (Future-space openness condition). *A long-horizon economic representation should treat its future state space as provisional when the mechanisms under analysis can generate new objects, relations, institutions, technologies, or evaluative categories that materially alter the set of economically reachable trajectories.*

The temporal coordinates developed in this section permit theoretical dialogue without imposing a universal theory of economic time. Equilibrium analysis can remain powerful where structural stability makes temporal compression appropriate; historical and path-dependent accounts become necessary where sequence changes reachability; evolutionary analysis emphasizes changing populations and routines; crisis and structural transformation identify discontinuous or constitutive change; multi-timescale analysis tracks coupled rates; irreversibility distinguishes return from formal reversal; and open-future analysis preserves endogenous novelty. These temporal distinctions prepare the next comparative problem. Section 21.10 examines how coordination, hierarchy, bargaining, institutional authority, depen-

dency, and power operate within the economic configurations whose histories have now been differentiated.

21.10 Economic Power and Coordination Architectures

Section 21.9 differentiated economic theories by their temporal architectures, including equilibrium adjustment, historical sequence, path dependence, crisis, structural transformation, irreversibility, and open futures. The present section adds the power–coordination coordinate required for theoretical dialogue. Its role is to compare how economic theories explain the organization of interdependent action and how unequal positions become consequential within that organization. The objective is to keep coordination, authority, asymmetry, dependency, and power analytically distinct while showing how they can become coupled. The section proceeds through price-based coordination, hierarchy, class position, institutional authority, bargaining, network position, capability asymmetry, care dependence, platform mediation, and relational power. Table 21.10 summarizes the resulting comparative coordinates.

Definition 21.182 (Economic power–coordination architecture). An *economic power–coordination architecture* specifies the positions whose actions require coordination, the mechanism through which coordination is organized, the authority or control rights attached to those positions, the dependencies and outside options that condition participation, the informational and institutional environment, the pathways through which asymmetry can alter feasible action or terms, and the mechanisms of contestation, revision, or exit available to affected positions.

This definition does not treat power as the residue left after coordination has been described. Coordination mechanisms themselves distribute decision rights, information, timing advantages, access to alternatives, and capacities to revise rules. At the same time, unequal resources or capabilities do not automatically constitute power. A relational comparison should identify the mechanism through which a difference becomes effective in another position’s feasible actions, burdens, terms, or future capacities.

Proposition 21.183 (Coordination–power separation condition). *An account of economic coordination should distinguish the mechanism that organizes interdependent action from the mechanisms that convert positional asymmetries into effective influence, control, dependency, or constraint; successful coordination does not by itself establish an absence of power; and asymmetry does not by itself establish power.*

21.10.1 Price-Based Coordination

Price-based coordination is commonly represented as a way of aligning decentralized decisions without requiring one actor to possess complete information about the economy. Hayek’s account of dispersed knowledge emphasizes the informational role of price movements in communicating changes that no central participant need observe in full (Hayek 1945). Coase, in a different register, showed that market coordination itself is institutionally costly and coexists with organizational coordination inside firms

Table 21.10: Power and coordination architectures for theoretical dialogue in economics

Coordinate	Primary analytical question	Characteristic reduction risk
Price coordination	How do prices, rules of exchange, and market institutions coordinate decentralized plans?	Treating price-mediated coordination as institution-free or power-free
Hierarchy	Which decisions are allocated to authoritative organizational positions?	Equating hierarchy with arbitrary command or treating authority as costless
Class position	How do recurrent production and property positions affect collective or structural capacity?	Inferring effective power directly from class membership
Institutional authority	Who can define, interpret, enforce, or revise economically consequential rules?	Treating formal jurisdiction as complete practical control
Bargaining	How do outside options, information, patience, coalition, and enforceability shape negotiated terms?	Treating agreement as evidence of symmetric bargaining position
Network position	How do brokerage, centrality, bottlenecks, and substitution affect mediation capacity?	Inferring power from topology without specifying edge semantics or dependence
Capability asymmetry	When does unequal capability become dependency-mediated influence or control?	Equating superior capability with generalized power
Care dependence	How do asymmetric need, continuity, exit cost, and recognition shape vulnerability and authority?	Treating dependence as one-directional weakness or care as ordinary exchange
Platform mediation	How do access, ranking, standards, data, and interfaces coordinate multiple sides?	Treating multisided coordination as equivalent to neutral intermediation
Relational power	Through which relation does a difference alter another position's feasible action or future capacity?	Using power as a generic synonym for inequality, influence, or size

(Coase 1937). The theoretical dialogue therefore concerns both what prices coordinate and the institutional conditions under which price signals become actionable.

A price can coordinate quantities, timing, entry, substitution, investment, or expectations while remaining silent about how initial property rights, purchasing power, participation conditions, or market boundaries were produced. Prices can also be administered, regulated, algorithmically generated, negotiated, or embedded in concentrated market structures. Price coordination should therefore be analyzed together with the rights and infrastructures that make exchange possible.

Definition 21.184 (Price-coordination profile). A *price-coordination profile* specifies

the priced object or entitlement, participating and excluded positions, the mechanism of price formation, information transmitted through price, adjustment margins available to participants, property and contract conditions, market-entry and exit conditions, relevant concentration or intermediation, and the decisions coordinated through the resulting signal.

The profile permits two theories to agree that prices coordinate behavior while disagreeing over whether the relevant causal object is marginal substitution, dispersed knowledge, monetary convention, market structure, or institutionalized exchange. It also prevents a price signal from being interpreted as a complete representation of bargaining position or social value.

Proposition 21.185 (Price-coordination scope condition). *A claim that prices coordinate an economic configuration should specify the decisions and information actually mediated by price and should separately identify the institutional, distributive, and power conditions that determine who can respond to the signal and on what terms.*

21.10.2 Hierarchical Authority and Organizational Coordination

Hierarchy coordinates activity by assigning some decisions to organizational roles whose directives are recognized within a bounded domain. Coase's analysis of the firm framed organizational authority as an alternative to repeated use of the price mechanism where market contracting is costly (Coase 1937). Williamson's institutional analysis later situated governance structures within comparative analysis of transaction and organizational arrangements (Williamson 2000). Hierarchy is therefore neither simply the absence of markets nor a synonym for domination. It is a specific allocation of decision rights, monitoring, information, and responsibility.

Organizational authority can reduce negotiation costs, support specialization, coordinate complementary tasks, and permit rapid response. It can also create dependency, suppress information, centralize discretion, or move risks toward positions with weaker voice. The same formal hierarchy can operate differently depending on professional norms, labor law, collective representation, internal appeals, ownership structure, and practical exit alternatives.

Definition 21.186 (Hierarchical-coordination profile). *A hierarchical-coordination profile specifies the organizational domain, authoritative roles, delegated decision rights, monitoring and information channels, obligations of subordinate and supervisory positions, limits on discretion, accountability and appeal mechanisms, exit conditions, and the capabilities required to enact or contest organizational decisions.*

Hierarchy can thus be compared across firms, public agencies, cooperatives, professional organizations, and hybrid institutions without presuming that every vertical relation has the same power content. The analytical question is which decisions the hierarchy coordinates and how the authority attached to those decisions is generated and bounded.

Proposition 21.187 (Hierarchical-authority condition). *Formal organizational rank supports a claim of effective hierarchical power only when the associated decision rights can be enacted through information, resources, monitoring, enforcement, or recognized authority in ways that alter the feasible actions of other organizational positions.*

21.10.3 Class Position and Structural Power

Class-oriented economic theories locate coordination and conflict partly in recurrent positions within production, ownership, and distribution. Marx's analysis of capitalist production emphasizes relations among owners of capital, labor power, production processes, and surplus appropriation rather than treating distribution as a sequence of isolated exchanges (Marx 1867). For theoretical dialogue, however, class position and class power should remain distinct. A structural position can generate recurrent interests, dependencies, or bargaining conditions without automatically producing collective organization or effective control.

Class power can operate through control over investment, employment, productive assets, political access, organizational resources, or the ability to absorb delay and exit. Workers can also acquire counter-capacity through organization, legal rights, collective bargaining, control over scarce skills, or coordinated withdrawal of labor. The relevant object is therefore not a scalar ranking of classes but the mechanisms through which a structural position is converted into practical influence over production, distribution, or institutional change.

Definition 21.188 (Class-power profile). *A class-power profile specifies the recurrent production or property positions under analysis, dependencies linking those positions, resources and organizational capacities available to each, relevant exit and delay capacities, collective-action structures, institutional protections, and the pathways through which position can alter terms of production, distribution, investment, or rule formation.*

This profile allows class analysis to enter dialogue with bargaining, institutional, and capability approaches without reducing any of them to one another. Class can identify a persistent structural relation while bargaining analysis identifies local negotiation and institutional analysis identifies the rules through which that relation is stabilized or transformed.

Proposition 21.189 (Class-position conversion condition). *A class position becomes effective economic power through identifiable mechanisms that convert structural location into control, bargaining capacity, collective action, agenda influence, or durable dependency; class membership alone does not establish the magnitude or form of that power.*

21.10.4 Institutional Authority and Rule-Shaping Capacity

Institutional power operates through the capacity to define, interpret, enforce, classify, or revise rules that structure economic interaction. Commons emphasized collective action and working rules as central objects of institutional economics (Commons 1931); North similarly treated institutions as humanly devised constraints that structure political, economic, and social interaction (North 1990). Ostrom's research demonstrates that rule systems can be organized through multiple centers and participant arrangements rather than one universal governance form (Ostrom 1990; Ostrom 2005).

Formal jurisdiction is only one component of institutional authority. Statistical classifications, professional standards, licensing requirements, eligibility criteria, technical protocols, adjudication practices, and administrative interpretation can alter economically relevant possibilities without changing a statute. Institutional power is

therefore partly rule-shaping and partly rule-enacting.

Definition 21.190 (Institutional-authority profile). An *institutional-authority profile* specifies the rules or classifications at issue, positions authorized to create, interpret, monitor, enforce, or revise them, the practical resources supporting those functions, procedures of participation and appeal, relations among overlapping jurisdictions, and the economic positions whose opportunities or obligations change through institutional action.

This profile also clarifies polycentric governance. Multiple institutions can possess partially overlapping authority, making coordination a problem of inter-institutional relation rather than centralized command. Power can then arise through jurisdictional bottlenecks, agenda control, expertise, information asymmetry, or the ability to define which institution has standing to act.

Proposition 21.191 (Rule-shaping power condition). *Institutional authority constitutes economic power to the extent that rule creation, interpretation, enforcement, classification, or revision changes the feasible actions, claims, burdens, or future capacities of other positions and affected positions possess unequal capacity to contest or revise those institutional effects.*

21.10.5 Bargaining Power and Outside Options

Bargaining analysis focuses attention on negotiated terms among positions whose interests are neither completely aligned nor completely independent. The same formal right to negotiate can coexist with radically different outside options, information, time horizons, risk-bearing capacities, coalition possibilities, legal protections, and ability to delay agreement. Agreement therefore does not by itself demonstrate symmetry. A party can accept terms because the feasible alternative is substantially worse.

Bargaining power is also relation-specific. A worker can have scarce technical expertise and still depend heavily on one employer because of visa status or geographic immobility. A small supplier can possess unique knowledge while facing severe liquidity constraints. A state can regulate a firm while depending on that firm's infrastructure or tax base. Bargaining should therefore be analyzed as a structured relation among alternatives, delay, information, commitment, and enforceability.

Definition 21.192 (Bargaining-power profile). A *bargaining-power profile* specifies the parties and negotiated object, each position's practical outside options, information, capacity to delay or absorb non-agreement, coalition and representation possibilities, commitment and enforcement mechanisms, institutional protections, dependency relations, and the distribution of consequences if negotiation fails.

The profile separates bargaining power from outcome alone. A favorable outcome can result from preferences, norms, regulation, or temporary circumstances; an unfavorable outcome need not prove weak bargaining power if the bargainer prioritizes other objectives. Power claims require the mechanism linking alternatives and capacities to the terms that become feasible.

Proposition 21.193 (Outside-option condition). *A bargaining-power claim should identify how practical outside options, delay capacity, information, coalition, or enforceability alter the feasible agreement set or the costs of non-agreement; formal freedom to reject an offer is insufficient where rejection is not practically sustainable.*

21.10.6 Network Position and Intermediation

Network theories and relational sociology emphasize that economic positions are embedded in structures of connection rather than linked only through anonymous exchange. Granovetter's analysis of embeddedness shows why ongoing social relations matter for economic action and institutional outcomes (Granovetter 1985). Network position can create access to information, brokerage opportunities, reputational advantages, exposure to contagion, or dependency on central intermediaries. Yet centrality is not itself power unless the relevant edges carry something that can be controlled or withheld.

A highly connected position can be vulnerable if connections transmit risk rather than alternatives. A peripheral specialist can exercise substantial influence if others depend on an irreplaceable connection. Network power therefore requires semantic interpretation of nodes and edges together with substitution, directionality, multiplexity, and temporal persistence.

Definition 21.194 (Network-intermediation profile). *A network-intermediation profile specifies the economically relevant nodes and edge types, direction and substitutability of connections, flows mediated through the network, brokerage or bottleneck positions, dependencies created by topology, alternative routes, temporal persistence, and the mechanisms through which positional structure affects access, coordination, or control.*

This profile supports comparison among supply networks, financial networks, labor referral networks, knowledge networks, and digital infrastructures without assuming one universal network-power metric. The same graph statistic can have different economic meaning when the edges represent trust, payment, ownership, technical dependence, or information.

Proposition 21.195 (Network-power identification condition). *A network position supports a claim of economic power only when the topology and edge semantics jointly create a mechanism through which that position can alter access, timing, alternatives, information, or resource flows for other positions.*

21.10.7 Capability Asymmetry and Dependency

Capability approaches direct attention to what subjects are substantively able to do, while the GRE power formalism developed earlier in the book distinguishes capability difference from its conversion into relational power. Sen's capability perspective emphasizes substantive opportunity and the heterogeneity of conversion between resources and effective freedom (Sen 1985; Sen 1999). For power analysis, unequal capability matters especially when one position becomes dependent on another for access to actions, resources, information, recognition, or infrastructures that cannot be substituted at acceptable cost.

A highly capable actor can coexist with others without dominating them when alternatives, interoperability, legal protections, counter-capacity, and institutional standing remain strong. Conversely, a modest capability difference can become powerful when attached to an indispensable bottleneck. The power object is consequently the dependency-mediated conversion of capability difference, not capability rank alone.

Definition 21.196 (Capability-dependency profile). *A capability-dependency profile specifies the capabilities relevant to the relation, their distribution across positions,*

complements required for effective use, dependencies on other actors or infrastructures, substitutability and switching costs, temporal persistence, counter-capacities, standing and contestability, and the consequences of withholding or conditioning access.

This architecture is particularly important for AI-intensive economies, specialized infrastructure, expertise, finance, and public-service systems in which capability can become concentrated while effective action remains distributed across dependent positions.

Proposition 21.197 (Capability-to-power conversion condition). *Capability asymmetry becomes relational economic power when dependence, limited substitution, control over complements, or institutional mediation enables one position to alter another position's feasible actions, terms, burdens, or future capability; superior performance alone is insufficient.*

21.10.8 Care Dependence and Relational Vulnerability

Care relations reveal forms of dependency that standard exchange or bargaining representations can capture only partially. Children, ill persons, disabled persons, older people, and others can depend on continuity, trust, tacit knowledge, bodily presence, or emotional and practical support that is difficult to substitute quickly. Caregivers can simultaneously depend on households, employers, welfare systems, migration regimes, or care recipients for income, legal status, recognition, or relational continuity. Feminist economics has emphasized that care and social reproduction are economically consequential even where market valuation is incomplete (Folbre 1994; Folbre 2001).

Dependence in care is therefore potentially reciprocal while remaining asymmetric in particular dimensions. The recipient can be vulnerable to withdrawal or neglect; the caregiver can be vulnerable to unpaid burden, weak bargaining position, limited exit, or moral expectations. Power analysis should preserve these differentiated vulnerabilities rather than treating dependence as a one-directional scalar.

Definition 21.198 (Care-dependency power profile). *A care-dependency power profile specifies the care needs and capabilities at issue, continuity and substitutability of the relation, temporal and bodily dependencies, resources and recognition available to caregivers and recipients, practical exit conditions, institutional support, representation and standing, and the consequences of interruption, neglect, coercion, or burden transfer.*

This profile also clarifies why market substitution can be incomplete. A monetary payment can expand options without recreating relational continuity, knowledge, trust, or availability. Conversely, idealizing care as purely relational can conceal exploitative burden or absence of exit. Coordination of care therefore involves both relational continuity and institutional protection.

Proposition 21.199 (Care-vulnerability condition). *Power in a care relation should be identified through the concrete dependencies, substitution limits, burden distributions, standing, and exit conditions that make one position vulnerable to another or to surrounding institutions; dependence alone does not determine a single direction of power.*

21.10.9 Platform Mediation and Infrastructural Control

Digital platforms coordinate multiple participant groups through interfaces, ranking, matching, payment, identity, standards, data processing, and access rules. Rochet and Tirole's analysis of two-sided markets shows that platform coordination can depend on cross-side participation effects and price structures that cannot be understood as ordinary one-sided pricing (Rochet and Tirole 2003). Power analysis adds further questions: who controls admission, ranking, data, interoperability, dispute resolution, technical standards, and the terms under which participants can reach one another?

Platform mediation can be economically productive. Shared infrastructure reduces search costs, establishes compatibility, enables reputation, and creates access to large participant pools. Yet these same functions can become bottlenecks when participants accumulate sunk investments, ratings, audiences, data histories, or complementary tools that are costly to transfer. Coordination and dependency can therefore intensify together.

Definition 21.200 (Platform-mediation power profile). *A platform-mediation power profile specifies the participant sides coordinated by the platform, access and exclusion rules, ranking and matching systems, pricing and fee structures, data and identity controls, technical standards and interoperability, switching and multihoming conditions, appeal and dispute mechanisms, dependent complementary assets, and the pathways through which platform decisions alter participant reach or capability.*

The profile distinguishes platform scale from platform power. A large platform can face strong interoperability, contestability, and multihoming; a smaller platform can exercise substantial control if it governs an indispensable niche infrastructure. The relevant mechanism is control over mediated relations and alternatives.

Proposition 21.201 (Platform-control condition). *Platform power arises where control over access, ranking, standards, data, interfaces, or dispute mechanisms combines with participant dependence or limited substitution to alter the feasible terms of participation; multisided coordination or large scale alone is insufficient.*

21.10.10 Relational Power and Coordination Plurality

The preceding coordinates show why economic power cannot be reduced to one institutional form. Price systems, hierarchies, class relations, institutional rules, bargaining arrangements, networks, capability structures, care relations, and platforms can all coordinate activity while generating different pathways through which asymmetry becomes effective. These mechanisms can also coexist. A worker can simultaneously face a market wage, managerial hierarchy, professional licensing, household care obligations, network dependence, collective bargaining, and platform-mediated scheduling. No single coordinate necessarily exhausts the power structure of that position.

The relational approach developed in Chapter 16 provides a common discipline for comparing such cases without treating them as identical. A difference becomes power-relevant when it matters to another position's possible actions; it becomes relationally realized power when a mechanism converts that difference into altered feasible action, burdens, terms, capacities, or trajectories. The comparison remains typed because legal authority, bargaining leverage, infrastructural control, class power, care dependency, and platform control operate through different carriers

and temporal structures.

Definition 21.202 (Relational power–coordination profile). A *relational power–coordination profile* specifies the coordination mechanisms operating in an economic configuration, the relevant positional differences, dependency and control pathways, institutional and infrastructural mediators, temporal persistence, domains in which power is effective, counter-capacities and contestability, and the interaction among multiple simultaneous power relations.

Coordination plurality also matters normatively and institutionally. Markets can counter some hierarchical dependencies; public institutions can constrain market power; collective organization can alter bargaining; interoperability can reduce platform lock-in; care infrastructure can reduce household dependence; and one governance arrangement can also create new bottlenecks elsewhere. Power analysis therefore benefits from examining conversion and counter-power across mechanisms rather than searching for one universally dominant institutional form.

Proposition 21.203 (Relational-power identification condition). A *comparative economic theory of power should identify the typed relation, the asymmetry or difference at issue, the mechanism of conversion, the affected domain, the resulting change in feasible action or future capacity, and the available counter-capacity; labels such as hierarchy, class, market power, dependence, or platform power are explanatory only when these relational components are made explicit.*

The power–coordination coordinates developed here permit theoretical dialogue without forcing every tradition into one concept of power. Price theories can emphasize decentralized adjustment; organizational theories can analyze authority; class approaches can track structural positions; institutional economics can trace rule systems; bargaining theories can focus on alternatives and negotiation; network analysis can identify intermediation; capability analysis can reveal dependency; care economics can recover relational vulnerability; and platform analysis can examine mediated access and infrastructural control. Their partial correspondences become analytically useful once their mechanisms remain typed. Section 21.11 therefore turns to the next comparison problem: how these traditions justify their claims through different forms of knowledge, evidence, and method.

21.11 Economic Knowledge, Evidence, and Methodological Warrant

Section 21.10 compared economic theories through their power and coordination architectures. The present section adds the epistemic coordinate required for theoretical dialogue. Its role is to compare how economic theories construct claims, what kinds of evidence they admit, which inferential operations connect evidence to propositions, and how the resulting warrant travels across contexts. The objective is to keep method, evidence, identification, interpretation, formal representation, and claim status analytically distinct while allowing them to be compared within a common relational framework. The discussion proceeds through deduction, econometric inference, historical reconstruction, institutional analysis, experimental evidence, situated observation, simulation, formal modelling, plural evidential regimes, and methodological translation. Table 21.11 summarizes the resulting coordinates.

Definition 21.204 (Economic evidential–methodological architecture). An *economic*

evidential–methodological architecture specifies the economic object and claim under investigation, the observations or representations treated as evidence, the method through which those materials are generated or organized, the inferential operations that connect them to a conclusion, the assumptions required for that inference, the uncertainty and missingness retained, the domain and temporal scope of the resulting warrant, and the conditions under which the claim should be revised, transported, or withheld.

The definition treats evidence as claim-relative. The same administrative record can support a descriptive claim about recorded employment, contribute to an econometric identification strategy, enter a historical reconstruction, or reveal an institutional classification practice. Its evidential role changes with the proposition being supported and the inferential pathway through which it is used. A theoretical dialogue should therefore compare architectures of warrant rather than rank methods in the abstract.

Proposition 21.205 (Warrant-locality condition). *The evidential force of a method should be evaluated relative to the claim, object, scale, assumptions, and inferential pathway for which it provides warrant; methodological prestige or technical sophistication does not by itself enlarge the scope of the supported conclusion.*

21.11.1 Deductive Theoretical Inference

Deductive reasoning remains central to economic theory because it makes conditional implications explicit. A model can begin with preferences, technologies, institutional constraints, accounting identities, behavioral rules, or other premises and derive consequences that follow within the specified formal domain. Samuelson’s *Foundations of Economic Analysis* exemplifies the effort to clarify economic reasoning through explicit mathematical structure and comparative conditions (Samuelson 1947). The strength of deduction lies in the traceability of the inferential chain: where premises and rules are explicit, the relation between assumptions and conclusions can be examined directly.

Logical validity, however, answers a different question from empirical adequacy. A conclusion can follow correctly from premises whose semantics, measurement correspondence, behavioral relevance, or domain of application remain uncertain. Conversely, an empirically successful regularity can lack a complete deductive derivation. The theoretical dialogue therefore benefits from separating internal implication from the warrant for treating the premises as an adequate representation of the economic configuration.

Definition 21.206 (Deductive-inference profile). *A deductive-inference profile* specifies the premises and definitions, formal domain, transformation or inference rules, derived propositions, semantic interpretation of the formal objects, empirical or institutional correspondence claimed for those objects, and the scope within which the derived implications are intended to apply.

This profile also makes comparison between theories more precise. Two theories can derive similar propositions from different premises, or use similar formal machinery while assigning different economic meaning to the variables. Shared mathematics therefore supplies a possible structural correspondence without establishing substantive identity.

Proposition 21.207 (Deductive-scope condition). *A deductively valid economic propo-*

Table 21.11: Evidential and methodological architectures for theoretical dialogue in economics

Coordinate		Primary epistemic contribution	Characteristic warrant risk
Deductive	inference	Derives consequences from explicit premises and formal relations	Extending logical validity beyond the empirical or semantic adequacy of the premises
Econometric	inference	Estimates empirical relations and, under additional assumptions, identifies causal or structural parameters	Treating statistical precision as causal identification or transportability
Historical	reconstruction	Reconstructs sequence, context, contingency, and mechanism through temporally situated evidence	Treating chronology or narrative coherence as sufficient causal warrant
Institutional	analysis	Connects rules, organizations, practices, and enactment to economic outcomes	Treating formal rules as complete representations of institutional operation
Experimental	evidence	Generates controlled or quasi-controlled variation for bounded causal claims	Extending local treatment effects beyond the experimental population, mechanism, or institutional setting
Situated	observation	Reconstructs meaning, practice, tacit knowledge, and local relational structure	Generalizing interpretive depth without an explicit scope argument
Simulation		Examines consequences generated by specified rules, agents, interactions, and parameterizations	Treating internally generated patterns as direct empirical confirmation
Formal	modelling	Clarifies mechanisms, consistency, structural relations, and conditional implications	Treating mathematical closure as empirical completeness or ontological proof
Plural	evidential regime	Combines partially non-equivalent forms of evidence around a shared object	Treating accumulation of heterogeneous evidence as automatic convergence
Methodological	translation	Maps claims and warrants across methods while preserving differences in evidential status	Translating conclusions while dropping assumptions, scope, or inferential remainder

sition acquires empirical or explanatory warrant only to the extent that the premises, semantic interpretation, and domain assumptions supporting the derivation are adequate to the economic object and claim under consideration.

21.11.2 Econometric Identification and Statistical Inference

Econometric analysis connects economic claims to statistical variation in observed or constructed data. Its epistemic contribution ranges from description and estimation to forecasting, structural parameter recovery, and causal identification. Modern applied econometrics places particular emphasis on research designs that make

the assumptions supporting causal interpretation visible (Angrist and Pischke 2009; Wooldridge 2010). The methodological issue is consequently broader than whether an estimated coefficient is statistically distinguishable from zero.

A dataset is already a representation produced through classification, sampling, administrative procedure, measurement technology, and institutional practice. Identification then adds further assumptions concerning counterfactual comparison, selection, exclusion, timing, interference, functional form, measurement error, or model specification. Statistical precision concerns uncertainty within this architecture; it does not erase uncertainty concerning the architecture itself.

Definition 21.208 (Econometric-identification profile). *An econometric-identification profile specifies the target estimand or parameter; population and unit, data-generating and measurement processes, source of identifying variation, counterfactual or structural assumptions, treatment and outcome definitions where applicable, interference and selection conditions, uncertainty representation, robustness checks, and the population, mechanism, and temporal scope to which the estimate is claimed to apply.*

The profile separates several possible claims that often travel together in prose: an association is present; a parameter is statistically identified under stated assumptions; an intervention caused an effect in a studied population; the mechanism has been identified; and the result transports to another setting. Each step requires additional warrant.

Proposition 21.209 (Identification-to-claim condition). *An econometric estimate should support only those descriptive, causal, structural, or predictive claims for which the identification assumptions, measurement architecture, population, and transport conditions provide adequate warrant; statistical significance alone does not determine claim type or scope.*

21.11.3 Historical Reconstruction and Contextual Evidence

Historical inquiry provides access to economic processes whose causal significance depends on sequence, institutional transformation, inherited categories, and contingencies that cannot be reconstructed from a cross-section alone. Archives, legislation, correspondence, organizational records, prices, demographic series, material traces, and earlier conceptual vocabularies can jointly reveal how an economic configuration emerged. North's institutional analysis illustrates the importance of historical persistence and institutional change for economic development (North 1990).

Historical evidence can support several distinct epistemic tasks: establishing that an event occurred, reconstructing chronology, identifying plausible mechanisms, tracing institutional genealogy, comparing trajectories, or assessing whether a later category can legitimately be projected backward. A dense narrative can be historically illuminating while still leaving a particular causal contrast underdetermined. Historical rigor therefore depends on source provenance, triangulation, counterevidence, temporal ordering, and explicit discrimination among alternative reconstructions.

Definition 21.210 (Historical-reconstruction profile). *A historical-reconstruction profile specifies the historical object and period, sources and provenance, sequence of relevant events, institutional and conceptual context, mechanisms proposed to connect those events, alternative reconstructions, missing or asymmetric archives, retrospec-*

tive categories introduced by the analyst, and the scope of the historical claim being made.

Historical inquiry is especially important for GRE because subjects, institutions, values, capabilities, infrastructures, and boundaries can change during the process being explained. The evidential object is then a trajectory or configuration history rather than repeated observations of a stable entity.

Proposition 21.211 (Historical-warrant condition). *A historical economic explanation should distinguish evidence for chronology, mechanism, interpretation, and counterfactual relevance, while preserving source limitations and the possibility that later categories only partially correspond to the historical objects being reconstructed.*

21.11.4 Institutional Analysis and Rule-Based Evidence

Institutional analysis examines how rules, norms, organizational arrangements, property regimes, decision procedures, enforcement systems, and shared expectations structure economic action. North emphasizes institutions as constraints shaping interaction, while Ostrom's work on commons governance demonstrates the analytical importance of rule configurations, monitoring, participation, and locally organized governance beyond a simple market-state dichotomy (North 1990; Ostrom 1990). The relevant evidence therefore includes more than formal statutes or organization charts.

An institution operates through written rules, interpretations, tacit practices, enforcement, professional norms, technical systems, exemptions, informal sanctions, and participants' expectations. Formal equivalence between rules can coexist with substantial variation in enactment. Institutional analysis must consequently connect rule representation to observed or reconstructed practice.

Definition 21.212 (Institutional-evidence profile). *An institutional-evidence profile specifies the institution and rule domain, formal rules and recognized roles, interpretive and enforcement practices, monitoring arrangements, informal norms, affected and participating positions, evidence of enactment, variation across sites or periods, exception and appeal mechanisms, and the economic consequences attributed to the institutional configuration.*

This profile allows legal text, organizational data, interviews, administrative decisions, and observed practice to contribute different forms of evidence without treating them as interchangeable. A statute may establish an authorized rule; enforcement records may show practical implementation; participant accounts can reveal how the rule is experienced and navigated.

Proposition 21.213 (Rule-enactment correspondence condition). *An institutional economic claim should distinguish evidence concerning formal rule content from evidence concerning interpretation, enactment, enforcement, expectation, and practical effect; documentary existence of a rule is insufficient to establish its operative economic mechanism.*

21.11.5 Experimental and Quasi-Experimental Evidence

Experimental methods create or exploit variation intended to isolate a causal contrast within a bounded design. Laboratory experiments can control information and in-

centives closely; field experiments observe behavior in more natural institutional settings; natural and quasi-experiments use variation generated outside the researcher's direct control. Experimental economics and behavioral institutional research have shown that controlled variation can illuminate cooperation, reciprocity, rule compliance, market behavior, and institutional response (Ostrom 1998).

The central epistemic strength is design-based clarity about the comparison generating the causal claim. The main boundary concerns transport. An internally credible effect can depend on the recruited population, institutional environment, implementation, stakes, treatment version, interaction structure, or period. Scaling can also alter the mechanism through congestion, strategic adaptation, political response, learning, or equilibrium effects.

Definition 21.214 (Experimental-evidence profile). *An experimental-evidence profile specifies the causal contrast, assignment or quasi-assignment mechanism, experimental population and setting, treatment and comparison conditions, outcome definitions, interference and compliance structure, implementation process, uncertainty, ethical and behavioral consequences of observation, and the mechanism and population to which the result is proposed to transport.*

Experimental evidence therefore enters theoretical dialogue most productively when the theory specifies which mechanism the treatment perturbs. The same observed effect can be compatible with several explanations if the design distinguishes treatment response more clearly than underlying mechanism.

Proposition 21.215 (Experimental-transport condition). *An experimentally identified effect should be transported to another population, scale, institution, or period only through an explicit argument concerning the persistence of the relevant mechanism, treatment, interactions, and contextual conditions.*

21.11.6 Ethnographic and Situated Observation

Ethnographic and situated observational methods provide access to economic practices whose meaning and organization are difficult to reconstruct from standardized variables alone. Participant observation, interviews, field notes, situated documents, and thick contextual description can reveal tacit routines, informal classifications, care relations, workplace practices, reputational systems, embodied skill, and the practical interpretation of rules. Geertz's account of interpretive inquiry provides a canonical articulation of the importance of thick description for context-dependent meaning (Geertz 1973).

The epistemic contribution is depth of relational and semantic reconstruction. Its characteristic challenge is scope. Detailed access to one organization, community, household, market, or professional field can reveal mechanisms omitted by broader representations, but the extent to which those mechanisms recur elsewhere requires a separate comparative argument. Situated knowledge is therefore neither epistemically inferior to standardized evidence nor automatically generalizable from local depth.

Definition 21.216 (Situated-observation profile). *A situated-observation profile specifies the field site and relational positions observed, researcher access and position, practices and meanings under reconstruction, observational and interview materials, temporal duration, interpretive procedures, divergent participant accounts, reflexive effects of observation, and the scope over which the reconstructed mechanism or*

meaning is claimed to travel.

Situated evidence is particularly valuable when economic categories themselves are part of the research object. Participants may enact categories such as household, worker, debt, obligation, skill, care, or fairness differently from the operational definitions used in a dataset. The divergence can identify a translation problem rather than a measurement nuisance.

Proposition 21.217 (Situated-warrant condition). *A situated economic interpretation should preserve the relation among observed practice, participant meaning, researcher position, and inferential scope, while treating generalization to other configurations as an additional comparative claim rather than an automatic consequence of interpretive depth.*

21.11.7 Simulation and Generative Computational Models

Simulation permits researchers to examine how specified rules, heterogeneous agents, networks, adaptation, and interaction can generate aggregate patterns that are difficult to derive analytically. Agent-based computational economics and generative social-science approaches make this logic explicit by asking whether a macro-pattern can be generated from a stated set of micro- or meso-level rules (Epstein and Axtell 1996; Tesfatsion 2006). Simulation is especially useful where feedback, path dependence, nonlinearity, heterogeneity, or endogenous structure complicate closed-form analysis.

A simulated pattern demonstrates what a specified model can generate. It does not by itself establish that the corresponding mechanism generated an observed economy. Empirical warrant requires additional calibration, validation, mechanism comparison, sensitivity analysis, or correspondence with independent evidence. Multiple rule sets can also generate superficially similar outcomes.

Definition 21.218 (Generative-simulation profile). *A generative-simulation profile specifies model entities and state variables, interaction and adaptation rules, topology or environment, initialization, parameterization, stochastic components, output statistics, sensitivity and robustness procedures, empirical correspondences, rival generating mechanisms, and the domain in which simulated behavior is interpreted economically.*

Simulation also provides a useful bridge between theory and history because path-dependent trajectories can be retained rather than compressed into a final equilibrium. Yet this advantage increases the importance of provenance: model code, parameter versions, randomization procedures, data interfaces, and output selection should remain reconstructable.

Proposition 21.219 (Simulation-warrant condition). *A simulated economic pattern supports a claim about possible mechanism within the specified model architecture; stronger claims concerning empirical mechanism, prediction, or historical explanation require independent warrant connecting the model's entities, rules, parameters, and generated patterns to the economic configuration studied.*

21.11.8 Formal Modelling and Structural Representation

Formal modelling expresses economic objects and relations through explicit mathematical or logical structures. Optimization, equilibrium systems, game forms, networks, dynamical systems, stochastic processes, operator structures, and other formalisms can clarify internal relations, reveal hidden assumptions, derive comparative consequences, and identify where intuitive arguments are incomplete. The methodological value of formalization therefore extends beyond prediction.

Formal models differ in epistemic status. Some are schematic representations intended to expose a mechanism; others are parameterized empirical structures; some function as analogies; others define exact identities or accounting relations. The dialogue among theories becomes confused when mathematical form is treated as a single evidential category. A theorem establishes a result in a formal system; an empirical model adds correspondence claims between that system and economic observations.

Definition 21.220 (Formal-model warrant profile). *A formal-model warrant profile specifies the formal objects and operations, economic semantics assigned to them, assumptions and closure conditions, propositions derived within the model, intended representational status, empirical or interpretive correspondence where claimed, sensitivity to excluded relations, and the boundaries beyond which the formal result is not asserted to travel.*

This profile is important for GRE because the book employs several formal languages as provisional representations. Formal tractability can reveal structure while still leaving ontological status suspended and empirical adequacy open to investigation.

Proposition 21.221 (Formal-representation condition). *The rigor of a formal derivation should be distinguished from the adequacy of the mapping between formal objects and economic reality; mathematical closure strengthens claims about implications within the representation while empirical, historical, or ontological claims require additional correspondence warrant.*

21.11.9 Plural Evidential Regimes

Complex economic objects frequently exceed the evidential reach of a single method. A policy can have an econometrically identified average effect while institutional analysis explains implementation variation, historical evidence reveals path dependence, interviews identify burden transfer, and simulation explores long-horizon feedback. These contributions can be mutually informative while remaining non-equivalent. Pluralism is consequently an architecture of coordinated partial access rather than a requirement that every study use many methods.

Evidence can converge, conflict, or address different claims. Apparent disagreement can arise because methods study different populations, scales, periods, manifestations, or mechanisms. Apparent agreement can also be weak if several methods share the same upstream dataset, classification, or assumption. Evidential plurality therefore requires a map of dependence among evidence sources as well as a list of methods.

Definition 21.222 (Plural evidential-regime profile). *A plural evidential-regime profile specifies the claims being evaluated, evidential sources and methods contribut-*

ing to each claim, inferential warrants attached to those contributions, dependencies or shared assumptions among evidence streams, convergences and conflicts, unresolved missingness, and the rule through which the combined evidence modifies confidence, scope, or theory choice.

Plural evidence is especially valuable where economic configurations are multi-level. Statistical estimates can establish population regularities, institutional records can locate rule changes, ethnography can reveal lived enactment, and formal or simulation models can clarify candidate mechanisms. Integration remains claim-specific.

Proposition 21.223 (Evidential-triangulation condition). *Multiple forms of evidence strengthen an economic claim when their distinct inferential contributions and dependencies are specified and when convergence concerns the same proposition or complementary components of a shared mechanism; numerical accumulation of methods alone does not constitute triangulation.*

21.11.10 Methodological Translation and Warrant Preservation

The final coordinate concerns translation among methodological architectures. Deductive, econometric, historical, institutional, experimental, ethnographic, computational, and formal approaches can speak about the same economic configuration while warranting different kinds of claims. Translation becomes epistemically unsafe when a conclusion is preserved but the assumptions and claim status that originally supported it disappear.

A causal estimate can enter a historical explanation, but the estimate does not reconstruct the entire historical mechanism. An ethnographic finding can motivate variables for broader measurement, but operationalization can compress meanings that were central to the original observation. A simulation can formalize a mechanism suggested historically, but successful reproduction of a pattern does not retrospectively prove the historical mechanism. A formal theorem can discipline conceptual reasoning, while its application to an empirical domain still requires a correspondence argument.

Definition 21.224 (Methodological-translation profile). *A methodological-translation profile specifies the source method and claim, evidential basis, inferential warrant and assumptions, target method or theoretical architecture, preserved semantic and causal content, transformations introduced by the translation, losses or unresolved remainders, and the claim status legitimately retained after translation.*

This profile supplies the epistemic bridge to the theory-specific sections that follow. Classical, neoclassical, Marxian, Keynesian, institutional, behavioral, evolutionary, feminist, capability, ecological, commons, sociological, and digital economic traditions differ partly because they privilege different objects and partly because they establish knowledge through different combinations of formal, historical, statistical, institutional, interpretive, and experimental warrants. The dialogue becomes useful when those warrants remain visible.

Proposition 21.225 (Warrant-preserving translation condition). *A claim translated across economic methods or theories should retain or explicitly reconstruct the assumptions, inferential status, domain, uncertainty, and evidential remainder that supported the source claim; semantic correspondence without warrant correspondence is insufficient for epistemic equivalence.*

Section 21.12 begins the theory-specific dialogue with classical political economy. The methodological coordinates developed here provide a common way to ask how each tradition constructs economic knowledge while preserving the possibility that its preferred evidential regime, explanatory object, or standard of warrant remains only partially translatable into GRE.

21.12 Classical Political Economy as Relational Architecture

Chapter 2, Section 2.16, reconstructed classical political economy genealogically through social wealth, production, labor, specialization, exchange, distribution, accumulation, and the changing organization of economic order. The present section takes that reconstruction as its historical baseline. Its role is narrower and comparative: to test how the classical coupling of production, distribution, property, class position, accumulation, and historical change behaves when examined through the common dialogue coordinates established in Sections 21.1–21.11. Historical distinctions are retained where they change the mechanism attributed to production, distribution, demand, accumulation, rent, or institutional change; they are not repeated as a second chronological reconstruction. The principal questions concern the domain in which classical mechanisms remain informative, the corrections they offer to GRE, and the semantic and historical limits governing translation. Table 21.12 summarizes these dialogue coordinates.

Definition 21.226 (Classical political-economic configuration). A *classical political-economic configuration* is a historically situated representation in which production, exchange, distribution, class position, property, population, accumulation, public institutions, and international trade are connected through mechanisms that determine the reproduction and transformation of wealth and the shares accruing to differently positioned groups.

The definition is intentionally broad. Classical political economy did not possess one internally uniform theory, and the differences among Smith, Ricardo, Malthus, and Mill are analytically significant. What makes comparison useful is the recurring organization of economic inquiry around social production and distribution rather than the assumption that these authors shared one complete model.

Proposition 21.227 (Classical-architecture reconstruction condition). A *relational reconstruction of classical political economy* should preserve the historically specific relations among production, distribution, class, accumulation, property, and institutional context before translating selected mechanisms into later theoretical vocabularies.

21.12.1 Production and Division of Labor

Section 2.16 established the historical development of classical production concepts. Here production and division of labor function as comparative coordinates. Across the relevant classical formulations, productive capacity depends on the organization of labor together with capital or stock, land and natural conditions, technical means, market extent, and institutional arrangements (A. Smith 1776; Ricardo 1817; Malthus 1820; Mill 1848). The dialogue therefore asks how productive organization changes dependency, skill composition, bargaining position, occupational differentiation, and

Table 21.12: Relational coordinates for classical political economy

Coordinate	Classical analytical object	Translation risk
Production	Division of labor, productive organization, capital, land, and labor	Reducing production to a timeless input–output mapping
Distribution	Wages, profits, and rent distributed among social positions	Treating functional shares as merely ex post statistical categories
Class position	Workers, owners of stock or capital, landlords, and related positions	Projecting later class concepts backward without qualification
Surplus	Product above immediate replacement or subsistence requirements and its disposition	Equating heterogeneous classical surplus concepts with later surplus-value theories
Accumulation	Saving, capital formation, reinvestment, population, demand, and expansion	Treating growth as an autonomous scalar independent of distribution
Historical change	Commercial development, institutional reform, technology, population, and trade	Reading historically conditioned mechanisms as transhistorical laws
Relational reconstruction	Coupling among production, distribution, property, class, and reproduction	Translating every classical category into a GRE counterpart
Translation boundary	Non-equivalent semantics, normative premises, and historical assumptions	Treating conceptual correspondence as theoretical identity

the reproduction of later productive capacity, rather than repeating the sequence of individual authors.

Definition 21.228 (Classical production profile). *A classical production profile specifies the organization of labor, capital or stock, land and natural conditions, technical means, division of tasks, market extent, institutional supports, and the mechanisms through which their combination affects productive capacity and the reproduction of the economic order.*

The profile permits dialogue with later production theory while preserving the wider social architecture in which classical analysis located productive activity. A modern production function can isolate a useful quantitative relation among inputs and output; classical production inquiry frequently asks a broader question concerning how the organization of society produces and reproduces those inputs, capacities, and positions.

Proposition 21.229 (Production-translation condition). *A translation of classical production into a later economic model should preserve the distinction between the technical transformation of inputs and the social organization through which labor, capital, land, knowledge, and market extent become productively combined.*

21.12.2 Distribution among Social Classes

The genealogical treatment in Section 2.16 established wages, profits, and rent as historically differentiated claims connected to productive and property positions (A. Smith 1776; Ricardo 1817; Mill 1848). The comparative question here is structural: distribution is not merely an ex post welfare adjustment if distributive shares alter accumulation, effective demand, labor reproduction, property relations, or the capacities of differently positioned groups. Under those conditions, distribution feeds back into production and historical change.

Definition 21.230 (Classical distribution profile). A *classical distribution profile* specifies the social product being distributed, the positions entitled to wages, profits, rent, or other shares, the institutional and property relations supporting those claims, the mechanisms determining their relative magnitude, and the consequences of those shares for reproduction and accumulation.

A relational reading also distinguishes functional distribution from personal distribution. A household or individual can receive several types of income, while the analytical significance of wages, profit, or rent derives partly from the relational position through which the income claim is generated.

Proposition 21.231 (Distribution–production coupling condition). *When distributive shares alter saving, accumulation, demand, labor reproduction, land use, or bargaining conditions, distribution should be represented as a constitutive component of the production–reproduction process rather than solely as an ex post allocation of a fixed output.*

21.12.3 Class Positions and Functional Shares

Classical class positions are used here as relational economic coordinates rather than as precursors to every later theory of class. Wages, profits, and rent connect recurrent positions to labor, property, productive role, and income claims (A. Smith 1776; Ricardo 1817). The dialogue therefore reconstructs class position as a configuration of property relation, productive role, dependency, and reproduction while avoiding both reduction to income brackets and projection of later concepts of class consciousness, exploitation, or historical agency backward into the classical texts.

Definition 21.232 (Classical class-position profile). A *classical class-position profile* specifies a recurrent social position through its relation to labor, land, capital or stock, its characteristic income claim, its dependence on other productive positions, its institutional supports, and its role in the reproduction or transformation of the political-economic order.

The profile is useful because functional shares acquire meaning through position. Rent is connected to landholding arrangements; profit to capital ownership and advance; wages to labor relations. Yet the categories remain historically contingent and internally heterogeneous. Their explanatory adequacy should therefore be established for the economic configuration under study.

Proposition 21.233 (Class-position specificity condition). *A comparison of classical class categories with later theories should preserve the specific property, production, and income relations that constituted each classical position and should avoid inferring later concepts of class power or historical agency solely from terminological similarity.*

21.12.4 Surplus and Reproduction

Section 2.16 showed that classical discussions of net product, profit, rent, accumulation, and reproduction employ heterogeneous notions of economic excess (A. Smith 1776; Ricardo 1817; Malthus 1820). The present comparison therefore treats *surplus* as a typed coordinate whose reproductive baseline, controlling position, and subsequent use must be specified. A residual product, distributive share, investible fund, and Marxian surplus value are not interchangeable merely because each involves an excess over some stated baseline.

Definition 21.234 (Classical surplus–reproduction profile). A *classical surplus–reproduction profile* specifies the baseline requirements treated as necessary for continuing production, the residual product or income above that baseline, the positions receiving or controlling that residual, the mechanisms governing consumption or reinvestment, and the consequences for subsequent reproduction and accumulation.

This profile clarifies why surplus analysis is relational. A residual quantity has different economic consequences depending on who controls it, what obligations accompany it, whether it is consumed or reinvested, and whether the underlying reproductive conditions are themselves maintained.

Proposition 21.235 (Surplus-semantics condition). *Claims concerning classical surplus should specify the reproductive baseline, residual object, controlling position, and subsequent use of the residual; numerical excess alone is insufficient to establish equivalence among distinct surplus concepts.*

21.12.5 Accumulation and Economic Growth

The classical genealogy connected accumulation to saving or surplus, productive organization, distribution, demand, land constraints, population, trade, and technical change (A. Smith 1776; Ricardo 1817; Malthus 1820; Mill 1848). Here the comparative issue is the recursive link between present distribution and later productive capacity. The dialogue therefore treats accumulation as a mechanism that can transform productive structure while asking separately whether the resulting expansion also preserves capabilities, ecological conditions, relational diversity, and future options.

Definition 21.236 (Classical accumulation profile). A *classical accumulation profile* specifies the source of investible surplus or saving, the positions controlling its disposition, the productive uses to which it is directed, complementary labor and resource conditions, demand and market conditions, constraints on continued expansion, and the resulting transformation of distribution and productive structure.

A GRE dialogue can learn from this coupling between distribution and future capacity while resisting an easy equivalence between classical accumulation and generativity. Accumulation may enlarge productive capacity while degrading ecological conditions, concentrating dependency, narrowing future options, or displacing care and maintenance. Generativity therefore asks additional questions that classical accumulation theory does not always pose.

Proposition 21.237 (Accumulation–generativity distinction). *An increase in accumulated capital or productive capacity establishes a claim about economic expansion only within its specified classical mechanism; a claim of broader generativity requires additional analysis of capability reproduction, relational effects, ecological conditions, value*

plurality, and future-option structure.

21.12.6 Historical Change and Institutional Context

Classical political-economic mechanisms were formulated within changing commercial, agrarian, industrial, demographic, legal, and international configurations (A. Smith 1776; Ricardo 1817; Mill 1848). Chapter 2 established that genealogy; the present section converts historical situatedness into a transfer discipline. A mechanism derived from particular property relations, land constraints, labor mobility, manufacturing organization, public institutions, or population dynamics can travel to another setting only where the constitutive conditions relevant to that mechanism remain sufficiently comparable.

Definition 21.238 (Classical historical-context profile). *A classical historical-context profile specifies the commercial, technological, demographic, property, legal, political, and international conditions within which a classical mechanism was formulated, together with the conditions required for that mechanism to remain explanatory in another historical configuration.*

This is also where classical political economy is especially valuable for GRE. Its broad object frequently links economy, institutions, property, public authority, and historical development. GRE can recover that breadth while maintaining modern distinctions among empirical identification, normative judgment, formal representation, and historical reconstruction.

Proposition 21.239 (Historical-transfer condition). *A classical political-economic mechanism should be transferred across historical settings only after the property relations, institutional supports, technological conditions, demographic structure, and relevant resource constraints constitutive of that mechanism have been compared explicitly.*

21.12.7 Relational Reconstruction of Classical Political Economy

The preceding coordinates permit a relational reconstruction without claiming that classical political economy already contained GRE. Classical inquiry frequently links economic positions through production, property, exchange, distribution, accumulation, and public institutions. These relations can be represented as a history-bearing configuration in which changes in one domain alter the reproduction of others.

A productive improvement, for example, can modify labor demand, profits, market extent, investment, bargaining conditions, and distribution. Changes in rent can alter distributive shares and accumulation. Property rules can change who controls residual claims. Population and demand can modify wages, prices, and growth. Trade can change market extent, specialization, relative prices, and sectoral structure. The classical object is therefore often relational even where the formal vocabulary differs from GRE.

Definition 21.240 (Classical relational-reconstruction profile). *A classical relational-reconstruction profile maps classical production, property, exchange, class position, distributive shares, accumulation, institutional conditions, and historical change into a connected analytical configuration while preserving the original semantics and evidential status of the classical concepts.*

Three possible contributions to GRE are especially important. First, classical political economy keeps production and distribution tightly coupled. Second, it treats social positions and property relations as economically constitutive rather than as mere background characteristics. Third, it places accumulation and reproduction within a historical process rather than treating the economy solely as a timeless allocation mechanism.

These contributions are dialogical rather than genealogical claims of ownership. GRE can learn from them while adding concepts of heterogeneous value, capability reproduction, relational infrastructure, epistemic conditions, ecological regeneration, radical capability asymmetry, and future formation that are not reducible to classical categories.

Proposition 21.241 (Relational-reconstruction restraint). *A GRE reconstruction of classical political economy is warranted when it reveals structural correspondences among production, distribution, property, class position, and accumulation while leaving concepts without genuine semantic or mechanistic correspondence as explicit remainders rather than assimilating them into GRE vocabulary.*

21.12.8 Translation Boundaries and Theoretical Remainders

Theoretical dialogue requires boundaries as well as correspondences. Classical concepts were developed before many contemporary distinctions among welfare, capability, ecology, care, information, institutional design, econometric identification, and artificial agency. Their omission from a classical text does not establish that classical theory denies those objects; it often means that the object had not yet become analytically constituted in the same form.

Translation also encounters semantic remainder. Classical value, rent, profit, productive labor, class, accumulation, or wealth cannot always be mapped one-to-one onto later categories. Even where terms persist, their mechanism and scope may have changed. Conversely, GRE concepts such as generative opportunity or relational infrastructure can sometimes clarify a classical mechanism without being concepts that classical political economists themselves possessed.

Definition 21.242 (Classical translation-boundary profile). *A classical translation-boundary profile records structural correspondences between classical and target theories, differences in semantics and mechanism, historically specific assumptions, normative premises, objects absent from one framework, evidential differences, and the residual content that should remain untranslated.*

This profile is especially important before the transition to neoclassical economics. Neoclassical theory will reorganize the analytical center around preferences, choice, marginal relations, scarcity, equilibrium, and welfare. Some classical problems survive that transition; others are reformulated, decomposed, or displaced. The dialogue is therefore best treated as a change in theoretical configuration rather than a simple replacement of an older theory by a newer one.

Proposition 21.243 (Classical translation-boundary condition). *A translation from classical political economy into another economic framework should be treated as partial whenever the target theory changes the relevant subject positions, value semantics, distributive mechanisms, temporal architecture, or institutional assumptions; preserved terminology alone is insufficient to establish equivalence.*

Section 21.13 turns to neoclassical economics. The transition will therefore examine not only which classical questions remain, but how a different theoretical configuration changes the objects, subjects, value architecture, coordination mechanisms, and standards of explanation through which those questions are posed.

21.13 Neoclassical Economics

Chapter 2, Section 2.17, supplied the genealogical account of marginalism, neoclassical economics, and the reorganization of economic analysis around value, scarcity, choice, equilibrium, welfare, information, and allocation. The present section treats that genealogy as established and asks a different question: where do preferences, feasible sets, marginal reasoning, price coordination, equilibrium, and welfare analysis provide especially strong local representations, and where do their abstractions cease to preserve historically generated agents, institutions, relations, or future-forming effects? The discussion therefore emphasizes analytical architecture, domain of adequacy, reciprocal correction, and translation boundaries rather than a second history of the marginal and neoclassical traditions. Table 21.13 summarizes the dialogue coordinates.

Definition 21.244 (Neoclassical analytical configuration). A *neoclassical analytical configuration* is a representation in which agents or decision units face feasible alternatives, order or evaluate those alternatives, respond to scarcity and constraints, make choices at relevant margins, and interact through price, market, or equilibrium relations whose welfare properties can be studied under stated assumptions.

The definition identifies a family resemblance across distinct historical constructions. Early marginal utility theory, Marshallian partial equilibrium, Paretian ordinal analysis, Hicksian consumer theory, Samuelsonian formalization, and Arrow–Debreu general equilibrium differ in objects, mathematical commitments, temporal treatment, and standards of explanation (Jevons 1871; Menger 1871; Walras 1874; Marshall 1890; Pareto 1971; Hicks 1939b; Samuelson 1947; Arrow and Debreu 1954; Debreu 1959). Their dialogue with GRE should therefore proceed through particular mechanisms and representational choices. A single image of “the neoclassical model” would erase analytically important differences among them.

Proposition 21.245 (Neoclassical reconstruction condition). A *relational reconstruction of neoclassical economics* should preserve the analytical gains produced by explicit preferences or objectives, constraints, marginal trade-offs, price coordination, and equilibrium consistency while identifying separately the historical formation of agents, preferences, feasible sets, institutions, and future-generative consequences.

21.13.1 Preferences

Section 2.17 traced the historical movement from marginal utility formulations toward ordinal and choice-based representations. In the present dialogue, preferences are treated as an interface between a decision unit and an ordered set of alternatives rather than as a single historical doctrine (Jevons 1871; Menger 1871; Pareto 1971; Hicks 1939b). The comparative question is whether the ordering is an adequate local primitive for the inquiry or whether its formation through institutions, relations, learning, identity, or prior choice becomes part of the mechanism that must itself be

Table 21.13: Relational coordinates for neoclassical economics

Coordinate	Neoclassical analytical object	Dialogue boundary
Preferences	Ordering or evaluation of available alternatives	Historical and relational formation of wants, identities, and evaluative categories
Choice	Selection from a feasible set under constraints	Endogenous transformation of the chooser, the alternatives, and the feasible set
Scarcity	Limited means relative to competing uses or ends	Production, institutional creation, distribution, and relocation of scarcity
Marginalism	Incremental trade-offs, substitution, and local adjustment	Path dependence, discontinuity, threshold effects, and structural transformation
Equilibrium	Mutual consistency among plans, quantities, prices, or optimizing conditions	Equilibrium selection, adjustment processes, institutional reproduction, and open-ended change
Welfare	Efficiency and welfare comparison under specified informational and normative criteria	Distribution, capabilities, rights, power, plural value, and future-generation effects
Relational reconstruction	Coupling among agents, constraints, prices, exchanges, and feasible allocations	Treating relational translation as theoretical identity
Domain of adequacy	Problems where stable objects, preferences, constraints, and institutional rules are useful approximations	Settings with rapid endogenous change in units, relations, institutions, or value structures
Translation limit	Semantic, historical, normative, and dynamical remainder	Absorbing unresolved differences into GRE terminology

explained.

Definition 21.246 (Preference representation profile). A *preference representation profile* specifies the decision unit, the alternatives being ordered, the domain over which the ordering applies, the informational assumptions supporting the ordering, its temporal stability, its relation to observed choice, and the interpretation assigned to changes in that ordering.

The profile separates two questions that are often conflated in cross-theoretical comparison. One concerns whether a preference representation is internally adequate for predicting or characterizing choice within a defined problem. The other concerns how the represented ordering arose. The first can often be answered without a theory of preference formation. The second may require psychology, sociology, institutions, culture, political economy, education, technology, or historical analysis.

GRE therefore has little reason to reject preference representations when they serve a well-defined local purpose. A household budget problem, a demand estimation exercise, or a mechanism-design problem may gain clarity from holding a preference ordering fixed over the relevant horizon. The additional GRE question concerns the conditions under which such stability is defensible. Advertising, social

learning, platform interfaces, status competition, institutional classification, habit formation, technological substitution, or changes in capability can alter the field within which preferences are articulated. In those settings, the preference profile itself becomes part of the evolving economic configuration.

Proposition 21.247 (Preference-stability condition). *A preference representation can be treated as locally stable when the research horizon and mechanism of interest make changes in ordering, evaluative categories, and agent identity sufficiently small for the intended inference; otherwise preference formation should enter the explanatory architecture explicitly.*

The proposition is methodological in status and leaves the ultimate causal basis of preferences open. It identifies the burden of approximation. A model may legitimately abstract from preference formation, while a historical or generative explanation of the same setting may need to analyze that formation directly.

21.13.2 Choice

The genealogical baseline in Section 2.17 established the analytical separation among alternatives, constraints, evaluation, and selection. Here choice is treated as a comparative mechanism: holding an ordering or objective fixed while varying prices, income, constraints, information, or feasible alternatives supports powerful counterfactual analysis (Hicks 1939b; Samuelson 1947). The GRE dialogue begins where the chooser, the ordering, the feasible set, or the institutional rules generating the choice problem become endogenous to the process under study.

Definition 21.248 (Choice-configuration profile). *A choice-configuration profile specifies the decision unit, available alternatives, constraints, information, preference or objective representation, institutional decision rule, and temporal horizon that jointly determine the set of admissible selections under study.*

A GRE reconstruction adds a further distinction between *choice within a configuration* and *choice that changes the configuration*. Purchasing one bundle rather than another may leave the relevant decision architecture approximately intact. Other decisions alter future options, capabilities, dependencies, identities, institutional positions, or the categories through which subsequent alternatives are perceived. Education, migration, long-term contracts, platform adoption, infrastructure investment, care decisions, and irreversible ecological interventions often possess this second character.

This distinction can be expressed without weakening standard choice theory. The local choice problem remains useful, while its output can be treated as an input into a later configuration. A sequence of such choices may therefore require a history-bearing representation if earlier selections alter later feasible sets, information, preference formation, or bargaining positions.

Proposition 21.249 (Configuration-changing choice condition). *When a present selection materially changes later feasible sets, capabilities, preference formation, relational positions, or institutional rules, analysis should distinguish the local choice problem from the intertemporal transformation of the configuration in which subsequent choices occur.*

This proposition establishes a bridge between local choice analysis and analysis at the level of the configuration. Neoclassical choice analysis is especially precise when

the configuration can be held sufficiently stable. GRE becomes more relevant when the consequences of choosing include changes in the architecture of later choice itself.

21.13.3 Scarcity

Scarcity is used here in the analytical sense established in the neoclassical genealogy: limited means acquire opportunity cost relative to competing uses or ends, rather than through physical shortage alone (Robbins 1932). This makes scarcity already relational to purposes, access, technology, rights, and time horizon. The comparative issue is therefore not whether scarcity exists, but which relations produce the effective scarcity relevant to the claim and whether those relations can be held fixed over the analytical horizon.

Definition 21.250 (Scarcity configuration). A *scarcity configuration* specifies the means under consideration, the competing uses or ends, the agents or positions with recognized claims, the technologies and institutions governing access, the relevant temporal horizon, and the opportunity costs generated by alternative deployment.

This definition permits a direct dialogue with GRE because it treats scarcity as a structured relation whose magnitude can change with uses, access, technology, institutions, and time. The further GRE inquiry concerns how scarcity is generated, maintained, relocated, or dissolved. A new technology may reduce the scarcity of computation while increasing electricity demand and dependence on specialized hardware. A licensing rule may create exclusive access to an otherwise reproducible informational good. A transport network may transform spatial scarcity by changing effective distance. An AI system may increase the supply of draft text while increasing the relative importance of trustworthy evaluation and problem selection.

Scarcity analysis can therefore be extended through a temporal question: what does an allocation do to the future scarcity configuration? Consumption may deplete a stock, investment may expand capacity, maintenance may preserve an infrastructure, and institutional change may alter access rules. These observations preserve scarcity as an analytical coordinate while making its generation and transformation an additional object.

Proposition 21.251 (Scarcity-transformation condition). *When present economic activity changes the quantity, accessibility, substitutability, institutional control, or future uses of relevant means, scarcity should be analyzed both as a current constraint and as an evolving configuration produced partly by prior economic action.*

The proposition is especially important for the later GRE research programme because the location of scarcity can move. Economic transformation may relax one bottleneck while creating another. A static measure of scarcity can remain correct for the initial period while becoming incomplete as an account of the process that generated the next period's opportunity structure.

21.13.4 Marginalism

Section 2.17 reconstructed the distinct marginal formulations associated with Jevons, Menger, Walras, and Marshall. The present dialogue treats marginalism as a local comparative technique rather than a unified ontology (Jevons 1871; Menger 1871; Walras 1874; Marshall 1890). Its strength lies in discriminating the consequence of incremental change. Its domain narrows where thresholds, discontinuities, network

effects, changing identities, endogenous feasible sets, or structural transformations make local variation a poor guide to the relevant trajectory.

Definition 21.252 (Marginal comparison profile). A *marginal comparison profile* specifies the variable changed, the reference configuration, the size and direction of the change, the quantities or evaluations held fixed for the comparison, and the range over which the local relation is expected to remain informative.

GRE can preserve this local discipline while distinguishing it from structural transformation. Some economic changes accumulate approximately continuously. Others cross thresholds, create new categories, destroy complementarities, reorganize networks, trigger increasing returns, or change the institutional rule through which later margins are evaluated. Marshall's own treatment of time and equilibrium already warns against assuming that one market period can stand for every temporal horizon (Marshall 1890). A relational-generative analysis extends that caution to cases where the relevant configuration changes qualitatively.

The distinction is particularly useful for policy analysis. A small tax change within an established market may be well studied through marginal responses. A reform that creates a new property regime, platform architecture, care infrastructure, or technological standard may change the set of actors, relations, and feasible actions. Local comparative statics can still contribute, while the overall explanation requires a representation of the structural change.

Proposition 21.253 (Marginal-domain condition). *Marginal reasoning has greatest explanatory force where local changes preserve the identity and relevant structure of the comparison domain; threshold crossing, endogenous category formation, and structural reconfiguration require additional analysis of the altered domain in which later margins are defined.*

The proposition therefore assigns marginalism a clear domain of analytical strength. It also prevents a converse error in which every local adjustment is redescribed as a large relational transformation. GRE needs marginal reasoning precisely because generative processes also contain many locally incremental decisions.

21.13.5 Equilibrium

The neoclassical genealogy established several non-identical equilibrium architectures, including Walrasian interdependence, Marshallian partial analysis, and later axiomatic general equilibrium (Walras 1874; Marshall 1890; Arrow and Debreu 1954; Debreu 1959). Here equilibrium functions as a typed coordination concept whose meaning must be stated before comparison. The dialogue asks whether market clearing, mutual consistency, optimization, or another equilibrium condition adequately represents the process at issue and whether the institutions and state variables required by that condition remain sufficiently stable.

Definition 21.254 (Equilibrium representation profile). An *equilibrium representation profile* specifies the agents and markets included, the variables required to be mutually consistent, the behavioral and technological assumptions, the institutional rules generating interaction, the temporal interpretation, the conditions supporting existence or local determination, and the adjustment process when such a process forms part of the model.

One major contribution of equilibrium analysis is that it constrains partial explana-

tions. A proposed change in one market can affect demands, supplies, incomes, input prices, and opportunities elsewhere. General equilibrium formalizes this interdependence; partial equilibrium deliberately narrows it when cross-market effects can be held secondary for the problem at hand. Both are relational in a limited but important sense because an outcome is defined through consistency among connected decisions and constraints.

GRE introduces a separate question concerning the relation between equilibrium and historical reproduction. A configuration may satisfy an equilibrium condition while depending on institutions, norms, infrastructures, legal rights, ecological inputs, care work, or political settlements that the equilibrium representation holds fixed. Conversely, a history-bearing system may remain far from a stable equilibrium while displaying persistent institutions or recurrent patterns. Equilibrium therefore identifies one kind of relational consistency; it does not by itself classify every form of persistence or change.

Proposition 21.255 (Equilibrium–reproduction distinction). *An equilibrium condition establishes mutual consistency relative to the variables and assumptions represented in the model; an account of economic reproduction additionally requires analysis of the processes that sustain, modify, or replace the institutions, resources, capabilities, and relations treated as given by that representation.*

This distinction preserves the formal achievement of equilibrium theory while preventing equilibrium from becoming a synonym for social stability. It also creates a useful interface with later complexity, evolutionary, institutional, and historical approaches, each of which will interpret persistence and transformation differently.

21.13.6 Welfare

Section 2.17 established the movement from utility-based welfare analysis toward Pareto, compensation, and axiomatic allocation criteria (Pareto 1971; Pigou 1920; Hicks 1939a; Kaldor 1939; Debreu 1959). The present comparison uses welfare analysis to separate efficiency claims from broader normative conclusions. The key boundary is that a formally efficient allocation can coexist with unequal endowments, capabilities, power, recognition, or future-generating conditions; GRE therefore treats welfare criteria as explicit evaluative operators rather than complete accounts of justice.

Definition 21.256 (Welfare-evaluation profile). *A welfare-evaluation profile specifies the persons or units whose positions count, the welfare or preference information admitted, the feasible alternatives, the efficiency or comparison criterion, the treatment of distribution and external effects, and the normative claims that the criterion is intended to support.*

GRE can use this discipline when developing generative evaluation. A claim that an allocation creates future options, strengthens relational infrastructure, improves capabilities, or regenerates ecological conditions still requires a rule specifying whose opportunities count, over what horizon, according to which value dimensions, and with what treatment of conflicts among them. Heterogeneous generative value does not remove the need for evaluative criteria. It makes the plurality and conversion structure of those criteria more explicit.

The dialogue also exposes a temporal extension. Conventional welfare comparison often evaluates alternative allocations or states at a given analytical level. GRE asks

how current allocations alter future evaluative capacity, future feasible sets, and the relations through which later value is generated or captured. This creates questions about intergenerational effects, capability formation, irreversible losses, and path-dependent value conversion. Such questions can sometimes be represented within extended welfare models; in other cases they require additional theoretical machinery.

Proposition 21.257 (Welfare-scope condition). *A welfare criterion should be interpreted within the information, population, temporal horizon, distributional treatment, and value dimensions that it explicitly admits; broader claims about justice, capability, relational sustainability, or future generativity require additional premises and evidence.*

The proposition reinforces a point central to Chapter 21: theoretical limitation is not equivalent to theoretical failure. A deliberately narrow welfare criterion can be highly useful when its scope is kept visible. Problems arise when a local criterion is silently expanded into a complete social evaluation.

21.13.7 Relational Reconstruction

The preceding concepts can be reconstructed relationally without converting neoclassical economics into GRE. Preferences relate decision units to alternatives; constraints relate intended actions to available means; prices relate dispersed plans through exchange; budget sets relate endowments and prices to feasible consumption; production possibilities relate technologies and resources to output; equilibrium relates multiple plans through consistency conditions; and welfare criteria relate feasible states through evaluative rules. The neoclassical architecture is therefore already rich in formally specified relations.

The difference concerns which relations are internal to the model and which are held outside it. A standard consumer problem may represent the relation among preferences, prices, income, and chosen bundles with great precision while leaving preference formation, legal personhood, household bargaining, cultural meaning, or future capability effects outside the active explanatory frame. A general-equilibrium model can represent economy-wide price interdependence while holding institutions, commodity definitions, property rights, or technological possibilities sufficiently fixed for the theorem or exercise at hand.

Definition 21.258 (Neoclassical relational-reconstruction profile). *A neoclassical relational-reconstruction profile maps decision units, preference or objective representations, constraints, endowments, technologies, prices, exchanges, equilibrium conditions, and welfare criteria into an explicit relational configuration while recording the historical, institutional, and generative conditions held outside that configuration.*

This reconstruction yields several contributions to GRE. First, neoclassical theory supplies disciplined methods for specifying trade-offs and thereby constrains any use of generativity as an economic good. Second, it requires opportunity costs to be made visible. Third, equilibrium analysis disciplines claims about interdependence. Fourth, welfare economics demonstrates the importance of separating efficiency from wider normative evaluation. Fifth, axiomatic formalization shows how strong results can be tied explicitly to assumptions rather than embedded in suggestive prose.

GRE adds a complementary layer by asking how the inputs to these models become

generated. Endowments emerge from histories of acquisition and inheritance; technologies arise through investment, learning, institutions, and knowledge; preference orderings can be shaped through social relations and infrastructures; market boundaries are institutionally constituted; commodity categories can be transformed; and allocations alter future capacities and constraints. These questions can be studied alongside neoclassical models within a plural formal architecture.

Proposition 21.259 (Relational extension condition). *A GRE extension of a neoclassical model is warranted when the mechanism of interest depends materially on the generation or transformation of agents, preferences, constraints, endowments, technologies, institutional rules, or future opportunity structures that the original model holds fixed.*

The condition prevents indiscriminate extension. Additional relational detail carries analytical cost. When fixed primitives are empirically adequate over the relevant horizon, retaining them can improve clarity. When they are themselves central causal objects, treating them as exogenous can hide the process the inquiry seeks to explain.

21.13.8 Domain of Adequacy

The dialogue requires a positive account of where neoclassical abstractions are especially effective. Their domain of adequacy is strongest when the research question concerns trade-offs among identifiable alternatives, responses to prices or constraints, substitution among uses, decentralized coordination, market interdependence, or welfare properties of clearly specified allocations. The relevant agents, commodities, technologies, preferences or objectives, and institutional rules need sufficient local stability for these abstractions to isolate the mechanism under study.

Definition 21.260 (Neoclassical domain-of-adequacy profile). *A neoclassical domain-of-adequacy profile specifies the empirical and analytical conditions under which stable decision units, ordered alternatives, explicit constraints, marginal responses, and equilibrium or welfare concepts provide a sufficiently accurate representation for the research question and time horizon at issue.*

Several kinds of inquiry fit this profile well. Demand responses to price changes can often be represented through constrained choice. Firms' local substitution among inputs can be studied through marginal conditions. Auction or mechanism problems can benefit from explicit incentive and feasibility structures. Competitive-equilibrium models can clarify the consistency requirements connecting many markets. Welfare analysis can identify efficiency properties and expose the normative information absent from an efficiency criterion. These achievements remain valuable even when a broader historical explanation is also required.

The domain profile should be assessed through empirical and theoretical fit to the research question. A problem situated inside a rapidly changing digital platform may still contain a stable local pricing problem. A historically institutional inquiry may still need a neoclassical model of a particular margin. Conversely, a familiar market setting may fall outside a simple neoclassical representation when preferences, product categories, market rules, or strategic power are changing endogenously over the relevant horizon.

Proposition 21.261 (Local-adequacy condition). *A neoclassical representation is locally adequate when transformations omitted for analytical tractability remain sufficiently limited that they do not materially alter interpretation of the result within the*

stated horizon and population.

This condition also disciplines GRE. A relational-generative model should earn its additional complexity. Where a simpler model captures the mechanism with sufficient accuracy, a larger ontology of relations can reduce interpretability without improving inference. GRE's open research programme therefore benefits from treating neoclassical models as reusable analytical components whose adequacy can be tested locally.

21.13.9 Limits of Translation

Translation between neoclassical economics and GRE encounters semantic, historical, formal, and normative remainders. Preference and value, utility and well-being, equilibrium and relational sustainability, capital and generative capacity, efficiency and justice, and allocation and generative configuration occupy different theoretical roles. A particular inquiry may establish partial correspondence between members of these pairs only after the relevant assumptions and semantic changes are stated explicitly.

The historical remainder is equally important. "Neoclassical economics" covers transformations extending from nineteenth-century marginalism through twentieth-century formal choice, equilibrium, and welfare theory. A GRE translation that projects contemporary meanings of preference, optimization, or equilibrium onto Jevons, Menger, Walras, or Marshall would obscure differences that are themselves analytically useful. The reverse risk also exists: criticism of an early utility formulation should not be transferred without qualification to ordinal preference theory or axiomatic general equilibrium.

Definition 21.262 (Neoclassical translation-boundary profile). A *neoclassical translation-boundary profile* records the concepts and mechanisms that admit structural correspondence with GRE, the assumptions required for that correspondence, the semantic and historical remainders that resist translation, and the changes in normative or empirical meaning introduced by the target framework.

Several translation boundaries deserve explicit preservation. A stable preference ordering is a useful analytical primitive even when GRE studies how preferences form. Pareto efficiency remains a precise property even when GRE asks additional questions about capability, power, or future options. Competitive equilibrium can establish consistency and welfare results under its assumptions even when the institutional conditions supporting those assumptions require separate explanation. Marginal reasoning can remain valid locally within a process that also contains discontinuities and structural change.

Theoretical dialogue therefore works best through layered explanation. A neoclassical model can analyze a local choice, allocation, or equilibrium relation. Historical and institutional inquiry can explain how the relevant market and rights were constituted. Behavioral analysis can study departures from the assumed decision structure. GRE can examine how the combined configuration generates later capabilities, dependencies, values, and constraints. These layers may overlap without collapsing into one another.

Proposition 21.263 (Neoclassical translation-restraint condition). A *translation between neoclassical economics and GRE should remain partial whenever correspondence depends on changing the meaning of preference, utility, scarcity, capital, equilibrium,*

efficiency, welfare, or allocation; the residual difference should remain visible as theoretical information and should resist purely terminological resolution.

The neoclassical dialogue therefore contributes both analytical tools and boundary conditions to GRE. It supplies precise languages for constrained choice, scarcity, marginal trade-offs, interdependence, equilibrium, and welfare. GRE contributes questions about the historical production of the modeled primitives, the transformation of relational configurations, heterogeneous generative value, power over conversion and opportunity structures, and the future consequences of present allocation. Section 21.14 turns next to Marxian political economy, where production, class relations, value, accumulation, exploitation, crisis, and historical transformation reorganize the comparative coordinates in a substantially different way.

21.14 Marxian Political Economy

Chapter 2, Sections 2.18–2.19, reconstructed historical materialism and Marxian theories of circulation and reproduction in genealogical depth. The present section uses that account as its historical baseline and concentrates on reciprocal theoretical dialogue. Its object is the Marxian architecture linking relations of production, class, value, exploitation, accumulation, crisis, circulation, reproduction, and historical materiality, together with the conditions under which those mechanisms can be compared with GRE without translating Marxian categories into generic relational vocabulary. The section therefore retains historical detail where competing interpretations alter the mechanism or scope of a claim, while emphasizing domain specificity, corrections to GRE, and explicit translation remainders. Table 21.14 summarizes the principal coordinates.

Definition 21.264 (Marxian political-economic configuration). *A Marxian political-economic configuration is a historically situated representation in which production is organized through definite social relations, subjects occupy positions within those relations, commodities and capital carry specific social forms, surplus is produced and appropriated through the organization of labor, accumulation reproduces and transforms the configuration, and contradictions can generate recurrent pressures toward restructuring or crisis.*

The definition identifies a family of analytical commitments with substantial internal variation. Marx's mature critique places commodity production, wage labor, capital, value, surplus value, accumulation, and historical transformation within a connected architecture (Marx 1859; Marx 1867; Marx 1993). Later Marxian traditions disagree about the interpretation of value, the status of historical materialism, the mechanisms of crisis, the role of class agency, the significance of social reproduction, and the scale at which capitalist dynamics should be reconstructed (Rubin 1972; Postone 1993; Luxemburg 2003; Harvey 1982; Vogel 1983; Fraser 2014). Those disagreements remain part of the object of dialogue.

Proposition 21.265 (Marxian reconstruction condition). *A relational reconstruction of Marxian political economy should preserve the historical specificity of capitalist social forms, the distinction between material processes and their social organization, the relational derivation of class and exploitation, and the endogenous connection among production, circulation, reproduction, accumulation, and transformation.*

Table 21.14: Relational coordinates for Marxian political economy

Coordinate	Marxian analytical object	Dialogue boundary
Relations of production	Historically specific organization of production, control, appropriation, and reproduction	Reduction of production relations to technology, legal ownership, or generic interaction
Class	Structural positions reproduced through production, property, labor, and appropriation relations	Translation of class into income rank, identity, or generic network position
Value	Social form of commodity-producing labor and its socially necessary temporal mediation	Identification with general worth, welfare, price, or heterogeneous generative value
Exploitation	Production and appropriation of surplus value through the wage-labor-capital relation	Identification with every asymmetry, dependency, injustice, or unequal outcome
Accumulation	Reinvestment and expanded reproduction of capital through recurrent production and circulation	Identification with simple asset growth or with generativity in every value domain
Crisis	Disruption emerging from historically specific tensions in reproduction, circulation, realization, finance, profitability, or accumulation	Treatment of one crisis mechanism as exhaustive across Marxian traditions
Historical materiality	Historical generation and transformation of social forms through material production and social relations	Mechanical technological determinism or ontological closure
Relational reconstruction	Coupling of social forms, positions, processes, reproduction, and historical transformation	Absorption of Marxian categories into generic relational vocabulary
Translation limit	Semantic, historical, normative, and causal remainder between Marxian and GRE categories	Theoretical identity inferred from structural resemblance

21.14.1 Relations of Production

Sections 2.18–2.19 established the Marxian genealogy of historically specific production relations. Here those relations are treated as a comparative architecture connecting control of productive conditions, labor-power, property, appropriation, and reproduction (Marx 1859; Marx and Engels 1970; Marx 1867). The analytical point is stronger than interpersonal connection: production relations organize recurrent social positions and the rules through which productive activity is reproduced. Translation into GRE is adequate only where those typed economic contents remain visible.

Definition 21.266 (Production-relations profile). A *production-relations profile* specifies the direct producers, controllers of means of production, labor-mobilization mechanisms, decision rights, appropriation rules, coordination forms, juridical expressions, and reproductive conditions through which material production acquires

a historically specific social form.

This profile helps separate material-technical content from social form, a distinction emphasized strongly in Rubin's reconstruction of Marxian political economy (Rubin 1972). A production technology may remain materially similar while the social relations governing access, control, remuneration, and disposition of output change. Conversely, technological transformation may alter the viable range of social organization, bargaining positions, skill structures, or dependence without mechanically determining one institutional result.

The distinction has direct relevance to GRE. GRE also studies relations that condition access, capability, control, and future formation. Marxian production relations add a sharper historical and economic specification: the relation is analytically significant because it structures production and reproduction within a particular mode of economic organization. A GRE reconstruction should therefore retain the typed content of the relation when representing connections between economic subjects.

Proposition 21.267 (Typed production-relation condition). *A Marxian production relation should be reconstructed through its historically specific control, labor, appropriation, and reproductive functions; relational connectivity by itself does not preserve the theoretical content of the category.*

This condition is especially important for contemporary extensions. Platform labor, algorithmic management, intellectual property, data infrastructures, global supply chains, and highly automated production can change the material and organizational form through which control is exercised. A Marxian analysis can remain informative when it asks how these changes reorganize access to productive assets, labor-power, surplus appropriation, and reproduction. GRE can add questions concerning generative capability, epistemic infrastructure, heterogeneous value, and future-option formation without replacing the original production-relations problem.

21.14.2 Class

The Chapter 2 genealogy established class as a historically constituted relation to production, property, labor, appropriation, and reproduction rather than as an income partition. The present dialogue therefore treats class position as a relational mechanism whose economic significance depends on rights, dependencies, asset control, labor-power, and the reproduction of those conditions (Marx 1867). Internal differentiation by occupation, authority, skill, household structure, legal status, geography, race, gender, or institution can modify the manifestation of a class relation without eliminating its structural content.

Definition 21.268 (Marxian class-position profile). *A Marxian class-position profile specifies a subject's recurrent position in relation to productive assets, labor-power, decision authority, appropriation of product or surplus, dependence on market participation, and the mechanisms through which that position is reproduced across time.*

The profile distinguishes class from identity and from distributive outcome. Persons with similar incomes can occupy different relations to productive assets and labor. Persons within a similar structural class position can possess different identities, capabilities, and political orientations. Class consciousness, organization, and collective agency constitute further questions that cannot be inferred automatically from the economic position itself. Later Marxian traditions have developed those questions in different directions, which reinforces the value of keeping structural position, lived

experience, and political agency analytically distinguishable.

Rubin's account of the personification of economic categories offers a useful bridge for relational analysis: owners of particular economic objects can occupy social functions because those objects mediate determinate production relations (Rubin 1972). The analytical point concerns the patterned constraints and enablements attached to roles through institutionalized relations among persons and things, while persons retain characteristics and capacities exceeding those roles.

Proposition 21.269 (Class-position distinction). *A class position provides a structural description of recurrent relations to production and appropriation; claims about identity, consciousness, organization, or political action require additional evidence concerning how subjects interpret, inhabit, and coordinate within those positions.*

GRE can extend this architecture by examining how class position intersects with capabilities, care dependence, epistemic access, platform mediation, environmental exposure, and intergenerational opportunity. Such extensions remain analytically useful when they preserve class as a typed economic relation and treat broader disadvantage through additional concepts.

21.14.3 Value

Marxian value is one of the strongest translation tests in this chapter because Chapter 2 already established its historically specific relation to commodity production, abstract labor, socially necessary labor time, and social mediation (Marx 1867; Rubin 1972). The present dialogue therefore resists translating value into either physical labor embodied or GRE's broader heterogeneous-value vocabulary. The comparative task is to preserve the social organization of commodity-producing labor and the objective forms through which that relation is expressed while identifying only those correspondences that survive the change of theoretical language.

Definition 21.270 (Marxian value-form profile). *A Marxian value-form profile specifies the commodity form, the historically specific organization of labor, the mediation through which heterogeneous concrete labors acquire an abstract social relation, the temporal standard relevant to socially necessary labor, and the monetary or exchange forms through which value becomes manifest.*

Postone develops one influential later reconstruction by treating value, abstract labor, and abstract time as historically specific forms of social mediation that help generate capitalism's distinctive temporal dynamic (Postone 1993). This interpretation is not interchangeable with every Marxist labor theory of value, yet it highlights an issue highly relevant to GRE: a measure can participate in social constitution while also serving descriptive purposes. When production is organized through value-mediated competition, socially necessary time can discipline producers, technologies, and investment decisions even though no single actor directly plans the total social allocation of labor.

GRE's concept of heterogeneous value operates at another level. It examines plural forms of value, conversion, circulation, capture, dissipation, and regeneration across economic and relational domains. Marxian value should therefore enter GRE as a historically specific social form with a narrower scope than value in general. Use-value, price, exchange-value, surplus value, welfare, capability, ecological value, care value, and generative value can interact while retaining distinct theoretical roles.

Proposition 21.271 (Value-translation restraint). *Marxian value should be translated into GRE only at the level supported by the specific inquiry; correspondence with labor mediation, temporal discipline, commodity form, or monetary manifestation does not establish identity with heterogeneous value, normative worth, welfare, or generative value.*

This restraint preserves a productive asymmetry between the frameworks. Marxian value theory offers GRE a powerful account of how social relations can acquire objective economic form through commodity mediation. GRE offers a wider architecture for examining value domains and conversion relations that Marxian value theory was not designed to classify exhaustively.

21.14.4 Exploitation

The genealogical baseline established Marxian exploitation through the distinction between labor and labor-power and through the production and appropriation of surplus value (Marx 1867). The present section keeps that derivation intact. Exploitation is therefore not a generic synonym for low wages, harsh conditions, unequal bargaining power, or distributive unfairness, even when those phenomena accompany it. The dialogue with GRE asks how this specific production relation interacts with broader power asymmetries without dissolving the Marxian mechanism into a general vocabulary of disadvantage.

Definition 21.272 (Marxian exploitation profile). *A Marxian exploitation profile specifies the purchase and use of labor-power; the conditions reproducing labor-power; the labor process through which new value is produced; the division between necessary and surplus labor in the relevant theoretical representation; the appropriation of surplus value; and the institutional relations reproducing that arrangement.*

This profile clarifies the relation between exploitation and power. Power can shape the conditions under which labor contracts are formed, work is organized, technologies are introduced, workplaces are governed, and alternatives are available. Marxian exploitation identifies a more specific surplus-producing relation within that wider power architecture. GRE can therefore model exploitation as one typed mechanism through which relational asymmetry and control affect value production and capture while preserving other forms of power that do not pass through wage labor.

The same distinction matters for non-wage forms of extraction. Rent, debt service, monopoly pricing, unpaid care work, platform fees, data appropriation, ecological externalization, and colonial or geopolitical transfers may involve important forms of capture or domination. Some Marxian traditions incorporate such processes into expanded accounts of capitalism, and social-reproduction approaches have emphasized the reproduction of labor-power beyond the immediate wage relation (Vogel 1983; Fraser 2014). Analytical expansion remains strongest when the mechanism of each transfer is stated explicitly and its relation to the wider capitalist configuration is demonstrated.

Proposition 21.273 (Exploitation–power distinction). *Marxian exploitation identifies a historically specific relation between labor-power; value production, and surplus appropriation, while relational power encompasses a wider class of mechanisms through which asymmetries alter action, dependence, conversion, and future opportunity.*

The distinction allows GRE to learn from the precision of the surplus-value mecha-

nism while retaining a broader vocabulary for power, care, ecology, platform control, epistemic dependence, and other relations whose causal structure may differ.

21.14.5 Accumulation

Chapter 2 reconstructed accumulation and capital circulation as recursive processes through which surplus value is reconverted, productive structure changes, and the conditions of later production are reproduced or transformed (Marx 1867; Marx 1993). The present dialogue uses accumulation to compare a historically specific capitalist mechanism with GRE's broader concept of generativity. The overlap lies in recursive transformation of later conditions; the boundary lies in the fact that generative capacity can arise in configurations that do not operate through capital, valorization, wage labor, or commodity reproduction.

Definition 21.274 (Marxian accumulation profile). A *Marxian accumulation profile* specifies the generation of surplus value, its realization and appropriation, the share converted into additional capital, the productive and financial forms through which reinvestment occurs, the labor and resource conditions enabling expansion, and the structural transformations produced by repeated reproduction on an enlarged scale.

Later Marxian analyses extend this architecture across different scales. Luxemburg examines accumulation through realization and the relation between capitalist and non-capitalist environments (Luxemburg 2003). Harvey emphasizes turnover, fixed capital, credit, geographical expansion, and built environments that can facilitate accumulation while creating later rigidities and spatial tensions (Harvey 1982). These accounts should be treated as theoretically distinct developments with different accumulation and crisis mechanisms.

GRE gains an important lesson from this recursive architecture: present appropriation and investment alter the future structure in which later economic action occurs. Accumulation can expand productive capability, infrastructure, knowledge, and coordination capacity. It can also deepen dependence, concentrate control, exhaust ecological conditions, displace reproductive labor, or narrow future options. The term *generativity* therefore adds an evaluative and multi-domain question that cannot be inferred from the magnitude of accumulated capital alone.

Proposition 21.275 (Accumulation–generativity distinction). *Capital accumulation establishes a recursive process of surplus realization, reinvestment, and expanded reproduction within a capitalist configuration; claims about broader generativity require additional analysis of capability, relational, ecological, epistemic, distributive, and future-option effects.*

This proposition creates a useful interface with earlier GRE chapters on conversion and capture. Accumulation can be represented as one family of conversion loops in which value produced in one phase becomes command over resources and productive conditions in a later phase. The Marxian account adds historically specific institutions and class relations to that loop, preventing a generic flow representation from obscuring who controls conversion and under what social conditions.

21.14.6 Crisis

Crisis analysis in Marxian political economy is better represented as a family of mechanisms than as one universally agreed theory. Marx's analyses of circulation,

turnover, reproduction, competition, accumulation, and realization identify several sites at which the reproduction of capital can encounter disruption (Marx 1867; Marx 1993). Later Marxian traditions have developed different emphases, including realization problems, disproportionality, overaccumulation, profitability pressures, credit dynamics, financial fragility, spatial displacement, and conflicts between accumulation and its social or ecological conditions (Luxemburg 2003; Harvey 1982; Fraser 2014).

The shared analytical intuition is relational: crisis emerges through incompatibility or interruption among processes that are individually connected to reproduction. Production can expand while realization lags. Credit can bridge temporal gaps while increasing future obligations. Fixed capital can support productivity while binding investment to spatial and technological configurations. Competitive pressures can induce productivity-enhancing investment while altering employment, demand, profitability, or the valuation of existing capital. Social reproduction and ecological conditions can sustain accumulation while being degraded by the pressures placed upon them.

Definition 21.276 (Marxian crisis-mechanism profile). A *Marxian crisis-mechanism profile* specifies the reproduction processes involved, the relation or temporal coupling that becomes strained, the mechanism through which incompatibility accumulates or propagates, the trigger or threshold associated with disruption, and the restructuring process through which the configuration is restored, transformed, or displaced.

This definition keeps crisis historically and mechanism-specific. A fall in asset prices, a banking panic, a profitability squeeze, a realization failure, a supply interruption, and a social-reproductive breakdown can interact while remaining different causal objects. The analyst therefore gains more explanatory precision by specifying the pathway than by treating crisis as a self-explanatory category.

GRE's work on criticality creates an obvious comparison, yet translation requires restraint. Criticality refers to dynamical conditions in which relatively small perturbations can produce large configurational changes under specified models or empirical indicators. Marxian crisis concepts concern historically structured contradictions, reproduction problems, and restructuring mechanisms. A crisis can occur without evidence that a system was near a mathematically defined critical point, and a near-critical system need not instantiate a Marxian accumulation contradiction.

Proposition 21.277 (Crisis-plurality condition). A *Marxian crisis explanation* should identify the reproduction mechanism, temporal coupling, propagation pathway, and historical conditions relevant to the case; the existence of recurrent capitalist crises does not establish one exhaustive causal mechanism across periods and scales.

The proposition also disciplines GRE. Concepts such as threshold, attractor, fragility, and critical transition can clarify particular crisis processes only where their formal and empirical assumptions are satisfied. Marxian crisis analysis can contribute historical and institutional specification to those dynamical models, while dynamical analysis can help separate mechanisms that otherwise remain grouped under broad crisis terminology.

21.14.7 Historical Materiality

Section 2.18 established the heterogeneous Marxian debates over productive forces, production relations, institutions, consciousness, structure, and agency (Marx 1859; Marx and Engels 1970; Althusser 2006; Cohen 2001; Thompson 1978). The present comparison therefore does not treat historical materiality as one deterministic proposition. It asks which material and relational conditions enter a given mechanism, how those conditions are reproduced, and what burden of historical specification is required before a Marxian account can be translated into GRE's more ontologically suspended architecture.

Definition 21.278 (Historical-materiality profile). A *historical-materiality profile* specifies the productive capacities, social relations, institutions, material dependencies, forms of consciousness, conflicts, and temporal sequences through which an economic configuration is reproduced and transformed, together with the causal claims linking these elements in the interpretation at issue.

Postone's reconstruction adds a further dimension by treating capitalism's basic categories as historically specific forms of social mediation whose scope is tied to capitalist social relations (Postone 1993). This emphasis is important for GRE because it aligns with the principle that analytical categories themselves can be historically generated. "Labor," "capital," "commodity," "market," or "value" should therefore be assigned the scope established by the social relations that make the category operative.

GRE can adopt historical sensitivity without adopting a fixed philosophy of historical succession. Ontological suspension leaves open the ultimate status of material, relational, symbolic, and institutional realities. Historical explanation can still examine how material constraints, technologies, property forms, political institutions, ecological conditions, knowledge, and social relations jointly condition later possibilities.

Proposition 21.279 (Historical-materiality restraint). A *GRE translation of historical materiality should preserve the historically specific coupling among material production, social relations, institutions, and transformation while leaving stronger claims of technological determination, necessary stage succession, or ultimate ontology to the evidence and argument of the particular Marxian interpretation.*

This restraint makes Marxian historical analysis especially useful as a corrective to timeless economic categories. It also leaves room for contingency. Historically generated structures can constrain action strongly while remaining dependent on political conflict, institutional experimentation, ecological conditions, technological change, and collective agency whose outcomes are not fully fixed in advance.

21.14.8 Relational Reconstruction

Marxian political economy admits a particularly rich relational reconstruction because many of its central categories are defined through relations among historically positioned subjects, things, and processes. Capital depends on recurrent relations among money, commodities, labor-power, production, circulation, appropriation, and reinvestment. Class positions arise through relations to productive assets and labor. Value is mediated through a social organization of commodity-producing labor. Exploitation is generated through a relation between labor-power and surplus pro-

duction. Accumulation recursively transforms the configuration that supports later accumulation. Crisis concerns disturbances in the reproduction of these connected processes.

Definition 21.280 (Marxian relational-reconstruction profile). A *Marxian relational-reconstruction profile* maps production relations, class positions, commodity and value forms, labor-power, surplus production, circulation, accumulation, reproduction, institutional conditions, and historical transformation into a connected configuration while retaining the historical specificity and causal semantics of the Marxian categories.

Several contributions to GRE follow from this reconstruction. First, Marxian analysis shows how apparently thing-like economic categories can express social relations. Rubin's social-form interpretation is especially useful here because it directs analysis from the material appearance of value, money, capital, profit, rent, or wages toward the production relations expressed through those forms (Rubin 1972). GRE's distinction between manifestation and relational reality can learn from this methodological move while maintaining its own ontological restraint.

Second, Marxian political economy integrates production and reproduction. Economic activity reproduces material outputs and can reproduce the relations, positions, institutions, and dependencies through which subsequent activity is organized. Volume II's circuits and reproduction schemes provide a particularly clear economic representation of this recursive structure (Marx 1993). GRE can generalize the question toward capability, ecological, epistemic, institutional, and relational reproduction without assuming that each domain follows the value logic of capital.

Third, Marxian analysis treats accumulation as a process that can transform the conditions of subsequent reproduction. Competitive pressure, technical change, concentration, spatial organization, and changing labor relations can transform the environment in which later decisions occur (Marx 1867; Harvey 1982). This complements GRE's emphasis on history-bearing economic configurations and path-dependent future formation.

Fourth, later social-reproduction and expanded-capitalism approaches identify background relations whose maintenance supports production and accumulation. Vogel centers the reproduction of labor-power, while Fraser analyzes social reproduction, ecology, and public power as enabling conditions that can be destabilized by accumulation dynamics (Vogel 1983; Fraser 2014). These developments create direct interfaces with GRE's work on care, relational infrastructure, ecological regeneration, and institutional maintenance.

Definition 21.281 (Marxian domain-of-adequacy profile). A *Marxian domain-of-adequacy profile* identifies research questions for which historically specific production relations, class positions, commodity mediation, surplus appropriation, accumulation, reproduction, and structural transformation are causally central, together with the empirical conditions under which those categories illuminate the case.

The domain is especially strong when an inquiry concerns wage labor, ownership or control of productive assets, accumulation, class-structured distribution, the reproduction of capitalist firms and households, recurrent pressures generated by competition, or historically changing relations between production and social reproduction. The framework can also illuminate contemporary digital and financial systems when the analyst specifies how newer assets, infrastructures, data, intellectual property,

and contractual forms connect to production, appropriation, and accumulation.

GRE adds value where the inquiry requires distinctions that Marxian categories alone do not settle: heterogeneous value outside the value form, capability conversion, epistemic infrastructures, ecological and care relations with partially independent dynamics, artificial agency, multiple scales of relational power, and open future formation. The appropriate relation is therefore modular. Marxian mechanisms can become analytically important components within a broader GRE configuration where the research question requires additional domains.

Proposition 21.282 (Marxian–GRE extension condition). *A GRE extension of a Marxian explanation is warranted when the mechanism under study depends materially on value forms, capabilities, relations, agents, ecological conditions, epistemic structures, or future-generation effects that cannot be represented adequately through the specified Marxian production, class, value, accumulation, and reproduction relations alone.*

The condition also works in the opposite direction. GRE should import Marxian categories when capitalist production relations, surplus appropriation, accumulation, or class reproduction are genuinely causal. A generic relational description of a workplace, platform, supply chain, or financial system can lose explanatory power if it omits the historically specific economic relations through which capital and labor are reproduced.

21.14.9 Limits of Translation

Translation between Marxian political economy and GRE encounters unusually strong semantic overlap together with equally important theoretical remainder. Both frameworks emphasize relations, history, reproduction, power-bearing structures, and endogenous transformation. Those common coordinates create many opportunities for dialogue. Their conceptual objects remain distinct enough that apparent similarity requires explicit translation rules.

The first boundary concerns *relation*. Marxian production relations are typed and historically specific economic relations embedded in modes of production. GRE uses relation as a broader analytical primitive across economic, legal, ecological, educational, epistemic, political, and other domains. Translating a Marxian production relation into a generic GRE relation therefore loses content unless ownership, labor, control, appropriation, and reproduction are preserved.

The second boundary concerns *value*. Marxian value belongs to a theory of commodity-producing labor and capitalist social mediation. GRE's heterogeneous-value framework includes forms of value that may lack a common scalar, market expression, or labor-time mediation. A mapping can examine interactions between Marxian value and other values, especially where accumulation converts economic command into institutional, ecological, epistemic, or political effects. Identity between the value concepts would erase the difference the dialogue is intended to preserve.

The third boundary concerns *exploitation* and *power*. Marxian exploitation has a specific relation to labor-power and surplus value. GRE power covers a larger class of realized asymmetries affecting action spaces, conversions, dependencies, and trajectories. Exploitation can therefore be modeled as one power-bearing relation within GRE without making every power relation an exploitation relation.

The fourth boundary concerns *capital*. In Marxian political economy, capital cannot be reduced to a stock of machines, money, knowledge, or productive capacity; it is reproduced through historically specific social relations and valorization processes (Marx 1867; Marx 1993). GRE's generative capacity is broader and can exist in households, public institutions, ecosystems, communities, scientific systems, or infrastructures that need not function as capital. The two concepts can interact without serving as synonyms.

The fifth boundary concerns *historical materiality*. GRE accepts the historical generation of categories and the causal importance of material conditions while suspending stronger ontological conclusions. Marxian traditions themselves disagree about determination, agency, structure, historical necessity, and the scope of material explanation. Translation should therefore identify which Marxian interpretation is being used before mapping it into GRE.

The sixth boundary concerns *crisis*. Marxian crisis analysis examines disruption in capitalist reproduction through historically specific economic mechanisms. GRE's criticality vocabulary addresses sensitivity, thresholds, regime change, and dynamical transformation under separately stated assumptions. Structural resemblance can motivate comparative models, while empirical equivalence requires evidence that the same mechanism and state variables are involved.

Definition 21.283 (Marxian translation-boundary profile). A *Marxian translation-boundary profile* records the Marxian categories that admit structural correspondence with GRE, the historical and causal assumptions required for the mapping, the semantic remainder preserved by the original category, and the domains in which the GRE concept has wider or different scope.

These boundaries support layered explanation while preserving theoretical differentiation. A Marxian model can explain how surplus appropriation and accumulation transform a production system. Institutional analysis can specify legal and organizational conditions. Feminist and social-reproduction analysis can examine household and care relations that reproduce labor-power. Ecological analysis can trace material throughput and biophysical limits. GRE can represent how these mechanisms interact, convert across domains, and alter future capability while preserving the distinct evidential and theoretical status of each layer.

Proposition 21.284 (Marxian translation-restraint condition). A *translation between Marxian political economy and GRE should remain partial whenever correspondence requires changing the historical meaning or causal role of production relation, class, value, exploitation, capital, accumulation, crisis, or materiality; the residual difference should remain visible as theoretical information.*

Marxian political economy therefore contributes a demanding relational challenge to GRE. It demonstrates how production, class, value forms, surplus appropriation, accumulation, crisis, and history can be analyzed as an interconnected process whose categories are themselves historically constituted. GRE can extend the field toward heterogeneous value, multiple domains of capability, ecological and epistemic infrastructures, artificial agency, and open future formation. The dialogue remains strongest when each framework retains the concepts it needs to identify mechanisms that the other would otherwise obscure. Section 21.15 turns next to Keynesian and Post-Keynesian economics, where effective demand, uncertainty, money, expectations, institutions, historical time, and financial instability reorganize the comparative architecture around macroeconomic coordination and open-ended

temporal processes.

21.15 Keynesian and Post-Keynesian Economics

This section continues the theory-specific dialogue by reconstructing Keynesian and Post-Keynesian economics through effective demand, uncertainty, money, expectations, institutions, historical time, and financial instability. Its role is to examine an analytical tradition in which macroeconomic outcomes emerge through interdependent expenditure decisions, monetary and financial arrangements, prospective judgments, and historically situated institutional structures. The objective is interpretive and comparative. The discussion begins with Keynes's analysis of aggregate demand, money, investment, and uncertainty, then draws selectively on Kalecki, Robinson, Davidson, Chick, and Minsky to identify extensions that became important within heterogeneous Post-Keynesian traditions. The section proceeds from effective demand and uncertainty to money, expectations, institutions, historical time, and financial instability, and concludes with a GRE relational reconstruction and explicit translation boundaries. Table 21.15 summarizes the principal dialogue coordinates.

Definition 21.285 (Keynesian–Post-Keynesian macroeconomic configuration). A *Keynesian–Post-Keynesian macroeconomic configuration* is a historically situated representation in which aggregate output and employment depend on effective demand, investment is conditioned by expectations and uncertainty, money and finance affect real economic activity, institutions shape adjustment and policy capacity, and sequential decisions can generate persistence, instability, and path-dependent transformation.

The definition names a family of approaches rather than a single unified doctrine. Keynes's *General Theory* reorganizes the analysis of employment around aggregate expenditure, investment, interest, money, and expectations (John Maynard Keynes 1936). His 1937 restatement emphasizes uncertainty and investment fluctuation while clarifying the relation between aggregate demand and output (J. M. Keynes 1937). Later Post-Keynesian work develops these themes in different directions: Kalecki connects effective demand to distribution and political conditions of full employment; Robinson extends analysis toward accumulation and longer-run development; Davidson emphasizes monetary production, uncertainty, and historical analysis; Chick reconstructs Keynes within changing monetary and institutional regimes; and Minsky develops a financial theory of investment and endogenous instability (Kalecki 1943; Robinson 1956; Davidson 1978; Chick 1983; Minsky 1986; Minsky 1992). The internal differences remain analytically relevant throughout the dialogue.

Proposition 21.286 (Keynesian reconstruction condition). *A relational reconstruction of Keynesian and Post-Keynesian economics should preserve the macroeconomic interdependence of expenditure and income, the constitutive role of monetary and financial arrangements, the prospective character of investment, the institutional conditions of adjustment, and the historical sequencing through which present decisions alter subsequent possibilities.*

Table 21.15: Relational coordinates for Keynesian and Post-Keynesian economics

Coordinate	Keynesian–Post-Keynesian analytical object	Dialogue boundary
Effective demand	Aggregate expenditure, income formation, output, and employment through interdependent spending decisions	Reduction to a generic network multiplier or demand-side preference effect
Uncertainty	Limited prospective knowledge affecting investment, liquidity preference, and commitment	Identification with measurable risk or generic ignorance
Money	Institutionally organized monetary claims, liquidity, settlement, finance, and contractual denomination	Treatment as a neutral token or generic symbolic relation
Expectations	Prospective judgments coordinating present commitments to uncertain future returns	Reduction to statistically correct forecasts or isolated beliefs
Institutions	Monetary, financial, fiscal, labor, legal, and political arrangements conditioning macroeconomic adjustment	Translation into undifferentiated relational context
Historical time	Sequential, partially irreversible economic processes in which decisions alter later conditions	Identification with chronological dating alone or with GRE open futures in general
Financial instability	Endogenous changes in financing positions, leverage, cash-flow commitments, and asset valuations	Identification with generic volatility, crisis, or criticality
Relational reconstruction	Coupled expenditure, monetary, expectation, institutional, and temporal relations	Absorption of macroeconomic mechanisms into generic relation language
Translation limit	Semantic, causal, and historical remainder between Keynesian–Post-Keynesian categories and GRE	Theoretical identity inferred from relational resemblance

21.15.1 Effective Demand

Effective demand supplies the first organizing coordinate because it changes the explanatory direction of macroeconomic analysis. In Keynes’s framework, aggregate output and employment depend on the level of expenditure that firms expect to be profitable, with investment and consumption jointly shaping realized income and employment (John Maynard Keynes 1936). The 1937 restatement presents demand and supply for output as a whole together with uncertainty and investment fluctuation, reinforcing the macroeconomic level at which the argument operates (J. M. Keynes 1937). The analytical object is consequently an interdependent expenditure–income process rather than a collection of independently determined market quantities.

The relational significance of effective demand appears through circular dependence. One agent’s expenditure becomes another agent’s receipt; current sales af-

fect production decisions; employment affects household income; income affects consumption; investment creates both present expenditure and future productive commitments. Macroeconomic coordination therefore depends on relations among sectors and balance positions whose local decisions can aggregate into outcomes that none of the participants individually selects.

Definition 21.287 (Effective-demand relation). An *effective-demand relation* is a macroeconomic dependence in which planned and realized expenditures condition current production, income, employment, and the revenues through which subsequent expenditure plans are revised.

The definition distinguishes effective demand from a static preference for consumption. It also separates the concept from a simple statement that “spending matters.” What matters analytically is the feedback architecture linking expenditure commitments, incomes, production, employment, and prospective profitability. The same expenditure can have different macroeconomic consequences under different import structures, capacity conditions, financial arrangements, tax systems, distributional patterns, and expectations.

Kalecki extends this perspective by treating public expenditure as capable of supporting full employment while also examining political resistance to sustained full-employment policy (Kalecki 1943). This extension is important for GRE because it shows that a technically feasible demand-management intervention may enter a power-bearing institutional configuration. Macroeconomic capacity and political willingness can therefore diverge.

Proposition 21.288 (Demand-interdependence condition). *Effective-demand analysis is most informative when expenditure decisions are represented as mutually conditioning sectoral commitments whose realized consequences feed back into income, employment, financing capacity, and later expenditure plans.*

GRE can use this insight when tracing how resource flows generate relational consequences beyond the immediate transaction. A fiscal expenditure, investment programme, or credit expansion changes more than current allocation. It can alter employment relations, income security, firm survival, household capabilities, tax capacity, bargaining positions, debt commitments, expectations, and future investment possibilities. The Keynesian contribution gives this generative chain a disciplined macroeconomic starting point.

The translation requires restraint. Effective demand refers to a macroeconomic mechanism with specific accounting, behavioral, monetary, and institutional content. A generic GRE relation among spending nodes would be too weak if it failed to preserve income formation, sectoral positions, investment response, and the monetary settlement structure through which expenditure becomes effective.

21.15.2 Uncertainty

Uncertainty provides the second coordinate because investment and portfolio decisions concern futures that are only partially knowable at the time commitments are made. Keynes’s 1937 discussion places uncertainty directly inside the explanation of investment fluctuation (J. M. Keynes 1937). Davidson later develops a Post-Keynesian interpretation in which uncertainty and historical analysis are central to monetary production rather than removable imperfections around an otherwise complete probabilistic model (Davidson 1978).

The relevant distinction is between prospective conditions that can be represented through sufficiently stable probability distributions and conditions in which the structure generating future outcomes is itself uncertain, changing, or only partially specified. In the latter case, economic agents rely on conventions, institutional routines, balance-sheet safeguards, liquidity, narratives, contractual devices, and provisional judgments to make commitments.

Definition 21.289 (Prospective uncertainty structure). A *prospective uncertainty structure* is the set of informational limits, model limits, institutional supports, conventions, and protective arrangements through which economic subjects make present commitments whose relevant future consequences cannot be represented with sufficient confidence by a stable probabilistic description.

This definition avoids turning uncertainty into a metaphysical property of the future. The analytical question is more local: what can the relevant subjects know, what representations are available, what contingencies are institutionally managed, and which future conditions remain outside credible calculation? The same environment can therefore contain calculable risks for one decision and deeper uncertainty for another.

Uncertainty has immediate relational consequences. A firm postponing investment affects suppliers and employment; a bank tightening credit changes borrowers' action spaces; households increasing liquid balances reduce current expenditure; public guarantees can alter financing terms; and a shared convention can coordinate many participants until the convention loses credibility. Uncertainty is therefore mediated through relations among expectations, contracts, liquidity positions, institutional credibility, and collective behavior.

Proposition 21.290 (Uncertainty-mediated commitment condition). *Where relevant future conditions resist sufficiently stable probabilistic representation, economic commitment depends materially on institutional supports, conventions, liquidity arrangements, and revisable judgments that connect present action to uncertain future states.*

GRE can extend this analysis by tracing heterogeneous consequences of uncertainty management. Liquidity protection for one organization may transfer risk to another; contractual flexibility may preserve one actor's option set while narrowing another's; public backstops may stabilize aggregate capability while generating distributional or political effects. The object of inquiry becomes the relational distribution of uncertainty-bearing, uncertainty-transfer, and uncertainty-insulation capacities.

A translation boundary remains. GRE uses uncertainty in many domains, including legal, ecological, technological, educational, and political processes. Keynesian uncertainty belongs to a more specific macroeconomic architecture involving investment, money, liquidity, and expectations. The broader GRE concept should therefore retain the Keynesian mechanism where it is used rather than treating the two vocabularies as interchangeable.

21.15.3 Money

Money occupies a constitutive position in Keynesian and Post-Keynesian analysis because production and investment take place through monetary contracts, financing relations, balance sheets, and liquidity choices. In the *General Theory*, interest, liquidity preference, investment, and employment are analytically connected (John Maynard Keynes 1936). Davidson's reconstruction further treats money as embedded in

a real-world monetary production system whose pricing and production processes cannot be cleanly separated from uncertainty and contractual organization (Davidson 1978).

A relational treatment begins by distinguishing several monetary functions that may coexist: unit of account, means of payment, settlement medium, store of value, contractual denomination, liquidity reserve, and component of financial portfolios. These functions depend on institutional arrangements and counterparties. A bank deposit, public currency, private debt instrument, or collateralized claim carries different rights, risks, settlement properties, and access conditions even when each is denominated in the same unit.

Definition 21.291 (Monetary-relation architecture). A *monetary-relation architecture* is the institutional configuration of denominated claims, payment and settlement rules, liquidity positions, financing channels, contractual obligations, and credibility relations through which monetary commitments coordinate present production with future payment.

The definition makes money analytically relational without reducing it to an abstract relation. Monetary claims have issuers, holders, settlement rules, legal statuses, maturity structures, and institutional supports. Their economic effects depend on these typed properties. A liquid asset is liquid relative to a market, institutional promise, settlement convention, or public authority capable of sustaining conversion under relevant conditions.

Chick's reconstruction is useful here because it emphasizes that Keynesian monetary analysis should be interpreted in relation to the institutional regime in which it operates (Chick 1983). Banking systems, central-bank practices, payment arrangements, capital markets, and fiscal institutions change over time. A monetary mechanism therefore may preserve its conceptual role while changing its concrete institutional realization.

Proposition 21.292 (Monetary non-neutrality condition). *Money becomes analytically non-neutral when monetary positions, liquidity preferences, financing conditions, or settlement institutions affect feasible production, investment, employment, or portfolio trajectories over the period relevant to the research question.*

This proposition does not require that monetary factors dominate every economic process. It identifies the conditions under which monetary relations enter the causal architecture. GRE can then examine how monetary access converts into productive capability, organizational survival, bargaining power, geographic mobility, political influence, or future option preservation.

The translation also clarifies a boundary with GRE's broader treatment of symbols and relational beings. Currency and financial claims may be relationally real because stable institutional arrangements give them causal efficacy. Their monetary character, however, depends on economic functions and institutional rules that generic symbolic efficacy does not capture. A GRE analysis of money should therefore retain denomination, liquidity, settlement, finance, and contractual enforceability as typed relations.

21.15.4 Expectations

Expectations connect uncertain futures to present macroeconomic commitments. Firms invest according to prospective revenues and financing conditions; households consume and save partly in relation to expected income and security; financial institutions price and ration credit through assessments of future repayment and collateral; asset holders form views about yields, liquidity, and capital values. Keynes's treatment of investment and the 1937 restatement place these prospective judgments close to the center of macroeconomic fluctuation (John Maynard Keynes 1936; J. M. Keynes 1937).

Expectations are relational because their consequences depend on interaction and mutual observation. An expectation about future demand partly concerns the expected decisions of other agents. A bank's lending outlook depends on borrower prospects and collateral markets. Firms observe competitors, policy signals, wage settlements, and financial conditions. Market participants can coordinate around conventions whose persistence changes the environment that initially made them plausible.

Definition 21.293 (Expectation-mediated commitment). An *expectation-mediated commitment* is a present allocation, contract, investment, financing, or employment decision whose feasible and preferred form depends materially on a revisable representation of future economic conditions.

The definition keeps expectations tied to action. Beliefs that do not affect commitments may remain epistemically interesting while playing a limited economic role. Conversely, weakly held expectations can become consequential when large investments, debt contracts, or employment decisions depend on them.

Post-Keynesian analysis often gives special importance to conventions and historically formed interpretive practices because uncertainty limits the possibility of continuously deriving expectations from a stable statistical model. Chick's contextual reading of Keynes and Davidson's historical approach support analysis of expectations as institutionally situated rather than purely individual forecasts (Davidson 1978; Chick 1983). This makes the social organization of confidence an economic object.

Proposition 21.294 (Expectation-feedback condition). *Expectation-mediated commitments can alter the conditions against which later expectations are formed, creating feedback between prospective judgment, current action, realized income and prices, institutional response, and subsequent revision.*

GRE can deepen this feedback analysis by examining who has the capacity to shape shared expectations and whose expectations carry greater allocative consequence. Central banks, governments, major financial institutions, large firms, rating organizations, platforms, and media infrastructures can affect expectation formation through asymmetric informational, symbolic, or institutional positions. Expectations can therefore become interfaces between epistemic structure and economic power.

A translation limit remains between expectation and manifestation. GRE distinguishes relational realities from their context-dependent manifestations. Expectations are prospective representations held or enacted by subjects; they are not direct observations of future relational reality. Their economic significance arises because those representations guide commitments that can help generate the future configuration they anticipate, frustrate it, or produce an unintended alternative.

21.15.5 Institutions

Institutions enter Keynesian and Post-Keynesian economics through the concrete arrangements that organize money, finance, wage formation, fiscal capacity, investment, and policy response. The analytical tradition is therefore difficult to reconstruct through behavioral functions alone. Chick explicitly emphasizes the relevance of institutional context to the interpretation of Keynesian macroeconomics (Chick 1983). Kalecki's full-employment analysis adds a political-institutional dimension by examining how business interests can respond to policies capable of sustaining demand and employment (Kalecki 1943).

Relevant institutions include central banks, commercial banking systems, fiscal authorities, labor-market organizations, collective bargaining arrangements, social insurance, accounting conventions, payment systems, bankruptcy law, financial regulation, corporate governance, and international monetary arrangements. Their effects are not uniform. Institutional combinations can influence how quickly expenditure changes affect employment, how financial losses are distributed, how credible public commitments appear, and which actors possess outside options during adjustment.

Definition 21.295 (Macroeconomic institutional configuration). *A macroeconomic institutional configuration is the historically situated set of monetary, financial, fiscal, labor, legal, and political arrangements that condition how expenditure, financing, expectations, prices, wages, employment, and policy responses interact.*

The definition supports comparison across regimes. Similar nominal policy instruments can operate differently when banking structures, labor institutions, exchange-rate arrangements, debt compositions, welfare systems, or political coalitions differ. Institutional context therefore changes both causal transmission and the distribution of adjustment burdens.

Minsky's analysis makes the institutional point especially visible in finance. Financial structures develop through relations among borrowers, lenders, asset markets, public authorities, and regulatory arrangements; the resulting system can become more fragile during periods that appear stable (Minsky 1986; Minsky 1992). Institutions can dampen such dynamics, redirect them, or create new forms of risk-taking through adaptation to existing safeguards.

Proposition 21.296 (Institution-conditioned macroeconomic mechanism). *A Keynesian or Post-Keynesian mechanism should be interpreted relative to the institutional configuration that governs financing, settlement, wage formation, policy capacity, and the distribution of risk during the period under study.*

This proposition fits GRE's emphasis on historically generated relational structures. Institutions can stabilize expectations, create reliable conversion pathways, distribute uncertainty, and preserve capabilities. They can also lock in dependence, privilege selected claims, transfer adjustment costs, or restrict alternative trajectories. GRE can therefore represent institutional macroeconomics through the joint analysis of coordination, power, value conversion, and future generativity.

Institutional translation requires specificity. Calling a central bank, wage-setting regime, or banking network a "relational structure" adds little unless the rights, authorities, liabilities, decision rules, and causal pathways are retained. GRE's broader relational vocabulary becomes useful only when it preserves the institutional mechanism identified by Keynesian or Post-Keynesian analysis.

21.15.6 Historical Time

Historical time provides the temporal coordinate through which Keynesian and Post-Keynesian analysis departs most sharply from descriptions that can be resolved through comparative statics alone. Investment commits resources before future returns are known; debts created today generate future payment obligations; capital equipment survives into later periods; institutions adapt; expectations are revised after realized outcomes; and macroeconomic trajectories inherit consequences of earlier decisions. Robinson's work on accumulation and Davidson's historical approach both place sequential development at the center of economic analysis (Robinson 1956; Davidson 1978).

Historical time is more than the inclusion of a time index. Sequence matters because changing the order of events can change the resulting configuration. A banking loss before a policy guarantee can produce a different path from the same loss after a credible guarantee. Investment before a collapse in demand creates different obligations from investment after demand conditions are known. Wage contracts, debt maturities, construction lags, training, and institutional reform each introduce temporal structures that cannot be compressed into a timeless equilibrium relation without analytical loss.

Definition 21.297 (Historically sequential macroeconomic process). *A historically sequential macroeconomic process is an economic evolution in which earlier commitments, realized events, and institutional responses modify the feasible states, information, balance positions, and decision conditions available at later stages.*

This definition is compatible with formal dynamic modeling, yet it does not presume that a single formalism captures the relevant history. Some questions may be addressed through stock-flow consistent models, simulations, event histories, archival reconstruction, or comparative institutional analysis. The methodological choice should follow the temporal mechanism under investigation.

Chick's emphasis on interpreting Keynes within historically changing monetary institutions reinforces this point (Chick 1983). A theory formulated within one monetary and financial regime may require modification when banking technology, policy instruments, payment structures, or market organization change. Historical context therefore affects both the economy and the adequacy of the model used to represent it.

Proposition 21.298 (Historical-state dependence). *Where earlier economic commitments materially alter later balance sheets, institutions, capabilities, expectations, or feasible actions, explanation should preserve the sequence through which those conditions were generated.*

GRE shares this interest in history-bearing configurations. Its generative space-time vocabulary can represent how economic events modify future relational possibilities across multiple timescales. Keynesian and Post-Keynesian analysis supplies sharper macroeconomic mechanisms for this broader architecture: investment lags, debt commitments, expectation revisions, institutional persistence, cumulative income effects, and financial restructuring.

The conceptual overlap remains partial. GRE's open-future language addresses a broader class of relationally generated possibilities, including ecological, educational, legal, technological, and political futures. Historical time in Post-Keynesian economics concerns specific economic processes and the methodological conse-

quences of sequential, irreversible, or path-dependent development. Translation is strongest when the macroeconomic mechanism remains explicit.

21.15.7 Financial Instability

Financial instability provides the clearest Post-Keynesian extension from uncertainty and money into endogenous system dynamics. Minsky's financial-instability hypothesis analyzes capitalist economies with capital assets, sophisticated finance, and debt commitments whose composition can change during periods of prosperity (Minsky 1992). His distinction among hedge, speculative, and Ponzi finance describes different relations between expected cash flows and contractual payment commitments, while *Stabilizing an Unstable Economy* develops the broader connection among investment, finance, asset prices, and cyclical instability (Minsky 1986).

The relational object is the balance-sheet linkage among borrowers, lenders, asset markets, and payment commitments. A debt position that is manageable under one income and refinancing environment may become fragile when interest rates, asset values, cash flows, or refinancing access change. Stability itself can alter behavior by encouraging greater leverage, shorter refinancing horizons, or stronger confidence in continued asset appreciation.

Definition 21.299 (Financial-fragility configuration). A *financial-fragility configuration* is a network of financing positions in which the capacity of economic units to meet contractual payment commitments depends increasingly on continued cash-flow performance, refinancing access, asset-price validation, or supportive institutional conditions.

The definition emphasizes dependence structure rather than a single leverage ratio. Two firms with the same debt-to-asset ratio can occupy different fragility positions if their maturities, cash-flow volatility, collateral quality, refinancing channels, currency denomination, or counterparties differ. Aggregate fragility likewise depends on correlated positions and institutional response capacity.

Proposition 21.300 (Endogenous fragility condition). A *financial system exhibits endogenous fragility when behavior generated during relatively stable conditions changes financing structures in ways that increase dependence on favorable refinancing, asset valuations, or cash-flow continuation and thereby amplify the consequences of later disturbance*.

This proposition creates a productive dialogue with GRE's work on criticality and multiscale dynamics. Both can study how apparently stable configurations accumulate sensitivity. The concepts remain distinct. Minsky's mechanism is financial and balance-sheet specific; GRE criticality is a broader dynamical vocabulary whose application requires separately defined state variables, transition mechanisms, evidence, and thresholds.

GRE can extend financial-instability analysis by tracing value conversion and power across the stabilization process. Bailouts, liquidity facilities, bankruptcy rules, collateral revaluation, debt restructuring, and fiscal support redistribute losses, claims, control rights, and future capabilities. Stabilization can preserve a system while changing who bears adjustment costs and who acquires future decision power.

The Minskyan contribution is therefore especially important for a generative relational economics of intervention. Policy enters a moving financial configuration in

which prior stability, institutional design, and participant adaptation have already generated the conditions of current fragility. Intervention changes the subsequent adaptive environment and can reshape future financing behavior as well as present solvency.

21.15.8 Relational Reconstruction

A GRE reconstruction of Keynesian and Post-Keynesian economics begins with macroeconomic interdependence rather than isolated subject choice. Effective demand links expenditures, incomes, employment, and production; uncertainty links prospective knowledge to commitment; money links claims and settlement to production and finance; expectations connect future representations to present action; institutions condition transmission and adjustment; historical time makes sequence consequential; and financial structures can transform stability into fragility. These coordinates form a relational macroeconomic architecture with unusually direct affinity to GRE.

Definition 21.301 (Keynesian–GRE translation profile). A *Keynesian–GRE translation profile* records the macroeconomic relations among expenditure, money, expectations, institutions, time, and finance, together with the GRE objects required to represent their effects on capabilities, power, value conversion, relational reproduction, and future possibility.

The first translation concerns *effective demand and generativity*. Demand management can preserve employment, organizational continuity, household income, and productive capacity, thereby affecting later generative possibilities. Yet generativity is broader than aggregate expenditure. An increase in demand can support capability formation, resource depletion, speculative asset appreciation, care provision, military production, ecological restoration, or several of these at once. GRE therefore adds differentiated value and future-formation questions after the effective-demand mechanism has been identified.

The second translation concerns *uncertainty and capability*. Liquidity, insurance, public guarantees, diversified income sources, savings, social protection, and access to credit can preserve action capacity under uncertainty. Their distribution is uneven. A system may therefore stabilize aggregate expenditure while leaving some households, firms, regions, or institutions with substantially narrower future option sets.

The third translation concerns *money and conversion interfaces*. Monetary access enables conversion among labor, goods, services, assets, claims, and future commitments. Control over payment infrastructure, credit creation, collateral recognition, or refinancing can become a source of relational power. GRE can examine these conversion interfaces while retaining the monetary specificity supplied by Keynesian analysis.

The fourth translation concerns *expectations and epistemic structure*. Expectations depend on information, models, conventions, narratives, institutional credibility, and authority. Their formation is therefore connected to the epistemic economy developed earlier in this book. Some actors possess greater capacity to produce forecasts, set policy signals, define accounting categories, or stabilize conventions. Macroeconomic expectation formation can consequently become a site of asymmetric generative capacity.

The fifth translation concerns *historical time and relational reproduction*. Investment creates assets and obligations that persist; employment histories shape skills and attachment; recessions can damage organizations and public finances; financial crises restructure ownership and regulation; policy responses can create institutional memory. GRE can model these as history-bearing configurations in which current intervention changes the structure from which subsequent decisions proceed.

Proposition 21.302 (Macroeconomic generativity condition). *A GRE extension of Keynesian or Post-Keynesian analysis becomes warranted when a macroeconomic mechanism materially changes the distribution, durability, convertibility, or future-generating capacity of relations and resources beyond the aggregate variables required to identify that mechanism.*

The proposition defines complementarity rather than theoretical succession. Keynesian analysis can be more precise than GRE when the research question concerns aggregate-demand shortfalls, liquidity preference, investment behavior, fiscal transmission, or financial fragility. GRE becomes useful when the same mechanism produces cross-domain effects involving capability, power, heterogeneous value, ecological conditions, knowledge infrastructure, or longer-run relational reproduction.

Proposition 21.303 (Keynesian domain-of-adequacy condition). *Keynesian and Post-Keynesian approaches have a particularly strong domain of adequacy where monetary production, aggregate expenditure, investment, uncertainty, financing structures, and historically situated institutions jointly condition output, employment, and macroeconomic stability.*

This domain should remain visible in multi-theoretical work. A relational vocabulary that merely redescribes effective demand or financial instability in more general terms would reduce explanatory resolution. The GRE contribution lies in connecting these well-specified macroeconomic mechanisms to additional relational domains while preserving their original causal content.

21.15.9 Limits of Translation

Translation between Keynesian–Post-Keynesian economics and GRE is unusually productive because both emphasize interdependence, historical development, uncertainty, institutions, and the causal significance of relations. The same overlap creates a risk of premature equivalence. The translation therefore requires explicit boundaries around the concepts that carry theory-specific meaning.

The first boundary concerns *effective demand*. Effective demand is a macroeconomic relation among expenditure, production, income, and employment. GRE generativity concerns the production or transformation of future capacities, relations, and possibilities across heterogeneous domains. Demand can affect generativity, while the concepts answer different questions. A demand expansion may raise employment even when its ecological or distributive generative consequences are contested.

The second boundary concerns *uncertainty*. Keynesian uncertainty is especially consequential for investment, liquidity, and expectations in a monetary economy. GRE addresses uncertainty in a wider range of relational processes. Translation should preserve the monetary and prospective decision mechanism rather than treating uncertainty as a generic synonym for incomplete knowledge.

The third boundary concerns *money*. Keynesian and Post-Keynesian money is

embedded in denomination, payment, finance, liquidity, and contractual structures. GRE's category of relational reality is broader. Currency can be represented as a relationally efficacious institution, while its economic role requires the more specific monetary architecture.

The fourth boundary concerns *expectations*. Expectations are representations of future economic conditions that guide present commitments. GRE manifestation refers more generally to context-dependent presentation and epistemic access. The two can interact, especially where observable manifestations shape expectations, yet one does not reduce to the other.

The fifth boundary concerns *institutions*. Keynesian institutions are often analyzed through their macroeconomic functions in monetary, financial, fiscal, and labor processes. GRE studies institutions across a wider set of domains and asks how they generate or constrain relations and capabilities. A translation gains value when the macroeconomic function remains typed inside the broader relational architecture.

The sixth boundary concerns *historical time*. Post-Keynesian historical time emphasizes sequence, commitment, irreversibility, and the dependence of later conditions on earlier economic events. GRE generative spacetime can incorporate these features while also representing cross-domain histories and open future formation. Structural correspondence therefore remains partial.

The seventh boundary concerns *financial instability and criticality*. Minsky's financial-instability hypothesis specifies balance-sheet mechanisms through which financing patterns can become more fragile during prosperity (Minsky 1992). GRE criticality refers to a broader family of dynamical situations involving sensitivity, thresholds, and possible regime change. A financial system can be studied with both vocabularies only after the variables, mechanisms, and empirical correspondences are specified.

Definition 21.304 (Keynesian translation-boundary profile). A *Keynesian translation-boundary profile* records the Keynesian or Post-Keynesian mechanism being translated, the institutional and temporal assumptions supporting it, the GRE coordinate to which it is related, and the causal or semantic remainder that should remain attached to the original concept.

These boundaries support layered explanation. A Keynesian model can identify an expenditure shortfall; a Minskyan analysis can identify fragility in financing positions; institutional analysis can specify policy and regulatory structures; distributional analysis can trace incidence; ecological analysis can examine material consequences; and GRE can study how these mechanisms jointly transform heterogeneous value, relational power, capabilities, and future option structures. The layers can communicate without collapsing into one vocabulary.

Proposition 21.305 (Keynesian translation-restraint condition). A *translation between Keynesian–Post-Keynesian economics and GRE should remain partial whenever relational correspondence would erase the macroeconomic role of effective demand, monetary institutions, prospective uncertainty, expectations, sequential history, or balance-sheet finance*.

Keynesian and Post-Keynesian economics therefore contribute a macroeconomic relational architecture in which expenditure, money, expectations, institutions, historical sequence, and finance jointly shape production and employment. GRE can extend this architecture toward heterogeneous value, cross-domain conversion, re-

lational power, capability formation, and open future generation while preserving the mechanisms that give Keynesian analysis its explanatory precision. Section 21.16 turns next to institutional and historical economics, where rules, habits, transaction structures, path dependence, and institutional change become the primary comparative coordinates.

21.16 Institutional and Historical Economics

Chapter 2, Section 2.20, established the genealogy of institutional economics and economic sociology. The present section uses that baseline to compare mechanisms rather than repeat the lineage. It examines how rules, habits, organizations, transaction structures, path dependence, governance arrangements, and historically specific institutional change enter explanation; where institutional and historical approaches outperform thinner representations of fixed constraints; what they require GRE to specify more sharply; and where translation into generative-relational terms would erase theory-specific mechanisms. The heterogeneous traditions associated with institutional analysis remain distinct throughout the comparison. Table 21.16 summarizes the principal dialogue coordinates.

Definition 21.306 (Institutional–historical configuration). An *institutional–historical economic configuration* is a historically situated arrangement in which recurrent rules, habits, organizations, governance forms, enforcement practices, inherited technologies, and collective expectations condition economic action and are themselves reproduced or transformed through that action.

This definition is deliberately broader than any one institutionalist vocabulary. Veblen’s evolutionary programme emphasizes cumulative causation and historically formed conduct; Commons places collective action, transactions, and working rules near the center of institutional economics; North defines institutions as humanly devised constraints structuring interaction; Coase and Williamson analyze governance and the costs of organizing transactions; and Polanyi treats economic processes as instituted within historically variable social arrangements (Veblen 1898; Commons 1931; North 1990; Coase 1937; Williamson 2000; Polanyi 1957). These formulations overlap while retaining distinct analytical meanings.

Proposition 21.307 (Institutional reconstruction condition). A *relational reconstruction of institutional and historical economics* should preserve the specific mechanisms through which rules, habits, governance arrangements, and inherited historical sequences condition action, while also preserving the capacity of actors and collective processes to reproduce, reinterpret, contest, and transform those arrangements.

21.16.1 Institutions

Institutions provide the first coordinate because institutional approaches assign explanatory weight to durable arrangements that organize recurrent economic interaction. The term nevertheless carries different meanings across traditions. Commons characterizes institutional economics through collective action and working rules governing transactions (Commons 1931). North describes institutions as humanly devised constraints that structure political, economic, and social interaction, while distinguishing institutions from organizations operating within those constraints (North

Table 21.16: Relational coordinates for institutional and historical economics

Coordinate	Institutional–historical analytical object	Dialogue boundary
Institutions	Durable rules, organizations, norms, governance arrangements, and patterned expectations structuring interaction	Reduction of heterogeneous institutions to generic constraints or context
Rules	Formal and informal prescriptions, permissions, procedures, and working rules governing recurrent action	Treatment of rules as self-executing statements detached from interpretation and enforcement
Habits	Acquired dispositions and recurrent modes of conduct participating in institutional reproduction	Identification of habit with mechanical repetition or fixed preference
Path dependence	Mechanism-specific dependence of later feasible trajectories on earlier sequences and investments	Use of historical sequence alone as sufficient evidence of path dependence
Transaction costs	Costs and frictions associated with discovering, negotiating, monitoring, enforcing, and governing exchange or organization	Expansion of transaction cost into an unrestricted residual explanation
Institutional change	Evolution, reinterpretation, bargaining, conflict, design, learning, and adaptation within inherited arrangements	Treatment of change as either purely deliberate design or purely spontaneous evolution
Historical specificity	Dependence of economic categories and mechanisms on historically generated institutional configurations	Conversion of contextual validity into unrestricted relativism
Relational reconstruction	Coupled rule, habit, governance, power, resource, and history-bearing relations	Absorption of institutional mechanisms into generic relational vocabulary
Translation limit	Conceptual and causal remainder among institutional traditions and GRE	Identity inferred from shared attention to relations and history

1990). Williamson separates the broader institutional environment from governance arrangements through which transactions are organized (Williamson 2000). Polanyi uses a wider historical lens in which economic activity is instituted through patterned relations of reciprocity, redistribution, and exchange (Polanyi 1957). Rutherford’s comparison of old and new institutionalism consequently cautions against treating institutional economics as a single theoretical programme (Rutherford 1994).

Definition 21.308 (Institutional relation). An *institutional relation* is a recurrently reproduced relation in which recognized rules, roles, expectations, enforcement practices, or organizational arrangements condition the admissible and intelligible conduct of participating subjects.

The definition emphasizes reproduction because an institution ordinarily persists through repeated enactment. A property regime, payment system, labor contract, corporate form, licensing rule, professional norm, or household convention affects conduct because participants anticipate that other actors, organizations, and authorities will respond in patterned ways. Institutional efficacy therefore depends on a configuration involving rule content, interpretation, recognition, material capacity, sanction, and expectation.

The relational view also clarifies why institutions can enable action while constraining it. Property rules restrict some forms of access while making other transfers more predictable. Corporate law can limit particular liabilities while enabling durable pooled organization. Accounting standards restrict representational discretion while enabling comparison and contractual coordination. Public standards can impose compliance burdens while creating compatibility among otherwise disconnected actors. The same institution can therefore alter multiple dimensions of capability simultaneously.

Proposition 21.309 (Institutional conditioning condition). *Institutional explanation is strongest when the relevant rule, role, organization, enforcement arrangement, and expectation structure can be identified together with the mechanism through which they alter feasible actions, anticipated responses, or the distribution of resources and authority.*

GRE can represent institutions as relatively stabilized relational configurations, but that translation should preserve institutional typing. A court, family norm, stock exchange, professional credential, payment protocol, and informal reciprocity practice may each stabilize expectations, yet their authority, enforcement, temporal durability, membership, and consequences differ. Relational abstraction becomes useful when it allows these differences to be compared without erasing them.

21.16.2 Rules

Rules supply a second coordinate because many institutional mechanisms operate through recurrent prescriptions, permissions, procedures, and expectations. Commons's concept of working rules is especially important: collective action structures what participants can, must, may, or may not do within transactions and organized relationships (Commons 1931). North likewise includes formal rules and informal constraints in the institutional structure that shapes interaction (North 1990). Hodgson's reconstruction of old institutional economics emphasizes rules together with habits as foundational to institutionally structured behavior (Hodgson 1998).

Definition 21.310 (Working-rule configuration). *A working-rule configuration is a recurrent arrangement in which a rule acquires practical economic effect through interpretation, recognition, monitoring, enforcement, and expectations concerning the responses of relevant participants.*

The practical effect of a rule therefore extends beyond its textual statement. Two jurisdictions can contain similarly worded legal provisions while differing in enforcement capacity, administrative interpretation, litigation cost, organizational compliance, and social recognition. A workplace may have a formal policy that is routinely displaced by an informal convention. A platform can alter effective rules through software architecture even when contractual terms remain unchanged. Institutional analysis consequently benefits from distinguishing rule formulation from rule enact-

ment.

Rules also vary in the economic objects they constitute. Some rules regulate an already recognized activity; others help constitute the categories through which the activity becomes possible. Currency law, corporate incorporation, intellectual-property regimes, professional licensing, bankruptcy procedure, and accounting classifications can participate in defining economic objects and statuses as well as governing their use. The relational effect is therefore partly generative: rules can contribute to the production of subjects, claims, assets, liabilities, offices, and recognized transactions.

Proposition 21.311 (Rule-enactment condition). *A rule should be treated as economically operative when its practical effects can be traced through the relations of interpretation, recognition, enforcement, and expectation that connect the rule to recurrent conduct.*

This proposition creates a direct interface with GRE's analysis of manifestation and relational reality. A written rule is one manifestation of an institutional arrangement. Its relational reality depends on the network of practices through which it becomes consequential. The translation remains incomplete whenever the legal, organizational, cultural, or technological mechanisms of enactment are left unspecified.

21.16.3 Habits

Habits introduce the formation of economic subjects into institutional analysis. Veblen's evolutionary economics treats conduct as historically cumulative, with behavioral dispositions formed through changing institutional conditions (Veblen 1898). Hodgson develops this institutionalist lineage by emphasizing habits and rules and by treating actor and structure as recursively related rather than analytically reducible to one another (Hodgson 1998). This perspective gives institutional economics a distinctive account of persistence: institutions endure partly because they become embodied in recurrent dispositions, routines, expectations, and interpretive practices.

Definition 21.312 (Habit-mediated institutional reproduction). *Habit-mediated institutional reproduction* is a process in which repeated participation in an institutional configuration contributes to durable dispositions or recurrent modes of action that, when enacted, help reproduce or gradually modify that configuration.

Habit in this sense is richer than mechanical repetition. Economic actors learn what counts as an appropriate contract, credible promise, reasonable price, normal career, legitimate authority, safe asset, or acceptable risk through repeated participation in institutional settings. These acquired dispositions reduce the need to reconstruct every decision from first principles. They also create inertia because changing a formal rule may leave embodied routines, expectations, professional practices, and organizational competencies in place.

The recursive structure is analytically important. Institutions influence the formation of habits; habitual conduct contributes to institutional persistence; changed conditions can make inherited habits maladaptive; revised practices can eventually alter institutional expectations. This sequence allows institutional analysis to study endogenous subject formation while preserving reflexivity, variation, and the capacity for innovation among subjects.

Proposition 21.313 (Reciprocal formation condition). *Institutional analysis gains ex-*

planatory depth when it identifies both the process through which an institution shapes recurrent dispositions and the process through which those dispositions contribute to the reproduction, reinterpretation, or transformation of the institution.

GRE can extend this mechanism through generative capacity. Habit formation can enlarge capability by creating skill, trust, fluency, and coordination capacity; it can also narrow perceived possibility by stabilizing conventions that make alternative arrangements difficult to imagine or enact. The relevant evaluative question therefore concerns the generative consequences of a habit-bearing institutional configuration across different subjects and timescales.

21.16.4 Path Dependence

Path dependence provides a more specific account of how history can enter economic explanation. David's analysis of technological adoption emphasizes technical interrelatedness, scale economies, and quasi-irreversibility as mechanisms through which early sequences can influence later trajectories (David 1985). Arthur formalizes related processes in settings with increasing returns, where historical events can influence technology selection and lock-in (Arthur 1989). North incorporates path dependence into institutional change by emphasizing increasing returns, organizational adaptation, and inherited institutional matrices (North 1990). The common insight is mechanism-specific: earlier events matter because they modify the conditions under which later choices are made.

Definition 21.314 (Institutional path dependence). *Institutional path dependence* is dependence of later feasible or comparatively attractive trajectories on earlier sequences through identifiable mechanisms such as increasing returns, learning, complementarity, sunk investment, coordination effects, or costly institutional conversion.

The definition prevents path dependence from becoming a synonym for the general importance of history. Every economic configuration has a past, but path dependence requires a mechanism linking sequence to later option structure. An early infrastructure standard may attract complementary investment; a legal form may generate specialized professional expertise; a payment network may acquire users because other users are already present; a welfare institution may create administrative capabilities and constituencies that affect later reform. In each case, the historical sequence changes the cost or feasibility of subsequent alternatives.

Path dependence also interacts with power. Early institutional advantages can create resources for defending an arrangement, while excluded groups can face increasing costs of entry or representation. These dynamics require separate analysis of power and become especially important where increasing returns attach to control over standards, infrastructure, legal recognition, data, or organizational capacity.

Proposition 21.315 (Path-mechanism condition). *A claim of institutional path dependence should identify the mechanism through which earlier events alter later opportunity, cost, coordination, or conversion structures, together with evidence that the mechanism persists over the relevant historical interval.*

GRE can represent such processes as history-bearing relational configurations. The added value lies in examining how the inherited path redistributes future generative capacity across subjects. Lock-in can preserve coordination benefits while constraining experimentation; institutional continuity can protect expectations while narrow-

ing alternative trajectories. The evaluation therefore remains multidimensional.

21.16.5 Transaction Costs

Transaction-cost analysis shifts attention toward the comparative organization of economic coordination. Coase's account of the firm begins from the observation that use of the price mechanism carries costs associated with discovering prices, negotiating, and organizing exchange, thereby creating an analytical problem of why coordination occurs through firms as well as markets (Coase 1937). Williamson develops this line into new institutional economics, treating governance structures as alternative arrangements for organizing transactions and distinguishing governance from the broader institutional environment (Williamson 2000). The resulting programme provides a mechanism-specific language for comparing contractual and organizational forms.

Definition 21.316 (Transaction-governance interface). A *transaction-governance interface* is the institutional arrangement through which parties discover counterparts, specify commitments, transfer claims or resources, monitor performance, resolve disputes, and adapt their relationship as conditions change.

The definition keeps transaction costs tied to concrete governance tasks. Search, measurement, bargaining, monitoring, enforcement, adaptation, and dispute resolution can each generate costs, but their relative importance varies by transaction and institutional setting. An open market, long-term contract, platform, cooperative, public agency, household, or vertically integrated firm can organize similar resource flows through very different authority and information structures.

Transaction-cost reasoning is particularly useful when governance forms can be compared against a defined coordination problem. Its explanatory precision declines when every institutional difference is retrospectively described as cost-minimizing. Observed arrangements can also reflect bargaining power, political settlement, legal inheritance, ideology, distributive conflict, technological constraints, and historical accident. Institutional explanation therefore benefits from treating transaction cost as one causal family among several.

Proposition 21.317 (Transaction-cost scope condition). *Transaction-cost analysis has a strong domain of adequacy when the research question concerns comparative governance of identifiable transactions and the relevant search, contracting, monitoring, enforcement, or adaptation costs can be specified independently of the observed organizational outcome.*

GRE can connect this analysis to conversion interfaces. A transaction frequently converts one recognized value or claim into another through legal, informational, monetary, and organizational infrastructure. Governance affects who can enter the interface, what information is visible, which risks are allocated, how disputes are resolved, and who bears adjustment costs. The relational extension therefore concerns the distribution and future consequences of governance as well as its coordination costs.

21.16.6 Institutional Change

Institutional change brings persistence and transformation into the same analytical frame. Veblen's evolutionary orientation treats institutions and conduct as cumula-

tively changing through historical processes (Veblen 1898). Commons emphasizes collective action and working rules, making bargaining, legal ordering, and organized adjustment central to institutional life (Commons 1931). North analyzes institutional change through interactions among formal rules, informal constraints, organizations, incentives, and path-dependent learning (North 1990). Rutherford's comparison further shows that institutional traditions differ over the relative importance of spontaneous evolution, deliberate design, and rule-following (Rutherford 1994).

Definition 21.318 (Institutional transformation). An *institutional transformation* is a change in the rules, roles, governance arrangements, enforcement practices, habitual expectations, or organizational capacities through which recurrent economic relations are constituted and reproduced.

Institutional change can proceed through multiple mechanisms. Legislatures may revise formal rules; courts may reinterpret existing rules; organizations may develop new routines; technologies may alter enforcement and coordination possibilities; crises may change coalitions; demographic or ecological pressures may make inherited arrangements less viable; informal practices may shift before law follows. These pathways can operate simultaneously and on different timescales.

This plurality matters because institutional persistence cannot be inferred from formal continuity. A nominally unchanged rule can acquire a different practical meaning as enforcement, technology, social expectation, or organizational capacity changes. Conversely, formal reform can have limited effect when complementary practices and capabilities remain unchanged. Institutional analysis therefore requires attention to the configuration surrounding the rule.

Proposition 21.319 (Institutional-change plurality). *An account of institutional change should distinguish the mechanisms of formal revision, interpretive change, organizational adaptation, habitual transformation, technological mediation, bargaining, and conflict when more than one contributes materially to the observed transition.*

GRE adds a future-oriented question: which transformations alter the capacity of a configuration to generate viable subsequent relations? An institutional reform can reduce current coordination cost while depleting ecological resilience, concentrate expertise while narrowing participation, or expand access while creating new dependencies. Institutional change is therefore evaluable through multiple generative consequences, including dimensions that extend beyond efficiency.

Proposition 21.320 (Institutional-generativity condition). *A GRE extension becomes analytically relevant when institutional change materially alters the distribution, durability, convertibility, or regenerative capacity of resources and relations beyond the institutional mechanism required to explain the immediate change itself.*

21.16.7 Historical Specificity

Historical specificity supplies the final substantive coordinate. Veblen's critique of taxonomic economics calls for an evolutionary account of cumulative economic life (Veblen 1898). Polanyi's historical analysis of market society emphasizes that the organization of land, labor, and money through market institutions arose through historically specific political and social transformations (Polanyi 1944). His concept of the economy as an instituted process further directs attention to historically variable patterns through which material provisioning is organized (Polanyi 1957). North similarly links institutional structures to long-run economic performance while treating

institutional evolution as path dependent (North 1990).

Definition 21.321 (Historical institutional specificity). *Historical institutional specificity* is the dependence of an economic category, mechanism, or empirical regularity on institutional relations whose form, authority, and practical meaning are generated within a bounded historical configuration.

Historical specificity remains compatible with comparison across periods and requires the object of comparison to be specified carefully. A market, firm, wage relation, household, contract, currency, welfare institution, or property claim can persist as a named category while its internal relations change significantly. Comparative analysis should therefore establish which relational features are sufficiently stable for comparison and which features are historically transformed.

The same discipline applies to models. A formal representation may be highly informative within an institutional range for which its categories remain stable. When the institution generating those categories changes, parameter adjustment may be insufficient because the economic object itself has changed. Historical institutional analysis is therefore especially relevant to regime change, technological transition, state formation, financial transformation, and the reorganization of labor or property relations.

Proposition 21.322 (Historical-scope condition). *An economic concept or model should carry its institutional scope conditions explicitly when the identity, measurement, or causal role of its principal objects depends materially on historically specific rules and organizations.*

GRE shares this concern through its treatment of relational reality and manifestation. A category such as “worker,” “owner,” “asset,” “firm,” or “currency” can be stable enough for analysis while remaining historically generated. Ontological restraint is therefore compatible with historically precise economic description: the aim is to identify the relational conditions under which a category becomes sufficiently durable and causally consequential for inquiry.

21.16.8 Relational Reconstruction

A GRE reconstruction of institutional and historical economics begins from the observation that institutions are already relational objects in a strong analytical sense. Rules connect participants to recognized permissions and obligations; habits connect past participation to present disposition; governance arrangements connect authority, information, monitoring, and adaptation; path dependence connects historical sequences to later opportunity structures; transaction costs arise at interfaces of coordination; and institutional change modifies the relations through which economic objects are reproduced. This affinity makes institutional economics one of the closest dialogue partners for GRE, while also increasing the risk of premature theoretical identification.

Definition 21.323 (Institutional–GRE translation profile). *An institutional–GRE translation profile* records the relations through which institutions structure conduct and historical trajectories, together with the additional GRE objects required to examine heterogeneous value, capability, power, epistemic access, conversion, and future generativity.

The first translation concerns *institutions and relational configurations*. An in-

stitution can be represented as a stabilized relation-bearing structure, but GRE should retain the institutional economist's distinctions among formal rules, informal constraints, organizations, governance forms, habits, and enforcement practices. Generic relational language becomes useful only after these local mechanisms are specified.

The second translation concerns *rules and constraints*. GRE treats constraints as fundamental analytical objects, yet institutional rules can simultaneously constrain, enable, constitute, and distribute authority. A bankruptcy rule, for example, restricts some claims while enabling reorganization; a professional credential excludes some entrants while creating a recognized competence interface. The generative effect therefore depends on which subjects, relations, and future actions are affected.

The third translation concerns *habits and subject formation*. Institutionalism supplies a mechanism by which economic subjects acquire durable dispositions through repeated participation. GRE can connect this to generative capacity by asking whether the resulting habits expand competence, trust, and coordination or reinforce dependency, exclusion, and narrowed possibility. These outcomes can coexist across different participants.

The fourth translation concerns *path dependence and generative spacetime*. Path-dependent institutions are history-bearing configurations whose current feasible transitions partly reflect prior investments, complementarities, and learning. GRE can add analysis of how these inherited structures distribute the capacity to create alternative paths. Some actors may possess resources to exit or redesign an institution while others remain strongly bound to it.

The fifth translation concerns *transaction governance and value conversion*. Governance arrangements organize interfaces through which resources, rights, information, and claims are converted. Transaction-cost economics can specify why one governance form coordinates a transaction more effectively under defined conditions. GRE can then examine who controls the interface, whose value dimensions are recognized, which costs are externalized, and what future dependencies are generated.

The sixth translation concerns *institutional change and power*. Institutions influence who can propose, veto, interpret, enforce, and benefit from change. Power therefore enters institutional dynamics through rule-making authority, organizational resources, agenda control, expertise, legal standing, and control over infrastructures. GRE's power framework can make these asymmetries explicit while relying on institutional analysis for the concrete mechanism.

Proposition 21.324 (Institutional relational complementarity). *GRE is most complementary to institutional economics when it begins from a specified institutional mechanism and extends the analysis toward heterogeneous value, capability, power, conversion, or future-generative consequences lying outside the explanatory task of the original mechanism.*

Proposition 21.325 (Institutional domain-of-adequacy condition). *Institutional and historical approaches have a particularly strong domain of adequacy where economic outcomes depend on durable rules, governance arrangements, recurrent practices, inherited trajectories, organizational capacities, or historically specific categories whose effects cannot be represented adequately as contemporaneous prices and preferences alone.*

This domain includes many problems central to GRE: institutional persistence,

rule-mediated allocation, governance of conversion interfaces, capability formation, historical lock-in, and organizational adaptation. The analytical gain from dialogue comes from preserving the institutional mechanism while widening the field of consequences that can be traced.

21.16.9 Limits of Translation

The affinity between institutional economics and GRE creates several translation risks. The first concerns heterogeneity within institutional economics itself. Old American institutionalism, new institutional economics, transaction-cost economics, historical institutional analysis, and Polanyian institutionalism differ in their accounts of agency, rationality, power, efficiency, evolution, and historical change (Rutherford 1994). A single relational paraphrase can conceal these disagreements.

Definition 21.326 (Institutional translation remainder). An *institutional translation remainder* is the portion of an institutional concept or mechanism whose explanatory content depends on historically specific rules, behavioral assumptions, governance mechanisms, or disciplinary commitments that remain irreducible to a more general GRE relational description.

The second risk concerns the meaning of institution. GRE's concept of a stable relational configuration is broader than most institutional-economic definitions. Treating every stable relation as an institution would weaken the institutional concept and obscure the special roles of rule recognition, authority, normativity, organization, and enforcement. Institutional status therefore requires additional criteria beyond relational persistence.

The third risk concerns transaction costs. A broad GRE account of conversion, coordination, or relational friction can include phenomena that transaction-cost economics does not classify in the same way. Transaction-cost explanation should retain its comparative-governance structure and remain bounded to costs that can be connected to specified transaction and governance mechanisms.

The fourth risk concerns path dependence. GRE's emphasis on history and open futures can resemble path-dependent analysis, yet the concepts operate at different levels. Path dependence requires a specified sequence-sensitive mechanism. Claims of lock-in, increasing returns, or quasi-irreversibility therefore require evidence beyond the general historical embeddedness of economic action.

The fifth risk concerns habits and agency. Institutional accounts of habitual conduct can illuminate subject formation while preserving actor reflexivity and innovation. GRE should therefore preserve the analytical distinction among habit, rule-following, strategic adaptation, learning, and deliberate institutional entrepreneurship rather than subsuming them under a single concept of relationally generated agency.

The sixth risk concerns efficiency and normativity. Institutional persistence, transaction-cost economizing, or adaptive fit carries no automatic inference of justice, desirability, or generative adequacy. An arrangement can be durable and low-cost for dominant participants while imposing unrecognized burdens on others. GRE can introduce heterogeneous value and justice questions, but those additions constitute an evaluative extension rather than an internal conclusion of institutional economics.

Proposition 21.327 (Institutional translation boundary). *Relational similarity between GRE and institutional economics supports dialogue only when the institutional mechanism, behavioral assumptions, historical scope, and evaluative criteria remain identifiable after translation.*

A final boundary concerns historical specificity. GRE's ontological suspension and relational pluralism can accommodate historically generated categories while preserving comparative explanation and conditional generalization across configurations. Institutional and historical economics remain capable of comparative explanation, causal inference, and conditional generalization. The appropriate translation therefore preserves both historical boundedness and the possibility of identifying mechanisms that recur across different institutional configurations.

The dialogue with institutional and historical economics consequently yields a strong methodological lesson for GRE. Relational analysis gains precision when it identifies the rules, organizations, habits, governance interfaces, and historical mechanisms through which a relation acquires practical force. Institutional economics, in turn, can be extended by tracing how those mechanisms alter heterogeneous values, capabilities, power relations, and future generativity. The two programmes overlap substantially, yet their explanatory tasks remain sufficiently distinct to justify continued theoretical plurality.

21.17 Behavioral and Experimental Economics

This section extends the theory-specific dialogue to behavioral and experimental economics. Its role is to examine approaches that place observed decision processes, psychologically plausible judgment, laboratory and field experimentation, and institutionally structured choice near the center of economic inquiry. The objective is interpretive and comparative. Behavioral economics and experimental economics overlap substantially, yet they remain analytically distinct: behavioral economics often studies systematic regularities in judgment and choice, while experimental economics supplies controlled methods for testing a wider range of economic theories, including theories compatible with conventional rational-choice models. The discussion proceeds through bounded rationality, heuristics, social preferences, framing, experimental design, and context, then develops a GRE relational reconstruction and identifies limits of translation. Table 21.17 summarizes the principal dialogue coordinates.

Definition 21.328 (Behavioral configuration). *A behavioral–experimental economic configuration is an analytically specified arrangement of subjects, tasks, information, incentives, institutional rules, representations, interaction partners, and observational procedures through which economic judgments, choices, and outcomes are generated and studied.*

The definition places behavior inside a structured configuration. Simon's behavioral model of rational choice develops choice with explicit cognitive and informational limits on optimization (Simon 1955). Tversky and Kahneman identify economic judgment procedures and systematic framing effects (Tversky and Kahneman 1974; Tversky and Kahneman 1981). Experimental economics, especially in Smith's methodological formulation, treats controlled environments and institutions as instruments for investigating how incentives, rules, and participant behavior jointly

Table 21.17: Relational coordinates for behavioral and experimental economics

Coordinate	Behavioral–experimental analytical object	Dialogue boundary
Bounded rationality	Choice under finite cognition, information, search capacity, and procedural limits	Identification of boundedness with generic error or irrationality
Heuristics	Economical judgment procedures such as representativeness, availability, and anchoring	Treatment of heuristic use as a universal defect independent of task ecology
Social preferences	Fairness, reciprocity, relative standing, punishment, and other-regarding motives inferred from structured interactions	Conversion of observed experimental behavior into a complete theory of value or moral motivation
Framing	Dependence of expressed choice on problem representation, reference points, and presentation	Identification of every representational difference with a framing effect in the technical behavioral sense
Experimental design	Controlled manipulation of incentives, information, institutions, tasks, and observations	Inference from laboratory control to unrestricted external validity
Context	Cultural, institutional, social, selection, scrutiny, and task conditions shaping observed behavior	Treatment of context as an unspecified residual explanation
Relational reconstruction	Subject–task–frame–institution–history configurations generating observable choice	Absorption of psychological and experimental mechanisms into generic relational language
Translation limit	Remainder among behavioral mechanisms, experimental identification, and GRE categories	Identity inferred from shared attention to situated and relationally conditioned behavior

generate outcomes (V. L. Smith 1976; V. L. Smith 1982). The resulting research field therefore concerns both properties of decision makers and properties of the situations in which decisions become observable.

Proposition 21.329 (Behavioral–experimental reconstruction condition). *A relational reconstruction of behavioral and experimental economics should preserve the distinction among subject-level decision processes, experimentally induced conditions, institutional rules, representational frames, social interaction, and the inferential relation between observed behavior and broader economic conduct.*

21.17.1 Bounded Rationality

Bounded rationality provides the first coordinate because it changes the analytical status of the decision maker. Simon’s behavioral model reorients analysis toward the procedures through which a finite subject reaches a decision. It asks how choice can

be represented when knowledge, computational capacity, search, and the structure of the decision environment limit the procedures available to an actor (Simon 1955). This shift makes the process of arriving at a decision analytically significant.

Definition 21.330 (Procedurally bounded choice). *Procedurally bounded choice* is choice generated through a finite decision procedure whose information, search, representation, computational demands, and stopping conditions are limited relative to the full decision problem that an external analyst could specify.

The definition separates bounded rationality from simple suboptimality. A decision procedure can be well adapted to a local environment while remaining unable to evaluate every feasible alternative, future state, or consequence. Search may stop after an acceptable option is found; attention may be allocated selectively; categories may compress complex environments; and organizational routines may substitute for repeated global calculation. Rationality can therefore be assessed partly through the relation between procedure and environment alongside the conventional criterion of conformity to a globally maximizing solution.

GRE can translate this insight through the relation between a history-bearing subject and a locally accessible decision configuration. A subject encounters only a subset of potentially relevant information, carries acquired categories and routines, and acts through institutions that alter the cost and meaning of search. The feasible decision procedure is consequently relationally conditioned. Education, organizational position, technology, language, social trust, time pressure, and access to expertise can change the effective decision space even where nominal alternatives remain constant.

Proposition 21.331 (Procedural adequacy condition). *The adequacy of a bounded decision procedure depends on the relation among cognitive capacity, available information, institutional support, time, task structure, and the consequences of residual error; a procedure that is adequate in one configuration may become inadequate after those relations change.*

This formulation also creates a bridge to the earlier GRE analysis of epistemic economy. Scarcity of attention and interpretive capacity can affect economic conduct across subjects with otherwise different psychological capacities. An organization may compensate for individual limits through routines, division of cognitive labor, software, or expert institutions. The same devices can create new dependencies and new possibilities for manipulation. Bounded rationality therefore supports a relational inquiry into the infrastructures through which finite agents become capable of coordinated action.

The translation has a boundary. GRE's epistemic incompleteness is broader than behavioral bounded rationality. Ontological suspension, underdetermined inference, missing observations, and open future formation can limit inquiry even for an ideally capable reasoner. Bounded rationality concerns limits on actual decision procedures. The two concepts can interact, yet their explanatory levels should remain distinct.

21.17.2 Heuristics

Heuristics sharpen the analysis of bounded decision processes by identifying recurrent procedures used to make judgments under uncertainty. Tversky and Kahneman's classic account studies representativeness, availability, and adjustment from an anchor, describing them as economical procedures that are often effective while

also generating systematic and predictable errors in specified tasks (Tversky and Kahneman 1974). The analytical object is therefore a structured judgment process with characteristic domains of usefulness and characteristic failure conditions.

Definition 21.332 (Heuristic judgment relation). A *heuristic judgment relation* is a recurrent mapping from a decision cue or representation to a judgment through a simplified procedure that reduces informational or computational demands relative to fuller evaluation.

Representativeness can substitute similarity judgments for probability assessment; availability can make ease of recall relevant to perceived frequency or plausibility; anchoring can make an initially accessible value shape subsequent numerical judgment. These mechanisms have different structures. Their common feature is compression: a difficult inferential problem is processed through a more tractable operation. A relational analysis should therefore preserve the specific cue, task, procedure, and error pattern and keep diverse mechanisms differentiated within the broader category of bias.

Prospect theory extends behavioral analysis into risky choice by modeling systematic departures from expected-utility descriptions, including reference-dependent evaluation and patterns associated with certainty and the presentation of prospects (Kahneman and Tversky 1979). The importance for GRE lies less in importing one behavioral value function than in recognizing that economically consequential evaluation can depend on relationally constituted reference conditions. Holdings, expectations, entitlements, recent trajectories, peer outcomes, institutional baselines, and narrative descriptions can each contribute to what a subject experiences as a gain, loss, improvement, or deterioration.

Proposition 21.333 (Heuristic localization condition). A *heuristic explanation* should identify the decision task, informational cues, simplified procedure, and relevant performance criterion before a recurrent judgment pattern is generalized across contexts.

GRE can extend this localization by asking how heuristic repertoires are acquired and stabilized. Professional training, organizational routines, technological interfaces, media environments, and repeated participation in specific markets may make some cues salient and others difficult to access. Such questions concern the historical formation of judgment procedures as well as their operation in a single choice episode.

This extension should preserve the behavioral mechanism. Relational language such as “context,” “history,” or “social influence” is too broad to substitute for evidence of representativeness, availability, anchoring, or another specified process. GRE adds questions about formation, distribution, infrastructure, and consequences after the local behavioral relation has been identified.

21.17.3 Social Preferences

Social-preference research provides a third coordinate by examining choices in which outcomes for other participants, relative payoff positions, reciprocity, punishment, or perceived fairness affect behavior. Ultimatum bargaining experiments made rejection behavior and proposal patterns observable within a simple strategic structure (Güth et al. 1982). Later formal models represented inequality aversion and relative payoff concerns as possible explanations for patterns across bargaining, cooperation, punishment, and competitive settings (Fehr and Schmidt 1999; Bolton

and Ockenfels 2000).

Definition 21.334 (Socially conditioned preference expression). A *socially conditioned preference expression* is an observed choice pattern in which a subject's decision varies with another participant's payoff, conduct, intention, relative position, or institutionally mediated relation to the subject.

The phrase *preference expression* is deliberate. Experimental behavior supports bounded inference about motives under a specified design, while an exhaustive or context-invariant preference ordering requires additional evidence. A responder who rejects an unequal ultimatum offer may be influenced by inequality, reciprocity, norm enforcement, anger, strategic expectations formed outside the experiment, or combinations of these. Experimental design and repeated evidence can discriminate among mechanisms, yet inference from action to motive remains a theoretical task.

The social-preference literature is especially useful for relational economic analysis because the same material payoff can acquire different behavioral significance across interaction structures. Fehr and Schmidt show that the economic environment can affect whether equity-motivated or materially self-regarding types dominate equilibrium behavior (Fehr and Schmidt 1999). Bolton and Ockenfels likewise model own payoff together with relative payoff standing across several laboratory settings (Bolton and Ockenfels 2000). These approaches make the relation among actor, counterpart, distribution, and institution part of the explanation.

Proposition 21.335 (Social-preference configuration condition). *An inference about social preference is strongest when the design separates own material payoff from the relevant relational variable and when alternative mechanisms such as strategic expectation, reputation, repeated interaction, and experimenter scrutiny are addressed by the identification strategy.*

GRE can extend the analysis in three directions. First, social relations are history-bearing: prior interaction, status, dependence, group membership, and remembered treatment may change the meaning of an otherwise identical allocation. Second, the objects evaluated can be heterogeneous. Money, recognition, dignity, obligation, reciprocity, belonging, and future access may remain only partially commensurable within one social-preference parameterization. Third, power can alter the feasible expression of social preferences. A participant may value fairness while lacking the institutional capacity to sanction an unfair arrangement outside a controlled experiment.

These extensions should preserve a distinction between descriptive preference models and normative evaluation. Evidence that subjects incur costs to punish inequality or reciprocate conduct describes a behavioral regularity; claims of justice, universality, or normative authority require a separate argument. GRE's heterogeneous value and justice analysis therefore begins after the descriptive mechanism has been specified.

21.17.4 Framing

Framing addresses the relation between representation and choice. Tversky and Kahneman demonstrate that different formulations of closely related decision problems can generate predictable shifts in expressed preference (Tversky and Kahneman 1981). Prospect theory had already linked risky choice to reference-dependent evaluation and to transformations in the presentation of prospects (Kahneman and Tversky

1979). Framing therefore makes the manifest form of a decision problem part of the causal analysis.

Definition 21.336 (Decision frame). A *decision frame* is the representation through which a choice problem is presented or construed, including the reference point, outcome description, categorization, probability presentation, and other features that organize how alternatives enter evaluation.

This concept has a direct interface with GRE's distinction between relational and manifestational reality. Economic subjects rarely encounter an entire underlying configuration. They encounter descriptions, interfaces, classifications, prices, rankings, contractual clauses, dashboards, narratives, or institutional categories through which portions of the configuration become actionable. A change in manifestation can alter action even where some underlying material consequences remain similar.

The analogy requires discipline. Behavioral framing is an empirically specified effect in which changes in representation alter choice under a controlled or otherwise identified comparison. GRE's manifestation reality is a broader epistemic category. It includes representation, observation, measurement, and context-dependent presentation even where no framing effect has been demonstrated. The broader category can help generate hypotheses about economically consequential representations, while behavioral evidence is required to establish the local choice effect.

Proposition 21.337 (Frame–manifestation distinction). A GRE manifestation becomes a behavioral decision frame only when the representation can be connected to a specified choice process and to an observable difference in judgment or action under an appropriate comparison.

This distinction is particularly important in digitally mediated economies. Default settings, interface ordering, labels, recommendation displays, price partitions, performance metrics, and AI-generated summaries can organize the manifestation through which subjects perceive alternatives. GRE can ask who designs these interfaces, whose interests shape the available representations, which alternatives remain visible, and how repeated exposure changes later expectations. Behavioral framing research supplies a more local empirical vocabulary for testing particular mechanisms within that wider relational architecture.

21.17.5 Experimental Design

Experimental design supplies the methodological core of experimental economics. Smith's induced-value framework shows how experiments can establish controlled incentives and observable institutional conditions for the testing of economic propositions (V. L. Smith 1976). His later account of microeconomic systems emphasizes the joint role of environments, institutions, and behavior in producing experimental outcomes (V. L. Smith 1982). This methodological tradition is broader than behavioral economics because controlled experiments can test market convergence, auction institutions, information structures, coordination mechanisms, and other propositions independently of any prior hypothesis of psychological bias.

Definition 21.338 (Experimental economic system). An *experimental economic system* is a deliberately constructed arrangement in which relevant features of participant endowments or incentives, information, institutional rules, interaction protocols, and observable outcomes are specified sufficiently to support controlled comparison and causal or theoretical inference.

Control has epistemic value because it creates contrasts that are difficult to obtain in many naturally occurring economies. A market institution can be varied while induced values are held stable; an information condition can be changed while the payoff structure remains fixed; a bargaining rule can be modified across otherwise comparable sessions. Such designs allow the analyst to connect observed differences to a narrower set of candidate causes.

Proposition 21.339 (Experimental identification condition). *The inferential value of an economic experiment depends on the alignment among the theoretical object, experimental manipulation, incentive structure, comparison condition, measurement procedure, and the population or domain to which the result is interpreted.*

From a GRE perspective, experimental design can be understood as deliberate construction of a local relational configuration. The experimenter specifies roles, admissible actions, information channels, temporal order, payoff consequences, interaction partners, and recording procedures. The resulting observations are therefore generated within a designed relational architecture. This feature is a strength because causal relations can be isolated. It also establishes the scope of the claim: an experiment identifies behavior under the constructed configuration, and broader generalization requires additional argument.

Experimental economics also offers an important corrective to any tendency in GRE to treat naturally occurring complexity as analytically inaccessible. A relational system can sometimes be decomposed into experimentally tractable interfaces. Market rules, communication protocols, ownership arrangements, matching procedures, or information structures can be varied in controlled environments to test mechanisms derived from a broader relational theory. Experimental construction can therefore become one component of GRE's methodological pluralism.

The reverse correction is equally important. Experimental identification retains a distinct evidential role where a feasible causal contrast can separate competing mechanisms. Claims that a frame, institution, norm, or interaction structure changes behavior should be tested through designs capable of separating that mechanism from competing explanations whenever the research question permits such control.

21.17.6 Context

Context becomes an explicit analytical object when behavior varies across populations, institutions, tasks, or observational settings. Cross-societal experiments reported by Henrich and colleagues document substantial variation across fifteen small-scale societies, challenging the presumption that behavior observed in one familiar participant population supplies a universal benchmark (Henrich et al. 2001). Levitt and List analyze how scrutiny, context, participant selection, and task selection can generate differences between laboratory behavior and naturally occurring conduct (Levitt and List 2007). These contributions make external validity a graded and structured problem of transport across settings.

Definition 21.340 (Behavioral context). *A behavioral context is the set of social, institutional, cultural, historical, material, and observational conditions that can alter the interpretation, incentives, expectations, or action possibilities associated with a decision task.*

Context should remain analytically typed. Cultural norms, market familiarity, anonymity, repeated interaction, experimenter presence, legal institutions, income

levels, status relations, linguistic categories, and recruitment procedures can influence behavior through different mechanisms. A context claim gains explanatory value when the relevant relation is identified. The methodological task is to determine which contextual dimension changes the observed behavior and through what pathway.

Proposition 21.341 (Contextual transport condition). *Transporting an experimental result to another population or setting requires an argument that the relations essential to the identified mechanism are sufficiently preserved, or an explicit model of how changes in those relations alter the expected outcome.*

This proposition gives GRE a precise use for its emphasis on history and relational configuration. External validity can be analyzed as a problem of relational transport. The analyst asks which elements of the experimental configuration are mechanism-essential, which are incidental, and which corresponding relations exist in the target setting. A laboratory result may travel well when the relevant incentives and institution are tightly replicated. It may travel poorly when identity, repeated relations, enforcement, or historical expectations are central to the naturally occurring decision.

Context also operates inside laboratories. Subjects interpret instructions through prior language and experience; money can carry different marginal significance; anonymity is experienced relative to expectations about social observation; and unfamiliar games can be understood through analogies to known social situations. Controlled design reduces many sources of variation while leaving some interpretive relations active. This clarification strengthens experimental interpretation by identifying the empirical work required to determine the domain across which a mechanism remains stable.

21.17.7 Relational Reconstruction

The preceding coordinates support a relational reconstruction centered on the production of observable choice within a configured relation among subject, task, representation, institution, counterpart, history, and measurement. Behavioral and experimental economics already contain important elements of such an architecture. Bounded rationality links decision procedures to finite capabilities and environments; heuristic research links judgments to cues and task representations; social-preference research links behavior to counterpart outcomes and interaction structures; framing links choice to manifestation; experimental economics links outcomes to controlled institutions and incentives; and external-validity research links observed behavior to population and context.

Definition 21.342 (Relational choice configuration). *A relational choice configuration is a history-bearing arrangement $\mathcal{C}$ consisting of a subject, a feasible action set, information and representations, institutional rules, material and social consequences, relevant counterpart relations, and a temporal context through which an observable choice is generated.*

The symbol $\mathcal{C}$ serves only as a compact label for the configuration described in the definition and carries only the analytical commitments stated here. Different research designs can operationalize the components through experiments, field data, qualitative evidence, or formal models. The key analytical move indexes the observed choice to a configuration and treats subject-level behavior as configuration-

dependent evidence.

Proposition 21.343 (Configuration-indexed behavior). *An observed behavioral regularity supports inference about a broader class of economic situations to the extent that the mechanism-relevant relations of the originating configuration remain stable, are appropriately transformed, or are explicitly modeled in the target class.*

GRE extends this architecture by adding questions about formation and consequence. How did the subject acquire the categories used in the task? Which institutions produced the available action set? Who controls the representation through which alternatives appear? Which values are omitted by the experimental payoff structure? How do repeated interactions alter future capabilities, trust, or dependence? Which actors possess the power to redesign the choice architecture? These questions move from local behavior toward the generative history and downstream effects of the configuration.

A second extension concerns heterogeneous value. Experimental payoffs are powerful precisely because they simplify and control incentives. Naturally occurring action can involve monetary payoff, time, recognition, identity, care, status, obligation, security, ecological consequence, and future access at once. GRE can use experimental methods to isolate selected value relations while retaining a broader account of the values left outside a particular design. This combination prevents experimental tractability from being mistaken for ontological completeness.

A third extension concerns relational intervention. Behavioral findings are often used to redesign defaults, information, incentives, or decision environments. GRE asks about the second-order consequences of such interventions: who acquires design authority, how repeated nudges alter capability and dependence, whether a short-run behavioral improvement changes long-run learning, and how benefits and burdens are distributed across subjects. Behavioral effectiveness and generative evaluation therefore occupy connected but distinct analytical levels.

Proposition 21.344 (Behavioral intervention extension). *A GRE evaluation of a behaviorally informed intervention should consider the identified local behavioral effect together with changes in capability, dependence, institutional power, heterogeneous value, and future option structure produced by repeated operation of the intervention.*

The domain of adequacy for behavioral and experimental economics is substantial. These approaches are especially powerful when a research question can be expressed through observable choice, when competing mechanisms can be separated by controlled comparison, when psychologically plausible procedures matter to prediction, or when institutional rules can be experimentally varied. GRE gains empirical discipline from this tradition because relational claims become more useful when they generate testable contrasts and move beyond broad contextual description.

21.17.8 Limits of Translation

Translation between behavioral and experimental economics and GRE encounters several boundaries. The first concerns explanatory scale. Behavioral economics often isolates mechanisms operating within a decision episode or a repeated class of decisions. GRE frequently asks how the decision subject, institutional environment, value structure, and available relations were historically generated. A successful local behavioral mechanism can therefore remain compatible with several different accounts of the wider relational history.

Definition 21.345 (Behavioral translation remainder). A *behavioral translation remainder* is the explanatory content of a behavioral mechanism or experimental identification strategy that depends on a specified psychological process, controlled manipulation, incentive structure, or inferential contrast and remains irreducible to a generic relational description alone.

The second boundary concerns bounded rationality. GRE's broader epistemic limits include inaccessible information, underdetermination, ontological suspension, and open future formation. These conditions can persist independently of cognitive capacity. Treating them as psychological boundedness would conflate properties of inquiry with properties of a decision procedure.

The third boundary concerns heuristics and bias. A relational account can explain why particular cues become available or socially salient, yet a heuristic claim requires evidence of the relevant judgment procedure. Historical or institutional context can modify the operation of a heuristic while its cognitive specification remains analytically identifiable.

The fourth boundary concerns social preferences. Fairness, reciprocity, relative payoff standing, and punishment are empirically valuable constructs. GRE's heterogeneous value vocabulary is broader and can include forms of value that are absent from an experimental payoff function. Conversely, attribution of a GRE value category to a given choice requires direct empirical evidence linking that category to the subject's conduct. Translation therefore requires empirical linkage beyond conceptual resemblance.

The fifth boundary concerns framing. GRE's manifestation layer includes any context-dependent presentation through which a relational reality becomes accessible. Behavioral framing identifies a narrower causal dependence of choice on representation. The former can organize research questions; the latter requires an identified behavioral comparison.

The sixth boundary concerns experiments as representations of economic worlds. Experimental control deliberately removes many relations in order to identify others. GRE should regard this reduction as an epistemic operation with a defined purpose. A laboratory market can illuminate price formation under specified rules while deliberately abstracting from much of the history, power structure, social meaning, and ecological embedding of a naturally occurring market.

Proposition 21.346 (Experimental translation boundary). *Relational reconstruction preserves the evidential force of an experiment only when the experimentally controlled variables, comparison structure, behavioral mechanism, and intended domain of generalization remain identifiable after translation.*

A seventh boundary concerns normativity. The desirability of exploiting, correcting, or preserving a predictable behavioral effect requires a separate normative judgment. A policy may increase compliance or welfare under one metric while changing autonomy, capability, trust, surveillance, or institutional dependence. Behavioral evidence can inform normative inquiry while leaving the normative ordering open to separate evaluation.

An eighth boundary concerns heterogeneity within the field. Simon's procedural approach, heuristics-and-biases research, prospect theory, social-preference models, and Smithian experimental economics differ in theoretical object and method. Their coexistence within one section reflects disciplinary dialogue and preserves their the-

oretical plurality. The GRE translation should therefore remain many-to-many: different behavioral and experimental programmes can illuminate different portions of a relational economic configuration.

The dialogue yields a reciprocal methodological lesson. Behavioral and experimental economics can discipline GRE by requiring relational claims to specify observable mechanisms, contrasts, and domains of validity. GRE can widen the behavioral-experimental research question by tracing how decision procedures, representations, experimental analogues, and interventions arise from history-bearing institutional relations and how they reshape later capabilities and possibilities. The overlap is productive precisely because the traditions retain distinct explanatory commitments.

21.18 Evolutionary and Complexity Economics

Chapter 2, Section 2.25, reconstructed evolutionary economics genealogically, while the present chapter also brings that lineage into dialogue with complexity economics. The present section therefore concentrates on mechanisms shared or contrasted across the two traditions: heterogeneity, interaction, adaptation, innovation, selection, emergence, networks, non-equilibrium dynamics, and path dependence. Its role is comparative rather than genealogical. The analysis asks where these mechanisms already supply more precise accounts of endogenous change than GRE, how GRE can connect them to heterogeneous value, power, epistemic access, and future formation, and which evolutionary or complexity concepts should remain irreducible to a general language of generation. Table 21.18 summarizes the dialogue coordinates.

Definition 21.347 (Evolutionary-complexity configuration). An *evolutionary-complexity economic configuration* is an analytically specified arrangement of heterogeneous agents, organizations, technologies, routines, institutions, interaction structures, selection environments, and historical conditions whose repeated interaction can modify both participant characteristics and aggregate economic patterns over time.

The definition provides a common comparative coordinate without identifying the two traditions. Nelson and Winter's evolutionary theory treats firms as carriers of routines whose search, innovation, and competitive selection contribute to industrial change (Nelson and Winter 1982). Dosi's account of technological paradigms and trajectories emphasizes structured directions of technical change and discontinuities associated with new paradigms (Dosi 1982). Arthur's complexity formulation emphasizes heterogeneous adaptive agents whose actions alter the aggregate environment to which they subsequently respond (Arthur 1999). Agent-based computational economics provides a constructive methodology for studying decentralized systems in which heterogeneous agents interact, learn, and generate institutional or aggregate outcomes (Tesfatsion 2006). The shared territory therefore concerns economic processes in which the conditions of action can themselves change through economic action.

Proposition 21.348 (Evolutionary-complexity reconstruction condition). A *relational reconstruction of evolutionary and complexity economics* should preserve the distinction among heterogeneity, interaction mechanisms, adaptation or search, selection, emergent aggregate patterns, network topology, historical sequence, and the institutional conditions that shape their coupling.

Table 21.18: Relational coordinates for evolutionary and complexity economics

Coordinate	Evolutionary–complexity analytical object	Dialogue boundary
Heterogeneity	Persistent differences in routines, capabilities, expectations, technologies, strategies, and organizational forms	Treatment of heterogeneity as an unspecified residual or as sufficient by itself to generate complex dynamics
Interaction	Local, strategic, institutional, market, and network-mediated coupling among heterogeneous participants	Identification of every economic relation with the interaction mechanisms used in a particular model
Adaptation	Search, learning, routine modification, innovation, imitation, selection, and coevolution	Reduction of adaptation to universal optimization or to biological replication by analogy alone
Emergence	Aggregate regularities generated through decentralized interactions and feedback	Use of emergence as a substitute for specifying generative mechanisms or levels of analysis
Non-equilibrium dynamics	Ongoing adjustment, innovation, feedback, transient states, and endogenous structural change	Rejection of equilibrium concepts even where they remain useful local benchmarks or limiting cases
Networks	Topologies of interaction, dependence, diffusion, intermediation, and coevolving connectivity	Identification of graph structure with the full relational content of economic life
Path dependence	Sequence-sensitive development produced by specified reinforcing, learning, coordination, or institutional mechanisms	Treatment of every historical influence as path dependence or every persistence as lock-in
Relational reconstruction	History-bearing configurations in which relations, capacities, constraints, and structures can change together	Absorption of evolutionary and complexity mechanisms into generic relational vocabulary
Translation limit	Remainders among evolutionary mechanisms, complexity formalisms, network representations, and GRE concepts	Identity inferred from shared attention to history, interaction, heterogeneity, or endogenous change

21.18.1 Heterogeneity

Heterogeneity provides the first coordinate because evolutionary and complexity approaches commonly begin with persistent differences that affect subsequent economic change. Firms may differ in routines, productive capabilities, technological knowledge, organizational structures, expectations, search procedures, or strategic

positions. Agents in complexity models may also differ in rules, information, beliefs, resources, or locations. These differences can influence both immediate behavior and the later distribution of surviving or expanding practices.

Definition 21.349 (Economically consequential heterogeneity). *Economically consequential heterogeneity* is a distribution of differences among economic participants or configurations whose persistence or transformation changes interaction, selection, adaptation, diffusion, or aggregate outcomes within the domain being studied.

Nelson and Winter make heterogeneity analytically central through firm-specific routines and differential search, allowing industrial populations to change as firms expand, contract, imitate, innovate, and exit (Nelson and Winter 1982). Metcalfe similarly places variety among firms and innovation within an evolutionary account of competition and creative destruction (Metcalfe 1998). Complexity economics extends the relevance of heterogeneity by examining systems in which differently situated agents adapt to patterns partly generated by their own collective activity (Arthur 1999). Heterogeneity therefore operates as a potential source of differential response and system-level change.

The analytical significance of a difference depends on the mechanism connecting it to outcomes. Variation in a firm's routines matters when routines affect production, innovation, search, or survival. Variation in expectations matters when expectations alter investment, trading, or coordination. Variation in network position matters when connectivity changes information, exposure, bargaining, or diffusion. A catalogue of differences does not yet constitute an evolutionary explanation.

Proposition 21.350 (Mechanism-indexed heterogeneity). *Heterogeneity becomes explanatory when a specified mechanism links differences among participants or configurations to differential behavior, interaction, adaptation, selection, reproduction, or future opportunity.*

GRE can translate this point through heterogeneous generative capacity, heterogeneous conversion possibilities, and differentiated relational position. Two organizations with similar measured resources may generate different future possibilities because their histories, routines, trust relations, knowledge, infrastructures, or institutional permissions differ. This translation broadens the object while preserving the evolutionary requirement that differences acquire explanatory force through identifiable processes.

The boundary is equally important. GRE should not infer that every difference is economically salient or that greater diversity is intrinsically beneficial. Heterogeneity can support experimentation and resilience under some conditions; it can also reflect exclusion, unequal access, segmentation, or incompatible standards. Its economic significance remains configuration-specific.

21.18.2 Interaction

Interaction provides the second coordinate because the consequences of heterogeneity depend on how heterogeneous participants encounter one another. Evolutionary competition, imitation, technological diffusion, organizational learning, strategic adjustment, and institutional coevolution all require channels through which actions and states become mutually consequential. Complexity economics makes this coupling especially explicit by treating aggregate patterns as products of repeated interactions among locally informed or adapting agents.

Definition 21.351 (Endogenously consequential interaction). An *endogenously consequential interaction* is an encounter or coupling in which the action, state, rule, position, or expectation of one participant changes conditions relevant to the subsequent behavior or state of another participant or of the interaction structure itself.

Arthur's complexity account emphasizes a recursive relation: agents react to aggregate patterns that their own actions help create, so expectations and strategies can be continually revised as the system evolves (Arthur 1999). Agent-based computational economics operationalizes related ideas by constructing artificial economies in which decentralized agents interact under specified institutional rules and the resulting system history is generated through simulation (Tesfatsion 2006). Epstein and Axtell's bottom-up artificial-society approach similarly demonstrates how repeated local interaction can be used to investigate the generation of aggregate social patterns (Epstein and Axtell 1996).

Interaction can be direct, mediated, or institutionally transformed. A firm's innovation may alter a competitor's search problem without direct communication. A price can mediate interaction among participants who never meet. A platform can reorder visibility and access among producers and consumers. A legal rule can change which interactions are possible and what consequences follow from them. The relevant interaction architecture therefore includes channels, interfaces, timing, information, and institutional conditions.

Proposition 21.352 (Interaction-architecture condition). *The consequences of heterogeneous behavior depend on the architecture through which participants are coupled, including the topology, timing, information conditions, institutional rules, and feedback pathways that transmit or transform their effects.*

This proposition creates a direct dialogue with GRE's relational emphasis while preserving a distinction. GRE uses relation in a broader sense than many interaction models. Ownership, historical obligation, legal status, inherited dependency, shared infrastructure, and symbolic recognition can remain economically consequential even when no contemporaneous bilateral interaction occurs. Complexity models can represent some of these features, yet a modeled interaction rule should not automatically be identified with the complete relational structure of the corresponding economic configuration.

21.18.3 Adaptation

Adaptation provides the third coordinate because evolutionary and complexity economics analyze economic participants whose behavior or organization can change in response to experience, competition, technological opportunity, or environmental transformation. The relevant processes include search, learning, imitation, experimentation, innovation, routine modification, entry, exit, and selection. Their diversity matters because different adaptive mechanisms generate different economic dynamics.

Definition 21.353 (Economic adaptation). *Economic adaptation* is a process through which an economic participant, population, or configuration changes behavior, routines, capabilities, strategies, organization, or composition in response to experienced conditions, generated variation, selection pressures, or changing environments.

Schumpeter's account of development gives innovation a discontinuous role through new combinations that disturb established economic reproduction (Schum-

peter 1934). Nelson and Winter formalize evolutionary change through routines, search, innovation, and selection among heterogeneous firms (Nelson and Winter 1982). Alchian shows how selection under uncertainty can retain viable practices even when observed success does not arise from complete foresight or explicit global maximization (Alchian 1950). Dosi's technological paradigms and trajectories locate innovative search within historically structured problem spaces with bounded directions of technically meaningful advance (Dosi 1982).

Adaptation therefore differs from a single optimizing response. Some adaptive processes are deliberate and reflective; others arise from organizational routines, imitation, trial and error, or population selection. Learning can improve performance relative to one criterion while creating dependence on a narrow trajectory. Selection can remove some forms while retaining others without demonstrating their normative superiority. Innovation can expand opportunities for some participants while closing established paths for others.

Proposition 21.354 (Plural adaptation mechanisms). *Evolutionary explanation should identify the mechanism through which change occurs—including search, learning, imitation, innovation, routine revision, selection, or coevolution—because these mechanisms imply different causal pathways and different interpretations of observed persistence or success.*

GRE can extend the analysis by asking how adaptive processes alter later generative capacities and relational conditions. A new technology may improve productivity while redistributing skill requirements, dependence, bargaining positions, environmental burdens, and access to future innovation. An organizational routine may stabilize cooperation while narrowing responsiveness to unfamiliar conditions. Adaptation thus becomes simultaneously a response to an inherited configuration and a contributor to the configuration faced later.

The biological analogy requires restraint. Hodgson's reconstruction of evolutionary economics explicitly distinguishes useful evolutionary principles from genetic reductionism and automatic progress narratives (Hodgson 1993). Hodgson and Knudsen develop variation, inheritance, and selection as high-level evolutionary principles while recognizing the need for domain-specific mechanisms in social and economic settings (Hodgson and Knudsen 2010). GRE should preserve the same discipline: relational inheritance, institutional reproduction, and organizational routine can be analyzed evolutionarily without presuming biological identity.

21.18.4 Emergence

Emergence provides the fourth coordinate because complexity analysis often investigates aggregate patterns whose organization cannot be read directly from the isolated properties of individual participants. Market conventions, spatial clustering, technological dominance, organizational ecologies, or systemic regularities may arise through repeated interaction and feedback. The analytical burden lies in specifying how the macro-pattern is generated and how it subsequently affects local behavior.

Definition 21.355 (Mechanism-grounded emergence). *Mechanism-grounded emergence* is the generation of a higher-level regularity, structure, or pattern through specified interactions among lower-level or component processes, where the generated pattern subsequently has an identifiable analytical description and may alter conditions for later component behavior.

Simon emphasizes hierarchical and near-decomposable organization as recurring features of complex systems and as methodological resources for analyzing systems across levels (Simon 1962). Holland develops complex adaptive systems through evolving signals, boundaries, and hierarchical organization (Holland 2012). In economic applications, agent-based models can make emergence operational by specifying local rules and examining the aggregate histories they generate (Epstein and Axtell 1996; Tesfatsion 2006).

Emergence should therefore carry explicit explanatory obligations. The investigator should specify the relevant components, interaction rules, temporal sequence, aggregation procedure, and evidence connecting the generated pattern to an empirical economic object. A simulated regularity establishes what a model can generate under stated conditions; it does not by itself establish that the same mechanism produced an observed historical outcome.

Proposition 21.356 (Emergence-evidence distinction). *A demonstrated emergent pattern in a formal or computational model establishes a generative possibility within that model; empirical explanation additionally requires evidence that the model's mechanisms, boundary conditions, and relevant scale correspond adequately to the economic process being explained.*

This distinction is particularly important for GRE. GRE's language of generativity concerns the production, transformation, preservation, or closure of future possibilities across relational configurations. Complexity emergence concerns the generation of higher-level patterns from interacting processes. The concepts can intersect when emergent structures alter later opportunity sets, yet generativity is neither a synonym for emergence nor a claim that every macroeconomic pattern arises through the same micro-to-macro mechanism.

GRE also permits downward or cross-level effects without treating them as mysterious. Once an institution, standard, platform, convention, or organizational structure becomes sufficiently stable to organize action, it can change the constraints and possibilities encountered by participants. The resulting configuration is recursively structured: local interactions contribute to larger patterns, and stabilized larger patterns condition subsequent local interactions.

21.18.5 Non-Equilibrium Dynamics

Non-equilibrium dynamics provide the fifth coordinate because evolutionary and complexity approaches commonly treat change as constitutive of the economic object. Innovation, entry, exit, technological diffusion, expectation revision, network rewiring, institutional transformation, and cumulative feedback can occur while the system is moving through states that are transient or historically contingent. Analysis therefore concerns trajectories and processes alongside, and sometimes in place of, stationary configurations.

Definition 21.357 (Process-dominant economic dynamics). *Process-dominant economic dynamics* are economic dynamics in which ongoing adaptation, innovation, interaction, or structural transformation is sufficiently consequential that the trajectory of change forms part of the explanatory object and cannot be represented adequately as only an adjustment path toward a predetermined equilibrium state.

Metcalf's evolutionary treatment of competition centers economic change and differential firm performance across an evolving competitive process (Metcalf 1998).

Arthur's complexity formulation similarly presents an economy in which agents continually adjust to patterns generated by the system itself (Arthur 1999). Nelson's account of coevolution among technology, industrial structure, and supporting institutions further illustrates how several components of an economic system can change reciprocally through mutually conditioning paths (Nelson 1994).

The analytical importance of non-equilibrium reasoning depends on the research problem. Equilibrium concepts can remain useful for local comparison, for identifying rest points of a model, for characterizing benchmark allocations, or for separating transient from persistent forces. Evolutionary and complexity economics expand the toolkit by making room for cases in which innovation and adaptation continually change the state space or the behavioral rules relevant to the system.

Proposition 21.358 (State-space revisability). *Where innovation, institutional change, or adaptation modifies the feasible actions, participant types, interaction rules, or relevant economic objects, an adequate dynamic representation may require revision of the state space as well as movement within it.*

This proposition connects strongly with GRE's open-future orientation. A new institution or technology can create categories of action that were previously unavailable, making economic change partly a transformation of possibilities. GRE nevertheless adds an epistemic caution: openness of the future can arise from incomplete knowledge, endogenous novelty, relational reconfiguration, or several of these together. A non-equilibrium model captures the mechanisms it explicitly represents and should not be treated as proof that the economic future is ontologically indeterminate in every relevant sense.

The same caution applies to criticality. Complexity economics can motivate inquiry into nonlinear transitions, cascades, or sensitivity to system structure, yet GRE should invoke criticality only where a model or empirical analysis supports the relevant dynamical properties. Persistent disequilibrium, volatility, or structural change does not by itself establish proximity to a critical point.

21.18.6 Networks

Networks provide the sixth coordinate because interaction is often structured by topology. Economic participants differ not only in attributes but also in whom they can reach, depend upon, observe, imitate, finance, employ, supply, or influence. Network representations make these patterns explicit and can reveal how local connectivity shapes diffusion, concentration, vulnerability, coordination, and systemic propagation.

Definition 21.359 (Economic interaction network). *An economic interaction network is a graph-based representation in which nodes denote specified economic units and edges denote specified relations or interaction channels whose topology is relevant to the economic mechanism under study.*

Newman's review establishes a general network-science framework for studying degree distributions, clustering, correlations, growth, and dynamical processes on networks (Newman 2003). Multilayer-network analysis extends this representation to systems containing several relation types or interconnected layers (Kivelä et al. 2014). Adaptive-network research further allows the states of nodes and the topology connecting them to coevolve through feedback (Gross and Blasius 2008). These tools are especially relevant to economic systems in which trading relations, credit

exposures, supply links, information channels, ownership, or platform connections have distinct structures.

Proposition 21.360 (Topology-mechanism coupling). *A network representation contributes economic explanation when a specified topological property changes a specified mechanism such as diffusion, exposure, bargaining, contagion, intermediation, search, coordination, or access.*

GRE can use network representations as partial manifestations of relational structure. They can expose positions, pathways, bottlenecks, communities, multiplex relations, and changing connectivity. Network analysis can also clarify how a local allocation or institutional intervention propagates through a wider configuration. A credit guarantee, platform-ranking rule, logistics disruption, or information standard may have effects that depend strongly on network position and on the relation type being modeled.

The translation boundary is substantial. A graph edge records only the relation encoded by the analyst. Two firms connected by a supply edge may also be linked by ownership, legal obligation, historical trust, shared labor markets, standards, or political institutions that are absent from the graph. Conversely, a dense graph does not necessarily imply a socially strong relationship if the encoded edges represent weak or transient transactions. GRE's relational reality is therefore broader than graph topology, while network science provides a precise family of representations for particular relational dimensions.

21.18.7 Path Dependence

Path dependence provides the seventh coordinate because evolutionary and complexity economics treat historical sequence as potentially causally consequential. Technologies, standards, routines, institutions, expectations, and network structures can develop through mechanisms in which earlier events alter the returns, constraints, or opportunities associated with later choices. Historical influence becomes path dependence when the sequence itself enters the mechanism.

Definition 21.361 (Mechanism-specific path dependence). *Mechanism-specific path dependence* is sequence-sensitive economic development in which earlier events or states modify later transition possibilities through an identifiable mechanism such as increasing returns, learning, coordination, sunk investment, institutional reproduction, adaptive expectations, or network reinforcement.

Arthur's analysis of competing technologies shows how increasing returns can make early historical events consequential for later adoption and can produce lock-in under specified conditions (Arthur 1989). David's historical analysis of the QWERTY keyboard likewise helped establish a research programme concerned with sequence, compatibility, learning, and historically accumulated coordination (David 1985). Dosi's technological trajectories and Nelson's coevolutionary analysis broaden the inquiry toward structured innovative search and reciprocal development among technologies, industries, and institutions (Dosi 1982; Nelson 1994).

Proposition 21.362 (Historical-sequence condition). *A claim of path dependence should identify how an earlier event or state changes later transition probabilities, costs, returns, capabilities, rules, or feasible alternatives; historical chronology alone is insufficient.*

This condition is especially important for GRE because the framework assigns strong analytical significance to history-bearing configurations. GRE can ask how past relations remain embedded in present capabilities, infrastructures, obligations, symbolic classifications, institutional permissions, or value-conversion pathways. The evolutionary literature supplies a discipline for specifying the mechanism through which such historical embedding persists.

Path dependence also differs from irreversibility and lock-in. A process can be path dependent while remaining reversible at some cost. A configuration can be difficult to reverse for physical, legal, political, or organizational reasons without having arisen through an increasing-returns mechanism. Lock-in is therefore a stronger and more specific condition than the general proposition that history matters.

The normative status of a path also remains open. Persistence may preserve valuable accumulated coordination or knowledge; it may also reproduce exclusion, technological rigidity, ecological damage, or unequal access. Historical survival demonstrates reproduction under particular conditions rather than social desirability.

21.18.8 Relational Reconstruction

The preceding coordinates support a relational reconstruction centered on history-bearing economic configurations whose participants, relations, capacities, constraints, and interaction structures can change together. Evolutionary and complexity economics already supply many of the mechanisms required for such a reconstruction. GRE's contribution is primarily architectural: it places these mechanisms within a broader account of heterogeneous value, power, epistemic access, conversion, generativity, and open future formation while preserving their local explanatory specificity.

Definition 21.363 (Evolutionary relational reconstruction). An *evolutionary relational reconstruction* represents an economic process as a history-bearing configuration in which heterogeneous participants interact through structured relations, adapt or are differentially selected, generate aggregate patterns, modify the interaction environment, and thereby alter the conditions of subsequent economic action.

The reconstruction has several components. First, heterogeneity becomes relationally situated. Differences in capabilities, routines, technologies, or expectations are analyzed together with the institutions and positions that make those differences consequential. Second, interaction is specified as an architecture with identifiable channels, timing, rules, and interfaces. Market rules, organizational boundaries, legal rights, platform interfaces, and network topology can alter the pathways through which local behavior becomes systemically consequential.

Third, adaptation and selection are connected to generative consequences. Innovation can create new productive capacities, new occupations, new standards, or new dependencies. Selection can change the population of firms or routines while also redistributing knowledge and access. Coevolution can modify several linked structures simultaneously. The relevant evaluative question therefore extends beyond whether an adaptive process survives competition to what future possibilities it creates, preserves, transfers, or closes for differently positioned participants.

Proposition 21.364 (Generative extension of evolutionary change). A GRE extension of evolutionary change examines both the mechanisms that generate and select variation and the downstream changes those mechanisms produce in capabilities, relational

positions, value-conversion pathways, and future opportunity structures.

Fourth, emergence is connected to institutional stabilization. A recurrent pattern generated through interaction may become encoded in rules, infrastructures, expectations, categories, or organizations. Once stabilized, it can become part of the relational environment within which later behavior occurs. This produces a recursive architecture in which emergent outcomes can become conditions for later emergence.

Fifth, network structure is integrated with broader relational content. A graph can represent one or several economically important relation types while GRE records the possibility that additional institutional, legal, symbolic, ecological, or historical relations remain relevant outside the graph. This permits network precision without reducing relational reality to topology.

Sixth, evolutionary and complexity methods can discipline GRE's own formal claims. Agent-based simulation can test whether a proposed local mechanism is capable of generating an aggregate pattern. Network analysis can expose structural positions and propagation channels. Evolutionary models can distinguish variation, inheritance, selection, and adaptation. Historical evidence can assess whether the modeled mechanisms correspond to actual sequences. These methods therefore provide routes from broad relational hypotheses toward more discriminating empirical or computational inquiry.

Proposition 21.365 (Reciprocal methodological discipline). *Evolutionary, complexity, agent-based, and network methods can strengthen GRE when they convert broad relational claims into mechanism-specific, scale-specific, and empirically contestable representations; GRE can reciprocally widen those representations by tracing power, heterogeneous value, historical embedding, and downstream generative consequences that a local model may omit.*

The reconstruction remains plural. A Nelson–Winter model of industrial evolution, an Arthur-style adaptive system, an agent-based artificial economy, and a multilayer network model do not become instances of a single formal object merely because each studies endogenous change. Their analytical units, mechanisms, evidential warrants, and mathematical structures can remain distinct within the common relational dialogue.

21.18.9 Limits of Translation

The translation between evolutionary and complexity economics and GRE remains partial. Shared attention to history, interaction, heterogeneity, endogenous change, and nonlinearity creates substantial overlap, yet the concepts operate at different levels and carry different methodological commitments. Several boundaries should remain visible.

The first boundary concerns evolution. Evolutionary economics contains multiple traditions, including Schumpeterian innovation, selection-based arguments, routine-based firm evolution, technological trajectories, and generalized Darwinian proposals. GRE can translate their relational implications while preserving their differences. The vocabulary of generation does not supply a replacement for variation, inheritance, selection, routine, search, or innovation when those mechanisms are doing explanatory work.

The second boundary concerns adaptation. Adaptive behavior can arise through

learning, imitation, search, routine revision, population selection, or algorithmic updating. GRE's history-bearing subject does not determine which mechanism operates. Empirical or formal analysis should identify the relevant adaptive process.

The third boundary concerns emergence. A GRE claim that a relational configuration generates a new structure is broader than a complexity-science demonstration that specified local rules generate a macro-pattern. The latter has stronger mechanistic content within its model and should retain that precision after translation. Conversely, an emergent computational pattern does not establish the full historical, institutional, or normative meaning of the corresponding economic phenomenon.

The fourth boundary concerns non-equilibrium language. Some economic processes are appropriately studied through persistent adaptation and structural change, while others can be usefully approximated through equilibrium or comparative-static representations. GRE should therefore treat non-equilibrium analysis as a problem-dependent resource whose adequacy depends on the economic process being studied.

The fifth boundary concerns networks. Network representations can precisely encode particular relations and reveal topological effects. GRE's relational vocabulary includes forms of dependence, recognition, obligation, institutional authority, and historical connection that may not be encoded as edges. Translation should preserve the distinction between modeled topology and the broader relational configuration.

The sixth boundary concerns path dependence. GRE's historical orientation can easily become too permissive if every historical influence is called path dependence. Evolutionary and institutional research improves the framework by requiring mechanism-specific sequence dependence. Increasing returns, learning, complementarity, sunk investment, institutional reproduction, and network reinforcement are analytically distinguishable mechanisms.

The seventh boundary concerns complexity and criticality. Complex adaptive behavior, nonlinear feedback, network propagation, and emergent structure do not automatically imply criticality. Where GRE invokes near-critical dynamics, the relevant order parameters, timescales, transition structure, or empirical signatures should be specified at the level justified by the application.

The eighth boundary concerns normativity. Evolutionary survival, competitive success, robustness, adaptability, and emergent stability are descriptive properties. They do not establish justice, welfare, legitimacy, sustainability, or generative desirability. A highly adaptive system may reproduce concentrated power or ecological depletion; a stable network may sustain exclusion; an innovative trajectory may generate valuable capabilities while imposing costs elsewhere. Normative evaluation therefore requires additional criteria.

Proposition 21.366 (Evolutionary-complexity translation boundary). *Relational translation preserves explanatory content only when the specific evolutionary mechanism, interaction architecture, adaptive process, emergent pattern, network representation, historical sequence, and evidential warrant remain identifiable after translation into GRE vocabulary.*

A final boundary concerns ontological inference. Complexity models can reveal that relatively simple specified mechanisms generate rich system behavior, and evolutionary models can reveal how populations and routines change through history. These analytical successes do not establish that the ultimate ontology of economic reality is computational, network-theoretic, evolutionary, or relational in one exclu-

sive sense. GRE's ontological suspension therefore remains active. Formalisms are selected because they illuminate particular economic structures and processes, while their success supports analytical adequacy within a stated domain and leaves ultimate ontology suspended.

The dialogue is consequently reciprocal. Evolutionary and complexity economics offer GRE unusually developed resources for modeling endogenous novelty, adaptation, interaction, sequence dependence, networks, and multi-level pattern formation. GRE can connect these mechanisms to heterogeneous value, power, conversion, epistemic access, and the distribution of future-generating capacities. The intellectual gain lies in preserving enough distinction for the traditions to correct one another while their specific mechanisms remain identifiable within the common vocabulary.

21.19 Feminist and Care Economics

Chapter 2, Section 2.23, reconstructed care, feminist, and social-reproduction economics as intellectual lineages that brought dependency, unpaid labor, embodied need, provisioning, and reproduction into the economic object. The present section takes that genealogy as established. Its role is to compare the mechanisms and evaluative objects developed by feminist and care economics with GRE while preserving their historical, normative, experiential, and political specificity. The section therefore emphasizes care, dependency, social reproduction, household relations, unpaid labor, embodiment, recognition, and the conditions under which GRE can be corrected by these analyses without dissolving gendered and care-specific structures into generic relational categories. Table 21.19 summarizes the principal dialogue coordinates.

Definition 21.367 (Feminist–care economic configuration). *A feminist–care economic configuration* is an analytically specified arrangement of persons, households, care relations, paid and unpaid work, institutions, material resources, social norms, embodied needs, and distributions of responsibility whose interaction shapes both present provisioning and the reproduction of future economic capacities.

The definition supplies a common relational coordinate without reducing feminist economics to care economics. Power's social-provisioning formulation presents feminist economics as an approach attentive to paid and unpaid care, human well-being, power relations, ethical values, and intersecting social differences (Power 2004). Folbre analyzes caregiving and social reproduction through structures of constraint that distribute responsibilities and costs unevenly across gender, age, class, race, and national location (Folbre 1994; Folbre 2001). Tronto treats care as a politically organized human activity whose distribution cannot be understood solely as a private moral matter (Tronto 1993). These contributions share an effort to move economically consequential dependence, maintenance, and provisioning into the analytical foreground while retaining different normative and theoretical commitments.

Proposition 21.368 (Feminist–care reconstruction condition). *A relational reconstruction of feminist and care economics should preserve distinctions among caring activity, dependency relations, social reproduction, household organization, unpaid labor, embodied need, recognition, distribution, and power while identifying the institutions that connect them.*

Table 21.19: Relational coordinates for feminist and care economics

Coordinate	Feminist–care analytical object	Dialogue boundary
Care	Activities and relations that maintain persons, capabilities, environments, and conditions of daily life	Identification of care with affection, femininity, or one institutional location
Dependency	Unequal or changing reliance on others for bodily, material, social, or institutional support	Treatment of dependency as exceptional deficiency or as a single undifferentiated condition
Social reproduction	Processes that sustain and renew persons, labor capacities, households, communities, and enabling institutions	Reduction of reproduction to household labor alone or identification of every maintenance process with one Marxian mechanism
Household relations	Internal allocations, responsibilities, authority, bargaining positions, obligations, and transfers	Representation of the household as a unitary actor where internal distribution is analytically consequential
Unpaid labor	Economically consequential work performed outside direct wage payment and often outside standard accounts	Equation of absence from market price with absence of value, or equation of monetary imputation with complete valuation
Embodiment	Material, temporal, life-course, and vulnerability conditions of economic subjects	Biological essentialism or treatment of bodily conditions as analytically irrelevant to economic organization
Recognition	Social and institutional visibility, standing, interpretation, and acknowledgment of persons and contributions	Substitution of recognition for redistribution, material provisioning, or institutional reform
Relational reconstruction	Interdependent provisioning architectures linking households, markets, states, communities, and infrastructures	Absorption of gendered and feminist analysis into generic relational vocabulary
Translation limit	Normative, experiential, political, and historically gendered remainders that resist full GRE translation	Identity inferred from shared attention to interdependence, power, reproduction, or relationality

21.19.1 Care

Care provides the first coordinate because economies depend on activities that sustain persons and the conditions under which persons can participate in social and economic life. Feeding, cleaning, accompanying, teaching, nursing, comforting, supervising, coordinating appointments, maintaining living environments, and supporting persons through illness, disability, infancy, aging, or temporary vulnerability can require time, skill, attention, emotional engagement, physical effort, material resources,

and institutional coordination. These activities can occur within households, markets, public services, communities, cooperatives, and mixed institutional arrangements.

Definition 21.369 (Economically consequential care). *Economically consequential care* is activity or organized support directed toward maintaining, restoring, or developing the functioning, capabilities, bodily condition, relational participation, or everyday living conditions of persons whose realization depends partly on the attention or action of others.

Tronto's political account of care emphasizes that care is a broad human activity and that its organization is structured by distributions of responsibility, privilege, and power (Tronto 1993). Held likewise develops care as a relational normative orientation that extends beyond intimate life to political, market, and global domains (Held 2006). England's review of care-work theories shows that care can be both paid and unpaid and that its economic organization raises distinct questions concerning devaluation, public-good characteristics, emotional attachment, and commodification (England 2005). Care therefore cannot be located analytically in a single sector.

The economic object also exceeds the observable task. A thirty-minute visit can involve travel, anticipatory planning, knowledge of another person's needs, responsibility for contingencies, and coordination with other caregivers or institutions. Conversely, time spent in proximity does not by itself establish that adequate care occurred. Analysis therefore benefits from distinguishing the measurable inputs of care from the relational quality and consequences of the caring process.

Proposition 21.370 (Care-organization condition). *An economic analysis of care should identify who requires support, who provides it, through which institutional arrangement, with what resources and authority, over what time horizon, and with what consequences for both recipients and providers.*

This condition makes distribution central. A household may meet a care need while concentrating time costs and foregone opportunities on one member. A market may expand paid care while reproducing low wages or insecure employment among care workers. A public programme may reduce household burdens while creating administrative conditions that affect access. The same care outcome can therefore be embedded in markedly different distributions of cost, risk, autonomy, and future capability.

GRE can translate these questions into relational-generative terms by examining how care changes future possibilities. Adequate care can preserve health, develop capabilities, sustain participation, support learning, and stabilize relations. Care deficits can propagate into later constraints. The translation should remain cautious: care is not valuable only because it produces later economic capacity. The care-economics literature also raises claims about dignity, need, obligation, and the quality of relations whose normative standing cannot be exhausted by downstream productivity.

21.19.2 Dependency

Dependency provides the second coordinate because economic subjects are situated within changing relations of reliance throughout the life course. Infancy, illness, disability, aging, injury, pregnancy, unemployment, migration, and institutional exclusion can intensify reliance on others, while ordinary adult life also depends on infrastructures, organizations, ecological systems, public services, and accumulated social

knowledge. Feminist analyses of dependency challenge economic representations that take practical independence as the unexamined baseline of agency.

Definition 21.371 (Dependency relation). A *dependency relation* is a structured condition in which a person's relevant functioning or participation relies materially on the continuing action, resources, access, or institutional support of another person or configuration, with the form and intensity of that reliance varying across domains and time.

Kittay places dependency and dependency work at the center of an account of equality, emphasizing that persons who provide intensive support to dependents can themselves become dependent on wider social cooperation and resources (Kittay 1999). Fineman similarly critiques the autonomous, self-sufficient subject by emphasizing pervasive interdependence and the institutional organization of caretaking responsibilities (Fineman 2004). These approaches make it possible to study dependency as part of social organization rather than as an exceptional departure from a fully independent economic actor.

Dependency is heterogeneous. A person may be financially independent while requiring assistance with mobility. A caregiver may possess professional expertise while depending economically on a household member because care time limits paid employment. A worker may appear individually autonomous while relying on public transport, healthcare, childcare, legal enforcement, and digital infrastructure. Different dependencies can therefore overlap without having identical causes or normative meanings.

Proposition 21.372 (Dependency-distribution condition). *The economic significance of dependency depends on both the underlying need or reliance and the institutional distribution of responsibility, resources, voice, risk, and exit possibilities through which that reliance is managed.*

This distinction prevents dependency from becoming a synonym for weakness. Some dependencies are constitutive of valuable cooperation; others become sources of domination when one party controls essential resources or when alternatives are inaccessible. GRE's power framework can help describe how asymmetry within a dependency relation modifies admissible actions, bargaining positions, and future alternatives. Feminist analysis adds an important warning: a formal option to exit may have little practical significance when bodily needs, caring obligations, social norms, immigration status, housing, or income make exit prohibitively costly.

Dependency also introduces time. Needs vary across the life course, and today's allocation of care can influence tomorrow's capabilities. The economic architecture therefore has to represent transitions among receiving care, providing care, and participating in other forms of production and social life. Such transitions are especially important for evaluating institutions that distribute the temporal burden of dependency unevenly across persons or generations.

21.19.3 Social Reproduction

Social reproduction provides the third coordinate because economic activity relies on processes that sustain and renew persons, labor capacities, households, communities, and institutional conditions across time. Feminist political economy has used the concept to connect activities frequently treated as external to production with the reproduction of the capacities and social relations on which production itself depends.

Definition 21.373 (Social reproduction). *Social reproduction* denotes the historically organized processes through which persons, embodied capacities, everyday life, generational continuity, and relevant social relations are maintained or renewed across time, including processes situated inside and outside markets.

Benería's analysis links production, reproduction, and the sexual division of labor, showing how the organization of reproductive activity participates in wider economic structures (Benería 1979). Vogel develops a social-reproduction account centered on the reproduction of labor-power and the social organization of domestic and generational processes within capitalism (Vogel 1983). Fraser later broadens the analysis by treating social reproduction as one of the background conditions on which capitalist accumulation depends and which accumulation can destabilize (Fraser 2014). These formulations overlap while differing in theoretical scope and mechanism.

The concept therefore requires specification. Reproduction of labor-power, reproduction of a household, generational replacement, maintenance of social norms, preservation of institutional capacities, and reproduction of an unequal social relation are distinct processes. Treating them as one mechanism would obscure the causal pathways that connect them. The analytical task is to identify what is being reproduced, by whom, through which practices and institutions, and with what changes across successive periods.

Proposition 21.374 (Reproduction-object condition). *A social-reproduction explanation should specify the persons, capacities, relations, institutions, or conditions being reproduced and the mechanisms through which their continuity or transformation occurs.*

This condition also leaves room for change. Reproduction rarely means exact duplication. Children acquire capabilities different from those of prior generations; care institutions change; gender norms shift; technologies reconfigure household work; migration reorganizes transnational care responsibilities; public services alter the boundary between household and collective provisioning. Social reproduction can therefore be simultaneously preservative and transformative.

GRE can connect social reproduction to generativity by asking which reproduced conditions make later action possible and which reproduce constraints. A childcare system can reproduce the daily conditions of employment while also shaping children's capabilities, caregivers' careers, gendered divisions of labor, public budgets, and future labor-market structures. The generative extension should preserve the source concept's attention to historical social relations rather than replacing social reproduction with a general statement that the future depends on the present.

21.19.4 Household Relations

Household relations provide the fourth coordinate because many economic decisions are organized through units whose internal distributions cannot always be represented adequately by a single preference ordering, budget, or objective. Households pool some resources, specialize activities, share risks, transfer income across persons and generations, provide care, and negotiate responsibilities. Internal authority and bargaining conditions can therefore affect both aggregate household outcomes and the distribution of well-being among members.

Definition 21.375 (Household relational architecture). *A household relational architecture* is the configuration of resource access, responsibilities, decision procedures,

obligations, information, authority, care relations, and exit possibilities through which household members coordinate provisioning and distribute its consequences.

Folbre's account of gender and the structures of constraint provides a useful bridge between individual action and household or institutional context, emphasizing that reproductive responsibilities and caring commitments are organized within intersecting structures rather than generated by unconstrained choice alone (Folbre 1994). Feminist economics more broadly has made the internal household distribution of resources and work analytically visible, thereby challenging representations in which household-level income or consumption automatically describes each member's access and welfare.

A relational account distinguishes pooling from equality. Two members may draw on a joint income while exercising different control over spending. A household may specialize efficiently in a narrow sense while one member accumulates less income, pension entitlement, professional experience, or bargaining power. Informal norms can shape who is expected to interrupt employment when care needs arise. Household organization thus links present allocation to later capabilities and outside options.

Proposition 21.376 (Household-disaggregation condition). *Household-level aggregates should be disaggregated whenever internal differences in resource access, authority, care responsibility, exposure to risk, or future opportunity materially affect the question under study.*

Disaggregation does not require treating cooperation as disguised conflict. Households can contain affection, reciprocity, shared commitments, and genuine common projects alongside unequal bargaining positions. The relevant economic question concerns how these relational forms coexist and how institutions influence them. Tax systems, parental leave, childcare services, inheritance rules, property regimes, labor-market conditions, housing, and immigration law can alter the resources and alternatives available to different members.

GRE's relational vocabulary is compatible with this analysis because the household can be represented as a history-bearing configuration rather than a point actor. The contribution of feminist economics is more specific: it provides reasons to ask which relations and inequalities disappear when household boundaries are used as the unit of observation. Relational reconstruction should therefore preserve the possibility that an aggregate improvement for a household coexists with deterioration for a particular member.

21.19.5 Unpaid Labor

Unpaid labor provides the fifth coordinate because the boundary of measured economic activity can exclude work that is materially necessary to daily life and social reproduction. Cooking, cleaning, childcare, eldercare, household administration, subsistence activity, and community support can consume substantial time and produce consequences for health, capabilities, paid employment, and institutional demand even when no wage is paid.

Definition 21.377 (Unpaid economic labor). *Unpaid economic labor* is purposive activity that contributes materially to provisioning, maintenance, care, reproduction, or collective functioning without direct wage payment for the activity itself.

Waring's critique of national accounting made the exclusion or marginalization of women's unpaid work a central problem of economic visibility and valuation (Waring 1988). Himmelweit's analysis adds conceptual caution by examining the consequences of extending a wage-labor-derived category of "work" to unpaid domestic activity (Himmelweit 1995). The two contributions together support a distinction between making economically consequential activity visible and assuming that one inherited category captures its full social meaning.

Measurement can proceed through time-use data, replacement-cost estimates, opportunity-cost estimates, satellite accounts, or direct measures of outputs and outcomes. Each representation answers a different question. Assigning a market-equivalent price to an hour of unpaid care can illuminate the scale of omitted activity, yet monetary imputation does not establish that paid and unpaid care are institutionally or relationally identical. Likewise, time measurement records duration but may miss intensity, responsibility, simultaneity, emotional demand, or interrupted availability.

Proposition 21.378 (Measurement-valuation distinction). *Making unpaid labor measurable and assigning it a monetary equivalent are distinct analytical operations; neither operation by itself supplies a complete account of the activity's value, quality, distribution, or relational meaning.*

This distinction is important for GRE's heterogeneous-value framework. Unpaid care can generate health, trust, knowledge, capability, continuity, and relational value while also imposing opportunity costs and reproducing inequality. Some effects are partially commensurable in monetary terms; others may remain heterogeneous. Analysis should therefore record multiple consequences rather than forcing them into one scalar measure.

The distribution of unpaid labor also links measurement to power. A policy that assumes unpaid family provision may shift public costs into households, where the burden can fall disproportionately on persons with weaker labor-market attachment or stronger social obligations. Conversely, public services, cash transfers, leave entitlements, or workplace flexibility can redistribute time and risk in different ways. The object of analysis is therefore both the quantity of unpaid work and the institutional architecture that generates its distribution.

21.19.6 Embodiment

Embodiment provides the sixth coordinate because economic subjects act through bodies with needs, capacities, vulnerabilities, rhythms, and life-course changes. Care and dependency make these conditions especially visible, yet embodiment also matters for work, mobility, fatigue, pregnancy, illness, disability, aging, exposure to hazards, and access to spaces or technologies. A relational economics that treats subjects only as abstract decision nodes can therefore miss constraints and capacities that arise through embodied conditions.

Definition 21.379 (Embodied economic condition). *An embodied economic condition is a materially situated bodily capacity, need, vulnerability, rhythm, or life-course state that changes a person's feasible activities, support requirements, exposure to risk, or participation in economic relations.*

Kittay's work on dependency demonstrates the analytical importance of bodily conditions that require sustained support and of the consequences for those who provide

such support (Kittay 1999). Care-economics research similarly shows that the organization of care cannot be understood solely through preferences and prices because the timing, continuity, and responsiveness of support are connected to embodied need (England 2005). Embodiment thus supplies a material constraint on institutional substitutability: some forms of support can be delayed, standardized, or automated more readily than others.

Embodiment should be represented without biological essentialism. Bodily differences acquire economic meaning through social and institutional arrangements. Pregnancy has material characteristics, but its employment consequences depend on workplace design, leave policy, healthcare access, discrimination, household organization, and income support. Disability can interact with architecture, transport, communication standards, assistive technologies, and legal rights. The economic effect therefore emerges through relations between bodily conditions and environments.

Proposition 21.380 (Embodiment-environment coupling). *The economic consequences of an embodied condition should be analyzed through its interaction with material environments, technologies, institutions, social expectations, and available support rather than inferred from bodily difference alone.*

This proposition fits GRE's distinction between properties and relationally generated states. A capacity limitation can be intensified or reduced by a surrounding configuration. Embodiment also introduces temporal non-substitutability: care required at a specific moment may lose value if supplied later, and recovery or development may depend on sequences of support. Such timing effects connect care economics to GRE's analysis of generative spacetime while preserving the empirical specificity of embodied needs.

21.19.7 Recognition

Recognition provides the seventh coordinate because economic contribution, need, standing, and identity are mediated through social and institutional classifications. Care work can be materially necessary while remaining symbolically devalued. Unpaid labor can be absent from headline economic accounts. Persons can possess formal rights while encountering institutional categories that misdescribe their needs or contributions. Recognition therefore concerns more than interpersonal appreciation; it can shape economic visibility, access, status, and participation.

Definition 21.381 (Economic recognition relation). *An economic recognition relation is a socially or institutionally organized mode of identifying, interpreting, acknowledging, or assigning standing to persons, needs, activities, or contributions in ways that can affect participation, valuation, resource access, or authority.*

Fraser and Honneth's debate distinguishes and connects recognition and redistribution while developing different accounts of their normative relation (Fraser and Honneth 2003). Feminist economics provides concrete economic settings in which such distinctions matter. National accounts can omit unpaid activity; occupational classifications can undervalue relational skill; administrative rules can recognize one family form while making another difficult to represent; and care recipients can be treated as passive costs rather than participants with preferences and agency.

Recognition is therefore connected to manifestation. What institutions count, name, record, and classify can affect what becomes visible to policy and what remains difficult to claim. Waring's critique of accounting illustrates this interface

directly: statistical boundaries participate in the public representation of economic contribution (Waring 1988). GRE can analyze these classificational structures with causal consequences, while feminist analysis supplies historically specific accounts of whose activities and needs have been obscured or devalued.

Proposition 21.382 (Recognition-redistribution distinction). *Improved recognition can change visibility, status, interpretation, and participation, but its distributive consequences depend on the institutions connecting recognition to resources, rights, authority, and material support.*

This proposition guards against symbolic substitution. Celebrating caregivers does not by itself provide income, respite, healthcare, pension rights, or workplace flexibility. Conversely, a transfer programme can improve material conditions while retaining stigmatizing classifications. Economic analysis therefore benefits from tracing the interfaces among recognition, redistribution, representation, and institutional participation.

Recognition also raises a reflexive question for GRE. The framework's own categories determine which relations become analytically visible. If care is translated only into "generative capacity," its immediate moral, affective, bodily, or political content may disappear. A responsible translation should preserve the source tradition's categories when they carry distinctions that GRE's general vocabulary would otherwise flatten.

21.19.8 Relational Reconstruction

The preceding coordinates support a relational reconstruction centered on provisioning architectures that connect embodied persons, dependency relations, households, markets, public institutions, communities, infrastructures, and intergenerational processes. Feminist and care economics already provide strongly relational analyses in many of these domains. GRE's contribution is therefore primarily integrative: it can connect care and social reproduction to heterogeneous value, history-bearing configurations, power, conversion interfaces, epistemic representation, and open future formation while preserving feminist economics' specific analyses of gendered organization and inequality.

Definition 21.383 (Care-centered relational reconstruction). *A care-centered relational reconstruction represents economic provisioning as a history-bearing configuration in which embodied needs, caring activities, dependencies, resources, institutions, norms, and distributions of responsibility jointly shape present functioning and future capabilities.*

The reconstruction begins by replacing the isolated economic subject with a situated participant whose practical agency can depend on care, infrastructure, rights, and prior social reproduction. This move does not eliminate individual agency. It identifies some of the conditions through which agency becomes exercisable. A person's feasible participation in education or employment may depend on childcare, accessible transport, health support, household time allocation, legal status, and the availability of other caregivers.

Second, the reconstruction treats provisioning as multi-institutional. Households, firms, markets, welfare states, schools, hospitals, community organizations, and digital platforms can substitute for, complement, or shift burdens onto one another. A reduction in public eldercare expenditure may increase household care time, affect

labor supply, alter intergenerational transfers, and intensify dependence on migrant care workers. The relevant unit of analysis is therefore the coupled architecture rather than a single sector.

Proposition 21.384 (Provisioning-interface condition). *A relational analysis of care should trace how changes at the interfaces among households, markets, public institutions, communities, and infrastructures redistribute time, cost, risk, authority, and future capability.*

Third, heterogeneous value becomes important because care can carry several forms of consequence simultaneously. It can preserve bodily functioning, support emotional security, enable paid employment, transmit knowledge, sustain relationships, and reduce or intensify future dependency. These consequences need not share one metric. A low-cost arrangement can be poor in continuity or dignity; a time-intensive arrangement can generate substantial relational and developmental value while constraining a caregiver's future options. Evaluation therefore requires explicit treatment of whose value and whose future possibilities are being considered.

Proposition 21.385 (Care-generativity distinction). *Care can have generative consequences by preserving or expanding future capabilities and relations, while the value and normative significance of care also include present needs and relational qualities that should not be reduced to later generativity.*

Fourth, power enters through the allocation of dependency responsibilities and control over essential resources. A person who controls income, housing, legal status, information, or access to services may shape another person's practical alternatives. Institutional rules can also distribute unpaid responsibilities without an explicit bilateral command. GRE's power vocabulary can represent these asymmetries, while feminist economics contributes historically grounded accounts of how gendered norms and institutions organize them.

Fifth, epistemic representation becomes part of the economic architecture. Time-use surveys, national accounts, eligibility categories, care-quality metrics, household statistics, and labor classifications make some aspects of provisioning visible and leave others weakly represented. Measurement can influence funding, recognition, and policy. The relation between manifestational representation and material provisioning is therefore recursive: what becomes legible can affect what institutions subsequently support.

Proposition 21.386 (Care-system generative assessment). *A generative assessment of a care system should examine present adequacy together with the distribution of future capabilities, caregiver sustainability, dependency risks, institutional resilience, and the reproduction or transformation of unequal relations.*

Such assessment is especially relevant when short-run efficiency and long-run reproduction diverge. Understaffing can lower immediate expenditure while increasing burnout and turnover. Reliance on unpaid household care can reduce public budgets while narrowing caregivers' later income and pension entitlements. Intensive early support can require substantial present resources while changing later health or educational trajectories. The generative lens thus extends the time horizon without displacing the immediate adequacy of care.

21.19.9 Limits of Translation

The translation between feminist and care economics and GRE is substantial because both attend to relations, interdependence, power, history, heterogeneous value, and the conditions through which economic agency is sustained. These shared coordinates create opportunities for dialogue, yet they do not establish theoretical identity. Feminist economics contains substantive historical, political, normative, methodological, and experiential commitments that a general relational framework cannot inherit merely by adopting similar vocabulary.

Definition 21.387 (Feminist–care translation remainder). *A feminist–care translation remainder* is a concept, normative commitment, historical diagnosis, experiential distinction, political category, or empirical mechanism whose analytical role is weakened or altered when translated into GRE’s more general relational vocabulary.

Gender provides the first major remainder. GRE can represent asymmetrical relations, constraints, norms, classifications, and differential generative capacities, but these general categories do not explain the historically specific organization of gender. Feminist economic analysis contributes empirical and theoretical accounts of gendered divisions of labor, occupational valuation, household responsibility, property, care expectations, and institutional design. Replacing those categories with generic asymmetry would lose explanatory content.

Care provides a second remainder. GRE can analyze care as a relation with generative effects, yet care ethics and care economics also examine attentiveness, responsibility, responsiveness, dependency, dignity, and the quality of caring relations (Tronto 1993; Held 2006). These dimensions cannot be derived automatically from a formal account of relational persistence or future possibility.

Social reproduction provides a third remainder. The concept can be translated partly into the reproduction of capacities and enabling relations, but specific social-reproduction theories connect those processes to historically defined modes of production, gender relations, households, labor-power, and institutional crisis (Vogel 1983; Fraser 2014). A generic reproduction operator would preserve too little of that theoretical architecture.

Proposition 21.388 (Specificity-preservation condition). *GRE translation is adequate only when it preserves the historically and politically specific categories that carry causal or normative content in feminist and care-economic explanations.*

A fourth remainder concerns standpoint and experience. Some feminist scholarship asks how social position affects what becomes observable, credible, or conceptually available. GRE’s epistemic framework can represent situated access and manifestational difference, but it should not presume that a general formal vocabulary reproduces the methodological and political work of feminist epistemology. Direct empirical engagement with lived conditions remains necessary.

A fifth remainder concerns normative judgment. Feminist and care economics frequently address justice, equality, dignity, need, autonomy, recognition, and responsibility. GRE can map distributions and generative consequences, but relational description alone does not settle how caring responsibilities should be allocated or which inequalities are justified. Normative conclusions require additional argument.

Proposition 21.389 (Relational non-identity of feminist economics). *Shared emphasis on interdependence and relational structure does not make feminist economics a special case of GRE or GRE a substitute for feminist economic analysis.*

The domain of adequacy is therefore complementary. Feminist and care economics are especially strong where economic explanation requires visibility of care, dependency, household power, unpaid labor, social reproduction, embodiment, gendered institutions, and the normative organization of provisioning. GRE can contribute a broader architecture for tracing how these relations interact with heterogeneous value, power, temporal dynamics, epistemic representation, and future possibility. The dialogue is productive when both directions remain open: feminist economics can enrich and correct GRE's account of relational economic life, while GRE can offer additional coordinates for connecting care and reproduction to other domains of economic change.

Proposition 21.390 (Feminist–care dialogue condition). *The strongest dialogue preserves feminist and care economics as sources of independent theoretical and empirical correction while using GRE to examine cross-domain relations, temporal propagation, heterogeneous value, and generative consequences that extend beyond any single provisioning institution.*

21.20 Capability and Human Development Approaches

Chapter 2, Section 2.22, established the genealogical foundations of capability and human-development approaches. The present section uses that baseline to compare their evaluative architecture with GRE. It focuses on functionings, capabilities, conversion factors, agency, freedom, and heterogeneity as independently developed analytical objects; on the conditions under which GRE's relational and generative language can illuminate the formation and transformation of capabilities; and on the limits that prevent capability from becoming a synonym for generative capacity or future opportunity. The section also asks where capability analysis provides a more disciplined evaluative space than GRE's broader architecture. Table 21.20 summarizes the dialogue coordinates.

Definition 21.391 (Capability–human-development configuration). A *capability–human-development configuration* is an analytically specified arrangement of persons, resources, personal characteristics, social institutions, environmental conditions, relations, and conversion processes that shapes achieved functionings, substantive opportunities, agency, and the practical freedoms available to persons or groups.

Sen's capability approach develops a space of evaluation centered on functionings and capabilities rather than commodity possession or utility alone (Sen 1985; Sen 1992). In *Development as Freedom*, this orientation is connected to development as an expansion of substantive freedoms and to the institutional conditions through which such freedoms become effective (Sen 1999). The human-development tradition institutionalized a related shift by treating development as an enlargement of people's choices and capabilities beyond income growth or aggregate production alone (United Nations Development Programme 1990). Nussbaum develops a distinct capability formulation organized around central human capabilities and threshold political principles, while Robeyns reconstructs the approach as a broader interdisciplinary framework with explicit attention to conversion factors and human diversity (Nussbaum 2000; Robeyns 2005).

Proposition 21.392 (Capability reconstruction condition). *A relational reconstruction of capability and human-development approaches should preserve distinctions*

Table 21.20: Relational coordinates for capability and human-development approaches

Coordinate	Capability–human-development analytical object	Dialogue boundary
Functionings	Achieved beings and doings that constitute dimensions of a person’s life	Identification of achievement with resources, utility, or one externally chosen outcome metric
Capabilities	Substantive opportunities to achieve valued combinations of functionings	Equation of formal permission, nominal choice, or resource ownership with effective opportunity
Conversion factors	Personal, social, institutional, relational, and environmental conditions mediating resource-to-functioning conversion	Treatment of resource possession as sufficient evidence of equivalent opportunity
Agency	Capacity to pursue goals and commitments that a person has reason to value, including concerns extending beyond personal well-being	Reduction of agency to preference satisfaction or individual welfare achievement
Freedom	Effective opportunity and relevant process conditions through which persons can pursue valued ways of living	Identification of freedom with an unweighted count of nominal options
Heterogeneity	Differences in bodies, needs, environments, relations, institutions, responsibilities, and conversion conditions	Use of one resource or achievement threshold as if equivalent across heterogeneous persons and contexts
Relational reconstruction	Coupled architecture through which institutions and relations shape conversion, opportunity, agency, and achievement	Absorption of capability evaluation into generic relational description without preserving its evaluative distinctions
Generative extension	Transformation of future capability spaces through present action, institutions, learning, care, infrastructure, and constraint	Attribution of GRE’s temporal-generative claims to the capability approach without separate argument
Translation limit	Normative selection, informational incompleteness, measurement, agency, and theory-specific remainders	Identity inferred from shared concern with possibility, freedom, human diversity, or enabling conditions

among resources, conversion conditions, achieved functionings, capability sets, agency, freedom, valuation, and institutional context while identifying the relations through which these elements affect one another.

21.20.1 Functionings

Functionings provide the first coordinate because the capability approach evaluates important dimensions of life in terms of what persons actually manage to be and do. Functionings can include being adequately nourished, being sheltered, moving through one's environment, participating in social life, learning, caring for others, working under acceptable conditions, exercising political voice, or maintaining self-respect. Their analytical significance lies in achieved states and activities rather than the mere possession of inputs from which those achievements might be produced.

Definition 21.393 (Functioning). A *functioning* is an achieved being or doing of a person that is treated as relevant within a specified evaluative context.

Sen's formulation distinguishes commodities and their characteristics from the functionings persons achieve through them (Sen 1985). A bicycle, for example, may possess transport-relevant characteristics, yet the functioning of mobility depends on whether a person can use it, whether roads or other infrastructures permit its use, whether social rules allow that use, and whether the person's bodily condition is compatible with it. The distinction creates analytical space between possession and achievement.

The same structure applies beyond material commodities. School enrollment differs from learning; healthcare access differs from restored or preserved health; legal political rights differ from effective participation; internet connectivity differs from the ability to acquire reliable information. In each case, an input or institutional entitlement participates in an achievement process whose outcome depends on additional conditions.

Proposition 21.394 (Functioning-specification condition). *A functioning-based analysis should specify the achieved being or doing under evaluation, the relevant person or population, the temporal and institutional context, and the evidence through which the achievement is identified.*

This condition matters because functionings can be described at different levels of abstraction. "Being healthy" can conceal heterogeneous dimensions of bodily functioning, pain, mobility, mental condition, chronic illness, or access to continuing treatment. "Participating in society" can include political voice, employment, community association, digital access, family participation, or cultural belonging. Analytical precision therefore requires a locally adequate description rather than a single universal granularity.

Functionings also introduce a distinction between achievement and the evaluative meaning of achievement. Two persons may exhibit the same observable state while arriving there through different opportunity structures. Fasting and involuntary hunger can produce superficially similar nutritional outcomes while differing sharply in available alternatives. A long working week can reflect valued professional commitment or severe economic constraint. Functioning evidence is therefore important while remaining incomplete for judgments about freedom.

GRE can translate achieved functionings into relational states produced through interacting resources, capacities, institutions, and relations. Such translation is useful for tracing the conditions of achievement, yet the capability approach contributes an evaluative discipline that asks whether the achieved states themselves belong in the relevant informational space. Relational explanation and capability evaluation consequently remain connected but distinguishable tasks.

21.20.2 Capabilities

Capabilities provide the second coordinate because the approach is concerned with substantive opportunities as well as achieved outcomes. A person who reaches a valued functioning through one constrained path can occupy a different evaluative position from a person who reaches the same functioning while retaining meaningful alternatives. Capability analysis therefore brings feasible ways of living into the evaluative space.

Definition 21.395 (Capability). *A capability is a substantive opportunity to achieve a functioning or combination of functionings that is relevant within the evaluative problem under consideration.*

Sen develops capability as freedom to achieve alternative functioning combinations rather than as a stock of resources or an achieved functioning alone (Sen 1985; Sen 1992). This distinction gives the approach a counterfactual component: evaluation concerns what a person could effectively achieve under the relevant conditions, including alternatives that may remain unrealized. The capability set is therefore richer than a record of observed outcomes.

The adjective “substantive” is important. Formal permission can exist while practical opportunity remains narrow. A person may be legally permitted to attend university while lacking prior education, income, transport, disability accommodation, immigration documentation, or time free from care responsibilities. A worker may be formally free to leave an employer while health insurance, visa status, housing, debt, or local labor-market conditions sharply limit effective exit. Capability analysis asks how these conditions affect what is genuinely feasible.

Proposition 21.396 (Substantive-opportunity condition). *An asserted capability requires evidence concerning effective feasibility under relevant personal, social, institutional, and environmental conditions rather than evidence of formal permission alone.*

Capability is also plural. Economic resources can support several functioning combinations, and the same resource bundle can generate different capability sets for different persons. This plurality complicates measurement. Some capabilities are difficult to observe because they are opportunities rather than realized states. Others depend on contingent institutional responses. Operational research therefore often combines functioning indicators, resource information, institutional evidence, and reasoned judgments about feasible alternatives rather than directly measuring an abstract capability set.

Alkire emphasizes both the practical value and the operational difficulty of capability-based poverty analysis, including the problem of selecting dimensions and evaluating plural freedoms without collapsing them into one metric (Alkire 2002). This difficulty is analytically productive: it exposes where an apparently simple welfare measure rests on choices about which opportunities count, whose valuation enters, and what evidence is sufficient.

GRE’s notion of an option space is close enough to enable dialogue, yet equivalence should remain partial. A GRE option space can describe feasible future transitions of many kinds, including institutional or organizational possibilities. A capability set is specifically connected to persons’ substantive opportunities and an evaluative concern with what they can be and do. Translating capability into generic possibility would therefore discard part of its normative and human-development role.

21.20.3 Conversion Factors

Conversion factors provide the third coordinate because resources acquire evaluative significance through the conditions that mediate their transformation into functionings and capabilities. The concept explains why equal resources can coexist with unequal substantive opportunities. Robeyns distinguishes personal, social, and environmental conversion factors as mediating conditions in the capability framework (Robeyns 2005).

Definition 21.397 (Conversion factor). A *conversion factor* is a personal, social, institutional, relational, or environmental condition that affects the extent or manner in which a resource, entitlement, service, or opportunity can be transformed into an achieved functioning or substantive capability.

Personal conversion factors can include bodily characteristics, health conditions, age, acquired skills, or literacy. Social and institutional factors can include laws, norms, discrimination, public-service design, family responsibilities, organizational procedures, language regimes, or administrative requirements. Environmental factors can include climate, geography, transportation networks, pollution, physical accessibility, and settlement structure. These categories are analytically useful while their empirical boundaries can overlap.

Consider equal cash transfers. Their capability effects can differ because recipients face different housing costs, medical needs, mobility conditions, caregiving responsibilities, debt obligations, discrimination, public-service availability, or geographic access. The monetary transfer remains important, yet equality in the transfer does not establish equality in the capability generated from it. Similar reasoning applies to educational resources, healthcare, digital technologies, legal rights, and public infrastructure.

Proposition 21.398 (Conversion-tracing condition). *Capability analysis should trace the conditions connecting resources or entitlements to effective opportunities and achievements whenever variation in those conditions materially changes the evaluative conclusion.*

The conversion concept creates a strong interface with GRE. GRE already treats conversion among heterogeneous value forms as an object of analysis. A public subsidy may be converted into mobility, education, health, political participation, or relational access through institutionally structured pathways. Control over conversion interfaces can therefore affect who realizes a capability from a nominally shared resource.

The overlap has limits. Capability conversion concerns the relation between means and valuable beings or doings, while GRE's conversion vocabulary can also describe transformations among currencies, symbolic forms, institutional statuses, knowledge, ecological value, or organizational resources. GRE should consequently avoid treating capability conversion as a special case of every heterogeneous-value conversion. The direction of translation is most precise when the object is a person's effective opportunity or functioning.

Conversion factors also make policy comparison sensitive to institutional complementarity. Income support may have larger capability effects where healthcare, public transport, childcare, legal documentation, and accessible services are available. Drèze and Sen's analysis of development and public action emphasizes such complementarities among economic, social, and political institutions in expanding effective

freedoms (Drèze and Sen 2002). Capability-oriented evaluation thus directs attention toward bundles of enabling conditions rather than isolated inputs.

21.20.4 Agency

Agency provides the fourth coordinate because capability approaches distinguish a person's ability to pursue goals and commitments from a narrower assessment of that person's own well-being. Persons can value family responsibilities, political causes, environmental protection, professional commitments, religious practice, community projects, scientific inquiry, or care for others even when these commitments impose personal costs. Sen's distinction between agency and well-being is therefore important for economic theories that otherwise represent action primarily through individual welfare or preference satisfaction (Sen 1992).

Definition 21.399 (Agency capability). An *agency capability* is a substantive opportunity for a person to pursue or participate in goals, commitments, or forms of action that the person has reason to value, including goals extending beyond the person's own well-being achievement.

Agency has both individual and relational conditions. A person may possess knowledge and motivation while lacking legal standing, organizational access, political voice, social recognition, financial resources, or collaborators. Conversely, institutions can create agency by establishing participatory procedures, public information, legal rights, collective organizations, or accessible channels of contestation. Development conceived through freedom therefore concerns the conditions under which persons can act as participants rather than solely as recipients of benefits (Sen 1999; Drèze and Sen 2002).

Proposition 21.400 (Agency-enablement condition). *An analysis of agency should distinguish personal intention from the relational and institutional conditions that make valued action practically exercisable.*

This distinction matters for public policy. A programme can increase income while leaving beneficiaries with little voice over its design. A health intervention can improve outcomes while relying on highly paternalistic procedures. A development project can create infrastructure while weakening local organizational capacities. Capability and agency analysis asks whether persons gain substantive scope to shape relevant aspects of their lives and collective environments, although the appropriate weight of agency relative to other values remains a normative question.

GRE's concept of generative capacity creates a nearby but distinct coordinate. Generative capacity concerns the ability of a subject or configuration to produce changes, relations, structures, values, or future possibilities. Agency capability concerns a person's substantive opportunity to pursue valued goals. A powerful organization can possess substantial generative capacity without expanding the agency of affected persons. A person can possess ethically significant agency even when the scale of generated systemic change is small. Preserving this distinction prevents power to produce effects from becoming a substitute for freedom to act as an agent.

Agency is also distributed. Collective action frequently depends on organizations, norms, infrastructures, and coordinated roles. Capability analysis can therefore examine the conditions of collective or political participation without requiring an isolated individualist ontology. Robeyns emphasizes that ethical individualism in capability evaluation does not imply that social structures or relations are explanatorily

irrelevant (Robeyns 2005). This point provides an important bridge to relational reconstruction.

21.20.5 Freedom

Freedom provides the fifth coordinate because the capability approach treats development and advantage partly through the substantive opportunities available to persons. Sen's development framework places expansion of substantive freedom at the center while also emphasizing the instrumental and constitutive roles of political freedoms, economic facilities, social opportunities, transparency guarantees, and protective security (Sen 1999). Freedom in this framework is therefore connected to both opportunity and enabling institutional arrangements.

Definition 21.401 (Substantive freedom). *Substantive freedom* is effective scope to pursue valued beings, doings, and forms of agency under conditions in which relevant opportunities are practically accessible rather than merely formally permitted.

Freedom is not adequately represented by the number of nominal options. Ten inaccessible options do not necessarily provide more substantive freedom than two practically realizable alternatives. Option quality, feasibility, information, cost, social meaning, risk, reversibility, and compatibility with other responsibilities can all affect the freedom represented by an opportunity set. Capability evaluation consequently requires more structure than option counting.

Proposition 21.402 (Freedom-quality condition). *Evaluation of substantive freedom should consider the feasibility, significance, accessibility, and relevant process conditions of available alternatives rather than the cardinality of nominal options alone.*

Freedom also interacts with achievement. An effective health capability can matter even when illness never occurs; political participation can matter even when a person chooses silence; mobility can matter even when a person chooses to remain nearby. Opportunity itself can therefore carry evaluative significance. At the same time, persistent failure to achieve basic functionings can indicate that nominally described opportunities are ineffective or that conversion conditions remain inadequate.

The relation between freedom and responsibility requires care. Expanded opportunity can enable agency, while responsibility for structural deprivation should not be transferred automatically onto individuals on the ground that options formally existed. A job seeker facing discrimination, inaccessible transport, or care obligations can have a very different substantive opportunity structure from another person with the same formal eligibility. Capability analysis keeps those background conditions within the evaluative frame.

GRE can contribute a temporal dimension by asking how present freedoms alter later option spaces. Education, legal status, health, savings, social networks, or political participation can expand future opportunities. Conversely, debt, incarceration, ecological damage, deskilling, prolonged unemployment, or exclusion can narrow later possibilities. This temporal extension is analytically compatible with the capability approach while remaining an additional GRE emphasis unless separately established within a capability formulation.

21.20.6 Heterogeneity

Heterogeneity provides the sixth coordinate because the capability approach takes human diversity seriously in evaluating resources and opportunities. Persons differ in bodily characteristics, health, age, household position, care obligations, social identities, skills, environments, institutional access, and exposure to discrimination. These differences can alter both needs and conversion possibilities. Sen's critique of resource-centered equality relies partly on the fact that equal resources can generate unequal freedom to achieve (Sen 1992).

Definition 21.403 (Capability-relevant heterogeneity). *Capability-relevant heterogeneity* is variation among persons or contexts that materially changes the conversion of resources and institutions into functionings, capabilities, agency, or substantive freedom.

Heterogeneity is not a residual adjustment after a representative-person model. In many problems it determines the object of evaluation. Disability can change the resources required for mobility; pregnancy can change nutritional and healthcare needs; linguistic difference can alter access to public services; rural location can change the practical value of transport infrastructure; caregiving responsibility can alter the time available for education or employment. Capability analysis therefore resists assuming that a uniform input carries a uniform opportunity value.

Proposition 21.404 (Heterogeneity-relevance condition). *Differences among persons or contexts should enter capability evaluation when they materially alter needs, conversion processes, feasible alternatives, agency, or the meaning of achieved functionings.*

The recognition of heterogeneity also complicates aggregation. A population average can improve while a subgroup with distinctive conversion barriers experiences little change. A national increase in school enrollment can coexist with inaccessible education for disabled students or with gendered barriers to completion. Human-development analysis therefore benefits from disaggregation by relevant dimensions where evidence permits.

Nussbaum's capabilities approach adds a different response to heterogeneity by proposing central human capabilities and threshold requirements within a theory of basic political entitlements (Nussbaum 2000). Sen generally leaves the selection and weighting of capabilities more open to reasoned evaluation and public reasoning. These approaches share attention to human diversity while differing in the degree of substantive specification built into the framework.

Adaptive preferences create an additional evaluative difficulty. Persons living under persistent deprivation or restrictive social conditions may adjust aspirations to feasible surroundings. Nussbaum's analysis makes this issue particularly salient in relation to gender injustice (Nussbaum 2000). Capability evaluation therefore cannot infer adequate freedom solely from reported satisfaction. The response, however, requires epistemic humility: external analysts can also misidentify what persons value. Public reasoning, participatory inquiry, contextual evidence, and explicit normative argument remain important safeguards.

21.20.7 Relational Reconstruction

A GRE relational reconstruction begins from a strong point of contact: capability is already mediated by relations among persons, resources, institutions, infrastructures,

environments, and social rules. The reconstruction therefore does not need to transform an isolated-resource theory into a relational one. Its task is to make the architecture of conversion and capability formation more explicit, especially where interdependence, institutional interfaces, power, and historical sequence shape effective opportunity.

Definition 21.405 (Relational capability architecture). *A relational capability architecture is the history-bearing configuration of resources, persons, institutions, infrastructures, social relations, conversion conditions, and power relations through which substantive opportunities and achieved functionings are enabled, constrained, distributed, and transformed.*

The first reconstruction concerns resource relations. A person's command over a resource can depend on property rights, household allocation, market access, administrative eligibility, social recognition, or political membership. Sen's entitlement analysis already demonstrates that access to food cannot be inferred directly from aggregate availability because persons' command over resources depends on legally and economically structured entitlement relations (Sen 1981). The capability framework generalizes the evaluative concern from command over commodities to what such command permits persons to achieve.

Second, conversion factors can be represented as relational interfaces. A public transit system converts geographic location and monetary resources into mobility only through schedules, accessibility, safety, legal access, and network coverage. A university converts prior learning and financial support into educational opportunity through admissions rules, teaching practices, language systems, housing, assessment, and disability accommodation. These interfaces are institutional and relational rather than properties of the resource alone.

Proposition 21.406 (Relational-conversion condition). *A capability explanation should represent conversion as a relation among resources, persons, institutions, and environments whenever effective opportunity depends on their joint configuration.*

Third, power affects capability formation. Control over housing, documentation, wages, care, credit, information, or public authorization can change another person's effective options. Discrimination can reduce conversion from education to employment. Household authority can limit practical access to income that appears available at household level. Administrative discretion can determine whether a formal entitlement becomes an effective service. GRE's power vocabulary can help trace these mechanisms while capability analysis supplies the evaluative question of what happens to persons' substantive opportunities and agency.

Fourth, capabilities can be interdependent across persons. One person's mobility may depend on another person's unpaid care. A child's educational capability can depend on parental time, school quality, public transport, and neighborhood safety. A caregiver's employment capability can depend on accessible childcare. Such relations create distributions of capability in which expansion for one person can support, leave unchanged, or constrain another person's opportunities depending on institutional design.

Proposition 21.407 (Capability-interdependence condition). *Where one person's capability depends materially on another person's time, resources, authority, or institutional position, analysis should represent the coupled capability effects rather than evaluating each person as an isolated unit.*

Fifth, representation matters. Capability indicators, poverty thresholds, composite indices, surveys, administrative records, and qualitative accounts are manifestations of a richer opportunity structure. They can support evaluation without fully reproducing it. GRE's epistemic framework therefore treats capability measurement as an inverse problem: observed functionings and institutional conditions provide evidence about effective opportunity, while several underlying capability configurations may remain compatible with the same observed outcome.

This reconstruction strengthens the connection between capability analysis and the book's wider economic architecture. Allocation affects capability through conversion relations; institutions organize conversion; power shapes access and agency; heterogeneous value affects which functionings matter; and historical trajectories shape the opportunity sets inherited by later persons. The reconstruction remains useful only if these additions preserve the capability approach's evaluative focus on what persons are effectively able to be and do.

21.20.8 Generative Extension

The generative extension asks how present capability configurations participate in producing future capabilities, constraints, relations, and institutional possibilities. Capability approaches already contain temporal concerns through education, health, participation, public action, and development. GRE adds a more explicit focus on the mechanisms through which capabilities become causes of later capability formation and on the possibility that institutions alter the rules governing those processes.

Definition 21.408 (Capability generativity). *Capability generativity* is the capacity of a present functioning, capability, relation, or institutional arrangement to contribute to the formation, preservation, transformation, or loss of future substantive opportunities for oneself or others.

Education provides a simple illustration. Literacy is an achieved functioning and can also expand later capabilities for employment, political participation, information access, further learning, and navigation of institutions. Health can preserve future work, care, mobility, and participation capabilities. Legal identity can enable later access to banking, education, healthcare, travel, and political rights. These effects are not uniform, and their pathways depend on institutions and relations.

Proposition 21.409 (Capability-propagation condition). *A generative capability analysis should identify the mechanism through which a present capability or functioning changes later opportunity structures, together with the persons, time horizon, and institutional conditions over which that effect is expected to operate.*

The extension also includes capability preservation. Some arrangements prevent the erosion of future opportunity rather than producing visibly new options. Preventive healthcare, social insurance, ecosystem protection, maintenance of public infrastructure, preservation of legal status, or continuing education can keep capability sets from contracting. Preservation is therefore generative in a broad temporal sense when it changes the future relative to a credible deterioration pathway.

Capability effects can propagate across persons and generations. Children's capabilities depend partly on adult care, education systems, public health, housing, and environmental conditions. Caregivers' opportunities can in turn depend on how those responsibilities are distributed. Infrastructure financed by one generation can expand or constrain the options of later generations. Generative assessment therefore

benefits from tracing capability relations across time and across linked subjects.

Proposition 21.410 (Interpersonal capability propagation). *Capability-generative effects should be evaluated across affected persons when one person's opportunity expansion or preservation depends on transfers of time, risk, resources, environmental burden, or institutional constraint to others.*

The generative extension also distinguishes capability expansion from an increase in the sheer number of options. An institution can create many low-value or inaccessible alternatives while weakening basic security. Conversely, a regulation can remove harmful options while expanding meaningful freedom through safety or trust. The evaluative object remains substantive capability, so generativity should be assessed through the quality and distribution of future opportunity rather than option proliferation alone.

Proposition 21.411 (Generative-quality condition). *An increase in future options constitutes capability expansion only to the extent that it enlarges substantive opportunities relevant to the evaluative problem and does not rely on hidden capability losses that alter the conclusion.*

A further extension concerns institutional self-reinforcement. Expanded education and political participation can alter public expectations, organizational capacities, and demand for accountable institutions; improved health systems can generate professional knowledge and administrative capability; exclusion can reproduce distrust, low participation, and weak institutional access. These are hypotheses about recursive capability formation rather than consequences that follow automatically from the capability approach. They require historical and empirical investigation.

The human-development lineage provides a natural interface because it already treats health, education, income, participation, and public institutions as mutually relevant to people's possibilities (United Nations Development Programme 1990; Sen 1999). GRE's contribution is to make recursive generation, temporal propagation, and changes in the capability-generating architecture explicit research objects.

21.20.9 Limits of Translation

The translation between capability and human-development approaches and GRE is extensive because both attend to possibility, heterogeneous conditions, institutional mediation, agency, and the consequences of present arrangements for what can occur. The overlap nevertheless leaves important remainders. Capability analysis is an evaluative framework concerned with substantive human opportunities, while GRE is a broader relational-generative research programme whose objects also include institutions, organizations, ecological configurations, symbolic systems, and non-human relations. Shared language of capability or possibility does not establish theoretical identity.

Definition 21.412 (Capability translation remainder). *A capability translation remainder is an evaluative distinction, normative commitment, informational requirement, measurement problem, or theory-specific concept whose role is altered or weakened when translated into GRE's more general vocabulary of relations, capacities, constraints, and future possibilities.*

The first remainder concerns valuation. Capability approaches require judgments about which functionings and capabilities matter. Sen leaves substantial room for

public reasoning and context-sensitive selection, while Nussbaum offers a more substantively specified list and threshold orientation (Sen 1992; Nussbaum 2000). GRE can represent heterogeneous value and competing evaluative regimes, but relational structure alone cannot select the capabilities that deserve priority. That choice requires normative and political argument.

The second remainder concerns the subject of evaluation. Capability approaches characteristically focus on persons and what they can effectively be and do. GRE can analyze capability-like properties of organizations or institutions, yet calling organizational adaptability a “capability” does not place it within the same evaluative space as human capability. The translation should therefore preserve the person-centered normative role of capability when capability literature is being reconstructed.

Proposition 21.413 (Person-centered translation condition). *GRE translation should preserve the person-centered evaluative role of capabilities where that role is constitutive of the source argument, even when broader relational analysis includes organizations, institutions, or ecological systems.*

The third remainder concerns agency. GRE can model generative capacity and power, yet these concepts do not determine whether a person enjoys agency freedom in Sen’s sense. Capacity to cause change can coexist with coercion, domination, or the inability to pursue goals one values. Conversely, agency can be meaningful even when systemic causal influence is limited. Translation therefore requires separate coordinates for causal efficacy and substantive agency.

The fourth remainder concerns measurement. Capabilities are partly counterfactual and can remain unobserved. Functioning data, stated preferences, resource measures, or administrative indicators provide incomplete evidence. Alkire’s operational work emphasizes the need for explicit dimension selection, valuation, and practical methods under informational constraints (Alkire 2002). GRE’s inverse-problem epistemology can describe this underdetermination, yet it does not by itself solve the empirical task of identifying feasible alternatives.

Proposition 21.414 (Capability-evidence condition). *A claim about substantive capability should state the evidential basis for inferred feasible alternatives and distinguish observed achievement from reconstructed opportunity wherever that distinction affects the argument.*

The fifth remainder concerns freedom’s normative status. GRE may treat future possibility as analytically important because option spaces affect resilience, agency, and generativity. Capability approaches additionally ask why particular human freedoms matter and how they should enter evaluation. An open future is not automatically a just or valuable future. Some possibilities involve domination, harm, or exclusion. Normative evaluation therefore remains indispensable.

The sixth remainder concerns incompleteness and pluralism. Capability frameworks often retain multidimensional informational spaces precisely because reduction to one scalar measure can hide important differences. Operational policy, however, frequently requires selection, thresholds, weights, or aggregation. Human-development indicators demonstrate both the practical value and the compression involved in measurement (United Nations Development Programme 1990). GRE’s heterogeneous-value framework can help keep the compression visible, but it cannot eliminate the need for accountable judgment when decisions require comparison.

Proposition 21.415 (Capability–GRE non-identity). *Shared attention to effective possi-*

bility, enabling conditions, heterogeneity, and freedom supports substantial dialogue between capability approaches and GRE while leaving distinct normative, informational, and person-centered commitments intact.

The domain of adequacy is therefore complementary. Capability and human-development approaches are especially strong when the economic question concerns what persons are effectively able to achieve, how resources convert differently across heterogeneous circumstances, how agency and substantive freedom should enter evaluation, and how development extends beyond income or production. GRE can contribute a broader architecture for tracing institutional interfaces, power over conversion pathways, temporal propagation, capability interdependence, and the generation of future opportunity structures. The dialogue is strongest when capability theory continues to discipline GRE's account of human freedom while GRE treats the production and transformation of capability spaces as an explicit historical and relational research object.

Proposition 21.416 (Capability dialogue condition). *A productive dialogue preserves capability and human-development approaches as independent evaluative frameworks while using GRE to investigate the relational and temporal mechanisms through which substantive opportunities are formed, distributed, preserved, and transformed.*

21.21 Ecological Economics

Chapter 2, Section 2.26, reconstructed ecological economics as a heterogeneous lineage concerned with material and energy flows, ecological constraints, human-ecological interdependence, intergenerational relations, and regenerative capacity. The present section treats that genealogy as a baseline and asks how ecological-economic mechanisms constrain and correct GRE. Its emphasis is on biophysical dependence, social metabolism, ecological limits, intergenerational and non-human relations, plural valuation, and the conditions under which a generative claim must remain physically grounded. The aim is reciprocal translation with explicit remainder, not absorption of ecological economics into a general relational vocabulary. Table 21.21 summarizes the principal coordinates.

Definition 21.417 (Ecological-economic configuration). *An ecological-economic configuration is an analytically specified arrangement of economic activities, material and energy flows, ecological stocks and processes, institutions, technologies, human and non-human affected positions, and temporal relations through which economic production, consumption, maintenance, and transformation depend on and alter ecological conditions.*

Ecological economics developed in part through dissatisfaction with representations of environmental problems as peripheral corrections to an otherwise self-contained economy. Costanza's early programmatic account described ecological economics as inquiry into relations between ecological and economic systems in a broad interdisciplinary sense (Costanza 1989). Material-balance analysis, thermodynamic reasoning, sustainability theory, systems analysis, social-ecological research, and debates over valuation subsequently provided distinct routes into this shared field (Ayres and Kneese 1969; Georgescu-Roegen 1971; Daly 1990; Norgaard 1994; Ostrom 2009). The resulting tradition contains substantial internal disagreement concerning substitutability, scale, valuation, welfare, technological change, governance,

Table 21.21: Relational coordinates for ecological economics

Coordinate	Ecological-economic analytical object	Dialogue boundary
Biophysical constraints	Material, energetic, regenerative, assimilative, and thermodynamic conditions of economic activity	Derivation of institutions, prices, distribution, or normative priorities directly from physical constraints
Social metabolism	Historically organized extraction, transformation, circulation, accumulation, consumption, and residual flows	Reduction of economic relations to material-flow accounting or treatment of monetary circulation as a sufficient physical description
Ecological limits	Thresholds, capacities, stocks, sinks, resilience properties, and Earth-system conditions relevant to continued activity	Treatment of every ecological limit as a fixed scalar ceiling or every technological response as unlimited substitution
Intergenerational relations	Transmission of resources, infrastructures, ecological conditions, risks, and option spaces through time	Identification of sustainability with one aggregate capital measure or one discounting rule
Non-human relations	Ecological dependence, causal participation, exposure, stewardship, represented interests, and forms of standing	Equation of ecological affectedness with agency, legal personhood, welfare, or one common normative status
Incommensurable values	Plural ecological, economic, cultural, ethical, capability, and relational values with partial or contested comparability	Presumption that monetary valuation exhausts significance or that plurality precludes every form of comparison
Relational reconstruction	Coupled history-bearing architecture linking economic and ecological processes, institutions, value, and power	Absorption of ecological economics into generic relational vocabulary without retaining biophysical specificity
Translation limit	Irreducibility of physical law, normative judgment, ecological knowledge, scale, uncertainty, and discipline-specific concepts	Identity inferred from shared concern with systems, relations, limits, resilience, or long-run generativity

and the appropriate relation between physical and monetary analysis.

Proposition 21.418 (Ecological reconstruction condition). *A relational reconstruction of ecological economics should preserve distinctions among biophysical feasibility, ecological capacity, social organization, valuation, distribution, institutional governance, and normative judgment while tracing the relations through which these dimensions condition one another.*

21.21.1 Biophysical Constraints

Biophysical constraints provide the first coordinate because ecological economics treats economic activity as materially and energetically situated. Production requires physical inputs, infrastructures, land, energy, and ecological processes; consumption and production generate residuals, emissions, heat, transformed matter, and accumulated stocks. Monetary accounts can record transactions while leaving these physical transformations incompletely represented. Ecological analysis therefore adds a domain of feasibility that remains relevant even where market values or financial flows appear internally balanced.

Definition 21.419 (Biophysical constraint). *A biophysical constraint is a material, energetic, thermodynamic, regenerative, assimilative, spatial, or ecological condition that limits, shapes, or conditions the feasible operation and continuation of an economic process within a specified system boundary and timescale.*

Ayres and Kneese's material-balance analysis made residual generation integral to the physical representation of production and consumption: material inputs remain physically consequential after market exchange and eventually enter products, stocks, wastes, or emissions (Ayres and Kneese 1969). Georgescu-Roegen developed a stronger thermodynamic account in which economic processes transform available matter and energy in ways characterized by irreversibility and qualitative degradation (Georgescu-Roegen 1971). These arguments establish a physical discipline on economic representation without supplying a complete theory of institutions, prices, or value.

The distinction between physical necessity and social organization is central. Conservation laws can constrain what transformations are physically possible, while technology, property, infrastructure, regulation, organizational routines, and consumption conventions affect which physically possible transformations are realized. A society can therefore encounter the same broad physical law through very different economic architectures. Biophysical embeddedness narrows the feasible domain while leaving substantial institutional and historical variation inside it.

Proposition 21.420 (Biophysical-institutional distinction). *A biophysical constraint can delimit feasible transformations without determining the institutional form, distributive arrangement, valuation regime, or normative priority through which economic actors respond to that constraint.*

This distinction also disciplines technological optimism and technological pessimism. Innovation can change conversion efficiency, material intensity, substitution possibilities, monitoring capacity, recovery processes, and the useful services obtained from a given resource flow. Such changes can materially alter local constraints. Their existence does not establish unbounded substitution because some ecological functions, spatial conditions, thresholds, or irreversible losses can remain difficult or impossible to replace at relevant scales. The empirical question concerns which constraint is altered, by what mechanism, over which timescale, and with which displaced burdens.

Daly's operational sustainability principles illustrate the importance of process-specific capacities by relating renewable-resource use to regeneration and waste emission to assimilative capacity (Daly 1990). The analytical object is therefore dynamic. A stock that appears adequate at one date can become vulnerable when extraction exceeds renewal; a sink can become impaired when residual flows exceed

its capacity to absorb or transform them. The future feasible set depends partly on rates and processes, not solely on contemporaneous quantities.

Proposition 21.421 (Dynamic biophysical condition). *Biophysical feasibility should be evaluated through stocks, flows, rates of renewal or degradation, relevant thresholds, and timescales whenever these dynamics materially affect later economic possibilities.*

GRE can translate these conditions as constraints acting within a history-bearing relational configuration. The translation becomes useful when economic institutions themselves alter later constraints through extraction, restoration, pollution, infrastructure, technological change, or land-use transformation. The resulting relation is recursive: current activity occurs within inherited ecological conditions and can contribute to the ecological conditions encountered by later activity. This recursive structure provides an interface with GRE's analysis of generativity while preserving the physical specificity contributed by ecological economics.

21.21.2 Social Metabolism

Social metabolism provides the second coordinate because material and energy flows acquire economic form through historically organized systems of extraction, transformation, circulation, accumulation, consumption, and disposal. The concept directs attention toward the physical reproduction of societies while retaining institutions, technologies, spatial organization, and social relations as mediating structures. It therefore provides a bridge between biophysical accounting and political-economic analysis.

Definition 21.422 (Social metabolism). *Social metabolism* denotes the historically organized processes through which a society or economic configuration appropriates material and energy, transforms and circulates them through infrastructures and production systems, accumulates them in stocks, consumes their services, and returns residuals to ecological systems.

Material-balance reasoning supplies one foundation for such analysis because physical inputs and residuals can be followed across stages that monetary accounts may separate (Ayres and Kneese 1969). The approach can reveal that a commodity transaction forms only one segment of a longer material history. A building incorporates extracted minerals, energy-intensive processing, transport, labor, land, and infrastructure; during use it requires maintenance and energy; at the end of use its materials may enter reuse, recycling, landfill, dispersion, or long-lived waste streams. The economic object consequently extends across a chain of transformations.

Social metabolism also makes spatial displacement visible. Consumption in one jurisdiction can depend on extraction, land transformation, water use, emissions, or waste treatment elsewhere. National income accounts can attribute value to the place of exchange or production while ecological burdens propagate through supply chains and distant ecosystems. The relevant relational structure can therefore cross firm, sectoral, regional, and national boundaries.

Proposition 21.423 (Metabolic boundary). *An analysis of social metabolism should state the spatial, temporal, organizational, and material boundaries within which inputs, accumulated stocks, useful outputs, and residual flows are being traced.*

The metabolism concept remains broader than circularity. Recirculation, reuse, repair, remanufacture, or recycling can reduce some virgin inputs and residual out-

puts, yet large material systems continue to require energy and frequently depend on additions to physical stocks. Empirical circularity studies therefore examine actual flows rather than inferring closure from the presence of recycling practices (Haas et al. 2015). A metabolism can become less throughput-intensive while remaining physically open.

Institutional organization affects metabolic form. Product standards, property rights, infrastructure, procurement rules, energy systems, urban design, taxation, trade arrangements, waste regulation, and business models can influence which materials move, how long stocks remain in service, and where residuals are transferred. Social metabolism is therefore neither a purely ecological process nor a free-standing social metaphor. It describes a physical process whose organization is socially and institutionally structured.

Proposition 21.424 (Metabolic mediation condition). *A metabolic account becomes economically explanatory when it identifies the institutions, technologies, infrastructures, and relations that organize material and energy flows in addition to measuring the flows themselves.*

GRE can extend this account by tracing how metabolic architectures redistribute generative capacity. A transport system can expand mobility while locking later investment into material-intensive infrastructures. A supply chain can generate income in one location while transferring pollution risk to another. A repair ecosystem can preserve material stocks and simultaneously maintain local knowledge, employment, and organizational capability. These are relational consequences coupled to physical flows. The GRE contribution lies in tracing their propagation across heterogeneous value dimensions; the ecological-economic contribution lies in ensuring that this tracing remains constrained by the material carriers and ecological processes through which those consequences occur.

21.21.3 Ecological Limits

Ecological limits provide the third coordinate because economic activity occurs within ecological processes that possess finite stocks, regenerative rates, assimilative capacities, thresholds, and resilience properties. The analytical problem concerns the conditions under which economic scale and composition remain compatible with continued ecological functioning. This problem differs from scarcity among substitutable market goods because some ecological changes can alter the conditions within which later substitution, production, and welfare become possible.

Definition 21.425 (Ecological limit). *An ecological limit is a context-specific boundary, threshold, capacity, stock condition, rate condition, or risk region beyond which additional pressure materially increases the likelihood of ecological degradation, loss of function, regime change, or contraction of relevant future possibilities.*

The definition is deliberately plural. Some limits concern depletion of a stock; others concern regeneration rates, pollution loads, habitat fragmentation, biodiversity, climatic conditions, or coupled Earth-system processes. Some can be approximated through relatively continuous response functions, while others involve nonlinear change, uncertainty, or path dependence. The existence of ecological constraint therefore does not imply that every ecological process has one precisely known scalar threshold.

Holling's distinction between resilience and stability is relevant because persis-

tence under disturbance differs from rapid return toward an equilibrium state (Holling 1973). An ecosystem can retain important relations across substantial variation, while another can appear stable until a disturbance moves it into a different regime. Economic governance based solely on average conditions can consequently miss the significance of response structure and recovery capacity.

The planetary-boundaries framework provides a large-scale example of limit-oriented reasoning. Steffen and colleagues identify interacting Earth-system processes and propose boundaries intended to characterize a space of lower systemic risk for human development (Steffen et al. 2015). Such boundaries are scientific risk frameworks rather than prices, legal entitlements, or complete policy rules. Translation into economic action requires institutional judgment concerning burden sharing, uncertainty, responsibility, technology, distribution, and development needs.

Proposition 21.426 (Limit-to-governance condition). *Identification of an ecological limit or risk boundary should be followed by a separate analysis of the institutional, distributive, technological, and normative mechanisms through which economic activity is expected to respond.*

Natural-capital debates expose a related issue concerning substitution. Costanza and Daly argue for maintaining natural capital under uncertainty and question reliance on substitution where ecological functions may be critical or poorly replaceable (Costanza and Daly 1992). A relational formulation can make the disagreement more precise by asking which function is being substituted, which beneficiaries and affected systems are included, which spatial and temporal scales are relevant, and what residual losses remain after substitution.

Proposition 21.427 (Substitution-specification condition). *Claims of ecological substitutability should specify the function being replaced, the substitute mechanism, affected subjects or systems, relevant scales and timescales, and the residual value or capacity losses that remain after the proposed substitution.*

GRE's criticality vocabulary can sometimes enter this dialogue, but the correspondence requires restraint. An ecological threshold, a regulatory limit, and a dynamical critical transition are different concepts. Evidence of nonlinear response or abrupt regime shift can motivate criticality analysis; the language of criticality should remain conditional on an identified dynamical mechanism. Ecological economics contributes the substantive ecological variables and processes against which such a formal description would need to be tested.

Ecological limits also create a generative question. Economic action can preserve, erode, or restore capacities upon which later action depends. A wetland, forest, aquifer, soil system, climate regime, or pollinator network can participate in the generation of future economic possibilities through ecological functions that are not reducible to contemporaneous output. GRE can therefore treat ecological capacity preservation as a form of future-option preservation where the empirical mechanism is established, while ecological economics supplies the biophysical content and measurement discipline for that claim.

21.21.4 Intergenerational Relations

Intergenerational relations provide the fourth coordinate because ecological decisions can transmit resources, infrastructures, pollution stocks, climatic conditions,

biodiversity, technologies, knowledge, risks, and institutional commitments to persons who enter the economic field later. The temporal asymmetry is substantial: present actors can alter future conditions while future persons generally cannot participate symmetrically in current bargaining or markets. Ecological economics therefore connects sustainability to questions of capital, substitution, discounting, uncertainty, and justice.

Definition 21.428 (Intergenerational ecological relation). *An intergenerational ecological relation is a temporally extended causal and institutional connection through which actions, infrastructures, ecological changes, or governance arrangements in one period alter the resources, risks, capacities, constraints, or substantive options available to persons and communities in later periods.*

Resource economics offers a formal route into this problem. Solow analyzes intergenerational consumption possibilities under exhaustible-resource use and substitution with reproducible capital, while Hartwick identifies conditions under which investing resource rents can sustain constant per-capita consumption in a specified model (Solow 1974; Hartwick 1977). These results clarify how substitution and investment can mediate depletion under particular assumptions. Ecological economics raises an additional question concerning the ecological functions for which manufactured substitutes may be limited, uncertain, or unavailable.

The resulting disagreement should be located at the level of assumptions rather than described as a simple opposition between economics and ecology. Relevant questions include whether the depleted resource provides one service or several, whether those services are separable, whether substitutes exist at sufficient scale, whether ecological thresholds are known, how uncertainty is treated, and which distribution of risk across generations is acceptable. The sustainability conclusion can change when these assumptions change.

Proposition 21.429 (Intergenerational transmission condition). *An intergenerational sustainability analysis should identify the ecological or productive capacities transmitted through time, the mechanism of preservation or substitution, the relevant uncertainty, and the distribution of residual risk among later affected populations.*

Discounting is one institutionalized method for comparing temporally distributed consequences, yet the choice of discounting framework includes empirical and normative commitments. Long-lived ecological damage can receive sharply different present weights under different rates and formulations. Rights, safe-minimum standards, preservation rules, liability regimes, and public investment can encode different temporal relations. Ecological economics makes these choices visible as part of economic evaluation.

GRE can reconstruct intergenerational relations through history-bearing configurations. Future persons need not be simultaneously present for current arrangements to alter their feasible conditions. Infrastructure, debt, educational systems, legal institutions, ecological stocks, and technological platforms can carry consequences forward. The relation is mediated through persistent structures and altered environments rather than contemporaneous exchange.

Proposition 21.430 (Future-option inheritance). *Present economic activity can generate an intergenerational consequence when it materially changes the feasible options, ecological capacities, institutional burdens, or risk exposures inherited by later populations.*

This formulation also separates sustainability from justice. Preservation of an aggregate productive capacity can coexist with unequal exposure to ecological harm, and equal present distribution can coexist with severe future capacity loss. Inter-generational evaluation therefore requires at least two analytically distinguishable questions: whether relevant capacities persist and how benefits, burdens, risks, and decision rights are distributed across time and populations.

The GRE concept of generativity creates a natural interface because present arrangements can expand or contract later spaces of action. Ecological economics strengthens that interface by identifying biophysical pathways through which generative consequences are carried. The translation remains partial: a larger future option space is not automatically ecologically sustainable, and ecological sustainability does not by itself specify a just distribution of those options.

21.21.5 Non-Human Relations

Non-human relations provide the fifth coordinate because economic processes depend on and affect ecological entities and systems that frequently fall outside conventional models of market agency. Soils, watersheds, forests, species assemblages, animals, climatic processes, and material infrastructures can participate causally in economic life through provisioning, regulation, exposure, vulnerability, and ecological interdependence. Their economic relevance does not require treating all of them as equivalent subjects or assigning them one common normative status.

Definition 21.431 (Non-human ecological relation). *A non-human ecological relation is an economically consequential connection involving a non-human organism, population, ecosystem, material system, or ecological process through dependence, causal participation, exposure, stewardship, representation, or another explicitly specified form of standing.*

Ecosystem-services research made many forms of ecological dependence legible to economic analysis by identifying contributions of ecological systems to human life and economic activity (Costanza, d'Arge, et al. 1997). Monetary valuation can support comparison, policy visibility, or damage assessment in some contexts. The same ecological configuration can also possess cultural, ethical, ecological, relational, or existence significance that is imperfectly captured by a monetary estimate. The analytical task is therefore to specify what form of relation and value a particular representation is intended to capture.

Non-human affectedness should remain distinct from agency. An ecosystem can be substantially altered by extraction or pollution without choosing, bargaining, or expressing preferences. Sentient animals can raise welfare questions that differ from questions concerning species persistence or ecosystem function. A river can possess legal standing in one institutional order without becoming an optimizing agent. A forest can be materially indispensable to livelihoods while its ecological importance extends beyond its contribution to human income. These distinctions prevent a broad relational vocabulary from flattening heterogeneous forms of relevance.

Proposition 21.432 (Affectedness–agency distinction). *Economic analysis should specify whether a non-human configuration enters the inquiry through causal participation, exposure, welfare, ecological function, legal standing, cultural relation, stewardship responsibility, or another identified dimension, and should avoid inferring agency from affectedness alone.*

Representation becomes an institutional problem where affected positions cannot participate through ordinary market or deliberative channels. Scientific monitoring, environmental law, guardianship, customary institutions, conservation organizations, community knowledge, ethical argument, and public agencies can represent different dimensions of ecological concern. Each representation selects variables, scales, baselines, and categories. The resulting manifestational layer can make some relations visible while leaving others obscure.

Ostrom's social-ecological systems framework illustrates the value of analyzing resource systems, resource units, governance systems, users, interactions, and outcomes together (Ostrom 2009). The framework does not require identical agency across components. Its analytical contribution lies in showing that sustainability outcomes emerge through coupled ecological and institutional relations. Norgaard's co-evolutionary account similarly emphasizes reciprocal change between social and ecological systems (Norgaard 1994).

Proposition 21.433 (Ecological representation condition). *Where non-human affected positions enter economic decision through human institutions or scientific representations, analysis should identify the representational mechanism, its evidential basis, the dimensions retained, and the dimensions that may remain unrepresented.*

GRE can accommodate non-human relations because its analytical domain is not restricted to point-like maximizing actors. The gain is an ability to trace relations of dependence, power, exposure, mediation, and future capacity across heterogeneous participants. Ontological restraint remains important. Relational inclusion does not establish consciousness, personhood, rights, welfare, or moral standing. Those claims require separate philosophical, scientific, legal, or political argument appropriate to the case.

21.21.6 Incommensurable Values

Incommensurable values provide the sixth coordinate because ecological decisions frequently involve heterogeneous dimensions that resist complete representation through a single metric. Market income, human health, biodiversity, livelihood, cultural attachment, ecological integrity, animal welfare, landscape meaning, capability, intergenerational interest, and option value can enter the same decision while differing in units, evidential bases, institutional recognition, and normative status. Ecological economics therefore places valuation itself inside the research problem.

Definition 21.434 (Ecological value plurality). *Ecological value plurality* is a configuration in which several ecologically relevant dimensions of value are recognized while their relations of comparability, commensurability, aggregation, and institutional priority remain explicitly specified rather than presumed in advance.

Plurality does not imply that comparison is impossible. Some decisions permit robust comparison within one dimension; others permit partial ordering, thresholds, constraints, multi-criteria reasoning, deliberative judgment, or monetary valuation for a specified purpose. Incommensurability identifies limits to a common measure, whereas incomparability concerns whether two alternatives can be ordered within a particular evaluative relation. These distinctions matter because declaring values "incommensurable" can otherwise obscure the practical forms of comparison that institutions actually use.

Research on commensuration shows that conversion to a common metric is itself

a social and political process with consequences for what becomes visible and actionable (Espeland and Stevens 1998). Fourcade's analysis of the monetary valuation of nature similarly demonstrates that economic valuation involves institutionalized techniques, cultural assumptions, and feedback into the way nature is represented (Fourcade 2011). Monetary valuation can therefore be analytically useful while remaining a transformation of heterogeneous significance into a particular comparison format.

Proposition 21.435 (Valuation-interface condition). *An ecological valuation should state which value dimensions enter the comparison, which conversion or aggregation procedure is used, which dimensions remain outside that procedure, and how the resulting representation affects decision authority and distribution.*

This point connects directly to GRE's analysis of heterogeneous value and conversion interfaces. An ecological service may be converted into a monetary damage estimate, a regulatory threshold, a conservation category, a legal right, a public-health indicator, or a cultural-protection claim. Each conversion enables some forms of coordination while potentially discarding other properties. Control over the interface can therefore become a form of power: actors able to determine the accepted metric can influence which harms and benefits become institutionally legible.

Anderson's account of plural modes of valuation supplies a broader philosophical support for retaining qualitative differences among goods and evaluative relations (Anderson 1993). GRE can use this plurality to analyze value conversion without presupposing that every value must terminate in a common scalar. At the same time, plural valuation does not remove the need to decide. Public institutions often require budgets, standards, priorities, permits, or prohibitions. The challenge is to make the conversions and residual remainders visible enough for those judgments to remain contestable.

Proposition 21.436 (Ecological conversion remainder). *When heterogeneous ecological values are translated into a common decision metric, the analysis should preserve any materially relevant value remainder whose exclusion could alter the interpretation, distribution, legitimacy, or reversibility of the decision.*

The domain of adequacy for monetary valuation is consequently conditional. Monetary estimates can support compensation analysis, cost comparison, budgeting, liability, or the visibility of previously ignored ecological functions. They become less informative where ecological thresholds, rights, irreversible losses, non-substitutable functions, or plural normative commitments dominate the decision. Ecological economics contributes a discipline of matching valuation method to evaluative object rather than treating one metric as universally sufficient.

21.21.7 Relational Reconstruction

The preceding coordinates permit a GRE reconstruction that preserves ecological economics as an independent source of biophysical and evaluative discipline. The central object is a history-bearing social-ecological configuration in which economic subjects, institutions, technologies, infrastructures, ecological processes, material flows, value systems, and governance arrangements co-condition one another over time. The reconstruction asks how these relations generate, preserve, redistribute, or erode later capacities while maintaining a distinction between physical mechanism and relational interpretation.

Definition 21.437 (Generative ecological architecture). A *generative ecological architecture* is a history-bearing configuration of ecological processes, economic relations, institutions, technologies, infrastructures, and value-conversion mechanisms through which present activity changes the capacities and constraints governing subsequent ecological and economic possibilities.

The first element is material grounding. GRE's relations require carriers and conditions where the phenomenon is materially instantiated. Food relations depend on soils, water, energy, organisms, transport, storage, knowledge, and institutions. Urban mobility depends on land, infrastructures, energy systems, vehicles, regulation, settlement patterns, and maintenance. A relational description that omits these physical conditions would lose part of the causal architecture identified by ecological economics.

The second element is temporal propagation. Extraction can produce present value while altering future stocks; restoration can impose present cost while improving later ecological capacity; infrastructure can create long-lived patterns of resource demand; pollution can accumulate before consequences become visible. GRE can represent these processes as changes in a history-bearing configuration whose effects appear at several later timescales.

Proposition 21.438 (Ecological generativity condition). *An ecological process should be described as generative within GRE only when a specified present relation or intervention can be linked through an evidenced mechanism to a change in later ecological, economic, institutional, or capability conditions.*

The third element is power. Ecological burdens and benefits are often distributed through property, regulation, infrastructure, trade, finance, territorial control, knowledge, and political representation. Actors with greater capacity to determine land use, extraction rates, technological standards, siting, acceptable evidence, or valuation metrics can shape the ecological conditions encountered by others. Ecological inequality therefore concerns more than unequal outcomes; it can include unequal authority over the processes that generate those outcomes.

Definition 21.439 (Ecological conversion power). *Ecological conversion power* is the relational capacity to influence the institutional interfaces through which ecological conditions, harms, services, risks, or values are translated into recognized economic categories, rights, prices, standards, or decisions.

The fourth element is representation. Ecological states are known through measurements, classifications, models, remote sensing, indicators, local knowledge, administrative records, and scientific inference. GRE's manifestation-reality distinction can help separate an ecological condition from the indicator used to represent it. A carbon price, biodiversity index, environmental-impact score, or satellite measure can be decision-relevant while remaining a partial representation of a more complex ecological configuration.

Proposition 21.440 (Ecological manifestation condition). *A GRE reconstruction should distinguish ecological processes from the indicators and classifications through which they become institutionally visible whenever representational choices materially affect inference or decision.*

The fifth element is regeneration. Ecological economics makes clear that preservation can be dynamic. Maintaining a stock can require continuing renewal, maintenance, disturbance regimes, institutional restraint, or active restoration. Genera-

tive analysis therefore includes both creation of new capacity and preservation of capacity against credible degradation. This structure parallels the book's broader treatment of preservation without converting ecological regeneration into a generic metaphor.

A final element is scale. Relations that appear sustainable locally can depend on burdens displaced elsewhere; efficiencies at a facility can coexist with rising aggregate throughput; restoration at one site can be outweighed by degradation across a wider landscape. A GRE ecological analysis should therefore state the scale at which generative consequences are assessed and examine cross-scale propagation where it affects the conclusion.

Proposition 21.441 (Cross-scale ecological condition). *Claims about ecological generation, preservation, or sustainability should identify the relevant spatial and temporal scale and examine displaced or propagated effects across other scales when those effects can materially alter the assessment.*

This reconstruction gives GRE a stronger ecological discipline while giving ecological economics a vocabulary for tracing heterogeneous relational consequences. The contribution is reciprocal. Ecological economics constrains GRE's generative analysis through material, energetic, and ecological processes; GRE connects those processes to power, value conversion, institutional formation, epistemic mediation, subject heterogeneity, and future option structures. The dialogue remains productive to the extent that each tradition retains the concepts through which it detects failures in the other.

21.21.8 Limits of Translation

The translation between ecological economics and GRE is extensive because both can analyze interdependence, history, heterogeneous value, feedback, capacity, uncertainty, and future possibility. The overlap nevertheless leaves important remainders. Ecological economics contains biophysical claims that retain validity independently of GRE's relational vocabulary, while GRE includes social, institutional, normative, and generative objects whose behavior cannot be inferred from ecological law. Productive dialogue therefore requires explicit limits to translation.

Definition 21.442 (Ecological translation remainder). *An ecological translation remainder is a biophysical law, ecological mechanism, normative commitment, measurement problem, scale dependence, uncertainty, or theory-specific concept whose analytical role would be weakened or altered if translated completely into GRE's general vocabulary of relations, constraints, value, and generativity.*

The first remainder is physical law. Thermodynamic and material constraints can be represented relationally, yet their validity does not depend on a relational interpretation. GRE should therefore avoid redescribing physical necessity as if it were produced by social relation alone. Social systems can alter technologies, efficiencies, extraction patterns, and institutional responses; they operate within physical regularities whose investigation belongs to the relevant natural sciences.

Proposition 21.443 (Biophysical non-reduction condition). *GRE translation should preserve independently established biophysical mechanisms and constraints as substantive scientific inputs rather than treating them as consequences of relational description.*

The second remainder concerns normativity. An ecological threshold does not by

itself determine a fair burden-sharing rule, a legitimate property arrangement, or an acceptable development pathway. Conversely, an ethically attractive distribution cannot eliminate a biophysical constraint. Ecological governance therefore requires both empirical ecological knowledge and normative-institutional judgment, with neither domain substituting automatically for the other.

The third remainder concerns scale and boundary selection. Ecological conclusions depend strongly on system boundaries, baselines, temporal horizons, spatial aggregation, and the chosen variable of interest. GRE's scale-sensitive architecture can represent this dependence, yet it does not select the correct ecological scale in advance. Domain expertise and empirical research remain necessary.

The fourth remainder concerns uncertainty and irreversibility. Some ecological processes involve incomplete knowledge, long delays, threshold uncertainty, or losses that are difficult to reverse at relevant timescales. A generative vocabulary can express future-option contraction, yet it should not convert uncertainty into a precise formal object without evidence. Precaution, robustness, safe-minimum standards, adaptive governance, and other decision principles remain separate institutional responses that require their own justification.

Proposition 21.444 (Ecological uncertainty condition). *Where ecological knowledge is incomplete and potential losses are persistent or difficult to reverse, analysis should keep empirical uncertainty distinct from normative choice about precaution, acceptable risk, and burden distribution.*

The fifth remainder concerns value. GRE's heterogeneous-value architecture aligns strongly with ecological pluralism, yet the existence of several value dimensions does not determine how conflicts among them should be resolved. Monetary valuation, rights, thresholds, deliberation, capability criteria, ecological integrity, and legal protections can yield different decision structures. GRE can expose conversion interfaces and power over them; it cannot derive one universally appropriate evaluative rule from relationality alone.

The sixth remainder concerns non-human standing. GRE can include non-human affected positions in its analytical domain, but relational inclusion does not establish moral status, welfare, rights, or legal personhood. Ecological economics itself also contains divergent positions on anthropocentric, biocentric, ecocentric, and instrumental valuation. Translation should preserve these disagreements as normative and philosophical questions rather than silently resolving them through the category of relation.

Proposition 21.445 (Ecological-GRE non-identity). *Shared attention to interdependence, capacity, history, heterogeneous value, and future conditions supports substantial dialogue between ecological economics and GRE while leaving biophysical, normative, methodological, and scale-specific commitments analytically distinct.*

The domain of adequacy is therefore complementary. Ecological economics is especially strong where the research question concerns material and energy throughput, ecological capacity, regeneration, sinks, social metabolism, Earth-system risk, resilience, natural-capital dependence, and the ecological conditions of sustainability. GRE can contribute a wider architecture for tracing how these processes interact with institutions, power, value conversion, epistemic representation, subject heterogeneity, and the generation of future possibilities. Ecological economics in turn constrains GRE by requiring generative claims to remain physically grounded wherever ecological processes carry the causal mechanism.

Proposition 21.446 (Ecological dialogue condition). *A productive dialogue preserves ecological economics as an independent source of biophysical and sustainability analysis while using GRE to investigate the relational architectures through which ecological capacities, burdens, values, and future possibilities are generated, distributed, represented, and transformed.*

21.22 Commons, Cooperative, and Solidarity Economics

Chapter 2, Section 2.24, established the genealogical distinctions among commons, common-pool-resource analysis, cooperative organization, shared infrastructures, reciprocity, and solidarity-oriented economic forms. The present section uses those distinctions as a baseline for comparative analysis. Its object is the institutional architecture connecting access, ownership, contribution, reciprocity, governance, community value, and future collective capacity. The dialogue asks which collective mechanisms require theory-specific institutional detail, where GRE adds useful temporal or cross-domain analysis, and where generic language of participation or relation would obscure legal form, situated governance knowledge, or political commitment. Table 21.22 summarizes the principal coordinates.

Definition 21.447 (Associational economic configuration). *An associational economic configuration is an analytically specified arrangement in which a plurality of participants coordinate access, production, use, ownership, distribution, or governance through shared rules, reciprocal obligations, collective decision procedures, or jointly constituted organizational forms.*

The traditions considered here are related without being identical. Commons scholarship often studies shared resources and the institutions through which access and use are governed. Cooperative economics studies enterprises in which membership, ownership, control, surplus allocation, and participation are organized differently from conventional investor-owned firms. Solidarity-economy scholarship encompasses a wider field of associations, cooperatives, mutuals, community initiatives, self-management practices, and participatory forms that seek to democratize economic activity or subordinate some economic relations to social purposes (Ostrom 1990; International Cooperative Alliance 1995; Laville 2010). Reciprocity enters all three fields but also has a wider anthropological and institutional history (Mauss 1990; Polanyi 1957).

Proposition 21.448 (Associational plurality condition). *A relational reconstruction should preserve distinctions among shared-resource governance, cooperative enterprise, reciprocity, mutual aid, peer production, solidarity-economy initiatives, and other associational forms whenever their property relations, decision rights, membership rules, or normative purposes differ materially.*

21.22.1 Commons

Commons provide the first coordinate because they make resource governance inseparable from relations among users, rules, ecological or informational characteristics, and institutional histories. A resource does not become a commons merely because several persons can use it. Commons analysis asks who may access a resource, who

Table 21.22: Relational coordinates for commons, cooperative, and solidarity economics

Coordinate	Associational analytical object	Dialogue boundary
Commons	Shared resources, access relations, appropriation, provision, maintenance, and rules governing use	Identification of a resource as a commons independently of the institutions and participants through which commoning is organized
Collective ownership	Bundles of access, use, management, exclusion, control, benefit, and transfer rights distributed across members or constituencies	Reduction of ownership to one legal title or assumption that collective title entails equal effective control
Reciprocity	Institutionally organized giving, return, mutual obligation, reputation, trust, and temporally extended exchange relations	Identification of reciprocity with altruism, barter, immediate equivalence, or one universal moral rule
Cooperation	Joint activity sustained through incentives, norms, repeated interaction, learning, shared purpose, and organizational design	Assumption that common purpose eliminates conflict, free riding, hierarchy, or heterogeneous interests
Collective governance	Rules, participation, monitoring, sanctions, conflict resolution, representation, and polycentric coordination	Equation of participation with equal influence or of self-governance with absence of authority
Community value	Material, capability, relational, cultural, infrastructural, and institutional value generated or preserved through collective arrangements	Reification of “community” as homogeneous or automatic conversion of local preference into public value
Relational reconstruction	History-bearing architecture linking membership, rights, obligations, resources, governance, value, and future capacity	Absorption of specific legal, political, cultural, and normative commitments into generic relational vocabulary
Translation limit	Organizational diversity, internal power, exclusion, scale, law, normativity, and historical specificity	Identity inferred from a shared emphasis on relation, participation, mutuality, or collective action

may appropriate from it, who contributes to maintenance or provision, how rules are made and changed, how use is monitored, how conflicts are resolved, and how benefits and burdens are distributed. Ostrom’s research on self-organized common-

pool resources demonstrated that durable governance can arise through institutional arrangements more varied than a simple state-versus-privatization binary (Ostrom 1990; Ostrom 2010).

Definition 21.449 (Commons configuration). A *commons configuration* is a resource-related arrangement in which access, appropriation, provision, maintenance, exclusion, or governance is organized through a specified set of participants and institutions whose relations materially shape the resource's use and continuation.

This definition separates the physical or informational resource from the governance arrangement. Forests, fisheries, irrigation systems, grazing lands, software, scientific knowledge, cultural materials, and shared infrastructures possess different rivalries, replenishment dynamics, exclusion possibilities, monitoring requirements, and scales. Knowledge commons illustrate the point particularly clearly: extending commons analysis beyond natural resources requires attention to access, intellectual-property rules, preservation, contribution, curation, and reuse rather than importing natural-resource assumptions without modification (Hess and Ostrom 2007).

Property is correspondingly differentiated. Schlager and Ostrom distinguish positions through bundles of operational and collective-choice rights, including access, withdrawal, management, exclusion, and alienation (Schlager and Ostrom 1992). This architecture resists a binary classification of resources as simply owned or unowned. Two arrangements can both be described as communal while assigning markedly different rights to users, claimants, proprietors, representatives, or external authorities.

Proposition 21.450 (Commons institutional condition). *Analysis of a commons should specify the resource, participant positions, relevant rights, contribution obligations, decision rules, monitoring arrangements, and temporal conditions through which shared use is organized.*

The temporal dimension is central. A commons may depend on restraint today to preserve future access, on continuing maintenance to prevent degradation, or on recurring contributions whose benefits are distributed across time. Resource users can therefore occupy simultaneously productive, appropriative, monitoring, and stewardship positions. A successful arrangement may generate future capacity by preserving the material resource, maintaining knowledge of governance, reproducing trust, and sustaining the institutions through which later users can participate.

This perspective also guards against romanticization. Commons can be durable, fragile, exclusionary, unequal, captured, or internally hierarchical. Local knowledge can improve governance while local institutions can also reproduce inherited inequalities. The analytical value of commons research lies in identifying the conditions and mechanisms of collective resource governance, not in treating every communal arrangement as normatively desirable.

Proposition 21.451 (Commons persistence condition). *The persistence of a commons should be analyzed through the relations that reproduce resource conditions, compliance, knowledge, legitimacy, and institutional capacity rather than inferred from communal ownership or local scale alone.*

21.22.2 Collective Ownership

Collective ownership provides the second coordinate because cooperative and commons-based arrangements distribute economic rights across multiple partici-

pants rather than locating them in a single abstract owner. The relevant analytical object is a bundle of rights and claims: membership, voting, control, residual income, access to assets, transfer, exit, inheritance, representation, and liability can be allocated differently. Legal title therefore supplies only one layer of the ownership architecture.

Definition 21.452 (Collective ownership architecture). *A collective ownership architecture is a distribution of rights, claims, responsibilities, and decision capacities over organizational or shared assets among a specified plurality of members, users, workers, beneficiaries, communities, trustees, or other recognized constituencies.*

The International Cooperative Alliance defines a cooperative as an autonomous association of persons who voluntarily unite to meet common economic, social, and cultural needs through a jointly owned and democratically controlled enterprise; its principles further specify democratic member control, member economic participation, autonomy, cooperation among cooperatives, and concern for community (International Cooperative Alliance 1995; International Cooperative Alliance 2017). These principles demonstrate that cooperative ownership joins legal, economic, and governance dimensions. Joint ownership acquires institutional meaning through membership criteria, voting rules, capital arrangements, surplus distribution, and organizational purpose.

Economic analysis of labor-managed firms likewise shows that changing ownership and decision rights can alter enterprise behavior. Ward and Vanek developed formal analyses in which worker-controlled firms face market constraints while operating under objectives and distribution rules that differ from conventional investor-owned firms (Ward 1958; Vanek 1970). The importance for relational dialogue lies less in adopting one canonical cooperative model than in recognizing that the firm is an institutional configuration whose objective function, governance, and distribution rules depend on historically constituted rights.

Proposition 21.453 (Ownership–control distinction). *Collective ownership should be distinguished from effective collective control whenever information, agenda setting, expertise, managerial authority, finance, representation, or unequal participation creates differences in practical decision capacity among nominal co-owners.*

This distinction matters because democratic rights can coexist with asymmetric participation. One member–one vote can constrain capital-weighted control while leaving differences in attendance, knowledge, time, status, language, or organizational position. Collective ownership can therefore redistribute formal authority without eliminating power. A relational analysis should ask who can initiate decisions, define admissible options, interpret rules, control records, mobilize resources, and sustain participation.

Asset relations also extend beyond current members. Cooperative assets can embody accumulated contributions from earlier cohorts and support later members. Restrictions on asset distribution, indivisible reserves, or community-benefit commitments can turn ownership into an intertemporal relation among present participants, past contributions, and future organizational continuity. The resulting arrangement is difficult to represent through an instantaneous allocation of private claims alone.

Proposition 21.454 (Intertemporal collective asset condition). *Where collectively governed assets embody accumulated contributions or are institutionally preserved for future members or purposes, ownership analysis should include the temporal rules governing appropriation, retention, transfer, and organizational continuity.*

21.22.3 Reciprocity

Reciprocity provides the third coordinate because many associational economies organize obligations and expectations through relations whose temporal and social structure exceeds spot exchange. Reciprocity can involve return to the original giver, contribution to a wider group, reputation-dependent response, mutual aid, gift relations, rotating obligations, or continuing membership expectations. Its economic significance lies in the institution of return and relation, not in the absence of material interests.

Definition 21.455 (Reciprocal economic relation). A *reciprocal economic relation* is a socially or institutionally organized relation in which an action, contribution, transfer, restraint, or benefit is connected to an expected, remembered, or normatively significant response across persons, groups, or time.

Mauss's analysis of gift exchange emphasizes obligations to give, receive, and reciprocate within social relations that combine legal, moral, political, religious, and status dimensions (Mauss 1990). Polanyi later treated reciprocity as one institutional pattern through which economic processes can be organized, alongside redistribution and exchange (Polanyi 1957). These accounts caution against interpreting reciprocity as merely delayed barter. The expected return may be qualitatively different from the initial contribution, directed through a group rather than back to the same person, or embedded in a durable relationship whose continuation is itself valuable.

Behavioral and institutional research supplies another interface. Ostrom's analysis of collective action emphasizes reciprocity, reputation, and trust as mechanisms through which participants can sustain cooperation in settings where short-run incentives might otherwise undermine it (Ostrom 1998). This mechanism remains contingent. Reciprocity can strengthen cooperation when participants can observe conduct, interpret intentions, expect future interaction, and sanction defection; it can also support exclusion, retaliation, patronage, or status hierarchy.

Proposition 21.456 (Reciprocity specification condition). *An economic analysis of reciprocity should specify the relevant actors, expected form of response, temporal horizon, informational conditions, institutional setting, and consequences of fulfilled or violated expectations.*

Reciprocity also creates memory. A contribution can alter later expectations, obligations, trust, and membership standing. Economic history is therefore carried partly through relational records that may be formal, such as accounts or membership histories, or informal, such as reputation and remembered assistance. These histories can generate capacity by lowering coordination costs, supporting mutual insurance, or enabling joint projects. They can also generate burdens where inherited obligations become coercive or unequally distributed.

Proposition 21.457 (Reciprocal memory condition). *Where prior contributions or violations alter later rights, expectations, trust, or obligations, reciprocity should be represented as a history-bearing relation rather than an isolated bilateral transfer.*

GRE can therefore translate reciprocity through temporally extended relational structure while retaining its institutional and cultural specificity. A reciprocal relation is not simply any relation with feedback. It contains socially interpreted expectations about response, obligation, contribution, or return. The interpretation may be contested, and the norm governing reciprocity may differ across communities and organizations.

21.22.4 Cooperation

Cooperation provides the fourth coordinate because commons, cooperatives, solidarity initiatives, and peer production depend on joint activity whose outcomes arise from coordinated contributions. Cooperation can be motivated by material benefit, shared purpose, identity, reciprocity, professional commitment, intrinsic motivation, norm compliance, future expectation, or combinations of these. A relational reconstruction therefore treats cooperation as an organized process rather than as a single preference type.

Definition 21.458 (Cooperative process). A *cooperative process* is a temporally organized pattern of interdependent contributions in which participants' actions jointly affect an outcome and in which the continuation, distribution, or governance of that outcome depends materially on coordination among them.

Commons research demonstrates that cooperation can be institutionally supported through rules, monitoring, graduated sanctions, conflict-resolution mechanisms, and nested governance rather than relying on homogeneous altruism (Ostrom 1990). Peer production provides a different case. Benkler's analysis of large-scale distributed production shows that shared projects can coordinate contributions through mechanisms that differ from both market pricing and managerial hierarchy (Benkler 2002). Software, knowledge, and other modular informational goods can permit contribution and reuse patterns that would be difficult to reproduce in resource systems characterized by strong rivalry or costly exclusion.

Proposition 21.459 (Cooperation mechanism condition). *A claim about cooperation should identify the contribution structure, interdependence among participants, coordination mechanism, distribution rule, and institutional conditions that sustain or destabilize joint activity.*

The relation between cooperation and conflict also requires care. Participants can cooperate on production while disagreeing about distribution, cooperate within a group while competing with outsiders, or share a collective purpose while possessing unequal bargaining power. Cooperative organizations can contain managerial hierarchy, labor conflict, generational disagreement, or unequal access to information. Cooperation therefore describes a relation of joint action in a specified domain; it does not imply complete harmony.

Learning is another generative dimension. Repeated cooperation can produce organizational routines, shared vocabularies, technical knowledge, trust, conflict-resolution skills, and expectations about others' conduct. These jointly produced capacities can outlast a particular transaction and change what the group can undertake later. Cooperative failure can have the reverse effect by eroding trust, exhausting volunteers, depleting shared assets, or concentrating control.

Proposition 21.460 (Cooperative capability formation). *Repeated cooperative activity can become generative when it produces durable knowledge, trust, routines, infrastructures, or governance capacities that change the feasible range of later collective action.*

This proposition creates an interface with GRE without collapsing cooperation into generativity. Some cooperative acts are transient and leave little durable structure; some highly generative arrangements contain competition or authority. Generativity concerns the production of later possibilities, whereas cooperation concerns interdependent joint activity. The two can overlap while remaining analytically distinct.

21.22.5 Collective Governance

Collective governance provides the fifth coordinate because associational economies require procedures for making, applying, revising, and contesting rules. Governance includes more than voting. Agenda formation, information, representation, monitoring, sanctions, conflict resolution, delegation, review, membership boundaries, and relations with external authorities all shape effective decision capacity. Commons and cooperative institutions therefore reveal governance as an economic variable rather than an administrative afterthought.

Definition 21.461 (Collective governance architecture). A *collective governance architecture* is the configuration of membership rules, decision procedures, delegated authorities, information channels, monitoring, sanctions, conflict-resolution mechanisms, and revision processes through which a plurality governs shared activities or assets.

Ostrom's institutional analysis identifies design features associated with many long-enduring common-pool-resource arrangements, including boundaries, rule congruence, participation in rule modification, monitoring, graduated sanctions, conflict-resolution mechanisms, and recognition of rights to organize (Ostrom 1990). Her later work on polycentricity emphasizes systems containing multiple formally independent decision centers whose interactions may produce coordination, learning, redundancy, or conflict (Ostrom 2010). These findings are best read as a research program for institutional diagnosis rather than as a universal organizational template.

Proposition 21.462 (Governance decomposition condition). *Collective governance should be decomposed into the distinct capacities to propose, deliberate, decide, implement, monitor, sanction, review, and revise because participation in one stage does not entail equal influence across the others.*

The decomposition reveals a frequent gap between formal democracy and effective participation. Members may possess equal votes while differences in expertise, information, time, status, digital access, or agenda control shape whose preferences become actionable. External finance, law, regulation, supply chains, or platform infrastructure can further constrain the feasible set of internal decisions. Self-governance is consequently relational both internally and externally.

Polycentricity adds a scale dimension. Local units may possess information and responsiveness while larger federations provide coordination, risk pooling, standard setting, or political representation. Cooperative federations and nested commons arrangements can distribute tasks across levels. The appropriate scale depends on the spatial and temporal reach of the resource, externalities, monitoring capabilities, mobility of participants, and the cost of coordination.

Proposition 21.463 (Nested governance condition). *Where collective-action problems operate across several scales, analysis should examine how decision rights, information, enforcement, and resources are distributed among local, federated, and external governance levels.*

Collective governance can itself be a produced capacity. Procedures for record keeping, deliberation, dispute resolution, leadership succession, and rule amendment require learning and maintenance. An organization can own productive assets while losing the governance capacity needed to manage them democratically. Conversely, a community with limited material assets may possess strong institutions that enable later cooperation and resource mobilization.

Proposition 21.464 (Governance-capacity persistence). *The continuity of collective ownership or shared resources depends partly on the reproduction of governance capabilities, including institutional memory, participation, monitoring, conflict resolution, and legitimate procedures for revising rules.*

21.22.6 Community Value

Community value provides the sixth coordinate because commons, cooperatives, and solidarity initiatives frequently pursue outcomes that exceed distributable monetary surplus. Shared infrastructure, local employment, continuity of services, mutual support, ecological stewardship, cultural reproduction, knowledge, trust, democratic experience, resilience, and access can all be economically significant. The analytical challenge is to recognize these heterogeneous values without presuming that “community” names a unified subject with a single preference ordering.

Definition 21.465 (Community value configuration). *A community value configuration is a plurality of material, capability, relational, institutional, cultural, ecological, or symbolic benefits and burdens associated with a collective arrangement for a specified set of participants and affected parties.*

Solidarity-economy scholarship is especially relevant here because it treats economic organization as connected to association, democratic participation, self-management, and social purpose rather than confining evaluation to enterprise surplus (Laville 2010). The cooperative principles likewise include concern for community, placing organizational activity within a wider field of affected relations (International Cooperative Alliance 1995). These commitments are normative and institutional; they should not be inferred from collective ownership alone.

Shared resources can also generate downstream value through enabling heterogeneous activities. Knowledge commons and shared infrastructures can support uses that no central planner needs to specify in advance (Hess and Ostrom 2007; Frischmann 2012). This feature provides a particularly strong interface with GRE: value may arise through the future activities that access to a shared resource makes possible, including activities whose exact content cannot be known at the time the resource is maintained.

Proposition 21.466 (Community-value plurality). *Evaluation of a collective arrangement should distinguish the several value dimensions it generates or preserves and identify the populations to whom those values and associated burdens accrue.*

Distribution remains essential. A community enterprise can preserve local services while concentrating unpaid work on a subset of members. A commons can sustain a resource while excluding migrants, women, minority groups, or neighboring users. A cooperative can distribute surplus broadly while imposing environmental costs elsewhere. Community value therefore requires mapping boundaries of membership and affectedness rather than treating the organizational boundary as the boundary of evaluation.

Definition 21.467 (Community boundary remainder). *A community boundary remainder is a materially relevant benefit, burden, dependency, or affected position that lies outside the membership boundary used by an associational organization to define participation or value distribution.*

Measurement poses another problem. Some benefits can be represented through

income, cost savings, service access, employment, or asset values. Others concern trust, democratic competence, continuity, belonging, ecological stewardship, or future option value. Monetary conversion may support comparison for selected purposes while leaving relational or institutional remainders. GRE's heterogeneous-value framework can make these conversion choices explicit without requiring one universal measure.

Proposition 21.468 (Community valuation interface). *When community value is converted into a common metric or organizational performance indicator, the analysis should state which value dimensions, populations, timescales, and external effects the representation includes and which remain outside it.*

21.22.7 Relational Reconstruction

The preceding coordinates permit a GRE reconstruction centered on the historical production of associational capacity. The relevant object is neither an isolated collective actor nor a generic network of relations. It is a history-bearing configuration in which resources, members, rights, obligations, governance procedures, knowledge, trust, infrastructures, external institutions, and value-conversion practices jointly condition what collective action can occur and what later possibilities it creates.

Definition 21.469 (Generative associational architecture). *A generative associational architecture is a history-bearing configuration of participants, shared resources, rights, obligations, governance processes, knowledge, infrastructures, and value relations through which collective activity changes the feasible capacities and relations of subsequent participants and affected parties.*

The first element is membership. Associational organizations establish boundaries that determine who can enter, vote, use resources, receive benefits, or bear obligations. Membership rules can protect a commons from uncontrolled appropriation or preserve cooperative purpose; they can also create exclusion and insider advantage. Membership is therefore both a governance mechanism and a relation of power over access.

Proposition 21.470 (Membership generativity condition). *Membership rules become generatively significant when they materially affect who can acquire capabilities, access shared resources, participate in governance, or transmit organizational benefits and burdens into later periods.*

The second element is shared infrastructure. A collectively maintained irrigation system, data repository, workspace, platform, forest, community fund, or cooperative reserve can support later activity by multiple participants. The generative effect is not exhausted by current use. Maintenance can preserve a field of future uses, while enclosure or depletion can contract it. Benkler's peer-production analysis and research on knowledge commons illustrate how shared informational resources can enable distributed contributions beyond conventional firm boundaries (Benkler 2002; Hess and Ostrom 2007).

The third element is governance as a produced relational capability. Rules do not merely constrain action; they can stabilize expectations, create channels for revision, allocate voice, and preserve institutional memory. Collective governance can thereby affect whether a group can respond to changing conditions without losing legitimacy or continuity. The relevant generative object is the capacity to reorganize relations while retaining enough coordination for joint action.

Proposition 21.471 (Associational governance generativity). *Collective governance is generative when its procedures and institutional memory increase the group's capacity to revise rules, resolve conflict, coordinate contributions, or incorporate new participants under changing conditions.*

The fourth element is reciprocal accumulation. Trust, reputation, remembered contribution, and mutual obligation can accumulate through repeated interaction. These relational assets can reduce some coordination burdens and permit projects requiring delayed or uncertain returns. Their distribution may nevertheless be unequal. Long-standing members can possess relational capital unavailable to newcomers, and reputational systems can encode prejudice or historical hierarchy.

Definition 21.472 (Associational relational capital). *Associational relational capital is a historically accumulated configuration of trust, recognized contribution, shared knowledge, mutual expectations, and coordination capacity that can enable or constrain later collective action within a specified organization or community.*

The fifth element is conversion. Contributions can be converted into voting rights, service access, patronage refunds, reputation, membership standing, care, reciprocal assistance, or community infrastructure. Control over these conversion rules shapes distribution and power. A formally equal cooperative can become substantively unequal if some contributions are systematically unrecognized or if decision procedures translate expertise, time, or social status into disproportionate influence.

Proposition 21.473 (Associational conversion-power condition). *Power within an associational economy includes the capacity to shape the interfaces through which contribution, membership, expertise, need, or use is converted into recognized rights, benefits, obligations, or decision influence.*

The sixth element is outward relation. Cooperatives, commons, and solidarity organizations operate within markets, legal systems, states, financial structures, supply chains, ecological systems, and wider communities. Their internal rules can be constrained by credit conditions, property law, taxation, procurement, platform dependence, labor regulation, or competition. A relational reconstruction therefore avoids treating the collective as a closed microcosm.

Proposition 21.474 (Associational embedding condition). *The capacities of a commons, cooperative, or solidarity organization should be analyzed jointly with the external legal, financial, market, infrastructural, ecological, and political relations that condition its feasible forms of self-organization.*

This reconstruction suggests a distinctive interface between GRE and associational economics. Commons and cooperative traditions provide institutionally detailed cases in which relations are deliberately constituted through rules, rights, membership, and shared assets. GRE can extend the analysis by tracing how those arrangements modify future capabilities, relational structures, conversion pathways, and value-generation possibilities. The benefit is reciprocal: associational economics disciplines GRE by showing that relations become economically consequential through concrete organizational mechanisms rather than through relational language alone.

21.22.8 Limits of Translation

The translation between commons, cooperative, solidarity, and GRE vocabularies is substantial but incomplete. Shared attention to relation, participation, institutional

form, heterogeneous value, and future capacity creates strong points of contact. Several remainders nevertheless require explicit preservation because their removal would convert historically specific traditions into generic relational descriptions.

The first remainder concerns the legal specificity of ownership and organizational form. GRE can describe bundles of rights relationally, yet cooperative statutes, trust forms, common-property regimes, nonprofit constraints, fiduciary duties, and membership rights possess legal consequences that cannot be inferred from a general relation among participants. Legal categories shape enforceability, liability, succession, asset protection, taxation, and external recognition. Translation therefore requires domain-specific legal analysis where those consequences matter.

Proposition 21.475 (Associational legal remainder). *A relational description of collective ownership remains incomplete when the research question depends on legally enforceable rights, liabilities, organizational personality, asset rules, or jurisdiction-specific institutional forms.*

The second remainder concerns normative purpose. Cooperative democracy, solidarity, mutual aid, equality, community benefit, or stewardship are not logical consequences of relation itself. Organizations can be highly relational while exploitative, exclusionary, authoritarian, or predatory. Solidarity-economy traditions often carry explicit commitments to democratization or social purpose that should remain visible as normative commitments rather than being redescribed as generic system properties (Laville 2010).

The third remainder concerns internal heterogeneity and power. A collective can contain employers and employees, core and peripheral members, long-term residents and newcomers, professional experts and lay participants, or groups with unequal time and resources. Formal equality in governance can coexist with durable inequalities in agenda setting, recognition, or participation. The label “community” can obscure these differences if it is treated as a unitary actor.

Proposition 21.476 (Collective non-homogeneity). *Neither common ownership nor shared membership warrants an assumption of homogeneous interests, equal influence, or equal exposure to the consequences of collective decisions.*

The fourth remainder concerns exclusion. Commons require boundaries, and cooperative membership can be selective. Boundary formation can protect shared resources or organizational commitments while also distributing scarcity, privilege, and voice. Evaluation should therefore ask who remains outside the arrangement, what alternatives they possess, and whether exclusion is necessary, contestable, discriminatory, or externally harmful.

The fifth remainder concerns scale and coordination. Institutional arrangements successful in one resource system or community cannot automatically be generalized to larger populations, mobile participants, global supply chains, digital platforms, or ecological systems with cross-boundary externalities. Polycentric arrangements can help coordinate several centers of authority, yet polycentricity itself does not guarantee coherent outcomes or justice (Ostrom 2010). Scale remains an empirical and institutional question.

Proposition 21.477 (Associational scale condition). *Claims about the performance of a commons or cooperative arrangement should state the scale, mobility, resource characteristics, externalities, enforcement capacities, and inter-organizational relations within which the observed governance mechanism operates.*

The sixth remainder concerns efficiency and justice. A commons can be ecologically durable while distributing benefits unequally. A cooperative can be productively efficient while reproducing external labor or ecological burdens. A solidarity initiative can provide essential services while depending on uncompensated care work. Institutional success, organizational survival, democratic procedure, distributive equality, and justice therefore remain distinct evaluative dimensions.

The seventh remainder concerns reciprocity. Reciprocity can support trust and cooperation, but it can also reproduce debt, patronage, retaliation, social surveillance, and obligations that participants experience as coercive. Cultural and historical interpretation is required to determine what a reciprocal norm means in a specific setting. GRE can trace the relation and its generative effects while remaining unable to derive the norm's legitimacy from relational structure alone.

Proposition 21.478 (Associational–GRE non-identity). *Shared attention to relations, collective capacity, institutional history, heterogeneous value, and future possibilities supports substantial dialogue between associational economics and GRE while leaving legal form, normative purpose, cultural meaning, internal power, and governance mechanisms analytically distinct.*

The domain of adequacy is consequently complementary. Commons research is especially strong where the problem concerns shared-resource governance, rights, monitoring, collective action, institutional durability, and polycentric coordination. Cooperative economics is especially strong where membership, democratic control, labor management, surplus distribution, and alternative enterprise forms are central. Solidarity-economy scholarship contributes analysis of association, mutuality, social purpose, and economic democratization across heterogeneous organizational forms. GRE can connect these domains through a wider account of historical relational formation, value conversion, power, epistemic representation, and the production of future capacities. The dialogue therefore preserves these traditions as independent sources of institutional and normative knowledge.

21.23 Economic Sociology and Relational Economics

Chapter 2, Sections 2.20–2.21, reconstructed institutional economics, economic sociology, relational sociology, and social-field theory as prior relational resources for GRE. The present section therefore has a particularly strict burden of attribution. Its role is to compare mature GRE with traditions in which embeddedness, networks, fields, institutions, trust, relational goods, and socially organized meaning are already primary analytical objects. The objective is to identify genuine proximities, independent corrections, and limits of identification while avoiding the rediscovery of established sociological insights under GRE terminology. Table 21.23 summarizes the principal dialogue coordinates.

Definition 21.479 (Relationally constituted economic action). *Relationally constituted economic action* is economic action whose feasible forms, meanings, expected consequences, or realized effects depend materially on the actor's ongoing relations, positions, institutional memberships, or socially organized interpretive environment.

This definition establishes a broad comparative object rather than a proprietary GRE category. Granovetter's account of embeddedness challenged explanations based on atomized action by locating economic conduct within ongoing social rela-

tions (Granovetter 1985). Network sociology has developed formal and interpretive approaches to positions, roles, ties, clusters, and dependencies (Wellman 1983; White et al. 1976; White 2008). Bourdieu's relational sociology and later field approaches place positions, structured struggle, capital, and mesolevel orders at the center of analysis (Bourdieu and Wacquant 1992; Fligstein and McAdam 2012). Relational-goods scholarship studies forms of value whose realization depends on interaction or shared relational experience (Uhlener 1989; Gui 2000; Donati 2019). Zelizer's relational work further shows that differentiated social relations are actively matched with economic transactions, media, boundaries, and meanings (Zelizer 2012).

Proposition 21.480 (Prior relational scholarship condition). *A GRE dialogue with economic sociology should treat relational constitution, embeddedness, network position, field structure, relational value, and socially organized meaning as established bodies of inquiry whose concepts require attribution and comparison before any GRE extension is proposed.*

21.23.1 Embeddedness

Embeddedness provides the first coordinate because it directly challenges the analytical isolation of economic action from ongoing social relations. Granovetter's formulation positioned economic conduct between undersocialized and oversocialized accounts: actors neither choose within a social vacuum nor simply enact a fully internalized social script. Concrete interpersonal relations, histories, and network structures can shape information, opportunity, enforcement, reputation, and the practical conditions of exchange (Granovetter 1985). This insight gives economic sociology one of its clearest interfaces with GRE.

Definition 21.481 (Relational embeddedness). *Relational embeddedness* is the condition under which an economic action, transaction, organization, or expectation depends materially on ongoing social relations whose history and structure affect the feasible or interpreted form of the economic process.

Embeddedness should nevertheless be specified rather than invoked as a general statement that society matters. A labor contract may be embedded in professional networks, migration status, family obligations, sectoral conventions, labor law, and workplace hierarchy. A credit relation may depend on kinship, reputation, collateral institutions, community knowledge, and prior transactions. A firm's procurement decision may be conditioned by repeated interorganizational ties, technical standards, regulatory relations, and local political arrangements. These forms of embeddedness can reinforce one another or create conflicting pressures.

Polanyi's broader treatment of the economy as an instituted process provides a different but related lineage. His analysis emphasizes institutional patterns such as reciprocity, redistribution, and exchange and rejects the treatment of market exchange as the transhistorical form of economic integration (Polanyi 1957). Granovetter's network-centered formulation and Polanyi's institutional-historical formulation therefore share an anti-atomizing impulse while operating at different analytical scales.

Proposition 21.482 (Embeddedness specification condition). *A claim of economic embeddedness should identify the relevant relation, institution, network, or historical configuration and state the mechanism through which it changes information, incentives, meaning, access, enforcement, power, or another specified economic outcome.*

Table 21.23: Relational coordinates for economic sociology and relational economics

Coordinate	Established relational object	Dialogue boundary
Embeddedness	Economic action situated within ongoing social and institutional relations	Use of embeddedness as a generic synonym for contextual influence without specifying the relevant relation or mechanism
Networks	Patterned ties, positions, roles, brokerage, closure, dependence, and multi-network structure	Identification of graph representation with the full social relation or with causal mechanism
Social fields	Positionally organized domains with stakes, rules, resources, power, interpretation, and structured interaction	Equation of field with network topology or with GRE field language independent of theory-specific assumptions
Relational goods	Goods or benefits whose realization depends constitutively on interaction, shared identity, or the relationship itself	Merger of distinct rational-choice, interpersonal, and relational-sociological formulations into one category
Institutions	Rules, classifications, conventions, organizational fields, meanings, and stabilized expectations shaping action	Reduction of institutions to external constraints or presumption that institutional persistence establishes efficiency or legitimacy
Trust	Relation-sensitive expectations and vulnerabilities affecting exchange, cooperation, information, and collective action	Equation of trust with reputation, compliance, familiarity, social capital, or moral virtue
GRE reconstruction	History-bearing relations whose configuration alters value, capability, power, knowledge, and later possibility	Attribution of established sociological insights to GRE or translation of sociological specificity into generic relational vocabulary
Analytical proximity	Shared rejection of strongly atomized explanation and shared attention to constitutive relations	Identity inferred from common relational language despite differences in questions, methods, ontology, and evaluative purpose

Embeddedness can enable and constrain simultaneously. Dense relations can support reputation, cooperation, knowledge transfer, and informal enforcement. The same density can restrict entry, intensify conformity, facilitate collusion, reproduce discrimination, or shield insiders from external scrutiny. The evaluative consequences therefore depend on whose relations are stabilized, who is excluded, what information circulates, and which forms of conduct the relational configuration makes easier or harder.

Temporal depth is equally important. A current tie carries traces of earlier interaction, remembered performance, inherited status, and prior institutional change.

The same formally specified transaction can therefore operate differently when embedded in relations with different histories. This provides a direct bridge to GRE's emphasis on history-bearing relations while leaving the original sociological insight intact.

Proposition 21.483 (Embedded-history condition). *Where prior interaction materially changes present economic conduct, the relevant analytical object includes the history through which expectations, reputation, obligations, meanings, and asymmetries were formed.*

Embeddedness also has a boundary problem. Researchers select which relations count as relevant. Expanding the contextual boundary indefinitely eventually dissolves explanation into an unbounded inventory of social influence. A useful relational analysis therefore requires a target-relative boundary: the included relations are those for which plausible mechanisms and evidence connect them to the economic process under study.

21.23.2 Networks

Networks provide the second coordinate because they make patterned relations directly observable and analyzable. Network analysis shifts attention from aggregated attributes toward ties, positions, paths, clusters, structural equivalence, brokerage, closure, and dependence. Wellman's structural perspective emphasizes patterned relations and network position, while White, Boorman, and Breiger show how roles and positions can be reconstructed from multiple networks rather than assigned solely from actor attributes (Wellman 1983; White et al. 1976).

Definition 21.484 (Economic network representation). *An economic network representation specifies a set of nodes, one or more types of relations among them, and the temporal or contextual conditions under which those relations are recorded for an economic research question.*

The definition emphasizes representation. A graph can encode buyer–supplier relations, collaboration, advice, ownership, credit, migration, friendship, membership, or several layers simultaneously. The interpretation of an edge depends on what relation it represents, how it was measured, whether it is directed or reciprocal, how long it persists, and what activity can pass through it. Network structure can therefore illuminate relational organization while remaining selective.

Multiple networks often matter at once. Persons can be connected through employment, kinship, friendship, finance, professional membership, or shared institutions. Organizations can be linked through ownership, contracts, personnel mobility, standards, research collaboration, and political association. Breiger's analysis of the duality of persons and groups illustrates how membership relations connect interpersonal and intergroup structure (Breiger 1974). White's later relational sociology extends the analysis toward identities, control efforts, meaning, and emergent social formations (White 2008).

Proposition 21.485 (Network mechanism condition). *A network association becomes an economic explanation only when the analysis identifies a mechanism through which the represented tie or position affects information, access, dependence, coordination, bargaining, diffusion, learning, enforcement, recognition, or another specified process.*

This requirement guards against equating centrality with power, density with trust,

or connectivity with beneficial access. A centrally located actor may possess brokerage opportunities while facing heavy obligations. Dense networks can facilitate coordination while reducing exposure to outside information. Sparse bridging ties can widen access while creating dependence on a small number of intermediaries. The direction and distribution of effects require substantive interpretation.

Networks can also be generative. Interorganizational collaboration can create channels for learning and innovation; Powell's work on network forms and biotechnology collaborations provides well-established examples of economic coordination and learning beyond a simple market–hierarchy dichotomy (Powell 1990; Powell et al. 1996). From a GRE perspective, the question is then whether a network relation merely transmits existing resources or also changes participants' later capacities, identities, knowledge, or feasible relations.

Definition 21.486 (Network-generative effect). A *network-generative effect* occurs when participation in a network relation or position materially changes the set of relations, capabilities, resources, knowledge, or organizational possibilities available in subsequent periods.

This concept is a GRE extension rather than a replacement for network analysis. Network methods remain especially strong for specifying structure, while generative analysis asks an additional temporal question about what the structure produces or makes possible later.

21.23.3 Social Fields

Social fields provide the third coordinate because some economic relations are intelligible only within positionally organized domains possessing stakes, recognized resources, rules, categories, and structured relations of power. Field approaches therefore move beyond isolated dyads while retaining mesolevel organization. Bourdieu and Wacquant develop a relational sociology centered on fields, forms of capital, habitus, position, and struggle (Bourdieu and Wacquant 1992). Fligstein and McAdam conceptualize strategic action fields as mesolevel social orders containing incumbents, challengers, governance units, shared understandings, and relations with other fields (Fligstein and McAdam 2012).

Definition 21.487 (Economic social field). An *economic social field* is a bounded-for-analysis domain in which actors or organizations occupy differentiated positions and orient action partly through field-specific stakes, resources, rules, classifications, expectations, and relations of power.

Field analysis differs from network analysis. Networks represent patterns of specified ties; fields can additionally include recognized stakes, categorical distinctions, symbolic valuation, rules of membership, authority, and position-dependent interpretation. Two actors may occupy proximate field positions without maintaining a direct tie, and the same network tie can carry different significance when participants occupy different field positions.

Power is therefore internal to field reconstruction. Positions can differ in access to valued resources, authority to define legitimate practice, capacity to set standards, visibility, or ability to shape the terms of competition. Bourdieu's relational method is especially important because it treats positions and forms of capital in relation to the structured space in which they acquire efficacy (Bourdieu 1977; Bourdieu and Wacquant 1992). Fligstein and McAdam similarly distinguish incumbents and challengers

and emphasize field stability, crisis, and transformation (Fligstein and McAdam 2012).

Proposition 21.488 (Field-position condition). *Claims about an economic actor's field position should specify the field boundary, relevant stakes, position-defining relations or resources, and the mechanisms through which position affects action or outcome.*

Fields are also nested and intersecting. A firm can participate simultaneously in a product market, profession, regulatory domain, financial field, technological community, and political environment. Changes in one field can alter resources or classifications in another. The resulting cross-field movement creates an important interface with GRE's interest in value conversion and relational transformation, although the theoretical vocabularies remain distinct.

Field boundaries are often objects of struggle rather than fixed containers. Actors may contest who counts as a legitimate participant, what forms of capital are recognized, which standards define quality, or which transactions belong inside a regulated domain. Boundary change can therefore redistribute both material opportunities and symbolic standing.

Proposition 21.489 (Field-boundary endogeneity). *Where actors can contest membership, classification, stakes, or legitimate resources, the field boundary should be modeled as historically produced and potentially transformable rather than treated as an exogenous analytical constant.*

GRE's own use of field language should remain disciplined by these distinctions. A GRE relational field is a target-relative representation of distributed conditions and relations; it should not be identified automatically with a Bourdieusian field, a strategic action field, or an organizational field. The correct translation depends on the research question and on which theoretical commitments the analysis actually requires.

21.23.4 Relational Goods

Relational goods provide the fourth coordinate because they challenge accounts in which value can be assigned independently of the interaction through which it is realized. The literature contains several formulations. Uhlaner develops an early rational-choice account in which sociability and participation can generate goods dependent on interaction or shared identity (Uhlaner 1989). Gui treats interpersonal encounters as productive processes capable of generating relational goods and relation-specific assets (Gui 2000). Donati develops a stronger relational-sociological conception in which the relationship itself can emerge as a good realized through sharing (Donati 2019).

Definition 21.490 (Relational-good family). The *relational-good family* comprises theories in which some economically or socially relevant benefit depends constitutively on interaction, shared participation, or the quality of a relation and therefore cannot be represented adequately as an independently possessed object without specifying that relational condition.

The plural term “family” is important because the theories differ. A relational good can be represented as an interaction-dependent payoff within rational action, as an interpersonal output jointly produced during an encounter, or as an emergent property of the relationship itself. These positions have different ontological and methodological commitments. Translation should preserve those differences.

Relational goods also make visible a distinction between a resource that enables relations and a good constituted in relation. A public meeting space can enable sociability without being identical to the friendship, trust, recognition, or shared experience produced there. An interoperable digital standard can enable cooperation while remaining an infrastructure rather than the relation itself. This distinction is relevant to GRE's earlier category of public relational goods, which includes enabling institutional and infrastructural conditions and therefore has a wider scope than some relational-goods theories.

Proposition 21.491 (Relational-value constitution condition). *Where the value of an outcome depends on the relationship through which it is produced or experienced, evaluation should preserve that constitutive relational condition rather than represent the outcome solely as an individually possessed quantity.*

Relational value can be heterogeneous and asymmetric. The same interaction can provide belonging or recognition to one participant while imposing emotional labor, surveillance, status obligation, or dependency on another. A family meal, community event, cooperative workplace, or service encounter can generate relational benefits without distributing them equally. The language of relational goods therefore requires an incidence analysis comparable to that used for other economic values.

Definition 21.492 (Relational-value incidence). *Relational-value incidence* is the distribution of benefits, burdens, recognition, obligations, and future relational consequences generated through a specified interaction or relationship among participants and other affected parties.

This creates another interface with GRE. A relation can generate value in the present and also alter later opportunities by creating trust, identity, knowledge, obligation, exclusion, or institutional continuity. GRE adds this temporal generative question while leaving the relational-goods literature as an independent source for understanding value constituted through interaction.

21.23.5 Institutions

Institutions provide the fifth coordinate because economic sociology treats economic conduct as organized through rules, classifications, conventions, organizational fields, cultural meanings, and stabilized expectations. This perspective overlaps with institutional economics while often placing greater emphasis on legitimacy, social meaning, organizational environment, and the production of categories. DiMaggio and Powell's analysis of organizational fields, for example, identifies coercive, mimetic, and normative processes capable of producing organizational similarity beyond direct efficiency selection (DiMaggio and Powell 1983).

Definition 21.493 (Sociological institutional configuration). A *sociological institutional configuration* is a historically stabilized arrangement of rules, classifications, norms, organizations, expectations, and legitimating meanings that structures economic action within a specified domain.

The concept should not imply that institutions are wholly external to actors. Institutions are reproduced, interpreted, enacted, and sometimes contested through practice. Organizational members can comply selectively, reinterpret categories, create informal routines, or mobilize alternative standards. Institutionalization therefore describes a degree and mode of stabilization rather than an immutable structure.

Economic categories themselves can be institutionally produced. What counts as employment, ownership, creditworthiness, professional competence, a legitimate firm, an eligible beneficiary, or a recognized transaction depends partly on classification systems and authoritative procedures. Such categories have material effects because they govern access, obligations, visibility, and enforceability. GRE's manifestation layer provides one vocabulary for studying these representations, but economic sociology supplies richer accounts of how categories acquire legitimacy and social force.

Proposition 21.494 (Institutional category condition). *When an economic outcome depends on a classification, status, credential, or organizational category, analysis should examine the institutions that produce, recognize, enforce, and contest that category in addition to measuring the category's downstream effects.*

Institutions also organize relations between formally separate organizations. Regulatory systems, professional associations, standards bodies, funding arrangements, rankings, and shared cultural models can create common expectations across organizational fields. Direct contractual ties therefore capture only part of the institutional environment.

Zelizer's relational-work perspective adds a particularly important correction to overly rigid institutional accounts. Economic and intimate relations are not simply separated into distinct spheres; people actively differentiate relations and match them with transactions, media, boundaries, and meanings (Zelizer 2012). The institutional question consequently includes how actors maintain distinctions among kinds of relations and what happens when the matching becomes contested.

Definition 21.495 (Institutional relation matching). *Institutional relation matching* is the socially organized process through which participants connect a type of relationship with recognized transactions, media, boundaries, obligations, or evaluative meanings.

This concept is especially useful for GRE because conversion across value forms often occurs through institutionally organized interfaces. Money, credentials, rankings, legal statuses, and organizational procedures can translate one kind of contribution into another kind of recognized claim. Economic sociology helps prevent GRE from treating these conversions as purely technical mappings by showing that the categories and boundaries themselves are socially constituted.

21.23.6 Trust

Trust provides the sixth coordinate because many economic relations involve incomplete information, vulnerability, deferred performance, and limited control over counterpart behavior. Arrow identifies trust and related social virtues as economically consequential for exchange (Arrow 1972). Coleman treats obligations, expectations, information channels, norms, and closure as forms of social capital embedded in social structure (Coleman 1988). Ostrom's work on collective action further emphasizes feedback among trust, reciprocity, and reputation in sustaining cooperation (Ostrom 1998).

Definition 21.496 (Economic trust relation). *An economic trust relation* is a relation in which one party accepts material, informational, organizational, or social exposure partly on the expectation that another party or institution will act within an anticipated range despite incomplete control or verification.

Trust should be distinguished from several neighboring concepts. Reputation concerns socially available information or beliefs about prior conduct. Familiarity concerns repeated exposure. Compliance concerns observed conformity with a rule. Confidence can arise from institutional safeguards that reduce vulnerability. Social capital can include trust while also encompassing obligations, norms, information channels, and network structure. Empirical research should therefore specify which object is being measured.

Proposition 21.497 (Trust-object specification). *A claim about trust should identify the trusted party or institution, the relevant domain of conduct, the exposure accepted by the trusting party, and the evidential basis for inferring trust rather than reputation, familiarity, compliance, or institutional assurance.*

Trust can reduce some transaction and monitoring burdens, facilitate knowledge sharing, support delayed reciprocity, and enable cooperation under uncertainty. It can also generate vulnerability. Trust placed in unreliable or predatory actors can magnify harm, while dense trust within an insider group can support exclusion or collusion toward outsiders. High internal trust therefore does not establish social desirability.

Power further complicates the relation. A dependent worker, borrower, patient, platform participant, or migrant may continue a relation while reporting or displaying cooperative behavior because exit is costly. Observed compliance in such settings should not be interpreted automatically as trust. Conversely, institutional protections can support cooperation among strangers by limiting exposure and providing remedies when trust fails.

Proposition 21.498 (Trust–power distinction). *Observed relational continuity or cooperative conduct should not be treated as evidence of trust when dependence, coercion, lack of alternatives, or asymmetric control provides a plausible alternative mechanism.*

Trust can become generative when it changes what participants can undertake together. A history of reliable collaboration can support more complex projects, longer time horizons, shared investment, or reduced duplication of verification. Broken trust can contract future options by increasing monitoring costs, reducing willingness to share information, or fragmenting networks. This temporal dimension provides a natural bridge to GRE.

Definition 21.499 (Trust-mediated generativity). *Trust-mediated generativity occurs when a trust relation materially changes the later set of feasible collaborations, exchanges, investments, or information-sharing arrangements available to participants.*

21.23.7 Relational Reconstruction

The preceding coordinates permit a GRE reconstruction centered on a history-bearing architecture of economic relations. Economic action is situated within networks, fields, institutions, categories, meanings, and trust relations that condition what actors can perceive, value, access, exchange, and become. GRE can connect these elements by asking how their configuration changes later capabilities, relations, value-conversion pathways, distributions of power, and future possibilities. The reconstruction remains an extension of established relational scholarship rather than a claim to have originated relational economic analysis.

Definition 21.500 (History-bearing economic relational architecture). A *history-bearing economic relational architecture* is a temporally evolving configuration of actors, relations, positions, institutions, meanings, representations, resources, and power whose prior development materially conditions present economic action and whose current operation can alter later feasible relations and capacities.

The first element is relation formation. Economic relations do not arise from opportunity sets alone. Entry can depend on referrals, credentials, institutional membership, language, geographic proximity, prior reputation, platform access, or social recognition. These conditions determine who can encounter whom and under what terms. Allocation to relationship-forming infrastructure can therefore alter the future network itself.

Proposition 21.501 (Relation-formation generativity). *A present allocation or institutional change is relationally generative when it materially changes which economically consequential relations can form, persist, dissolve, or become accessible in subsequent periods.*

The second element is position. Network and field positions influence access to information, brokerage, legitimacy, resources, and bargaining leverage. GRE adds a temporal question: how does occupying a position change the actor's later capabilities and the structure available to others? A prestigious institutional affiliation can generate additional invitations and credentials; a peripheral position can reproduce exclusion by limiting access to relation-forming opportunities.

The third element is meaning. Zelizer's relational work shows that economic transactions are matched with socially differentiated relations and meanings (Zelizer 2012). GRE's manifestation layer can model the categories through which these relations become legible, while remaining dependent on sociology and historical inquiry to establish what those categories mean in practice. A payment can signify wage, gift, compensation, contribution, care, debt repayment, or honorarium depending on the relation and institution in which it occurs.

Proposition 21.502 (Relational meaning condition). *An economic transfer should be interpreted through the relation, institutional category, and social meaning that organize it whenever those features materially affect rights, expectations, valuation, or subsequent interaction.*

The fourth element is relational value. Interaction can generate trust, recognition, belonging, shared competence, identity, or obligations whose value cannot always be separated from the relation itself. GRE can place such value alongside material, capability, institutional, ecological, epistemic, and symbolic value without presuming commensurability. Conversion among these forms is itself relational: a professional network can convert recognition into employment opportunity; a credential can convert institutional classification into access; trust can convert prior reliable interaction into reduced verification burdens.

The fifth element is power. Relations can distribute the capacity to define categories, set terms of exchange, control access to networks, certify membership, govern data, allocate recognition, or determine which relational value becomes economically convertible. Economic sociology's field and institutional traditions help make these mechanisms concrete. GRE can then trace how current asymmetries propagate through future relation formation and value conversion.

Definition 21.503 (Relational conversion power). *Relational conversion power* is the

capacity, grounded in a specified economic relation or position, to influence whether and how another participant's resources, status, recognition, contribution, or relational value becomes convertible into an economically consequential claim or opportunity.

The sixth element is recursive transformation. Economic relations can alter the subjects and institutions participating in them. Collaboration can create shared vocabularies and identities; market participation can reshape organizational routines; repeated classification can influence self-understanding; exclusion can redirect affiliation; and institutional reform can change what kinds of relationships are recognized. This recursion is a central point at which GRE's generative orientation extends established relational analysis.

Proposition 21.504 (Relational recursion condition). *Where participation in an economic relation changes the actors, categories, institutions, or relation-forming capacities that structure later interaction, the relation should be analyzed as a recursive transformation rather than as a fixed channel connecting unchanged entities.*

21.23.8 Analytical Proximities among Relational Traditions

Economic sociology, relational sociology, relational economics, and GRE possess substantial analytical proximity. The purpose of identifying that proximity is comparative clarification rather than disciplinary assimilation. Several shared orientations explain why translation can be unusually strong in this domain.

The first proximity is resistance to strongly atomized explanation. Granovetter's embeddedness thesis, network analysis, field theory, and relational sociology all treat the relations among actors as explanatory rather than incidental (Granovetter 1985; Wellman 1983; Emirbayer 1997). GRE shares this orientation and extends it toward the downstream production of later possibilities.

The second proximity concerns endogenous social structure. Networks, fields, institutions, and identities can emerge, stabilize, and transform through interaction. White's account of identity and control and Fligstein and McAdam's field theory exemplify social formations that cannot be reduced cleanly to fixed individual attributes (White 2008; Fligstein and McAdam 2012). GRE likewise treats subjects and structures as potentially history-bearing and transformable.

The third proximity concerns meaning. Economic sociology has long resisted the view that transactions possess economically relevant meaning independently of their social classification. Zelizer's relational-work approach is especially close to GRE's interest in heterogeneous value and conversion because it examines the matching among relations, transactions, media, boundaries, and meanings (Zelizer 2012). GRE benefits from this literature by avoiding an overly structural account of relations.

The fourth proximity concerns multiple levels of organization. Dyadic relations, networks, organizations, fields, institutions, and broader historical structures can interact. Relational sociology supplies mature concepts for moving across these levels without assuming that one scale exhausts explanation. GRE's multiscale and generative-spacetime language can complement this work when the research question requires explicit temporal propagation.

Proposition 21.505 (Relational-proximity condition). *Conceptual proximity between GRE and an established relational tradition should be stated at the level of the shared*

analytical object or mechanism and should not be extended automatically to ontology, method, normative commitments, or explanatory scope.

The fifth proximity concerns power and position. Bourdieu's fields, network dependence, institutional classification, and boundary work all show that relations are structured by unequal capacities and differentiated positions. GRE's power framework can translate some of these asymmetries into effects on future capability, conversion, and relation formation while remaining dependent on the originating theories for their historically specific mechanisms.

The sixth proximity concerns relational value. Uhlaner, Gui, and Donati offer distinct theories in which value depends on interaction or the relation itself (Uhlaner 1989; Gui 2000; Donati 2019). GRE's heterogeneous-value framework can accommodate such value while asking additional questions about circulation, dissipation, capture, regeneration, and conversion. The proximity is therefore substantive, yet equivalence remains partial.

Definition 21.506 (Relational theoretical proximity). *Relational theoretical proximity* is a partial correspondence between theories in which one or more analytical objects, mechanisms, or explanatory commitments overlap sufficiently to support translation while other theoretical commitments remain distinct.

This definition is useful beyond the present section. Theories can be close enough for productive dialogue without being variants of one framework. Indeed, the strongest value of dialogue may arise precisely when neighboring theories illuminate different dimensions of the same relational configuration.

21.23.9 Limits of Identification

The proximity between GRE and relational traditions creates a special risk: concepts can appear so similar that translation is mistaken for identity. This subsection therefore specifies the principal boundaries that should remain visible.

The first boundary concerns intellectual priority. Embeddedness, network position, social fields, relational goods, institutional classification, trust, and relational meaning all have substantial literatures predating GRE. GRE can reorganize some of these insights within a generative research programme, but reorganization does not establish conceptual priority. Attribution is part of theoretical discipline.

Proposition 21.507 (Relational priority condition). *When a GRE concept overlaps materially with an established relational concept, the manuscript should identify the prior literature and state the narrower feature introduced by the GRE formulation rather than treating relationality itself as the innovation.*

The second boundary concerns ontology. Emirbayer's relational sociology explicitly contrasts substantialist and relational modes of thought, while Bourdieu's field theory, White's network sociology, and Donati's relational sociology carry their own commitments about the status of relations, positions, identities, or emergent relational goods (Emirbayer 1997; Bourdieu and Wacquant 1992; White 2008; Donati 2019). GRE maintains ontological suspension. Similar vocabulary therefore does not warrant importing another theory's ontology into GRE without argument.

The third boundary concerns representation. A network is one representation of selected relations; a field is a theory-laden mesolevel structure; a relational good is a value concept; embeddedness is an explanatory orientation; trust is a relational ex-

pectation under exposure. These objects operate at different analytical levels. Calling each of them “relational” does not make them interchangeable.

Proposition 21.508 (Relational-category non-equivalence). *Network, field, institution, embeddedness, trust, relational good, and GRE relation should remain distinct categories unless the research design establishes a specific mapping among them.*

The fourth boundary concerns method. Economic sociology employs ethnography, interviews, archival work, network analysis, organizational research, surveys, experiments, comparative history, and formal models. Relational economics similarly spans several methodological styles. GRE’s methodological pluralism can accommodate these approaches, but it does not supply their evidential warrants. A relational claim remains dependent on the method appropriate to the phenomenon under study.

The fifth boundary concerns normativity. Relations can produce trust, cooperation, belonging, and mutual benefit; they can also organize domination, exclusion, dependency, discrimination, surveillance, and collusion. Relational density or persistence therefore has no automatic positive normative status. The same caution applies to relational goods: the presence of interaction-dependent value does not settle questions of fairness, consent, recognition, distribution, or external effects.

Proposition 21.509 (Relational normative neutrality). *The existence, density, persistence, or generativity of an economic relation does not by itself establish the relation’s justice, desirability, legitimacy, or welfare value.*

The sixth boundary concerns generativity. Economic sociology already studies emergence, reproduction, institutionalization, diffusion, path dependence, learning, identity formation, and social change. GRE’s distinctive contribution cannot therefore consist in the observation that relations have consequences through time. Its narrower contribution lies in making the downstream production, preservation, contraction, and redistribution of future capabilities and relational possibilities a systematic economic object across heterogeneous value domains.

Definition 21.510 (GRE generative remainder). *The GRE generative remainder in dialogue with relational economic traditions is the explicit analytical focus on how present relational configurations alter the distribution and structure of later feasible relations, capabilities, value-conversion pathways, and open possibilities across specified timescales.*

Even this remainder should be stated modestly. Particular sociological theories may already analyze some or all of these dynamics. The GRE contribution is architectural: it places them within a shared economic research programme and connects them systematically to heterogeneous value, allocation, power, epistemic mediation, and future option structures.

The seventh boundary concerns disciplinary purpose. Economic sociology can explain how markets, organizations, classifications, identities, and transactions are socially constituted without adopting an economic-theory programme. Relational economics can pursue welfare, participation, interpersonal value, or institutional questions using its own conceptual commitments. GRE seeks to build an economic research programme around generative relational questions while retaining interfaces with sociology, law, political theory, ecology, education, AI studies, and other domains. These purposes overlap without collapsing into one discipline.

Proposition 21.511 (Economic-sociology–GRE non-identity). *Strong overlap in rela-*

tional objects supports extensive dialogue between economic sociology, relational economics, and GRE while leaving disciplinary history, ontology, method, normative purpose, and the systematic focus on future generative consequences analytically distinct.

The domain of adequacy is therefore complementary. Economic sociology is especially powerful where economic action depends on social structure, networks, institutions, fields, categories, culture, meaning, status, or trust. Network and field approaches provide mature tools for relational position and mesolevel organization. Relational-goods scholarship clarifies forms of value constituted through interaction. GRE can integrate these insights into a wider account of historical relational transformation and future possibility, while those established traditions constrain GRE against rediscovering relational insights under new terminology. The dialogue is strongest when theoretical proximity increases mutual intelligibility without erasing intellectual difference.

21.24 Digital, Platform, and Data-Centered Economic Analysis

This section extends the theory-specific dialogue to digital economics, platform economics, data-centered analysis, and adjacent research on algorithmic coordination and digitally mediated work. Its role is to examine economic arrangements in which software interfaces, data infrastructures, ranking and matching systems, network effects, and digitally organized control become material components of coordination. The objective is to distinguish the principal economic objects made visible by these literatures and then assess their relation to GRE without treating digital mediation as a single mechanism. The discussion proceeds through platforms, data, network effects, attention, algorithmic intermediation, digital labor, and rent and control before developing a relational reconstruction and specifying limits of translation. The method is comparative, institutional, and mechanism-centered. It draws on platform and digital-economics research, organizational analysis of algorithmic control, information economics, and selected political-economic interpretations while preserving differences among those traditions. Table 21.24 summarizes the principal dialogue coordinates.

Digital economics provides an important starting point because digitization can alter several economically consequential costs at once. Goldfarb and Tucker identify reductions in search, replication, transportation, tracking, and verification costs as recurring mechanisms through which digital technologies reorganize economic activity (Goldfarb and Tucker 2019). Platform economics adds a distinct coordination problem: participation and pricing on one side of a platform can affect participation and value on another, so the economic object includes cross-side relations rather than a single buyer–seller exchange (Rochet and Tirole 2003). Data-centered analysis further expands the object by making large-scale observation, inference, experimentation, and prediction part of economic organization (Einav and Levin 2014). These developments overlap, yet each foregrounds a different mechanism.

Definition 21.512 (Digital economic mediation). *Digital economic mediation* is the organization of economically consequential interaction through computational interfaces, data structures, software rules, or communication infrastructures that condition access, visibility, matching, exchange, evaluation, coordination, or control.

Definition 21.512 identifies a broad comparative object. Digital mediation can occur in a commercial platform, a public data infrastructure, an internal organizational system, a labor-management application, a payment network, or a distributed technical standard. The category therefore concerns the mechanism through which interaction is organized rather than the legal identity of the organization operating it.

Proposition 21.513 (Digital mechanism differentiation). *Analysis of a digital economy should distinguish cost reduction, cross-side coordination, data generation, network effects, attention allocation, algorithmic intermediation, labor organization, and control over bottleneck resources because these mechanisms can vary independently and can produce different economic consequences.*

21.24.1 Platforms

Platforms provide the first coordinate because they organize interaction among participant positions through a shared technical and institutional architecture. In two-sided market analysis, the participation of one group can affect the value received by another, and the structure of prices can matter independently of the aggregate price level (Rochet and Tirole 2003). A payment network, marketplace, operating system, labor-matching service, application store, or advertising-supported service can therefore require coordinated decisions across several participant groups. The platform becomes part of the economic mechanism through which those groups become mutually accessible.

Definition 21.514 (Platform coordination position). *A platform coordination position is an institutional and technical position from which an actor or organization can set or implement interfaces, participation conditions, standards, pricing structures, ranking rules, or exchange pathways that coordinate interactions among two or more participant groups.*

The definition focuses on a position rather than a firm category. A cooperative, public authority, private corporation, open-source foundation, or federated consortium can operate platform-like coordination. Conversely, a digital firm that provides a single service without materially organizing interaction among distinct participant positions may fit poorly within multi-sided platform analysis. Analytical precision therefore requires specification of who interacts, through which interface, and under whose rules.

Platform coordination can create value by lowering search costs, standardizing exchange, supplying identity or reputation systems, enabling payments, reducing verification burdens, and supporting complementary innovation. These functions can enlarge the set of feasible transactions. They can also make continued participation depend on a particular interface, technical standard, reputation system, installed user base, or access rule. The same coordination architecture can consequently create capability and dependency at once.

Proposition 21.515 (Cross-side coordination condition). *A platform claim based on multi-sided interaction should identify the relevant participant sides and specify how participation, pricing, quality, visibility, or another condition on one side changes incentives or feasible interaction on another.*

Srnicek's account of platform capitalism places these coordination functions within a broader political economy of data extraction, network effects, infrastructural positioning, and capitalist accumulation (Srnicek 2016). That account and formal two-

Table 21.24: Relational coordinates for digital, platform, and data-centered economic analysis

Coordinate	Established analytical object	Dialogue boundary
Platforms	Multi-sided coordination through shared interfaces, rules, pricing, standards, and participation structures	Identification of every digital service with a platform or treatment of platform mediation as a neutral container
Data	Recorded, inferred, linked, and reusable representations generated through economic and social activity	Equation of data volume with knowledge, value, accuracy, or legitimate control
Network effects	Participation value conditioned by installed base, compatibility, complementarity, or cross-side participation	Inference of monopoly, welfare, or permanence directly from the existence of a network effect
Attention	Scarce orientation and visibility allocated among abundant informational objects	Equation of exposure with preference, belief, consent, or realized demand
Algorithmic intermediation	Computational ranking, matching, pricing, scheduling, moderation, prediction, and evaluation	Treatment of an algorithm as an autonomous institution independent of rules, objectives, data, operators, and review procedures
Digital labor	Work whose tasks, access, evaluation, coordination, or output are materially mediated by digital systems	Merger of automation, platform work, remote work, content production, and data-producing activity into one labor mechanism
Rent and control	Returns and bargaining advantages associated with scarce interfaces, assets, standards, rights, or dependency positions	Classification of every digital profit as rent or every concentration outcome as the product of one control mechanism
GRE reconstruction	History-bearing digital relations connecting mediation, data, attention, labor, power, value, and later possibility	Attribution of established platform or digital-economics insights to GRE or reduction of technological specificity to generic relational language

sided market theory operate at different levels. The former asks how platforms function as organizational forms within contemporary capitalism; the latter models coordination and price structure across participant groups. Their partial overlap supports dialogue while preserving their distinct explanatory objects.

Proposition 21.516 (Platform-role differentiation). *A platform should be analyzed through the roles it actually performs—for example matching, payment, hosting, ranking, identity, rule enforcement, data processing, or infrastructure provision—because different roles generate different dependencies and governance questions.*

This role-based approach also avoids equating scale with a single economic effect.

A large installed base may increase matching quality, complement availability, or interoperability. It may also raise switching costs or make exclusion more consequential. The evaluative result depends on the mechanisms connecting scale to participant opportunities, costs, and alternatives.

21.24.2 Data

Data-centered economic analysis expands the object of inquiry from transactions to the traces, records, measurements, classifications, and inferred variables produced through economic activity. Einav and Levin emphasize the growing availability of large, granular, and timely datasets generated by administrative and private-sector systems and the resulting possibilities for economic measurement and research (Einav and Levin 2014). Digital systems also lower the costs of tracking and verification, making recurrent observation part of ordinary economic organization (Goldfarb and Tucker 2019).

Definition 21.517 (Economic data relation). An *economic data relation* is a structured relation among data-generating activities, represented subjects or objects, collection mechanisms, storage and linkage systems, access rights, analytic procedures, decision uses, and downstream consequences.

The relational formulation matters because data rarely arise as detached resources. Transaction records depend on a payment system and its categories; mobility data depend on devices and location infrastructures; platform engagement data depend on interface design and available actions; employment metrics depend on task definitions and monitoring systems. Dataset construction therefore involves prior institutional and technical decisions about what becomes recordable and how observations are classified.

Data can be copied and recombined at low marginal cost, yet economically useful data can remain scarce because collection access, provenance, linkage rights, timeliness, coverage, exclusivity, legal permissions, or complementary analytic capacity are scarce. The information-economics tradition has long emphasized that information differs from ordinary rival goods and that appropriation can be difficult under some conditions (Arrow 1962). Digital infrastructures alter the practical forms of those problems without eliminating them.

Proposition 21.518 (Data provenance condition). An *economic claim based on data should preserve the relation between the dataset and the processes through which observations were generated, selected, classified, transformed, and made available for analysis*.

Provenance is economically relevant as well as epistemically relevant. The ability to collect and combine data can improve matching, forecasting, fraud detection, service design, scientific inquiry, or public administration. The same ability can create asymmetry when one position observes another in detail while access to the resulting representation, correction process, or inferential model remains one-sided. Documentation practices such as datasheets illustrate one response to this broader problem by making motivation, composition, collection, recommended uses, and dataset history explicit (Geburu et al. 2021).

Proposition 21.519 (Data-value non-equivalence). *Data quantity, data quality, informational usefulness, economic value, and normative legitimacy should remain separate analytical dimensions because improvement in one dimension does not establish im-*

provement in the others.

This distinction is especially important for GRE. A large dataset can improve a prediction while narrowing the categories through which a subject becomes economically legible. A small dataset can be highly valuable when it concerns a scarce scientific or operational process. Data may support future capability when they enable learning and coordination, while the same data architecture can reduce future options when exit, correction, or reuse rights are highly asymmetric. The generative question therefore concerns the relation in which data are produced and used.

21.24.3 Network Effects

Network effects identify a mechanism through which the value or usefulness of participation depends on the participation or adoption decisions of others. Katz and Shapiro analyze systems competition in settings where compatibility and installed base affect product value and competitive dynamics (Katz and Shapiro 1994). Platform analysis extends this mechanism across participant sides: additional participation by one group can increase or reduce value for another (Rochet and Tirole 2003). The resulting feedback can influence entry, pricing, standardization, and the persistence of particular systems.

Definition 21.520 (Network-dependent participation value). *Network-dependent participation value* is the component of a participant's expected or realized value that changes materially with the number, composition, activity, compatibility, or position of other participants or complementary components in the relevant system.

The definition keeps several mechanisms visible. Same-side effects concern relations among participants of a similar type. Cross-side effects concern interactions among different participant groups. Compatibility effects concern whether products, services, identities, files, applications, or standards can interoperate. Complement effects concern the availability of associated goods or services. Congestion can produce negative effects when additional participation lowers service quality or intensifies competition for scarce attention or capacity.

Proposition 21.521 (Network-effect specification). *A network-effect claim should identify the relevant participant set, the direction of the effect, the mechanism connecting participation to value, and the range over which the effect is expected to operate.*

Network effects can contribute to concentration, while concentration remains a broader outcome. Scale economies, data advantages, brand, contractual restrictions, technical standards, capital requirements, regulatory structure, switching costs, acquisitions, and complementary assets can also affect concentration. Conversely, interoperability, multihoming, open standards, or low switching costs can weaken the persistence associated with an installed-base advantage. The presence of a network effect therefore supplies one causal mechanism rather than a complete market-structure diagnosis.

Proposition 21.522 (Network-effect concentration boundary). *Inference from a network effect to monopoly, durable dominance, welfare loss, or irreversibility requires additional evidence about entry, interoperability, multihoming, switching, governance, and competing mechanisms.*

For GRE, network effects have a temporal significance because present participation can alter the future feasibility of alternative networks. Early adoption can attract

complements, investment, skills, standards, and reputational infrastructure. These cumulative processes can make later switching more costly even when the original technological difference was modest. A generative analysis should therefore study both current participation value and the way installed relations reshape the future option set.

21.24.4 Attention

Digital abundance makes attention economically salient because growth in available information does not proportionally expand a recipient's capacity to inspect, interpret, or act on it. Simon's formulation of an information-rich world identifies recipient attention as the scarce resource consumed by abundant information sources (Simon 1971). Search engines, feeds, recommendation systems, advertising markets, notifications, rankings, and interface defaults can therefore become allocation mechanisms for scarce orientation.

Definition 21.523 (Mediated attention allocation). *Mediated attention allocation* is the patterned distribution of visibility, salience, sequence, or discoverability among competing informational or economic objects through an interface, institution, or ranking process.

Attention allocation can influence economic outcomes because visibility affects discovery, demand formation, reputation, participation, and access to opportunities. A creator placed prominently in a recommendation feed may receive more opportunities for evaluation; a seller appearing high in search results may receive more transactions; a worker receiving rapid task notifications may gain access to work before others. These consequences establish attention as an economic interface while leaving the recipient's eventual judgment open.

Proposition 21.524 (Attention-conversion condition). *The economic consequence of attention depends on the conversion pathway connecting visibility to later action, transaction, recognition, learning, or resource allocation; exposure alone does not establish any of those outcomes.*

This distinction separates attention from preference. A person can see an object without valuing it, value it without acting, act under constraint, or discover a preference through exposure and learning. Similarly, engagement metrics represent selected manifestations of interaction rather than a complete measure of welfare, interest, or social value. Chapter 17 developed attention as part of the epistemic economy; the present dialogue adds the platform-economic question of who controls the interfaces through which scarce attention is allocated.

Proposition 21.525 (Attention-metric boundary). *A metric of clicks, viewing time, impressions, reactions, or other observable engagement should be treated as a representation of selected behavior rather than as a direct measure of preference, welfare, consent, or heterogeneous value.*

Attention can also accumulate. Repeated visibility can produce familiarity, data, reputation, complementary investment, and further recommendation, creating a feedback process between past allocation and future discoverability. The result can support learning and coordination while also narrowing exposure to alternatives. The relevant economic question concerns how the allocation rule, participant response, and feedback structure jointly shape later opportunities.

21.24.5 Algorithmic Intermediation

Algorithmic intermediation concerns computational procedures that rank, match, predict, price, schedule, recommend, moderate, classify, or evaluate within an economic relation. Such procedures can process information at scales and speeds difficult to achieve through direct human administration. They can also standardize criteria, update decisions rapidly, and coordinate large participant populations. Their economic significance depends on the institutional role in which the procedure is embedded.

Definition 21.526 (Algorithmic intermediation). *Algorithmic intermediation* is the use of computational procedures to transform data into rankings, classifications, predictions, matches, prices, schedules, recommendations, or other decision-relevant outputs that condition economically consequential interaction.

The same technical procedure can occupy different economic roles. A recommender can assist discovery, an allocation algorithm can distribute tasks, a fraud model can condition payment access, and a performance system can shape promotion or dismissal. Organizational research on algorithms at work shows that computational systems can become mechanisms of direction, evaluation, and discipline within labor processes (Kellogg et al. 2020). This places algorithmic intermediation within organizational control as well as prediction technology.

Opacity also has several sources. Burrell distinguishes secrecy, technical-literacy barriers, and opacity arising from the characteristics and scale of machine-learning systems (Burrell 2016). These forms have different remedies. Disclosure can address some secrecy, explanation and institutional support can address some literacy barriers, and audit or verification procedures may be required when behavior cannot be reconstructed through ordinary inspection.

Proposition 21.527 (Algorithmic-institution condition). *The economic effect of an algorithm should be analyzed together with its objective, training or input data, institutional mandate, decision authority, affected positions, update process, and available routes of review or contestation.*

Kroll and colleagues develop accountability approaches for consequential algorithmic decisions that rely on technical and institutional procedures beyond ordinary review of a human decision maker (Kroll et al. 2017). The underlying point is broader than legal accountability. Computational intermediation can separate the party affected by a decision from the actors who select objectives, collect data, implement the model, set thresholds, and govern appeals. Responsibility therefore becomes distributed across a technical-institutional chain.

Proposition 21.528 (Algorithmic accountability relation). *Accountability for algorithmic intermediation requires identification of the actors and institutions responsible for objectives, data, implementation, decision authority, monitoring, correction, and appeal, with the computational procedure treated as one component of the decision architecture.*

Algorithmic outputs can feed back into their own future inputs. A ranking changes visibility; visibility changes interaction; interaction generates new data; new data influence later rankings. A labor allocation system can similarly shape which workers accumulate experience and performance records. These recursive effects make temporal analysis particularly important because an apparently local decision can modify the data-generating environment on which later decisions rely.

21.24.6 Digital Labor

Digital labor is a heterogeneous category. It can refer to work obtained through platforms, work coordinated or evaluated through digital systems, remote work enabled by communication infrastructure, content or moderation work performed inside digital ecosystems, and tasks reorganized by automation or artificial intelligence. These forms share technological mediation while differing substantially in contract, skill, autonomy, bargaining position, location, and relation to the output produced.

Definition 21.529 (Digitally mediated labor relation). A *digitally mediated labor relation* is a labor relation in which access to work, task decomposition, coordination, monitoring, evaluation, remuneration, communication, or output distribution depends materially on digital infrastructure or computational intermediation.

This definition preserves labor as a social and institutional relation. A worker using ordinary software does not necessarily face algorithmic management; a platform contractor can encounter detailed computational scheduling and evaluation without holding a conventional employment contract; an employee may work remotely while retaining substantial discretion; a content creator may depend on ranking and monetization systems even without receiving task assignments from the platform. Digital mediation therefore modifies labor through several channels.

Task-based economic analysis helps distinguish automation from labor displacement as a whole. Acemoglu and Restrepo separate displacement through automation from reinstatement through the creation of new tasks, emphasizing that technological change can reorganize the task content of production rather than produce one uniform employment effect (Acemoglu and Restrepo 2019). The distinction is useful for digital labor because the same system can automate one activity, create complementary tasks, change required skills, and redistribute monitoring or coordination work.

Proposition 21.530 (Digital task-recomposition condition). *Analysis of digitally mediated work should identify which tasks are automated, created, recombined, intensified, relocated, or newly measured and should distinguish those changes from aggregate claims about employment or labor demand.*

Algorithmic management adds another dimension. Kellogg, Valentine, and Christin show how algorithms can become contested mechanisms of control when they direct, evaluate, or discipline work (Kellogg et al. 2020). Digital systems can also increase worker capability by improving information, reducing coordination burdens, expanding market access, or supporting performance. The distributional question concerns which gains are realized by workers, customers, platform owners, complements, or other positions and how bargaining institutions affect that division.

Proposition 21.531 (Digital-labor control differentiation). *Digital monitoring, task allocation, performance evaluation, communication infrastructure, and contractual status should be analyzed as distinct dimensions of labor control because they can vary independently within the same workplace or platform relation.*

Digital labor can also generate data as a by-product of work. Performance traces, interaction records, ratings, location histories, or content can improve later coordination systems. Whether those data return capability or value to workers depends on access, portability, governance, bargaining, and ownership arrangements. The labor relation therefore can become simultaneously productive, informational, and infrastructural.

21.24.7 Rent and Control

Digital political economy frequently emphasizes rent, concentration, and control. These concepts require careful separation. Profit can arise from innovation, risk bearing, organizational capability, temporary scarcity, market power, contractual rights, ownership, or several mechanisms together. Economic rent likewise has several theoretical meanings. The present comparative purpose is therefore to identify the concrete control position that supports a persistent claim on value and to classify digital income according to the mechanism that generates it.

Definition 21.532 (Digital interface control). *Digital interface control* is the capacity to set, withhold, modify, or condition access to a technical or institutional interface through which other actors conduct economically consequential activity.

Interfaces can include application stores, payment rails, identity systems, cloud services, advertising exchanges, data repositories, software standards, ranking systems, marketplaces, or APIs. Control can derive from property, contract, technical design, regulatory authorization, organizational hierarchy, intellectual property, installed base, or dependence on complementary assets. Property-rights theory offers one useful analytical distinction by treating ownership as an allocation of residual control rights when contracts cannot specify every future use of an asset (Grossman and O. D. Hart 1986; O. Hart and Moore 1990). Digital systems add layers in which control over software, data, standards, and access permissions can be distributed across different actors.

Proposition 21.533 (Digital control-bundle condition). *Claims about digital control should identify the relevant bundle of rights or practical capacities, including where appropriate access, exclusion, modification, data use, standard setting, pricing, ranking, interoperability, and residual decision authority.*

A bottleneck position can support rent-like returns when participants lack practical alternatives and access to the bottleneck is scarce or controlled. Network effects can reinforce such a position, yet they are only one mechanism. Contractual restrictions, reputation non-portability, accumulated data, complementary assets, capital requirements, or regulatory barriers can also matter. Srnicek's analysis of platform capitalism emphasizes the strategic importance of data, network effects, and infrastructural positioning within contemporary accumulation (Srnicek 2016). Empirical work on superstar firms likewise shows that increasing concentration can coexist with high productivity and declining labor shares in sectors where activity reallocates toward leading firms (Autor et al. 2020). These literatures motivate analysis of concentration without resolving its cause in advance.

Proposition 21.534 (Digital-rent source specification). *A claim of digital rent should specify the scarce asset, right, interface, positional advantage, or dependency relation that supports the return and distinguish that mechanism from ordinary profit accounting or concentration alone.*

Control can also be distributed. A platform operator may control ranking while a payment provider controls settlement, a device manufacturer controls installation, a regulator controls licensing, and users collectively supply the participation that gives the network value. Economic power can therefore emerge from coupled control positions rather than a single owner. GRE's power analysis is useful where these positions alter another subject's feasible actions, conversion possibilities, or future options, while the empirical identification of each control mechanism remains domain-

specific.

Proposition 21.535 (Coupled digital control). *Digital market power may arise from interacting control positions held by different actors; analysis should therefore reconstruct the dependency chain and identify whether control is unitary, distributed, or layered.*

21.24.8 Relational Reconstruction

The preceding coordinates can be reconstructed within GRE as components of a history-bearing digital relational architecture. The relevant configuration includes participant positions, interfaces, data-generation processes, attention-allocation mechanisms, network dependencies, computational intermediaries, labor relations, ownership and control rights, standards, external institutions, and the temporal feedback through which present interaction changes later conditions. This reconstruction builds on the substantive platform analysis in Section 19.8 while serving a different purpose here: the present section compares GRE with existing economic traditions, whereas the earlier section provides a domain-level diagnostic.

Definition 21.536 (Digital relational architecture). *A digital relational architecture is a history-bearing configuration of participant positions, technical interfaces, data relations, attention mechanisms, computational rules, labor relations, standards, rights, and governance arrangements through which digital economic interactions are generated, stabilized, revised, and made consequential for later possibilities.*

The architecture makes several forms of recursion visible. Participation generates data that can improve matching or prediction; improved matching can attract participation. Attention produces interaction records that influence future rankings; rankings redistribute later attention. Labor produces both outputs and performance traces; those traces can shape later task allocation. Platform scale attracts complements; complements can increase the value of the platform. Control over an interface can generate revenue that finances further infrastructure and acquisition. Each loop can expand capability for some positions while increasing dependency for others.

Proposition 21.537 (Digital recursive-formation condition). *A digital economic mechanism becomes generatively consequential when its present operation changes the relations, capabilities, data, standards, dependencies, or institutional conditions that structure future economic interaction.*

This proposition identifies GRE's distinctive temporal question without claiming priority over the mechanisms themselves. Network economics already studies installed-base effects; platform economics studies cross-side participation; organizational scholarship studies algorithmic control; data-centered economics studies measurement and prediction. GRE asks how these mechanisms combine across heterogeneous value forms and timescales to alter the future possibility structure of the configuration.

Definition 21.538 (Digital conversion interface). *A digital conversion interface is a digitally mediated arrangement through which one form of participation, data, attention, labor, reputation, access, or capability is transformed into another economically consequential form.*

Examples include the conversion of attention into advertising revenue, labor performance into ratings, ratings into task access, data into predictions, predictions

into prices or eligibility, installed base into complement investment, or reputation into transaction opportunity. These conversions often cross heterogeneous value domains. Their governance determines who can initiate conversion, inspect its rule, contest an outcome, appropriate the resulting value, or preserve an alternative pathway.

Proposition 21.539 (Digital conversion-power condition). *Power over a digital conversion interface increases when a position can materially determine conversion rules or access while affected participants possess limited practical capacity to inspect, contest, substitute, or exit the conversion pathway.*

The relational reconstruction also distinguishes extraction from return. Data, attention, labor, and participation can create value for the wider system. Some of that value may return through lower prices, improved service, income, learning, reputation, infrastructure, interoperability, or collective capability. Other arrangements can concentrate gains while leaving participants dependent on the same interface that their activity helps reproduce. GRE therefore asks how generated value and capability circulate through the relation rather than presuming that either extraction or mutual benefit characterizes a digital system as a whole.

Proposition 21.540 (Digital generative-return condition). *A digital economic arrangement has stronger relational generativity when value and capability produced through participation contribute materially to the continuing capacity of relevant participants and institutions to learn, act, innovate, reorganize, and form viable alternatives.*

This condition remains evaluatively plural. A system can improve consumer convenience while weakening supplier bargaining; expand creator reach while increasing income volatility; improve prediction while reducing privacy; lower transaction cost while concentrating infrastructural control. GRE's heterogeneous-value architecture records these tensions without converting them automatically into one scalar judgment.

Proposition 21.541 (Digital heterogeneous-value condition). *Evaluation of a digital arrangement should preserve materially distinct value dimensions—including economic output, time, privacy, autonomy, learning, recognition, security, access, institutional capacity, and future option value—where their conversion into one common metric is unsupported.*

Finally, the reconstruction is epistemic. Data, metrics, rankings, predictions, and dashboards are manifestations of selected aspects of the underlying relational configuration. Their operational use can feed back into that configuration. A productivity score can alter work assignment; a risk score can alter access; a recommendation can alter visibility; a user category can change pricing. Digital economies therefore make especially visible the GRE distinction between relational reality and manifestational representation: representations can become causally effective while remaining partial.

Proposition 21.542 (Operational representation feedback). *When a digital representation is used to allocate access, visibility, price, work, or institutional standing, the representation can become part of the causal process that generates the later reality it is used to describe.*

21.24.9 Limits of Translation

The proximity between GRE and digital-economy analysis is substantial because both can study interaction, information, feedback, heterogeneous positions, and institutional mediation. Translation nevertheless remains partial. Digital economics, platform economics, organizational research on algorithms, labor economics, information economics, and political economy carry different research questions and evidential standards. GRE can connect their objects without replacing those domain-specific theories.

The first boundary concerns technological specificity. Lower search or replication cost is a concrete technological-economic mechanism (Goldfarb and Tucker 2019). Cross-side pricing is a platform mechanism (Rochet and Tirole 2003). Network effects arise through specified compatibility or participation relations (Katz and Shapiro 1994). Algorithmic opacity can arise through secrecy, expertise barriers, or model characteristics (Burrell 2016). Translating each mechanism into the generic language of relations would lose explanatory content if the specific mechanism were omitted.

Proposition 21.543 (Digital specificity preservation). *A GRE translation of digital-economy research should preserve the technological, contractual, organizational, and market mechanism established by the source theory alongside the relational reconstruction.*

The second boundary concerns data. Data can be economically valuable and causally consequential while remaining a partial representation generated through prior classifications and collection processes. GRE's manifestation language helps articulate that status, while statistical analysis, measurement theory, database engineering, privacy law, and sector-specific evidence remain necessary for claims concerning data quality and use.

Proposition 21.544 (Data-translation boundary). *GRE can analyze the relations through which data become consequential while empirical claims about data quality, inference, prediction, privacy, or system performance continue to require the methods appropriate to those objects.*

The third boundary concerns power. A platform can be large without controlling every participant action; a small interface can be highly consequential when alternatives are absent. Network effects, property rights, contractual restrictions, ranking authority, switching costs, information asymmetry, and regulatory privilege can each contribute to power through different paths. GRE's power vocabulary can compare these paths, while identification of actual power requires evidence about dependencies and feasible alternatives.

Proposition 21.545 (Digital-power identification condition). *A claim of digital power should identify the affected capability or choice set, the mechanism through which another position conditions it, and the practical alternatives available to the affected position.*

The fourth boundary concerns labor. Automation, algorithmic management, remote work, platform contracting, and digitally assisted work can occur separately or together. Labor-market outcomes also depend on institutions, demand, bargaining, skill formation, task creation, and macroeconomic conditions. A digital-labor category is therefore useful for comparison only when the relevant labor mechanism remains explicit.

Proposition 21.546 (Digital-labor translation boundary). *GRE should preserve distinc-*

tions among task automation, labor-process control, contractual status, workplace capability, labor demand, and distribution when translating research on digitally mediated work.

The fifth boundary concerns rent. Platform political economy often uses rent and extraction to emphasize asymmetric appropriation or control over infrastructural positions. These categories can reveal important distributional structures. Their use within a comparative chapter should nevertheless identify the theoretical definition and empirical source of the return. Profit, monopoly profit, quasi-rent, innovation return, land-like rent, intellectual-property income, and returns to a bottleneck position are related but non-identical categories.

Proposition 21.547 (Digital-rent translation boundary). *A relational reconstruction should retain the theory-specific meaning of rent and state the mechanism supporting the return before linking that return to GRE concepts of conversion, capture, or power.*

The final boundary concerns normative inference. Greater interoperability, stronger privacy, wider data access, tighter platform control, more decentralization, or stronger personalization can each be valuable under some conditions and costly under others. Technical architecture redistributes capabilities, risks, and responsibilities across heterogeneous positions. Evaluation therefore requires an explicit normative criterion in addition to descriptive relational analysis.

Proposition 21.548 (Digital normative-separation condition). *Descriptive findings about digital scale, network structure, data accumulation, algorithmic coordination, labor organization, or interface control should remain distinct from normative conclusions until the relevant evaluative criterion and affected positions are specified.*

The dialogue with digital, platform, and data-centered economics therefore yields a bounded result. Existing literatures specify mechanisms of cost reduction, multi-sided coordination, data generation, network feedback, attention allocation, algorithmic control, task recomposition, and infrastructural concentration. GRE connects these mechanisms through time and examines their effects on heterogeneous value, power, capability, epistemic representation, and future possibility. The correspondence is strongest when domain theory supplies the mechanism and GRE supplies relational-generative coordinates for their interaction.

21.25 Translation among Economic Theories

The theory-specific reconstructions in Sections 21.12–21.24 establish that economic traditions can illuminate overlapping objects while organizing those objects through different concepts, scales, temporalities, evidential practices, and value commitments. The role of the present section is to make the act of translation itself an explicit object of analysis. Its objective is to distinguish several forms of cross-theoretical translation, state the conditions under which each form is warranted, and identify what can be lost when a concept or explanation is moved between theoretical architectures. The discussion proceeds through conceptual, functional, structural, historical, cross-scale, and cross-value-regime translation before examining translation loss and non-equivalent translation. The method is comparative and metatheoretical. It uses the common coordinates developed in Section 21.3 while treating every translation as a scoped reconstruction rather than as evidence that the source and target theories are interchangeable. Table 21.25 summarizes the resulting translation modes and their

principal safeguards.

Translation is required because theories rarely divide economic reality at identical joints. A “preference” in one framework, a “capability” in another, a “class position” in a third, and a “relationally constituted subject position” in GRE can each organize inquiry into economically consequential action, yet their meanings, explanatory roles, and normative implications differ. Similar difficulties arise with value, institutions, power, equilibrium, reproduction, uncertainty, care, ecological constraint, network position, and platform control. Cross-theoretical dialogue therefore requires more than substituting one vocabulary for another. It requires an account of what relation is being preserved through the substitution and what remainder is being left behind.

Definition 21.549 (Theoretical translation). *A theoretical translation is an explicit, scoped mapping from an object, concept, relation, mechanism, representation, or explanatory role in a source theoretical configuration to an object, concept, relation, mechanism, representation, or explanatory role in a target theoretical configuration, together with a statement of what is intended to be preserved and what remains outside the mapping.*

Definition 21.549 makes translation directional. Translating a capability into a GRE relational description need not yield the same result as translating a GRE generative-capacity claim into capability language. The source theory determines what must first be reconstructed on its own terms; the target theory determines the vocabulary and distinctions available for the mapping. Translation can therefore be informative in one direction and coarse in the other.

Proposition 21.550 (Translation-warrant condition). *A cross-theoretical translation is warranted only to the extent that the analyst identifies the source object, target object, preserved relation, relevant scale and time horizon, inferential purpose, and known remainder of the mapping.*

The proposition establishes a minimum discipline for the remainder of the chapter. A translation can be useful even when incomplete. Its adequacy depends on whether the preserved feature is the feature relevant to the question being asked.

21.25.1 Conceptual Translation

Conceptual translation concerns the movement of a meaning-bearing distinction from one theoretical vocabulary into another. It is the most familiar form of translation and one of the easiest to overstate. A concept is rarely exhausted by a dictionary definition. Its meaning is partly determined by the contrasts it draws, the questions it makes visible, the assumptions under which it operates, and the inferential consequences attached to its use.

Consider “scarcity.” In a choice-theoretic context, scarcity can characterize a relation between limited means and competing ends. In institutional analysis, scarcity can be partly produced by property rules, access restrictions, or organizational arrangements. In ecological economics, the relevant constraint can be biophysical and regenerative. In the epistemic economy, attention can become scarce under informational abundance. Section 21.8 showed that these uses can be placed in dialogue through a common scarcity–access–distribution architecture. The translation succeeds only if the distinct generating conditions remain visible.

Table 21.25: Translation modes among economic theories

Translation mode	Primary object preserved	Minimum warrant	Principal risk
Conceptual	Meaning-bearing distinctions and category boundaries	Source definition, target definition, shared referent or problem, and explicit remainder	Synonymy inferred from lexical resemblance
Functional	Contribution performed within an explanatory or institutional system	Specified function, relevant conditions, substitutes, and performance domain	Similar outcome inferred to imply similar mechanism
Structural	Pattern of relations among positions or components	Identified nodes or positions, relation types, directionality, and boundary conditions	Topological resemblance treated as substantive identity
Historical	Sequence, inheritance, reproduction, and transformation through time	Periodization, mechanism of persistence or change, and historically situated categories	Present categories projected backward or sequence compressed
Cross-scale	Relations between analytical levels or spatial and temporal scales	Aggregation or decomposition rule, cross-level mechanism, and scale-specific evidence	Properties transferred across levels without warrant
Value-regime	Evaluation, commensuration, conversion, and recognition relations	Value form, evaluator, conversion procedure, losses, and normative standing	Heterogeneous values collapsed into one metric
Loss-aware	Explicit record of information, mechanism, or normative content discarded in translation	Identified omitted dimensions and consequences for inference	Remainder treated as negligible by default
Non-equivalent	Limited intelligibility without a claim of substitutability or equivalence	Precisely stated partial correspondence and stopping condition	Dialogue converted into forced synthesis

Definition 21.551 (Conceptual translation). A *conceptual translation* maps a concept in a source theory to a concept or structured set of concepts in a target theory while preserving a specified semantic distinction, analytical referent, or inferential role.

Conceptual translation can take several forms. A near-direct translation preserves a relatively close distinction. A decompositional translation maps one source concept into several target concepts. A compositional translation reconstructs one target concept from several source distinctions. A contrastive translation identifies a shared object while preserving different conceptual cuts through that object. These forms should be distinguished because they imply different losses.

Proposition 21.552 (Conceptual-context condition). *Lexical similarity is insufficient*

for conceptual translation; the relevant contrasts, assumptions, inferential roles, and domain conditions of the source and target concepts must also be compared.

The condition is especially important where familiar economic words carry theory-specific meanings. “Value” can refer to utility, labor-mediated social form, market price, capability evaluation, care-related worth, ecological significance, relational value, or generative consequence. “Power” can refer to bargaining leverage, class relation, authority, network position, control rights, dependency, or relational conversion of asymmetry. “Institution” can refer to rules, habits, organizations, stabilized social relations, or historically instituted arrangements. A translation that replaces these terms one-for-one can remove the distinctions that made the source theory explanatory.

GRE can support conceptual translation because its relational coordinates allow several theories to be described within one comparative interface. That usefulness creates a corresponding risk. If every concept is redescribed as a relation, configuration, constraint, or generative process, conceptual specificity can disappear behind broad vocabulary. A careful GRE translation should therefore preserve the source concept’s own internal distinctions before expressing its relational profile.

Proposition 21.553 (Conceptual-remainder condition). *A conceptual translation should record the aspects of the source concept that the target vocabulary does not preserve, especially where the omitted content carries historical, normative, institutional, or methodological significance.*

Conceptual translation is consequently a bridge for inquiry rather than a claim that two theoretical languages say the same thing. Its principal contribution is to make differences comparable without dissolving them.

21.25.2 Functional Translation

Functional translation asks what an object, relation, rule, institution, or concept does within a theoretical or economic configuration. Two structures can differ in composition while performing a partially comparable function. Price signals, administrative allocation, community rules, reputation mechanisms, and platform ranking can each coordinate access under some conditions. Household care, public provision, market purchase, and cooperative provision can each contribute to the reproduction of capabilities. Money, credit arrangements, guarantees, and institutional commitments can each support coordination across time in distinct ways.

Definition 21.554 (Functional translation). *A functional translation maps a source object or mechanism to a target object or mechanism by reference to a specified contribution it performs within an identified system and domain of conditions.*

The phrase “specified contribution” is essential. Functional claims become vague when the function is described only as “coordination,” “efficiency,” “stability,” or “value creation.” The analyst should specify the relevant output, affected positions, time horizon, and environmental conditions. A mechanism that coordinates exchange under repeated interaction may fail under anonymity. A governance form that preserves a local commons may not scale through simple replication. A digital reputation system and long-term interpersonal trust can both support cooperation while generating different vulnerabilities and evidential traces.

Proposition 21.555 (Functional-domain condition). *Functional translation requires*

specification of the function, the system boundary within which it is performed, the conditions supporting performance, and the criteria by which the functional claim is evaluated.

Functional translation can reveal substitutes and complements. A market and a hierarchy can sometimes solve related coordination problems while distributing decision rights differently. A formal contract and a trust relation can sometimes support exchange jointly rather than substitutively. Public infrastructure can enable market activity that would otherwise be infeasible. The relevant translation therefore concerns a role within an architecture, not an isolated object.

The distinction between function and mechanism also protects against premature theoretical convergence. Two arrangements can produce similar observed outcomes through different causal processes. Conversely, similar mechanisms can perform different functions when embedded in different institutional settings. A price change may ration demand, transmit information, redistribute purchasing power, alter expectations, or trigger institutional response. Which function matters depends on the theoretical question.

Proposition 21.556 (Function–mechanism distinction). *Functional correspondence does not by itself establish mechanism correspondence; a valid translation should state separately what contribution is shared and how each theory explains the production of that contribution.*

Functional translation is therefore particularly useful for institutional comparison. It permits dialogue among theories that classify economic arrangements differently while still asking whether those arrangements address related coordination, provisioning, reproduction, learning, or governance problems.

21.25.3 Structural Translation

Structural translation shifts attention from isolated concepts to patterned relations among positions. The source object can be a class structure, ownership arrangement, input–output relation, network, household organization, governance system, platform architecture, or ecological dependency. Translation asks whether a relevant relational pattern can be represented in another theoretical language while preserving the relations that matter to the explanation.

Definition 21.557 (Structural translation). *A structural translation maps a source configuration to a target representation by preserving a specified pattern of positions, relations, dependencies, constraints, or transformation rules across an explicitly stated boundary.*

Structural translation can be more demanding than conceptual translation because relations are jointly defined. Ownership means something different when voting rights, residual claims, control rights, exit options, and legal liabilities are distributed differently. A household cannot be translated adequately into a representative decision unit when the question concerns intrahousehold bargaining or care dependency. A platform cannot be translated into a conventional firm model if cross-side participation and interface control are central to the phenomenon under study.

Proposition 21.558 (Structural-relation preservation). *A structural translation should identify which positions and relation types are preserved, which are aggregated or omitted, and whether directionality, multiplicity, hierarchy, feedback, or boundary*

membership is altered by the target representation.

Section 21.6 established that exchange, production, ownership, labor, care, network, ecological, institutional, and power-bearing relations can overlap within one economic configuration. Structural translation should therefore resist the temptation to choose a single relation merely because the target theory represents it conveniently. The appropriate target structure depends on the explanatory object.

GRE's relational language can make structural correspondences unusually visible. Class positions can be represented through relations of control and appropriation; capability constraints through access and conversion relations; network positions through adjacency and intermediation; care dependency through asymmetric reproductive relations; platform power through infrastructural mediation. Yet these redescriptions preserve only part of the source theories. Marxian class, capability freedom, care ethics, and platform governance contain theoretical content beyond a graph of relations.

Proposition 21.559 (Structural-semantic remainder). *Preservation of a relational pattern does not establish preservation of the semantic, historical, normative, or causal interpretation attached to that pattern in the source theory.*

Structural translation prepares the stronger equivalence questions addressed in Section 21.26. At the present stage, the objective is narrower: to identify which structures can be compared and which properties the comparison actually preserves.

21.25.4 Historical Translation

Historical translation concerns theoretical claims whose meaning depends on sequence, inheritance, institutional formation, or historically specific categories. It is necessary because an economic concept can change its referent as the underlying configuration changes. “Labor,” “firm,” “market,” “household,” “property,” “money,” “platform,” and “data” can each refer to institutions with materially different legal, technological, and social architectures across periods.

Definition 21.560 (Historical translation). A *historical translation* reconstructs a source concept, mechanism, or configuration across temporal contexts while preserving the historically relevant sequence, inherited conditions, category formation, and mechanisms of persistence or transformation.

Historical translation has two directions. Diachronic translation compares a concept or mechanism across periods within a tradition or domain. Cross-theoretical historical translation compares theories whose categories were formed in different historical settings. Classical political economy, Marxian analysis, Keynesian theory, institutional economics, platform economics, and ecological economics each emerged in relation to different economic problems and institutional environments. Their categories can remain useful outside their originating contexts, but that extension requires argument.

Proposition 21.561 (Historical-specificity condition). *A historical translation should distinguish properties that belong to the general analytical relation from properties that depend on a particular institutional, technological, legal, ecological, or political configuration.*

Sequence matters as well as context. Path-dependent analysis in Sections 21.16 and 21.18 showed that earlier states can change the accessibility of later states. Key-

nesian and Post-Keynesian analysis in Section 21.15 showed that expectations and irreversible commitments can make historical time economically consequential. Marxian political economy in Section 21.14 embeds categories in historically specific relations of production and accumulation. Translating these accounts into a static relational description would preserve positions while losing the process by which those positions became possible.

Proposition 21.562 (Sequence-preservation condition). *Where a source explanation is sequence-sensitive, a translation that preserves only initial and final states is insufficient unless the omitted sequence is shown to be irrelevant to the claim being translated.*

Historical translation also disciplines GRE. A generative-relational vocabulary can describe how present relations condition later possibilities, yet it should not retroactively redescribe every historical theory as if it had already formulated generativity, relational reality, or open possibility spaces. Historical dialogue requires preserving the conceptual resources actually available to the source tradition while using GRE only as a later comparative language.

21.25.5 Translation across Scales

Economic theories operate at different scales of observation and intervention. Individual choice, household organization, firm governance, class structure, network topology, institutional systems, national macroeconomies, global production arrangements, and social-ecological systems are not interchangeable units. Section 21.4 treated scale selection as part of object construction. Translation across scales therefore requires an account of how properties move, aggregate, decompose, or transform between analytical levels.

Definition 21.563 (Cross-scale translation). *A cross-scale translation maps a claim, mechanism, or representation between analytical levels or spatial, organizational, or temporal scales through an explicit aggregation, decomposition, coupling, or emergence relation.*

A familiar problem arises when individual-level properties are attributed directly to aggregates. Household saving decisions do not automatically determine macroeconomic saving outcomes under every demand regime. Individual preferences do not by themselves determine institutional categories. Firm-level adaptation does not imply system-level optimality. Local cooperation does not establish global governance capacity. Conversely, macroeconomic or institutional regularities cannot always be assigned directly to individuals as stable dispositions.

Proposition 21.564 (Cross-scale mechanism condition). *Translation across scales requires a specified mechanism connecting the levels; aggregation, decomposition, or emergence should not be inferred solely from similarity of labels or outcomes across levels.*

Scale also changes the meaning of relations. A network tie can be consequential at the dyadic level while system-wide outcomes depend on topology. A local ecological practice can be regenerative in one watershed while shifting pressure elsewhere. A household care arrangement can sustain members while depending on national labor markets and public services. A platform rule can appear as an interface choice to one participant and as infrastructural governance at the system level.

Definition 21.565 (Scale-relative adequacy). *Scale-relative adequacy is the extent to*

which a theoretical representation preserves the relations and mechanisms relevant to a claim at the analytical level for which that claim is made.

This definition prevents scale pluralism from becoming indiscriminate multi-level description. A theory can be highly adequate at one scale and intentionally silent at another. Neoclassical choice theory can illuminate local constrained choice without supplying a historical theory of preference formation. Network analysis can reveal positional patterns without identifying the full institutional meaning of each tie. Macroeconomic accounting can establish aggregate identities without reconstructing household experience.

Proposition 21.566 (Scale-specific translation warrant). *A successful translation at one scale should not be generalized to another scale unless the cross-scale relation and its evidential support are independently established.*

GRE benefits from multi-level relational representations, but those representations should preserve the explanatory autonomy of scale-specific theories where appropriate. A multi-scale map is valuable when it clarifies coupling; it becomes misleading when it treats every level as a projection of one preferred ontology.

21.25.6 Translation across Value Regimes

Value creates a particularly difficult translation problem because economic theories can disagree about both the object of valuation and the procedure through which evaluation becomes legitimate. Section 21.7 distinguished utility, labor-mediated value, price signals, capabilities, care value, ecological value, relational value, and generative value. These categories can overlap in empirical settings while remaining theoretically heterogeneous.

Definition 21.567 (Value-regime translation). *A value-regime translation maps evaluative claims across theories or practices by specifying the valued object, evaluator or evaluative position, value form, comparison rule, conversion procedure, institutional context, and remainder that resists or escapes conversion.*

Translation across value regimes is sometimes operationally necessary. Public decisions compare monetary cost, capability effects, care burdens, ecological impacts, distributional incidence, and long-run generative consequences. Organizations convert heterogeneous performance dimensions into rankings or budgets. Households translate time, money, obligation, affection, and future security into practical decisions. Such conversion practices are economically consequential even when no philosophically complete commensuration exists.

Proposition 21.568 (Value-conversion transparency). *Where heterogeneous values are translated into a common decision representation, the conversion rule, decision authority, exclusions, uncertainty, and unrepresented remainder should remain visible in the analysis.*

A monetary valuation can support comparison without exhausting the value of an ecological system. A capability indicator can reveal substantive opportunity without capturing every dimension of agency or meaning. A measure of unpaid care time can make hidden labor visible without reducing care to hours. A generative-value analysis can trace downstream capability formation without deciding every normative conflict among beneficiaries, non-human affected entities, and future generations.

The translation problem is therefore partly political. Control over categories, met-

rics, discount rates, eligibility rules, data standards, and conversion procedures can determine which values become institutionally actionable. A technically coherent commensuration can still reflect contested authority over what is recognized.

Proposition 21.569 (Value-translation governance condition). *Translation across value regimes should include the governance of valuation itself, especially where actors differ in their ability to define categories, select metrics, authorize conversions, or make resulting representations consequential.*

GRE's heterogeneous-value vocabulary is useful here because it can represent conversion, circulation, capture, dissipation, and return without assuming a universal scalar. That flexibility also creates a responsibility to avoid empty pluralism. The analyst should still specify what is valued, how it is evidenced, and which normative judgment remains outside the formal translation.

21.25.7 Translation Loss

Every translation selects. It preserves some distinctions and compresses others. Translation loss is therefore a normal feature of cross-theoretical dialogue rather than an exceptional failure. The relevant question is whether the lost content matters for the inference, explanation, evaluation, or intervention being considered.

Definition 21.570 (Translation loss). *Translation loss* is the set of distinctions, relations, mechanisms, historical conditions, evidential warrants, normative commitments, or practical implications present in a source theoretical configuration that are omitted, merged, weakened, or transformed in the target representation.

Loss can be semantic, structural, historical, scalar, evidential, or normative. A network representation can preserve ties while losing institutional meaning. A welfare metric can preserve an ordering while losing the process through which preferences were formed. A capability measure can preserve selected opportunity dimensions while losing interpersonal care relations. A macroeconomic aggregate can preserve accounting relations while losing distributional positions. A GRE relational reconstruction can preserve dependence and generativity while losing the source theory's distinctive moral vocabulary.

Definition 21.571 (Material translation loss). *A material translation loss* is a translation loss whose omission can change the conclusion, explanatory mechanism, normative evaluation, empirical test, or intervention implied by the translated representation.

The distinction between ordinary and material loss makes translation practically usable. Complete preservation is rarely possible and often unnecessary. A simplified model can be adequate for a narrow question if the omitted dimensions do not affect that question. Conversely, a seemingly small omission can be material when it removes a boundary condition or distributional consequence.

Proposition 21.572 (Loss-audit condition). *A consequential cross-theoretical translation should include a loss audit identifying the principal omitted dimensions and assessing whether any omission is material to the intended use of the translation.*

Loss can also be asymmetric. Translating a rich historical account into a compact formal model can remove context; translating the formal model into narrative prose can remove precision about assumptions and derivation. Translating ethnographic evidence into categorical variables can improve comparability while losing

situated meaning; translating statistical regularities into case narratives can obscure population-level frequency and uncertainty. Methodological dialogue therefore requires attention to what each evidential form cannot carry into another.

Proposition 21.573 (Asymmetric-loss condition). *Translation loss should be assessed directionally because the information preserved when moving from theory or method A to B can differ from the information preserved when moving from B to A.*

The loss audit also provides a discipline for interdisciplinary work. It turns the question from whether two theories can be “integrated” into the more precise question of which elements can be translated for a given purpose, which elements remain theory-specific, and which omissions would distort the result.

21.25.8 Non-Equivalent Translation

Some translations are useful precisely because they stop before equivalence. Two theories can render one another partially intelligible while continuing to disagree about ontology, mechanism, evidence, value, history, or normative purpose. Non-equivalent translation gives such dialogue a positive analytical status.

Definition 21.574 (Non-equivalent translation). *A non-equivalent translation is a mapping that establishes a limited correspondence sufficient for comparison, communication, or joint inquiry while explicitly withholding a claim that the source and target concepts, structures, mechanisms, or explanations are substitutable.*

This form of translation is common across the traditions examined in this chapter. A capability can be translated into a relational profile of access and conversion without becoming identical to GRE generative capacity. Marxian exploitation can be represented through asymmetric production and appropriation relations without becoming interchangeable with a general GRE account of power. Minskyan financial instability can be related to nonlinear and path-dependent dynamics without becoming a generic critical-transition model. Care can be represented as a relation of dependency and reproduction without exhausting its ethical or experiential meaning. Ecological limits can enter a relational constraint architecture without becoming merely one more social constraint.

Proposition 21.575 (Partial-correspondence condition). *A non-equivalent translation should state the dimension along which correspondence holds and the dimensions along which substitutability is withheld.*

Non-equivalent translation has three advantages. First, it enables empirical cooperation among researchers who retain different theoretical commitments. Second, it allows one theory to borrow a measurement, mechanism, or distinction from another without claiming total synthesis. Third, it keeps contradiction visible where disagreement itself is informative.

Definition 21.576 (Translation stopping condition). *A translation stopping condition is a stated point at which further mapping would erase a distinction that is material to the source theory, target theory, empirical question, or normative evaluation.*

A stopping condition can arise when theories identify different objects, when their value commitments conflict, when one theory requires historical specificity that another abstracts away, when evidential warrants are incompatible for the claim at issue, or when the target language has no distinction capable of carrying the source concept without distortion. Stopping is therefore part of rigorous translation rather

than evidence that dialogue has failed.

Proposition 21.577 (Non-equivalence discipline). *Theoretical dialogue should prefer an explicit partial translation to a stronger equivalence claim whenever the additional claim would require unverified preservation of structure, mechanism, history, scale, value, or evidential warrant.*

The distinction prepares the analysis in Section 21.26. Translation establishes intelligibility and scoped correspondence. Equivalence requires additional evidence about what structures or behaviors are preserved. Identity would require a still stronger claim. Keeping these levels separate allows Chapter 21 to compare economic theories without turning comparison into assimilation.

Proposition 21.578 (Translation hierarchy). *Conceptual, functional, structural, historical, cross-scale, and value-regime translations provide distinct kinds of correspondence; none of these forms alone establishes the stronger equivalence relations examined in Section 21.26.*

The translation framework developed in this section also changes the status of GRE within the chapter. GRE can function as one translation language because its relational vocabulary is broad enough to represent many economic objects. That breadth does not give it privileged access to the meanings carried by other theories. Its adequacy must be tested translation by translation, with losses and stopping conditions made explicit. Sections 21.26–21.30 therefore move from translation to stronger equivalence claims, irreducible disagreement, multi-theoretical explanation, learning from existing economics, and the limits of GR itself as a translation language.

21.26 Equivalence without Identity

Section 21.25 established translation as a directional and scoped mapping among theoretical configurations. The role of the present section is to examine the stronger claim that two translated objects, structures, models, mechanisms, or representations are equivalent in some specified respect. Its objective is to distinguish several forms of equivalence, identify the evidence required for each form, and prevent a local correspondence from being expanded into a claim of theoretical identity. The discussion first distinguishes isomorphism, homomorphism, simulation, bisimulation, functional equivalence, manifestational equivalence, and role equivalence. It then adds a second analytical axis: the locus and historical extent of the comparison, including within-level, cross-level, realized-history, continuation, and dynamical-regime comparisons. The section closes by specifying limits on equivalence claims. The method is metatheoretical and formal-interpretive. Mathematical and computational terms are used as disciplined comparative relations whose economic meaning must be stated locally; they do not establish an ontology of economic reality. Table 21.26 summarizes the principal relation types, while Table 21.27 later distinguishes comparison scopes that can host more than one relation type.

An equivalence claim is selective by construction. Two representations may preserve the same adjacency pattern while attaching different meanings to the relations. Two models may reproduce the same aggregate trajectory while assigning different mechanisms to its production. Two institutions may perform a comparable provisioning function while distributing authority, burden, and recognition differently. Two empirical states may present the same measured indicator while arising from distinct

underlying relational configurations. The analytical task is therefore to state what is being treated as equivalent, under which mapping, at which scale and time horizon, and for which inferential purpose.

Definition 21.579 (Equivalence signature). An *equivalence signature* is the explicit set of objects, relations, properties, transformations, observables, functions, roles, reality or representation loci, historical extents, scales, resolutions, temporal conditions, and evaluative dimensions that an equivalence claim requires to be preserved.

The equivalence signature converts a broad resemblance into a testable comparative statement. A structural claim can require preservation of relation types and directionality. A dynamic claim can require preservation of admissible transitions. A functional claim can require comparable contribution to a specified system objective. A manifestational claim can require indistinguishability under a stated observation procedure. The signature therefore identifies both the content of the claim and its boundary.

Definition 21.580 (Scoped equivalence). Two theoretical or empirical configurations are *scoped-equivalent* when a stated mapping preserves the equivalence signature relevant to a defined analytical purpose and domain of conditions.

Proposition 21.581 (Equivalence-indexing condition). *A theoretically consequential equivalence claim should identify its equivalence signature, mapping, domain, reality or representation locus, historical extent, scale or resolution, time horizon, and inferential purpose before the claim is used for explanation, comparison, prediction, or intervention.*

Definition 21.580 makes equivalence relative to a question rather than an unrestricted relation between theories. A neoclassical choice model and a behavioral model can yield equivalent predictions over a restricted decision domain while differing in their accounts of cognition. A cooperative and a conventional firm can be equivalent with respect to a particular production function while differing in control rights and surplus allocation. A capability indicator and an income measure can coincide over a specific population without becoming equivalent evaluative frameworks. Equivalence becomes informative when the preserved dimension is explicit and the remainder remains visible.

21.26.1 Isomorphism

Isomorphism is the strongest structural relation used in this section. Its usefulness lies in exact preservation of a selected structure, while its danger lies in allowing exactness within that structure to appear broader than the structure actually specified. Economic theories often contain mathematical objects for which isomorphism can be defined rigorously, yet a structural isomorphism between representations leaves open whether the represented economic meanings, histories, evidential warrants, and normative commitments are also preserved.

Definition 21.582 (Structural isomorphism). Let two representations be specified by domains of objects together with designated relations or operations. A *structural isomorphism* is a bijective mapping between the domains that preserves and reflects every relation or operation included in the stated equivalence signature.

The words “included in the stated equivalence signature” carry most of the methodological burden. A network representation of ownership can be isomorphic to an-

Table 21.26: Equivalence relations for cross-theoretical comparison

Relation	Primary preservation claim	Minimum comparative warrant	Principal remainder
Isomorphism	Specified structure in both directions	Bijective correspondence plus preservation and reflection of the selected relations or operations	Meaning, history, ontology, and normativity beyond the signature
Homomorphism	Selected structure in one mapped direction	Explicit mapping plus demonstrated preservation of designated relations or operations	Distinctions collapsed by the mapping
Simulation	Behavior of a target over a stated domain	Input/state correspondence, output or transition criterion, and error or tolerance conditions	Directional mechanism and untested behavior
Bisimulation	Matched admissible transitions in both directions	State relation, observable agreement, and reciprocal transition matching	Unrepresented semantics and off-domain dynamics
Functional	Contribution to a specified system function	Function definition, system boundary, conditions, and performance criterion	Mechanism, distribution, authority, and history
Manifestational	Indistinguishability under a stated observation regime	Observation operator, measurement resolution, and relevant evidence conditions	Underlying relational configuration and causal pathway
Role	Comparable relational position within an architecture	Role definition, relevant counterpart relations, and boundary conditions	Intrinsic attributes, local history, and role-specific meaning

other network with respect to directed edges while ignoring contract terms, voting rights, legal jurisdiction, historical formation, or the identities of the parties. Two input–output systems can be isomorphic at the level of sectoral dependence while differing in labor institutions, ecological burdens, or distributional incidence. A formal isomorphism therefore establishes exact correspondence only within the selected structure.

Proposition 21.583 (Structural-reflection condition). *An isomorphism claim warrants bidirectional structural substitution only for the relations and operations included in its equivalence signature and only within the domain for which the mapping is defined.*

Bidirectional substitution can be powerful. If a proof depends only on the pre-

served structure, an isomorphic representation can support the same structural inference. This permits one theory to borrow a formal result from another representation when the required structure has been demonstrated to correspond. The transfer remains conditional on the proof-relevant structure. An economic conclusion depending on institutional meaning, historical sequence, or normative evaluation requires additional argument.

Definition 21.584 (Isomorphic remainder). The *isomorphic remainder* is the set of theoretically or empirically relevant properties of the compared configurations that lie outside the structure preserved by the isomorphism.

A nonempty remainder is compatible with exact structural correspondence. This is especially important in Chapter 21 because the theories being compared frequently organize similar relations through different semantic and historical categories. A household bargaining structure, a class relation, a network brokerage position, and a capability-conversion relation can each admit formal representations with comparable topology. Their theoretical meanings remain different unless those meanings are also included and preserved in the equivalence signature.

Proposition 21.585 (Isomorphism–identity separation). *Structural isomorphism does not by itself establish identity of theoretical objects, empirical entities, causal mechanisms, historical formations, or normative interpretations.*

The proposition provides the first reason for the title of this section. Exact structural correspondence can coexist with substantive difference. GRE can therefore use isomorphism to identify transferable structural reasoning while retaining the source theory's distinct conceptual and historical content.

21.26.2 Homomorphism

Many useful theoretical translations preserve less than an isomorphism. A richer configuration can be mapped into a coarser one while retaining selected operations or relations and collapsing others. Homomorphism provides a language for this asymmetric preservation. It is particularly relevant to economics because aggregation, coarse-graining, typification, institutional classification, and reduced-form representation routinely compress distinctions.

Definition 21.586 (Structural homomorphism). A *structural homomorphism* is a mapping from a source representation to a target representation that preserves the designated relations or operations included in the equivalence signature without requiring the mapping to be one-to-one, onto, or structurally reversible.

A homomorphic translation can map several heterogeneous household arrangements into one household category, several kinds of ownership relation into one control indicator, or several relational histories into the same state variable. Such a mapping can be analytically appropriate when the collapsed distinctions are irrelevant to the current question. The same compression can become material when the omitted distinction carries the mechanism being studied.

Definition 21.587 (Homomorphic collapse). A *homomorphic collapse* is the set of source distinctions that receive the same target representation under a structure-preserving mapping.

The concept makes aggregation visible as an epistemic act. Consider an analysis that maps diverse labor relations into employment status. The mapping can preserve

participation in paid work while collapsing contract security, bargaining position, task control, dependence on platform ranking, and access to collective representation. The result can remain adequate for one question and inadequate for another.

Proposition 21.588 (Homomorphic-adequacy condition). *A homomorphic translation is adequate for a claim only when the distinctions collapsed by the mapping are immaterial to the inferential purpose of that claim.*

Homomorphism also clarifies a common relation between formal models and historically richer theories. A model can preserve a subset of causal or structural relations from a broader account while compressing the institutional and historical environment. Such a model need not be judged by whether it reproduces the entire source theory. Its adequacy depends on whether the preserved structure is sufficient for the proposition being investigated.

Proposition 21.589 (Homomorphism-direction condition). *The existence of a structure-preserving mapping from a richer source representation to a coarser target representation provides no general warrant for reconstructing the richer source from the target without additional information.*

The directionality mirrors the translation-loss analysis in Section 21.25. Compression can support comparison while limiting recovery. Recording the homomorphic collapse therefore becomes part of the warrant for using the reduced representation.

21.26.3 Simulation

Simulation shifts the equivalence question from static structure to behavior. The relevant claim is that one representation can reproduce a specified class of behaviors, outputs, or trajectories associated with another configuration. This relation is weaker than identity of mechanism and can be directional. A model may simulate an observed process over a restricted domain even when its internal variables have different interpretations or when several alternative models reproduce the same observed pattern.

Definition 21.590 (Behavioral simulation relation). A representation *A* *simulates* a representation or empirical process *B* over a stated domain when a specified mapping of inputs, states, or conditions permits *A* to reproduce the selected outputs, transitions, or trajectories of *B* within an explicit criterion of correspondence.

The correspondence criterion can involve exact equality, qualitative ordering, distributional similarity, bounded error, invariant pattern, event sequence, or another problem-specific standard. The criterion should be specified before the simulation is treated as evidence of equivalence. A model that reproduces an aggregate growth rate has established less than a model that also reproduces distributional dynamics, institutional transitions, and path-sensitive responses to intervention.

Definition 21.591 (Simulation domain). The *simulation domain* is the set of inputs, states, interventions, temporal horizons, scales, and observables over which a simulation-equivalence claim has been evaluated.

Proposition 21.592 (Simulation-domain condition). *A simulation-equivalence claim should not be extended beyond its evaluated domain without an additional warrant connecting the tested and untested conditions.*

This discipline is important for economic theory. Two models can match historical data under observed policy regimes while diverging under counterfactual interven-

tions. Two agent-based systems can generate similar macro-patterns through different micro-rules. A reduced-form relation can predict within a stable regime while failing after institutional change. Simulation therefore establishes behavioral correspondence under conditions, not mechanism identity.

Proposition 21.593 (Simulation–mechanism separation). *Successful simulation of a selected behavior does not by itself establish that the simulator and the simulated configuration share the same causal mechanism, ontology, or internal organization.*

The distinction has a direct GRE implication. A generative-relational model can be evaluated by whether it reproduces observed trajectories or transition patterns, yet empirical fit alone cannot establish that the model's relational objects correspond uniquely to the underlying social reality. The epistemic inverse problem remains. Multiple relational configurations may generate similar manifestations, and a simulation can therefore be empirically useful while ontologically underdetermined.

Proposition 21.594 (Simulation-comparison condition). *Where several models simulate the same target behavior, comparative evaluation should use additional evidence concerning mechanism, intervention response, historical fit, scale transfer, and evidential traceability before stronger equivalence claims are made.*

21.26.4 Bisimulation

Bisimulation strengthens behavioral comparison by requiring reciprocal matching of admissible transitions. It is useful where the object of analysis is a process rather than a static state and where each configuration contains several possible next steps. Economic applications can include institutional transition systems, bargaining processes, adaptive strategies, platform-rule changes, policy regimes, or other situations in which the structure of possible evolution matters.

Definition 21.595 (Bisimulation relation). *A bisimulation relation between two state-transition representations relates states whose designated observables correspond and for which each admissible transition from either related state can be matched by a designated transition from the other representation leading to states that remain related under the same criterion.*

Bisimulation is therefore reciprocal and recursive. Matching an initial state and one subsequent outcome is insufficient. The relation must continue through the transitions included in the equivalence signature. This makes bisimulation particularly demanding when theories differ in the set of possible events they recognize.

Proposition 21.596 (Reciprocal-transition condition). *A bisimulation claim requires reciprocal transition matching for the transition classes included in the equivalence signature; one-directional reproduction supports simulation rather than bisimulation.*

The distinction between simulation and bisimulation helps clarify theoretical comparison across dynamic models. Suppose one model allows an institution to move among three governance regimes while another aggregates two regimes into one. The coarser model may simulate selected observed sequences. Full bisimulation can fail because a transition visible in the richer model has no distinct counterpart in the coarser state space. The failure identifies a material loss rather than a defect in either model.

Definition 21.597 (Dynamic equivalence boundary). *A dynamic equivalence boundary is the set of state distinctions, transition classes, temporal resolutions, and inter-*

vention types beyond which reciprocal transition matching ceases to hold.

Dynamic equivalence can also depend on temporal resolution. Two systems can appear equivalent when observed annually and diverge when monthly adjustment, delay, sequencing, or fast-slow coupling becomes visible. Similarly, two models can generate comparable long-run attractors while differing in transition risk, path dependence, or distribution of transient costs.

Proposition 21.598 (Temporal-resolution condition). *A dynamic-equivalence claim should state the temporal resolution at which transitions are compared because aggregation over time can conceal transition differences that are material to explanation or intervention.*

Bisimulation therefore provides a rigorous language for a limited class of cross-theoretical claims. It is most informative when both theories represent states and transitions explicitly. Its use becomes metaphorical when transition spaces, observables, or correspondence rules remain unspecified.

21.26.5 Functional Equivalence

Functional equivalence compares what differently constituted objects or arrangements contribute within a system. Section 21.25.2 introduced functional translation; the present subsection raises the stronger question of when two translated arrangements can be treated as equivalent with respect to a specified function. Such claims are common in economics because institutions with different internal architectures can provision similar goods, coordinate similar transactions, stabilize similar expectations, or satisfy similar regulatory objectives.

Definition 21.599 (Functional equivalence). Two arrangements are *functionally equivalent* within a stated domain when they satisfy the same explicitly defined system function to the required performance criterion under the conditions included in the equivalence signature.

A market, cooperative, public agency, household, or commons arrangement can sometimes provide access to a similar service. A formal contract and a trust relation can sometimes support repeated exchange. Alternative payment infrastructures can sometimes settle the same transaction. Functional equivalence allows such comparisons without assuming common ownership, authority, incentive, or historical structure.

Definition 21.600 (Functional performance envelope). A *functional performance envelope* specifies the environmental conditions, demand range, resource conditions, temporal horizon, scale, reliability threshold, and affected positions over which two arrangements are claimed to perform the same function adequately.

The performance envelope matters because functional equivalence can disappear under stress or scale change. Two provisioning systems can serve ordinary demand equally well while differing under crisis. Two coordination mechanisms can perform similarly at small scale while generating different congestion, exclusion, or governance problems at larger scale. An arrangement can also satisfy an aggregate function while distributing burdens differently.

Proposition 21.601 (Functional-distribution condition). *Aggregate functional equivalence should be separated from equivalence in the distribution of costs, benefits, authority, risk, recognition, and future capability among affected positions.*

This distinction is important for GRE because generative consequences can differ even when immediate function is equivalent. Two educational arrangements can produce comparable measured attainment while generating different networks, confidence, institutional access, or future opportunity. Two energy systems can deliver comparable electricity while producing different ecological burdens and infrastructural lock-in. Two digital platforms can provide comparable matching services while creating different dependencies and data-control structures.

Proposition 21.602 (Functional-generative separation). *Functional equivalence at one time horizon does not establish equivalence in downstream generative effects unless the relevant future relations, capabilities, constraints, and conversion pathways are also included in the equivalence signature.*

Functional equivalence is therefore valuable precisely because it can support institutional comparison while leaving mechanism and consequence open for further inquiry.

21.26.6 Manifestational Equivalence

Manifestational equivalence is especially important for the epistemology developed in earlier GRE chapters. Economic inquiry generally encounters manifestations: prices, survey responses, administrative categories, measured output, observed transactions, reported preferences, network traces, accounting records, textual artifacts, or experimental behavior. Distinct relational configurations can produce the same manifestation under a particular observation procedure. Equivalence at the level of manifestation therefore requires explicit separation from equivalence at the level of relational reality.

Definition 21.603 (Manifestational equivalence). Two configurations are *manifestationally equivalent* relative to an observation regime when the designated measurement, classification, or observation procedures cannot distinguish them with respect to the observables included in the equivalence signature.

The phrase “relative to an observation regime” prevents observational sameness from becoming an unrestricted claim. Equal income can conceal different wealth, household obligations, public-service access, capability conversion, or exposure to ecological risk. Equal employment status can conceal different autonomy, contract security, algorithmic control, or care burden. Equal prices can arise under different ownership structures or bargaining relations. Equal measured output can coexist with different unpaid work, ecological throughput, or distributional incidence.

Definition 21.604 (Observation regime). An *observation regime* is the combination of categories, instruments, sampling procedures, measurement resolution, data-generating institutions, and inferential conventions through which manifestations become available to inquiry.

Proposition 21.605 (Manifestation-underdetermination condition). *Manifestational equivalence provides evidence of indistinguishability under the stated observation regime and leaves the underlying relational configuration underdetermined unless additional evidence identifies it.*

This proposition applies equally to theories. Two theories can generate observationally equivalent predictions over the available data while differing in latent variables, mechanisms, or counterfactual implications. More evidence can sometimes

separate them; in other cases, the available observation regime may leave the difference unresolved.

Manifestational equivalence also has a reflexive dimension. Measurements can change the configurations they record. Rankings can reorganize organizational behavior; eligibility categories can alter participation; platform metrics can redirect attention; risk scores can change access to credit. Where measurement becomes consequential, an observation regime is part of the relational configuration rather than an external window onto it.

Proposition 21.606 (Reflexive-observation condition). *When an observation regime causally changes the configuration being observed, manifestational equivalence should be assessed together with the feedback generated by the measurement, classification, or publication process.*

The GRE contribution is therefore methodological restraint. Similar manifestations can justify comparison, while inference to common relational reality requires a further evidential step.

21.26.7 Role Equivalence

Role equivalence compares positions by the relations they sustain to other positions within an architecture. Two actors, institutions, or theoretical objects can occupy comparable roles even when their intrinsic characteristics and immediate counterparts differ. The concept is useful for cross-domain comparison because many economic functions depend on relational position: intermediary, residual claimant, guarantor, gatekeeper, caregiver, standard setter, broker, lender of last resort, platform operator, or commons monitor.

Definition 21.607 (Role equivalence). Two positions are *role-equivalent* within a specified relational architecture when they sustain the same designated pattern of relation types, obligations, permissions, dependencies, or transformation capacities relative to the classes of counterpart positions included in the equivalence signature.

Role equivalence is less demanding than direct relational identity. Two intermediaries can connect different actors while occupying a comparable brokerage role. Two institutions can enforce different substantive rules while occupying a similar rule-authorizing position. A public regulator and a platform operator can each possess gatekeeping capacity over access within different governance architectures, while their legal authority and accountability remain distinct.

Definition 21.608 (Role context). A *role context* is the relational boundary, counterpart classes, rule environment, scale, and temporal conditions within which a role-equivalence claim is evaluated.

Proposition 21.609 (Role-context condition). *A role-equivalence claim should remain indexed to its role context because the same position can occupy different roles across domains, scales, institutions, or historical periods.*

Role equivalence is particularly useful for theoretical translation. A “firm” in one theory and an “organization” in another can occupy comparable coordinating positions for a specific question. A “class position” and a “network position” can each identify structured advantage while encoding different mechanisms. A “capability converter” and an “institutional access point” can play comparable enabling roles without sharing the same normative meaning.

Proposition 21.610 (Role–mechanism separation). *Role equivalence does not establish equivalence of the mechanisms through which the compared positions acquire, exercise, reproduce, or legitimate their roles.*

The distinction matters for power analysis. Similar gatekeeping roles can arise through property, law, technical standards, expertise, social recognition, infrastructure, or dependence. Treating the roles as equivalent can support comparative analysis while preserving the different sources and consequences of power.

Proposition 21.611 (Role-transfer condition). *An inference transferred across role-equivalent positions requires an additional warrant whenever the inference depends on attributes, mechanisms, histories, or normative statuses outside the shared role signature.*

21.26.8 Equivalence across Reality Levels and Coupled Structures

The relation types developed above answer one question: what kind of preservation relation has been established? A second question concerns the analytical locus on which that relation is evaluated. The three-level GR architecture developed in Chapter 4 makes this distinction consequential. A manifestational comparison concerns what becomes available under a declared manifestation or observation regime. A relational comparison concerns retained relations, structures, capacities, dependencies, or transformations. Ontological reality remains suspended unless an additional ontology supplies a determinate comparison rule. The role of the present subsection is therefore to index equivalence claims to their reality or representation locus and to make the relation between levels itself available for comparison.

Definition 21.612 (Equivalence locus). The *equivalence locus* of a comparison is the declared GR reality level, representation level, or coupled collection of levels on which the compared objects and preservation conditions are defined.

The equivalence locus is not an ontological ranking. It specifies where the evidence and formal relation are being asserted. Section 4.9 already established that distinct relational configurations can become manifest in the same way under a selected manifestation regime. Conversely, comparable relational organization can admit different manifestations when the relevant manifestation conditions differ. A positive result at one locus therefore requires a bridge before it can support a result at another.

Proposition 21.613 (Level non-lifting condition). *An equivalence established at one GR reality or representation locus supplies no automatic warrant for equivalence at another locus; a cross-locus inference requires an explicit bridge specifying which structures and mappings are preserved.*

The proposition is deliberately two-sided. Manifestational equivalence does not establish relational equivalence. Relational equivalence does not establish manifestational equivalence under every context, because the manifestation mappings can differ. Neither result settles ontological equivalence or non-equivalence. Ontological suspension in Section 4.3 therefore acts as an inference boundary rather than as a negative metaphysical conclusion.

A cross-level comparison requires a larger analytical object. Let a declared relational carrier be denoted by R , a manifestation carrier under context c by X_c , and the relevant manifestation mapping by M_c . The coupled architecture may then be

written compactly as $\mathfrak{L}_c = (R, X_c, M_c)$, with the understanding that M_c can be partial, multivalued, probabilistic, path-dependent, or historically changing where the application requires it. The triple is a representation of the relation among levels, not a claim that the levels reduce to one mathematical structure.

Definition 21.614 (Cross-level structural equivalence). Two coupled architectures $\mathfrak{L}_c^A = (R_A, X_{c,A}, M_{c,A})$ and $\mathfrak{L}_c^B = (R_B, X_{c,B}, M_{c,B})$ are *cross-level structurally equivalent* relative to a declared signature when the comparison supplies mappings between the retained relational carriers and between the retained manifestation carriers that preserve the selected internal structures and preserve the designated correspondence induced by the manifestation mappings.

Cross-level structural equivalence is stronger than establishing separate equivalences on R_A and R_B and on $X_{c,A}$ and $X_{c,B}$. The additional burden concerns the coupling. Two theories can partition relational configurations similarly and classify manifestations similarly while disagreeing about which relational configurations generate which manifestations. Two institutions can produce the same administrative categories from different relational conditions. Two Human–AI systems can generate similar interface behavior while organizing authorship, responsibility, dependence, or memory differently behind the interface. In each case, equivalence inside the carriers can coexist with non-equivalence of the map that connects them.

Proposition 21.615 (Coupling-preservation condition). *Separate equivalence of the retained source and manifestation carriers is insufficient for cross-level structural equivalence when the analytical claim depends on how source configurations are connected to manifestations.*

The converse implication also requires care. Cross-level equivalence relative to a coarse signature can preserve the selected coupling while omitting distinctions that matter under a finer relational or manifestation criterion. The equivalence signature must therefore state whether provenance, responsibility, historical formation, classification rules, measurement resolution, or feedback from manifestation into later relations belongs to the retained structure.

Definition 21.616 (Cross-level equivalence remainder). The *cross-level equivalence remainder* is the set of distinctions in the source carrier, manifestation carrier, or coupling between them that are excluded from the declared cross-level signature but remain potentially relevant to explanation, intervention, or evaluation.

This remainder is particularly important when manifestation mappings become relationally real in the sense developed in Section 4.8. A classification rule, platform interface, accounting convention, or measurement procedure can participate in later generation. Cross-level comparison must then ask not only whether two systems present the same output, but whether the institutionalized mapping that produces, stabilizes, and feeds back from that output is itself preserved.

21.26.9 Historical, Continuation, and Dynamical Equivalence

Static equivalence at a selected slice leaves open how the compared configurations arrived there and what continuations remain available. The role of this subsection is to distinguish three additional comparison objects: realized history, admissible continuation, and dynamical regime. These objects correspond to different historical extents of an equivalence claim and can support different substitution or intervention inferences. Table 21.27 summarizes the distinction.

Table 21.27: Comparison scopes for equivalence claims

Scope	Primary comparison object	Additional warrant	Non-implication to retain
Within-level	Objects or structures at one declared locus	Preservation criterion appropriate to that locus	Does not automatically lift to another level
Cross-level	Coupled carriers and the mapping between them	Preservation of the selected coupling as well as the carriers	Separate within-level equivalences do not establish coupling equivalence
Realized history	Ordered states, events, or transformations already realized	Historical tracking plus preservation of declared order or transition structure	Endpoint equivalence does not establish historical equivalence
Continuation	Admissible extensions or branching futures	Explicit admissibility model plus preservation of retained successor structure	Shared realized history does not establish equivalent future possibility
Dynamical regime	Organization of families of evolutions or extracted regime structure	Structural regime mapping or diagnostics shown to characterize the target relation	Agreement on selected diagnostics does not by itself establish regime equivalence

Definition 21.617 (Historical equivalence). Two realized histories are *historically equivalent* relative to a declared signature when a stated correspondence preserves the selected historical objects together with the order, transitions, provenance, or other trajectory structure required by that signature over the retained interval.

Historical equivalence can therefore be statewise, order-preserving, transition-preserving, or richer, depending on the signature. Equality of terminal states establishes only endpoint equivalence. Section 16.11 showed why this distinction matters for justice: two histories can terminate in comparable present conditions while differing in deprivation, coercion, burden, responsibility, recognition, or opportunity along the path. The same logic applies beyond normative evaluation. Path dependence, noncommuting operations, accumulated learning, institutional memory, ecological depletion, and irreversible investment can make historical order analytically material even when endpoints coincide.

Proposition 21.618 (Endpoint-insufficiency condition). *Endpoint equivalence establishes historical equivalence only when the declared historical signature is fully determined by the endpoint; where order, transition, provenance, accumulated burden, or path-dependent transformation is retained, a separate historical warrant is required.*

Realized history is still only one historical extent. A comparison can additionally concern the futures that remain admissible from the selected historical boundary. Chapter 18's distinction between generative foreclosure and generative return makes

this future-oriented comparison economically important: two arrangements can deliver the same current function while leaving participants with different capacities, institutional memories, dependencies, and sets of feasible continuation.

Definition 21.619 (Continuation equivalence). Two history-bearing configurations are *continuation-equivalent* relative to a declared signature when their admissible extension structures correspond in the manner required by that signature, including any retained branching, successor, operation, weight, cost, or capacity information.

Continuation equivalence can be exact or weaker. An isomorphism can preserve the selected extension structure in both directions. A simulation can establish that continuations available on one side can be matched on the other without requiring the reverse. A bisimulation can require reciprocal matching of selected successor structure. These are the relation types developed earlier in this section applied to a future-oriented carrier rather than to a static state space.

Proposition 21.620 (Realized-history–continuation separation). *Historical equivalence over a realized interval does not by itself establish continuation equivalence beyond that interval, and continuation equivalence relative to a future-oriented signature does not require identity of the realized histories that precede the compared boundary.*

The first direction prevents sampled agreement from being mistaken for equivalent possibility. Two platforms can exhibit the same observed transaction history while differing in latent governance options or exit pathways. Two educational arrangements can produce similar observed attainment while leaving different future capabilities. Two AI-mediated systems can match a realized interaction sequence while differing in the continuations available after model updates, access changes, memory retention, or institutional delegation. The second direction permits distinct histories to converge into comparably structured future opportunity without implying that their histories have become identical.

Dynamical-regime comparison changes the object once more. Instead of comparing one realized trajectory or one branching continuation structure, it compares organization that can characterize families of evolutions: attractor-like structure, basin organization, metastability, critical response, cycle structure, algebraic composition, topological organization, or another declared dynamical feature.

Definition 21.621 (Dynamical-regime equivalence). Two represented systems are *dynamical-regime equivalent* relative to a declared signature when a stated correspondence preserves the dynamical organization included in that signature over the relevant state, parameter, perturbation, and temporal domain.

Dynamical regimes are often compared through extracted diagnostics rather than through a complete structural map. Let E denote the target structural equivalence relation on a declared dynamical domain and let Q denote a retained family of diagnostics. Exact agreement of the diagnostic profile defines a comparison on what Q can observe. Its inferential force depends on whether Q merely remains invariant within E -equivalence classes or also separates distinct E -classes.

Definition 21.622 (Diagnostic sufficiency for an equivalence target). A diagnostic family Q is *sufficient for a target equivalence relation E* on a declared domain when equality of the retained diagnostic profiles holds exactly for pairs in E on that domain.

Proposition 21.623 (Diagnostic-agreement ceiling). *Equality of selected dynamical or structural diagnostics warrants the target equivalence relation only when the diagnos-*

tic family has been shown sufficient for that target on the retained domain; otherwise the warranted claim is diagnostic agreement, not structural or regime equivalence.

This condition prevents an attractor count, spectrum, critical-response statistic, homological summary, or another invariant from carrying more inferential force than its separating capacity supports. Diagnostic disagreement can sometimes refute a proposed structural equivalence when the diagnostic is known to be invariant under that relation. Diagnostic agreement is generally weaker: several non-equivalent structures can share the same invariant. The distinction is especially important when coarse resolution suppresses economically material differences.

Proposition 21.624 (Historical-extent plurality). *State, realized-history, continuation, and dynamical-regime equivalence are distinct comparison scopes; a positive result in one scope supplies no automatic implication to another unless a typed bridge and preservation argument establish it.*

The proposition supplies a second dimension to the equivalence profile introduced below. A pair of theories, institutions, or modeled systems can be manifestationally equivalent at one time slice, historically non-equivalent, continuation-equivalent under a restricted future signature, and dynamically non-equivalent under perturbation. Recording these distinctions makes equivalence more informative rather than weaker: it states where substitution is warranted and where additional structure remains consequential.

21.26.10 Limits of Equivalence Claims

The preceding relations provide a vocabulary for stronger comparison after translation. Their value depends on disciplined stopping. Equivalence becomes misleading when a preserved local property is allowed to stand for an entire theory, when a coarse observational match is treated as mechanism identity, or when equivalence at one scale and time horizon is silently transferred to another. The final task of this section is therefore to specify an audit for the scope and ceiling of equivalence claims.

Definition 21.625 (Equivalence warrant). *An equivalence warrant is the evidence and argument establishing that a specified equivalence relation preserves its declared signature within the stated domain, scale, temporal horizon, observation regime, and inferential purpose.*

The warrant differs by relation. Isomorphism requires demonstrated structural preservation and reflection. Homomorphism requires preservation of the selected structure plus an account of collapsed distinctions. Simulation requires behavioral correspondence over a tested domain. Bisimulation requires reciprocal transition matching. Functional equivalence requires a defined performance envelope. Manifestational equivalence requires an observation regime. Role equivalence requires a relational role context.

Definition 21.626 (Equivalence profile). *An equivalence profile records, for a pair of compared configurations, which equivalence relations are supported, the reality or representation loci and historical extents on which they are evaluated, the signatures and domains for which they hold, and the principal remainders that remain outside each claim.*

An equivalence profile avoids forcing a pair of theories into one binary judgment. Two models can be functionally equivalent, manifestationally equivalent over cur-

rent data, and structurally non-isomorphic. Two institutions can be role-equivalent while dynamically non-bisimilar. Two representations can be structurally isomorphic while carrying different normative interpretation. The profile records this plurality rather than compressing it into “equivalent” or “different.”

Proposition 21.627 (Equivalence-plurality condition). *Different equivalence relations and comparison scopes may hold simultaneously or fail independently for the same pair of configurations; evidence for one relation at one locus or historical extent supplies no automatic warrant for another.*

Equivalence can also be local in scale and time. Aggregation can create equivalence by averaging away differences. Disaggregation can reveal previously hidden divergence. Institutional change can break a relation that held under an earlier rule environment. Learning, adaptation, ecological degradation, technological change, or power shifts can alter the mappings on which the equivalence depended.

Proposition 21.628 (Scale–time locality). *An equivalence established at one analytical scale, temporal resolution, or historical configuration should be treated as local to that domain unless a separate argument supports transfer across scale or time.*

Intervention creates an additional test. Two configurations can be observationally equivalent under existing conditions and respond differently when policy, technology, ownership, or institutional rules change. Intervention response can therefore reveal distinctions hidden by passive observation.

Definition 21.629 (Intervention-sensitive equivalence). An equivalence relation is *intervention-sensitive* when its preservation depends on the class of interventions applied to the compared configurations.

Proposition 21.630 (Intervention-stability condition). *Where an equivalence claim is used to justify policy transfer or institutional substitution, the warrant should include evidence that the claimed equivalence remains adequate under the relevant intervention class.*

Normative interpretation also sets a ceiling. Equivalent outputs can coexist with unequal burdens, rights, recognition, ecological consequences, or future opportunities. A mapping can be technically exact while omitting the dimension on which the normative dispute turns.

Definition 21.631 (Normative equivalence remainder). The *normative equivalence remainder* is the set of morally or politically relevant distinctions excluded from the equivalence signature but potentially material to evaluation or institutional choice.

Proposition 21.632 (Normative-remainder condition). *A positive equivalence claim on structural, behavioral, functional, manifestational, or role grounds should not be used as a normative equivalence claim unless the evaluative dimensions relevant to the judgment are themselves included and warranted.*

The same restraint applies to ontology. The book’s ontological suspension means that formal equivalence among representations cannot establish that the represented entities possess identical ultimate being. It can establish that specified relations, behaviors, or manifestations are interchangeable for a defined analytical purpose.

Definition 21.633 (Equivalence ceiling). An *equivalence ceiling* is the strongest equivalence relation warranted by the available structure, evidence, domain conditions, and stated analytical purpose after translation loss and relevant remainders have been assessed.

Proposition 21.634 (Equivalence-ceiling discipline). *Cross-theoretical comparison*

should state the strongest equivalence relation actually warranted and retain weaker or non-equivalent translation where stronger preservation has not been established.

The equivalence ceiling supplies a practical decision rule for the chapter. A conceptual translation may support role equivalence while leaving structure unresolved. A structural translation may support homomorphism while failing isomorphism. A simulation may support prediction over an observed regime while leaving bisimulation and mechanism equivalence unsupported. Manifestational equivalence may remain the strongest available claim when underlying configurations cannot be identified. A shared endpoint can remain below the ceiling for historical equivalence, and a shared realized history can remain below the ceiling for continuation equivalence. Diagnostic agreement can remain below the ceiling for dynamical-regime equivalence when the diagnostics have not been shown to separate the target equivalence classes.

This hierarchy also clarifies why identity is an unnecessarily strong destination for much theoretical dialogue. Economic theories can share structures, functions, behaviors, manifestations, or roles while retaining different objects, causal stories, temporalities, normative commitments, and evidential practices. Those differences can be analytically productive. Equivalence provides a way to state what can travel between theories; the remainder records what should continue to resist substitution.

Proposition 21.635 (Equivalence-without-identity principle). *A warranted equivalence establishes substitutability only with respect to its declared signature and domain; theoretical identity requires additional preservation claims beyond the equivalence relation itself.*

The principle completes the progression from Section 21.25. Translation establishes intelligibility. Equivalence establishes a stronger, explicitly indexed preservation relation. Identity remains a separate claim. The next section turns to cases in which even carefully scoped equivalence leaves substantive disagreements that should remain visible rather than being converted into stronger synthesis.

21.27 Irreducible Theoretical Disagreement

Sections 21.25 and 21.26 established two increasingly demanding forms of cross-theoretical relation: translation and scoped equivalence. The role of the present section is to identify the boundary beyond which improved translation or stronger equivalence warrants do not dissolve substantive disagreement. Its objective is to distinguish disagreements that arise from constitutive commitments concerning ontology, epistemic warrant, normative evaluation, method, historical constitution, and value, and to specify how such disagreements can remain analytically productive. The discussion proceeds through these six sites of disagreement before developing a practice of productive persistence and a protocol for preserving incommensurability. The method is metatheoretical and comparative. It treats disagreement neither as evidence of intellectual failure nor as a reason to abandon comparison; it asks which commitments would have to change for apparent disagreement to disappear and whether those commitments are constitutive of the theories being compared.

Translation can fail because vocabulary is incomplete, evidence is sparse, scales differ, or one representation is too coarse. Such failures are potentially repairable. A different situation arises when two theories can understand one another sufficiently well and still give incompatible answers because they organize inquiry through differ-

ent constitutive commitments. A theory that treats preferences as analytically given for a specified problem and a theory that treats preference formation as part of the explanatory object may produce different accounts even after their terms are translated carefully. A theory that evaluates institutions by welfare consequences and a theory that evaluates them through capabilities, recognition, ecological integrity, or democratic standing can share empirical descriptions while retaining distinct evaluative judgments. The remaining disagreement is substantive because further convergence would require revision of the commitments that make the theories the theories they are.

Definition 21.636 (Constitutive theoretical commitment). A *constitutive theoretical commitment* is a commitment concerning analytical objects, admissible explanations, evidential warrants, normative standards, methodological procedures, historical scope, or value relations whose removal or reversal would materially alter the identity or explanatory architecture of a theory.

Constitutive commitments need not be immutable. Theories can revise them through criticism, new evidence, conceptual reconstruction, or historical change. The definition concerns their current structural role. A disagreement becomes especially important when resolution is available only by asking one side to surrender such a commitment while the other side remains unchanged.

Definition 21.637 (Irreducible theoretical disagreement). An *irreducible theoretical disagreement* is a disagreement that persists after adequate conceptual translation, relevant evidential clarification, and appropriate scope specification because the compared theories retain incompatible constitutive commitments within the domain under examination.

The word “irreducible” is therefore local and revisable. It does not mean eternally irresolvable. It records that, given the present theories and available warrants, the disagreement cannot be removed by terminological substitution, improved measurement, or a stronger mapping without changing constitutive commitments.

Proposition 21.638 (Translation-exhaustion condition). A *disagreement should be classified as irreducible only after plausible translation errors, scale mismatches, evidential ambiguities, and differences in stated scope have been examined sufficiently to show that the remaining conflict concerns constitutive theoretical commitments.*

This condition prevents premature declarations of incommensurability. Some disputes that appear philosophical are generated by different units of analysis, observation windows, or meanings assigned to the same word. Section 21.25 supplies the translation audit; Section 21.26 supplies the equivalence audit. The present section begins where those procedures leave a material remainder. Table 21.28 summarizes the six principal sites of disagreement and the preservation requirement associated with each.

21.27.1 Ontological Disagreement

Ontological disagreement concerns the status of the objects through which theories construct the economic world. The relevant differences can concern whether individuals, classes, institutions, relations, fields, capabilities, ecosystems, technologies, or processes are treated as primary explanatory objects; whether aggregate categories are reducible to lower-level objects; and whether a formal representation is interpreted realistically, instrumentally, or heuristically. These differences can remain

Table 21.28: Sites of irreducible theoretical disagreement and their preservation requirements

Site	Constitutive question	Evidence of irreducibility	Preservation requirement
Ontological	Which kinds of entities, relations, processes, or structures enter the theory's account of economic reality?	Translation leaves incompatible commitments about what the explanatory objects are or what status they possess	Keep ontological assertions, suspensions, and modeling conveniences explicitly separated
Epistemic	What counts as warranted knowledge about the economic object?	Theories accept different evidence or inferential standards even after observing the same manifestations	Record observation regimes, inferential warrants, and underdetermination
Normative	Which evaluative standards govern judgment?	Shared empirical description supports different evaluations because the standards themselves differ	State evaluative dimensions and retain normative remainders
Methodological	Which procedures are adequate for producing or testing explanations?	Disagreement concerns the relation between question, method, and admissible inference rather than technique alone	Preserve method-question coupling and limits of transfer
Historical	Which categories are historically constituted, and over what temporal domain can they travel?	A category treated as portable by one theory is treated as historically specific by another	Index claims to historical conditions and transformation pathways
Value	What constitutes value, how is it expressed, and what conversions are legitimate?	Theories retain incompatible value grammars or refuse a common measure on material dimensions	Preserve plural value forms and the boundaries of commensuration

after extensive conceptual translation because the theories assign different explanatory standing to the translated objects.

Definition 21.639 (Ontological register). An *ontological register* is the set of entity, relation, process, structure, event, property, and state categories to which a theory assigns explanatory standing, together with the status the theory attributes to those categories.

Two theories can use similar words while operating in different ontological registers. “Individual” can denote a preference-bearing decision unit, an embodied and dependent person, a position constituted through social relations, or an evolving agent whose characteristics change through interaction. “Institution” can denote a rule constraint, a historically formed practice, an organization, a governance arrangement, or a relationally stable configuration. Translation can align these uses sufficiently for dialogue while leaving disagreement about their explanatory priority or status.

Definition 21.640 (Ontological disagreement). An *ontological disagreement* occurs when theories retain incompatible commitments about the explanatory objects or ontological status relevant to a shared economic question after their terms and scopes have been adequately clarified.

Ontological disagreement is especially easy to overstate. Different formalisms do not automatically imply different ontologies. A network, field, game, optimization problem, or dynamical system can serve as a representation without asserting that economic reality ultimately consists of the mathematical objects in the representation. Conversely, ontological disagreement can remain even when two theories employ similar mathematical structures if they interpret the represented objects differently.

Proposition 21.641 (Representation–ontology separation). *Formal similarity or formal difference should not be used as sufficient evidence of ontological agreement or disagreement unless the compared theories explicitly connect the formal objects to claims about the status of the represented economic objects.*

GRE's own response is ontological suspension. The framework can model relations, fields, histories, events, or spacetime-like structures where these representations are analytically useful while withholding a claim that any one representation exhausts ultimate ontology. This stance does not eliminate ontological disagreement with theories that make stronger ontological claims. It changes the form of the disagreement: GRE can often translate and work with the objects while declining to adopt the stronger ontological commitment.

Proposition 21.642 (Suspension-preservation condition). *Where one theory suspends an ontological commitment that another theory affirms, translation should preserve the difference between affirmation and suspension rather than representing suspension as tacit agreement or denial.*

This condition matters throughout the comparative sections. A relational reconstruction can show how a class, preference, institution, capability, ecosystem, or platform becomes analyzable within GRE without asserting that the source theory and GRE share the same ontology. Ontological dialogue is therefore possible without ontological merger.

21.27.2 Epistemic Disagreement

Epistemic disagreement concerns the warrants through which a theory treats an economic claim as knowable, credible, or sufficiently supported. The dispute can involve observational categories, causal identification, interpretation, historical reconstruction, model adequacy, counterfactual reasoning, testimony, ethnographic evidence, experimental control, measurement, or formal proof. Methodological differences become epistemic disagreements when the theories differ about what a method can establish and what kinds of evidence should alter belief.

Definition 21.643 (Epistemic warrant architecture). An *epistemic warrant architecture* is the organized relation among admissible evidence, observation regimes, inferential procedures, standards of adequacy, uncertainty treatment, and revision rules through which a theory supports or revises claims.

The same manifestation can carry different epistemic force across theories. A stable revealed choice can be treated as evidence concerning preference within one analytical framework, while another framework may regard the same choice as underde-

terminated because institutional constraint, social expectation, adaptive preference, or power remains unobserved. A randomized intervention can provide a strong local causal estimate while leaving a historical theory's question about institutional formation largely untouched. A historical sequence can be central evidence for a path-dependent explanation while being peripheral to a model whose object is a local equilibrium relation.

Definition 21.644 (Epistemic disagreement). *An epistemic disagreement occurs when theories retain incompatible standards concerning what evidence warrants a claim, what inferential moves are admissible, or what uncertainty remains material after examining the same relevant manifestations.*

Epistemic disagreement can survive agreement on data. Two theories can accept the same observations and disagree over whether the observations identify a mechanism, reveal a preference, justify generalization, support a historical interpretation, or warrant intervention. The disagreement therefore concerns the path from manifestation to claim.

Proposition 21.645 (Shared-data insufficiency). *Agreement on an empirical dataset does not establish epistemic agreement when the compared theories retain different observation models, identification assumptions, standards of generalization, or rules for revising claims.*

GRE's inverse-problem epistemology makes this issue especially visible. Manifestations can be compatible with multiple relational configurations, as discussed in Section 21.26. Yet GRE should not convert that underdetermination into a blanket skepticism about empirical identification. Different research designs reduce different forms of underdetermination. The relevant disagreement concerns how much has been identified and what remains outside the evidential reach of the design.

Proposition 21.646 (Epistemic-remainder condition). *Cross-theoretical comparison should record which claims are supported by shared evidence and which claims remain dependent on theory-specific inferential warrants after the evidence has been considered.*

Preserving this remainder allows empirical dialogue to proceed without requiring one epistemology to absorb the other. A theory can learn from evidence generated under another methodology while retaining a different account of what further evidence is required.

21.27.3 Normative Disagreement

Normative disagreement arises when theories differ in the evaluative standards through which economic arrangements, outcomes, processes, or relations are judged. Welfare, freedom, capability, need, rights, equality, recognition, democratic standing, ecological integrity, care, reciprocity, and future generativity can each serve as evaluative dimensions. Their relationships can be partially aligned in specific cases while remaining conceptually distinct.

Definition 21.647 (Normative criterion set). *A normative criterion set is the collection of evaluative dimensions, priority rules, admissible trade-offs, affected subjects, and procedural commitments through which a theory or evaluative framework judges an economic configuration.*

A normative criterion set need not be a complete moral theory. It can be local to an

economic problem. A welfare analysis may evaluate preference satisfaction under specified constraints. A capability analysis can ask which substantive opportunities people possess. Feminist and care approaches can evaluate dependency relations, recognition, and the distribution of reproductive burdens. Ecological economics can introduce duties concerning ecological limits and intergenerational effects. Commons and cooperative approaches can foreground participation, reciprocity, or collective self-governance. These criteria can converge on a policy recommendation while doing so for different reasons.

Definition 21.648 (Normative disagreement). *A normative disagreement occurs when theories or evaluative frameworks retain incompatible judgments because their normative criterion sets assign different standing, priority, or permissible trade-offs to materially relevant evaluative dimensions.*

The disagreement is irreducible at the present stage when additional factual agreement would not determine the evaluative judgment. Better evidence can reveal who bears a burden, how large an effect is, or which alternatives are feasible. It cannot by itself establish whether aggregate welfare, equal standing, ecological preservation, capability protection, democratic participation, or some other criterion should govern the judgment.

Proposition 21.649 (Fact–criterion separation). *Where theories agree on the relevant empirical description but differ in their normative criterion sets, additional descriptive evidence alone does not resolve the evaluative disagreement unless it changes the applicability or interpretation of the criteria themselves.*

GRE's heterogeneous-value architecture increases the need for restraint. Generativity can be economically important without becoming a universal normative maxim. An intervention that expands future possibilities for one group can restrict them for another, increase ecological burden, deepen dependency, or weaken recognition. The normative problem therefore requires explicit judgment about whose generativity, which relations, what time horizon, and which constraints matter.

Proposition 21.650 (Generativity–normativity separation). *A finding that an arrangement increases generative capacity or expands a future possibility set does not by itself establish normative priority over competing claims concerning rights, justice, care, ecological limits, recognition, or the distribution of burdens and opportunities.*

Normative disagreement should consequently remain visible even when GRE can translate the competing standards into a common relational description. Common description creates a site for argument; it does not supply the missing normative premise.

21.27.4 Methodological Disagreement

Methodological disagreement concerns the relation between a research question and the procedures considered adequate for answering it. Economics contains formal, econometric, experimental, historical, comparative, ethnographic, institutional, computational, accounting, network, and interpretive methods. Many disagreements among them are practical rather than irreducible: more data, improved design, or clearer assumptions can often reconcile results. Irreducible methodological disagreement appears when theories differ about what the research object requires a method to preserve or disclose.

Definition 21.651 (Method–object coupling). *Method–object coupling* is the relation between a method’s operations and the features of the research object that the method is expected to identify, preserve, estimate, interpret, or reconstruct.

A method adequate for estimating a local treatment effect can be poorly matched to a question about the historical production of the treatment category. A formal model can clarify consistency conditions while leaving empirical parameterization open. Ethnography can reveal meaning and situated practice while offering a different basis for generalization than a large-sample design. Agent-based simulation can explore generative mechanisms under explicit rules while leaving the empirical adequacy of those rules to separate investigation. Methodological pluralism therefore begins with specification of the object and inferential task.

Definition 21.652 (Methodological disagreement). A *methodological disagreement* occurs when theories retain incompatible judgments about which features of an economic object must be preserved or identified for a method to count as adequate to a stated research question.

The disagreement can concern aggregation, abstraction, controllability, reproducibility, contextuality, historical sequence, causal identification, or interpretive meaning. It becomes irreducible when changing the methodological standard would alter what the theory recognizes as the research object or as an adequate explanation.

Proposition 21.653 (Local-method adequacy). *Methodological comparison should evaluate a method relative to a specified research object, inferential task, scale, and evidential environment rather than infer general epistemic superiority from success in another domain.*

This proposition implements the methodological pluralism developed earlier in the book. It also prevents pluralism from becoming indiscriminate acceptance. A method can be inadequate to a particular question. The point is that adequacy must be argued through the method–object coupling rather than through disciplinary prestige or a universal hierarchy of methods.

Proposition 21.654 (Methodological-conflict audit). *Where methods yield conflicting conclusions, comparison should distinguish disagreement generated by data, assumptions, identification strategy, scale, model closure, interpretive frame, and method–object coupling before treating the conflict as irreducible.*

A productive methodological disagreement can then specify what each approach sees and what it systematically leaves unresolved. This prepares the multi-theoretical explanation developed in Section 21.28.

21.27.5 Historical Disagreement

Historical disagreement concerns whether economic categories, mechanisms, and regularities are portable across historical configurations. Some theories intentionally abstract from historical formation to identify relations that hold under a specified model. Other theories make historical constitution part of the explanatory object: markets, firms, classes, households, property, labor, money, preferences, technologies, or states acquire their economic meaning through historically specific institutions and relations. Both strategies can be analytically useful, yet they support different claims about transfer across time.

Definition 21.655 (Historical scope condition). A *historical scope condition* specifies

the institutional, technological, legal, ecological, political, cultural, and relational configuration within which a theoretical category or mechanism is claimed to retain its meaning and explanatory adequacy.

Historical scope differs from a date range. A mechanism can recur across periods when the relevant relational conditions recur. A category can cease to travel even across adjacent periods when its constitutive institutions change. Digital platforms, for example, can alter the informational and contractual environment of intermediation without eliminating older market mechanisms. Care relations can persist while household, labor-market, and welfare institutions transform their distribution. Historical analysis therefore asks which relations reproduce the category and which changes modify its explanatory content.

Definition 21.656 (Historical disagreement). *A historical disagreement occurs when theories retain incompatible commitments concerning the historical constitution, temporal portability, or transformation of categories and mechanisms relevant to a shared economic question.*

One theory may treat a category as a stable analytical primitive over the problem domain, while another treats its formation as endogenous to the history being explained. The disagreement cannot be resolved merely by attaching a historical example to the first theory or by redescribing the second theory in abstract variables. The constitutive role of history differs.

Proposition 21.657 (Historical-indexing condition). *A cross-theoretical claim that transfers a category or mechanism across historical configurations should state the relations and institutions whose persistence is required for that transfer to remain warranted.*

GRE's own historical orientation does not entail that every analysis must reconstruct the full genealogy of its objects. Local abstraction can be legitimate when historical change is outside the question or sufficiently slow relative to the analytical horizon. Historical disagreement becomes material when the omitted history changes the mechanism, the subject, the institutional boundary, or the future trajectory relevant to the claim.

Proposition 21.658 (Historical-materiality condition). *Historical disagreement is analytically material when alternative historical constitutions would change the meaning, mechanism, admissible comparison, or downstream generative consequences of the economic object under examination.*

This condition prevents history from becoming ceremonial context. History enters the explanation where sequence and constitution change what the theory can validly say.

21.27.6 Value Disagreement

Value disagreement is broader than normative disagreement. Economic theories use "value" to identify different objects: exchange value, utility, labor-mediated value relations, capabilities, care, ecological values, relational goods, social meaning, monetary valuation, or generative effects. Some of these are explanatory categories, some are measures, some are evaluative standards, and some concern the institutional process through which heterogeneous qualities are converted into commensurable forms. Dialogue becomes distorted when these distinct uses are translated into one

scalar vocabulary too early.

Definition 21.659 (Value grammar). A *value grammar* is the theory-specific organization of value-bearing objects, value relations, measures, conversion rules, commensuration procedures, evaluative meanings, and institutional conditions through which value claims become intelligible.

A value grammar can permit exact commensuration for one purpose and reject it for another. Market prices can provide a monetary comparison without exhausting ecological, capability, care, recognition, or relational significance. A capability index can support multidimensional comparison while leaving contested weighting choices visible. Marxian value categories can organize an account of capitalist production without becoming interchangeable with welfare valuation. GRE's heterogeneous-value vocabulary is designed to keep these distinctions available for analysis.

Definition 21.660 (Value disagreement). A *value disagreement* occurs when theories retain incompatible commitments concerning what bears value, how value is generated or recognized, which conversions are legitimate, or which measures can represent the relevant value relations.

The strongest form appears where no common metric is warranted for the dimension under dispute. This does not imply that comparison is impossible. Ordinal comparison, threshold reasoning, dominance relations, procedural judgment, deliberation, or separate reporting can remain available. The disagreement concerns the legitimacy of a particular conversion or common measure.

Definition 21.661 (Local value incommensurability). *Local value incommensurability* is the absence, within a specified decision or analytical domain, of a warranted common measure that preserves the value distinctions material to the comparison.

Local incommensurability is deliberately weaker than a claim that values can never be compared. A decision can be made without reducing every dimension to one number. Institutions routinely combine thresholds, rights, budgets, deliberation, expert judgment, and plural indicators. The analytical requirement is to state what is converted, what remains separate, and who controls the conversion interface.

Proposition 21.662 (Commensuration-warrant condition). *A cross-theoretical value comparison should employ a common metric only when the conversion preserves the distinctions relevant to the stated purpose or when the losses introduced by the conversion are explicitly justified for that purpose.*

This condition links value disagreement to power. Commensuration rules can privilege actors able to define categories, prices, indicators, accounting boundaries, or data infrastructures. A disagreement over value can therefore concern both conceptual commensurability and institutional authority over conversion.

Proposition 21.663 (Value-conversion governance). *Where value disagreement is mediated through an institutional conversion rule, analysis should distinguish disagreement about the value grammar from disagreement about authority over the rule that performs the conversion.*

Preserving that distinction is central to GRE because heterogeneous value and power over conversion interfaces are analytically connected while remaining separate objects.

21.27.7 Productive Persistence of Disagreement

Irreducible disagreement need not terminate inquiry. Once the disagreement has been located precisely, it can improve theory by identifying hidden assumptions, revealing omitted objects, creating discriminating empirical questions, and showing where normative or methodological judgment enters an analysis. The appropriate aim can therefore be productive persistence: maintaining the disagreement in a form that generates further inquiry while preventing it from collapsing into rhetorical opposition.

Definition 21.664 (Productive persistence). *Productive persistence* is the continued coexistence of a specified theoretical disagreement under conditions that make its constitutive commitments, evidential consequences, domains of adequacy, and potential revision pathways explicit.

Productive persistence differs from simple stalemate. A stalemate merely records incompatible positions. Productive persistence asks what each position predicts, notices, excludes, or evaluates differently; what evidence could revise a non-constitutive part of either theory; and which research questions arise precisely because the disagreement remains.

Definition 21.665 (Disagreement map). A *disagreement map* records the shared question, translated concepts, relevant equivalence relations, constitutive commitments in conflict, common evidence, theory-specific warrants, empirical discriminators, normative remainders, and revision conditions associated with a theoretical disagreement.

The map turns disagreement into research infrastructure. An ontological disagreement can motivate comparative formalizations that hold observations constant while varying object structure. An epistemic disagreement can motivate studies of transport, external validity, measurement, or historical reconstruction. A methodological disagreement can motivate triangulation across distinct access modes. A value disagreement can motivate explicit analysis of conversion losses and governance. A normative disagreement can identify where collective judgment remains necessary after empirical questions have been clarified.

Proposition 21.666 (Disagreement-generativity principle). *A theoretical disagreement is productively persistent when preserving the disagreement generates discriminating questions, new evidence, sharper scope conditions, or clearer normative choices that would be obscured by premature synthesis.*

This principle gives disagreement a generative role without romanticizing conflict. Some disagreements rest on error, incoherence, or obsolete evidence and should be revised. Productive persistence applies when the competing commitments remain sufficiently defensible and analytically fruitful to justify continued comparison.

Proposition 21.667 (Revision-openness condition). *Preserving an irreducible disagreement should remain compatible with revision when new evidence, conceptual analysis, or changed historical conditions undermine a constitutive commitment that previously sustained the disagreement.*

Irreducibility is therefore a present analytical diagnosis rather than a declaration of permanent incompatibility. The diagnosis can itself change as theories evolve.

21.27.8 Preserving Incommensurability

The final task is to preserve forms of incommensurability that carry material theoretical content while retaining the possibility of dialogue. Incommensurability is used here in a local and disciplined sense. It concerns dimensions for which a common measure, common criterion, or lossless mapping is presently unwarranted. It does not imply complete mutual unintelligibility. Section 21.25 already showed that partial translation can remain possible when equivalence fails; the same principle applies when some dimensions resist a common metric or criterion altogether.

Definition 21.668 (Theoretical incommensurability). Two theoretical commitments are *incommensurable relative to a specified dimension* when no currently warranted common measure, criterion, or preservation mapping represents that dimension without eliminating a distinction material to at least one of the theories.

The definition is explicitly dimension-specific. Two theories can be commensurable in prediction and incommensurable in normative evaluation. They can share a functional comparison while resisting a common value metric. They can translate each other's concepts while disagreeing about ontological status. They can be empirically distinguishable while retaining different standards concerning what would count as an adequate explanation.

Definition 21.669 (Incommensurability profile). An *incommensurability profile* records the dimensions on which common comparison is warranted, the dimensions on which comparison requires lossy conversion, and the dimensions on which a common measure or criterion should remain suspended.

The profile complements the equivalence profile of Section 21.26. Equivalence profiles state what can be preserved strongly. Incommensurability profiles state where preservation reaches its limit. Used together, they prevent both fragmentation and forced unity.

Proposition 21.670 (Partial-dialogue condition). *Incommensurability on one dimension does not preclude translation, empirical comparison, functional analysis, or co-operative inquiry on other dimensions for which adequate common relations can be established.*

This condition is important for economic pluralism. A welfare economist, capability theorist, ecological economist, feminist economist, institutionalist, and Marxian economist can investigate the same policy while disagreeing about the ultimate evaluative or explanatory register. Shared empirical work remains possible when the shared questions are specified. The disagreement should remain visible in the interpretation of the evidence and the criteria of judgment.

Definition 21.671 (Non-forced synthesis). *Non-forced synthesis* is a mode of theoretical coordination that combines compatible insights or explanations while leaving materially incommensurable commitments unmerged and explicitly represented.

The term identifies a boundary for GRE's translation language. Relational description can create common coordinates, yet common coordinates need not erase disagreement. A class relation can be represented relationally without converting it into a generic network tie. Care can be represented as a relation without exhausting its embodied and normative meaning. Ecological constraints can be represented as constraints on generative trajectories without converting ecological value into a generic possibility metric. Capability can be related to generative capacity without identifying the two concepts.

Proposition 21.672 (Anti-assimilation condition). *A relational translation should preserve a source theory's constitutive distinctions whenever eliminating those distinctions would convert substantive disagreement into apparent agreement by definitional absorption.*

The anti-assimilation condition is especially important for GRE because a sufficiently general relational vocabulary can redescribe many theories. Redescription is useful only when it remains capable of recording what the source theory contributes that the receiving framework does not already contain.

Definition 21.673 (Disagreement preservation protocol). *A disagreement preservation protocol records, for a cross-theoretical comparison, the translated common ground, the strongest warranted equivalences, the constitutive commitments still in conflict, the incommensurability profile, the evidence relevant to revision, and the dimensions that should remain separate in subsequent synthesis or application.*

Proposition 21.674 (Preserved-disagreement principle). *Cross-theoretical dialogue is stronger when it preserves material disagreement explicitly than when it produces apparent unity by weakening, omitting, or redefining the commitments on which the disagreement depends.*

This principle completes the sequence begun in Sections 21.25 and 21.26. Translation identifies possible common language. Equivalence identifies dimensions of warranted substitutability. Irreducible disagreement identifies the constitutive remainder that survives those procedures. The resulting theoretical ecology can therefore contain common coordinates, local equivalences, and preserved incommensurabilities simultaneously.

The next section turns from disagreement itself to explanation. Multi-theoretical explanation can draw on several theories at complementary levels, scales, or historical layers without requiring their constitutive commitments to be fully synthesized. The disagreement preservation protocol established here supplies the boundary conditions for that combination.

21.28 Multi-Theoretical Explanation

Sections 21.25–21.27 established a sequence for cross-theoretical dialogue: translation can create common coordinates, equivalence can identify scoped preservation relations, and irreducible disagreement can remain when constitutive commitments continue to differ. The role of the present section is to determine how several economic theories can nevertheless contribute to one explanation. Its objective is to specify forms of multi-theoretical explanation that preserve level, scale, temporal, causal, and normative distinctions while permitting explanatory combination where the combination is warranted. The discussion proceeds through complementary levels, competing explanations, nested explanations, scale-specific explanations, historical layering, and explanatory pluralism before stating criteria for combination and limits of synthesis. The method is metatheoretical and constructive. It treats theoretical plurality as an explanatory resource only when the contribution of each theory, the relation among contributions, and the remaining disagreements are made explicit.

Economic phenomena routinely span more than one analytical register. A labor-market transition can involve individual search behavior, organizational routines,

bargaining institutions, macroeconomic demand, technological change, household care arrangements, platform intermediation, and historically specific legal categories. A single theory may explain one or several of these relations well while leaving others outside its intended domain. Multi-theoretical explanation therefore concerns the disciplined coordination of partial explanations rather than the accumulation of theoretical labels around one case.

Definition 21.675 (Multi-theoretical explanation). A *multi-theoretical explanation* is an explanation of a specified economic phenomenon that assigns two or more theories distinct explanatory contributions and states the relations among those contributions, including their levels, scales, temporal domains, causal roles, evidential warrants, and remaining theoretical disagreements.

The definition requires assignment. Merely citing several traditions does not create a multi-theoretical explanation. Each theory must perform identifiable explanatory work. A behavioral account may identify a decision process; an institutional account may identify the rule structure within which the decision occurs; a political-economic account may identify the distribution of authority over that structure; and an ecological account may identify a biophysical boundary on the feasible trajectories. Their coexistence becomes explanatory only when the relations among these contributions are stated.

Definition 21.676 (Explanatory contribution). An *explanatory contribution* is the theory-indexed account of a specified object, relation, mechanism, condition, process, or evaluative consequence that materially reduces uncertainty about the phenomenon under examination within an identified domain.

Proposition 21.677 (Contribution-identification condition). A *multi-theoretical explanation* should identify the explanatory contribution of each participating theory before claiming that the theories jointly explain the phenomenon.

This condition prevents pluralism from becoming additive rhetoric. It also creates the basis for testing whether two contributions are complementary, competing, nested, scale-specific, historically layered, or incompatible. Table 21.29 summarizes these principal relations.

21.28.1 Complementary Levels

Complementary-level explanation applies when theories illuminate different levels of organization within a common phenomenon. An individual-level model can explain how agents respond to incentives or uncertainty; an organizational theory can explain routines and authority; an institutional theory can explain rules and enforcement; a macroeconomic theory can explain aggregate demand or financial conditions; and a relational or political-economic account can explain how power shapes the interfaces among these levels. Complementarity arises when the contributions concern different explanatory objects and the relations among those objects are material to the outcome.

Definition 21.678 (Explanatory level). An *explanatory level* is a relatively stable analytical stratum at which a theory identifies objects, relations, mechanisms, or regularities whose explanatory adequacy depends on treating that stratum as locally coherent for the question under examination.

Levels are question-relative rather than metaphysically fixed. A household can

Table 21.29: Relations among theoretical contributions in multi-theoretical explanation

Relation	Explanatory role	Combination requirement	Principal risk
Level complementarity	Theories explain different levels of one phenomenon	Specify cross-level dependence and avoid duplicating the same mechanism	Level collapse or unexplained aggregation
Competing explanations	Theories explain the same target through materially different mechanisms	State discriminating evidence, scope, and possible coexistence	Premature averaging or false reconciliation
Nested explanations	One explanation operates within boundary conditions supplied by another	Specify containment, interfaces, and autonomy of the nested mechanism	Treating containment as reduction
Scale-specific explanations	Theories are adequate at different spatial, organizational, or temporal scales	State scale of validity and cross-scale transfer conditions	Extrapolation beyond the warranted scale
Historical layering	Theories explain mechanisms produced in different historical layers that coexist	Reconstruct sequence, persistence, and interaction among layers	Flattening historically distinct mechanisms
Plural explanatory architecture	Several irreducible contributions jointly constrain the account	Record contribution map, warrants, and preserved disagreement	Unstructured eclecticism or forced synthesis

be treated as an aggregate actor in one inquiry and as an internally differentiated field of bargaining, care, dependency, and resource conversion in another. A firm can appear as a production unit, a nexus of contracts, an organization with routines, a governance structure, a site of class relations, or a network position. Multi-theoretical explanation should therefore justify the level at which each contribution operates.

Definition 21.679 (Level complementarity). Two explanatory contributions exhibit *level complementarity* when they address causally or constitutively connected levels of the same phenomenon and neither contribution duplicates the explanatory role assigned to the other.

Complementarity does not imply harmony among theories. A theory of household choice and a feminist account of intra-household power can be jointly useful while disagreeing about how preferences are formed or which unit should be treated as primary. The multi-theoretical explanation can preserve that disagreement while assigning each theory a local task.

Proposition 21.680 (Cross-level interface condition). *A complementary-level explanation should specify the interface through which states, actions, constraints, or transformations at one level affect the explanatory objects identified at another level.*

Without an interface, levels are merely juxtaposed. Cross-level interfaces can include contracts, prices, rules, organizational authority, budgets, infrastructures, classification systems, household transfers, ecological flows, or data-mediated controls.

The relevant interface depends on the problem.

Proposition 21.681 (Aggregation-accountability condition). *Where an explanation moves from lower-level relations to an aggregate outcome, the aggregation rule or causal pathway should be stated rather than inferred from the coexistence of lower-level mechanisms.*

This condition is particularly important when individual actions interact nonlinearly, when institutions filter or transform local effects, or when aggregate variables possess dynamics that cannot be reconstructed by simple summation. Complementary levels expand explanatory coverage only when their coupling is made analytically visible.

21.28.2 Competing Explanations

Multi-theoretical inquiry also encounters theories that explain the same target through materially different mechanisms. Unemployment can be attributed to search frictions, insufficient effective demand, bargaining institutions, technological displacement, sectoral restructuring, or historically specific configurations of investment and power. Firm boundaries can be explained through transaction costs, property rights, capabilities, routines, network coordination, or platform architecture. Such explanations should not be declared complementary simply because several mechanisms are plausible.

Definition 21.682 (Competing explanation). Two explanations *compete* when they assign materially different causal, constitutive, or functional accounts to the same explanandum within overlapping scope conditions such that evidence bearing on one account can alter the warranted standing of the other.

Competition can be exclusive or partial. Two mechanisms may both operate, yet their relative explanatory importance can vary by domain or period. The central task is therefore to identify the overlap in explanandum and scope before deciding whether the theories genuinely compete.

Definition 21.683 (Explanatory overlap). *Explanatory overlap* is the portion of an explanandum, domain, scale, and time horizon for which two or more theories claim explanatory responsibility.

Proposition 21.684 (Competition-localization condition). *Competing explanations should be compared within their region of explanatory overlap rather than through global judgments about the theories as wholes.*

Localized comparison prevents a theory's strength in one domain from substituting for evidence about another. It also allows competition to become empirical. A mechanism may dominate under one institutional configuration while another becomes more important after a structural change.

Definition 21.685 (Discriminating evidence). *Discriminating evidence* is evidence whose expected interpretation differs materially across competing explanations after their concepts, scales, and background conditions have been aligned sufficiently for comparison.

Proposition 21.686 (Mechanism-discrimination condition). *Where competing theories predict similar outcomes through different mechanisms, explanatory comparison should seek evidence about mediating processes, counterfactual responses, timing, distributional signatures, or intervention effects that can discriminate among the mecha-*

nisms.

Similar outcomes therefore do not establish equivalent explanation. Section 21.26 distinguished manifestational equivalence from deeper structural or behavioral equivalence. The same caution applies here: observational agreement can coexist with explanatory competition.

Proposition 21.687 (Coexistence-with-competition principle). *Evidence that several mechanisms coexist does not remove explanatory competition when the theories continue to disagree about mechanism weight, boundary conditions, causal ordering, or the conditions under which one mechanism transforms another.*

A multi-theoretical account can therefore retain competing explanations within one research programme. The task is to make the competition explicit and to state what further evidence would revise the relative explanatory weights.

21.28.3 Nested Explanations

Nested explanation arises when one theoretical account operates within conditions described by another. A behavioral mechanism can operate inside an institutionally specified choice architecture. A transaction-cost explanation can operate inside a historically specific property regime. A financial-instability mechanism can operate inside a broader political and regulatory order. A capability-conversion process can operate inside ecological and infrastructural constraints. The outer explanation establishes conditions under which the inner mechanism becomes possible, salient, or differently parameterized.

Definition 21.688 (Nested explanation). An explanation E_i is *nested* within an explanation E_o when the objects, mechanisms, or parameters of E_i operate within boundary conditions or relational structures whose formation or persistence is explained by E_o .

The notation identifies a structural relation rather than an ontological hierarchy. The outer account can itself be nested within another explanation, and the inner account can retain substantial autonomy. Nested explanation is therefore compatible with methodological pluralism.

Definition 21.689 (Explanatory boundary condition). An *explanatory boundary condition* is a condition supplied by one explanatory account that materially defines the domain, parameters, admissible states, or transition possibilities of another account.

Proposition 21.690 (Nested-autonomy condition). *Nesting should not be interpreted as reduction unless the outer explanation can reconstruct the inner mechanism at the level of detail required by the explanandum without importing the inner theory's distinctive explanatory resources.*

An institutional account that explains why a market has particular rules does not thereby replace price theory within those rules. A political-economic account of property does not automatically replace an engineering model of production. Conversely, local mechanism models do not explain the formation of their own boundary conditions merely because those conditions appear as parameters.

Proposition 21.691 (Boundary-endogeneity condition). *When a theory treats as fixed a boundary condition that another theory explains as historically or relationally endogenous, multi-theoretical explanation should record both the local analytical usefulness of the fixed condition and the higher-order process through which that condition is gen-*

erated or transformed.

This condition is especially important for GRE. A relational-generative analysis often asks how the parameters of a local model came to exist and how present activity may alter them later. The question extends the explanation without invalidating a locally adequate model whose purpose requires temporary closure.

21.28.4 Scale-Specific Explanations

Scale-specific explanation concerns theories whose adequacy depends on the spatial, organizational, population, temporal, or network scale at which the phenomenon is examined. A mechanism visible at the transaction scale can disappear at the sectoral scale; a network relation can matter locally while macroeconomic stabilization dominates aggregate outcomes; ecological constraints can be negligible within a short project horizon while decisive over a longer material cycle. Scale therefore affects both what is observed and which explanatory relations remain stable.

Definition 21.692 (Explanatory scale). An *explanatory scale* is the spatial, organizational, population, network, temporal, or resolution range within which an explanatory contribution is claimed to retain adequate object definitions, mechanism relations, and evidential interpretation.

Definition 21.693 (Scale-specific adequacy). An explanation has *scale-specific adequacy* when its explanatory relations are sufficiently stable and informative within a stated scale range while their transfer beyond that range remains contingent on additional conditions.

Scale-specific adequacy avoids two errors. The first is to dismiss a theory because it does not explain phenomena outside its intended scale. The second is to generalize a successful local explanation to larger or smaller scales without testing whether the objects and relations survive the change in resolution.

Proposition 21.694 (Scale-transfer condition). *An explanatory relation should be transferred across scales only when the aggregation, disaggregation, interaction, or invariance conditions required for that transfer are stated and sufficiently supported.*

Cross-scale transfer can fail through composition effects, emergent interactions, institutional mediation, changing network topology, or altered temporal feedback. The relevant failure is empirical and structural rather than a general prohibition on scale transfer.

Definition 21.695 (Cross-scale explanatory coupling). *Cross-scale explanatory coupling* is a specified relation through which a mechanism at one scale changes the state, parameters, constraints, or transition structure relevant to an explanation at another scale.

Proposition 21.696 (Scale-coupling condition). *A multi-scale explanation should identify the mechanisms of cross-scale coupling rather than infer causal influence solely from correlation among outcomes measured at different scales.*

The condition is particularly important where fast and slow processes interact. Short-horizon adjustments can accumulate into long-horizon institutional change; long-horizon infrastructures can constrain short-horizon choice; and shocks can propagate across network or organizational scales. Multi-theoretical explanation can assign different theories to these processes while keeping the coupling explicit.

21.28.5 Historical Layering

Historical layering addresses economic configurations in which mechanisms formed in different historical periods continue to coexist. A contemporary platform economy can combine long-standing property law, industrial labor institutions, financial conventions, digital network effects, algorithmic coordination, and recently constructed data-governance rules. A welfare regime can contain older household norms, later social-insurance institutions, contemporary activation policies, and emerging AI-mediated administrative processes. Theories developed for different historical objects can therefore remain simultaneously relevant when the corresponding relational layers persist.

Definition 21.697 (Historical explanatory layer). A *historical explanatory layer* is a set of mechanisms, institutions, categories, or relational structures generated under identifiable historical conditions that continues to exercise explanatory effects within a later configuration.

Layers need not be chronologically neat. Older institutions can be transformed by newer technologies; newer practices can depend on inherited legal categories; and periods of rapid change can create hybrid structures in which several generative logics coexist.

Definition 21.698 (Layered causal inheritance). *Layered causal inheritance* is the persistence of historically generated structures or mechanisms that continue to shape later economic possibilities while being modified by subsequent layers.

Proposition 21.699 (Historical-layering condition). A *multi-theoretical historical explanation* should distinguish mechanisms that persist from earlier configurations, mechanisms generated by later configurations, and interactions through which the later layers reproduce, redirect, or erode the earlier ones.

This requirement prevents historical theories from being assigned to periods as if theories expired when their original contexts changed. The relevant question is whether the mechanism or relation remains materially instantiated.

Proposition 21.700 (Temporal-coexistence principle). *Theories associated with different historical problem settings can contribute simultaneously when the mechanisms they identify coexist within the present configuration under distinguishable scope conditions.*

Historical layering also guards against presentism. Contemporary categories can make older structures difficult to see even when those structures remain causal. Conversely, inherited theoretical categories can obscure genuinely new relations. Multi-theoretical explanation therefore requires a temporal audit of both the object and the concepts used to explain it.

Definition 21.701 (Historical-layer interaction). A *historical-layer interaction* is a relation through which mechanisms generated in distinct historical layers alter one another's operation, persistence, interpretation, or generative consequences within a later configuration.

Historical-layer interaction can be reinforcing, constraining, substitutive, or transformative. The analytical objective is to reconstruct the relation rather than to infer a single historical logic from coexistence.

21.28.6 Explanatory Pluralism

The preceding forms of combination support a disciplined explanatory pluralism. Pluralism is warranted when a phenomenon contains explanatory relations that cannot be represented adequately within one theoretical architecture at the required level of detail and scope. It is unwarranted when several theories merely restate the same mechanism, when incompatible commitments are silently averaged, or when theoretical diversity is treated as intrinsically superior to a simpler adequate explanation.

Definition 21.702 (Explanatory pluralism). *Explanatory pluralism* is the disciplined use of multiple explanatory architectures when their differentiated contributions jointly improve the adequacy of an explanation relative to the stated question while their disagreements, redundancies, and scope limits remain explicit.

This definition makes pluralism conditional on explanatory gain. The gain can consist of improved mechanism specification, broader domain coverage, better cross-scale reconstruction, stronger historical explanation, clearer normative localization, or identification of interactions that no single participating theory captures adequately.

Definition 21.703 (Explanatory architecture). An *explanatory architecture* is the organized set of analytical objects, mechanisms, levels, scales, historical layers, evidential warrants, and relations among them used to explain a specified phenomenon.

Proposition 21.704 (Pluralism-gain condition). *Adding a theory to a multi-theoretical explanation is warranted when its contribution changes the explanatory architecture materially by adding a distinct mechanism, boundary condition, scale relation, historical layer, evidential discriminator, or evaluative consequence relevant to the stated question.*

The condition excludes decorative pluralism. A contribution that merely renames an existing mechanism can still be pedagogically useful, but it does not strengthen the explanation unless the new language reveals a material distinction.

Definition 21.705 (Explanatory redundancy). *Explanatory redundancy* occurs when two contributions perform substantially the same explanatory role over the stated domain without adding a material distinction in mechanism, scope, evidence, or implication.

Redundancy is not always undesirable. Independent theories can converge on similar relations, thereby increasing confidence or offering alternative formalizations. The relevant point is to distinguish corroborative redundancy from additional explanatory coverage.

Proposition 21.706 (Minimal-plurality principle). *A multi-theoretical explanation should employ no more theoretical architectures than are needed to preserve the distinctions and mechanisms material to the explanandum at the stated level of adequacy.*

Minimal plurality combines parsimony with non-reduction. It does not demand a single theory; it demands that each retained theory earn its explanatory place.

Definition 21.707 (Plural explanatory map). A *plural explanatory map* records each participating theory's assigned contribution, explanatory target, level, scale, historical layer, evidential warrant, interfaces with other contributions, region of competition or redundancy, and preserved theoretical remainder.

The map extends the disagreement map of Section 21.27. The disagreement map records where theories cannot be merged. The plural explanatory map records how

they can still cooperate in one explanation.

21.28.7 Criteria for Combination

Combination requires stronger discipline than coexistence. Theories can be individually useful and still form an incoherent joint explanation if their objects, causal directions, scales, or background conditions conflict. The criteria developed here therefore concern the compatibility of explanatory contributions, not the global compatibility of the theories from which they originate.

Definition 21.708 (Combination warrant). A *combination warrant* is the stated justification for integrating two or more explanatory contributions within one explanatory architecture, including their distinct roles, interface relations, scope conditions, evidential support, and preserved disagreements.

Proposition 21.709 (Object-compatibility condition). *Explanatory contributions can be combined only when the objects they connect can coexist within a sufficiently specified representation or when a translation relation between those objects is supplied without erasing a material distinction.*

A representative-agent model and an internally differentiated household account, for example, cannot simply be placed side by side if both are asked to explain the same intra-household allocation mechanism. They can be combined if the representative unit is restricted to an aggregate task while internal relations are assigned to the differentiated account.

Proposition 21.710 (Causal-consistency condition). *Where combined theories assign causal relations among overlapping objects, the joint explanation should state whether those relations are compatible, sequential, reciprocal, competing, or condition-dependent.*

Contradictory causal arrows are not resolved by placing them in different paragraphs. They require adjudication, scope separation, or explicit preservation as competing explanations.

Proposition 21.711 (Scope-intersection condition). *A combination warrant should identify the intersection and differences among the participating theories' domain, scale, temporal, and institutional scope conditions.*

Proposition 21.712 (Evidential-coordination condition). *A multi-theoretical explanation should distinguish evidence that supports a shared empirical premise from evidence that supports one theory-specific mechanism, and it should avoid transferring warrant across theories merely because they address the same phenomenon.*

Evidential coordination matters because the same observation can play different roles in different theories. A price change can be an outcome, a signal, a manifestation of power, a coordination device, or evidence of scarcity depending on the explanatory architecture. Shared data do not automatically create shared inference.

Definition 21.713 (Combination matrix). A *combination matrix* records, for each pair or set of explanatory contributions, object compatibility, causal relation, scope overlap, scale relation, temporal ordering, evidential relation, normative remainder, and the status of unresolved disagreement.

Proposition 21.714 (Disagreement-preserving combination). *A combination is warranted only if the explanatory architecture can retain the constitutive disagreements identified by the disagreement preservation protocol whenever those disagreements re-*

main material to interpretation or judgment.

This proposition prevents combination from becoming covert synthesis. A welfare analysis and a capability analysis can contribute to one policy explanation while maintaining distinct evaluative criteria. A neoclassical price mechanism and a Marxian class analysis can coexist in a historical account without treating price and value categories as identical. An ecological constraint can bound a growth model without translating ecological significance into a single monetary metric.

Proposition 21.715 (Combination-revisability condition). *The architecture of a multi-theoretical explanation should remain revisable when new evidence changes the contribution, weight, boundary condition, or compatibility of one of its component explanations.*

Combination is therefore a research result rather than a permanent settlement. As theories and evidence change, explanatory roles can be reassigned.

21.28.8 Limits of Synthesis

Multi-theoretical explanation reaches its limit where combination would require eliminating distinctions that remain explanatory, evidential, historical, or normative. Synthesis is one possible result of dialogue, yet it is stronger than combination. A synthesis constructs a more unified explanatory architecture in which previously distinct contributions are integrated under common concepts or relations. Such integration is valuable when it preserves the explanatory gains of the source theories. It becomes misleading when unity is purchased through abstraction that removes the very disagreements or mechanisms that made the plurality informative.

Definition 21.716 (Theoretical synthesis). *A theoretical synthesis is a reconstructed explanatory architecture that integrates contributions from previously distinct theories through a sufficiently common set of objects, relations, mechanisms, or evaluative coordinates while preserving the distinctions required for the stated explanatory purpose.*

The definition makes synthesis purpose-relative. It does not require complete unification. A local synthesis can be warranted for a specific domain while broader disagreements remain.

Definition 21.717 (Synthesis loss). *Synthesis loss is the explanatory, semantic, historical, evidential, or normative content that becomes unavailable when distinct theoretical contributions are integrated into a more unified architecture.*

Synthesis loss resembles translation loss but occurs at a later stage. Translation can already be lossy; synthesis adds the risk that translated concepts become absorbed into a common vocabulary and their source-specific functions disappear.

Proposition 21.718 (Synthesis-warrant condition). *A theoretical synthesis is warranted only when the explanatory gains from integration exceed the material synthesis losses for the stated purpose and when those losses are explicitly recorded.*

Definition 21.719 (Synthesis boundary). *A synthesis boundary is the point at which further integration would require suppressing a constitutive disagreement, collapsing a scale or historical distinction, conflating incompatible value grammars, or treating a theory-specific mechanism as interchangeable with a broader relational description.*

Proposition 21.720 (Synthesis-stopping condition). *Theoretical integration should*

stop at the synthesis boundary and retain a multi-theoretical architecture when additional unification would reduce explanatory adequacy or erase a material theoretical remainder.

This stopping condition is especially important for GRE. Its relational vocabulary is broad enough to host many translated concepts, yet hosting them does not establish that they should be absorbed into GRE's own categories. Care can enter a relational architecture while retaining its embodied and normative specificity. Capabilities can interact with generative capacity while remaining a distinct evaluative space. Marxian value can be related to heterogeneous value without being converted into it. Ecological limits can constrain generative trajectories without becoming generic constraints detached from biophysical mechanisms.

Definition 21.721 (Explanatory federation). *An explanatory federation is a multi-theoretical architecture in which theories retain identifiable conceptual and methodological autonomy while their contributions are coordinated through explicitly specified interfaces for a shared explanatory task.*

An explanatory federation provides a useful model where synthesis reaches its boundary. The participating theories need not share one ontology, one value grammar, or one method. They require enough translation and interface specification to cooperate on the shared problem.

Proposition 21.722 (Federated-explanation principle). *When material theoretical remainders persist, a federated explanation is preferable to deeper synthesis if it preserves greater explanatory adequacy, clearer evidential accountability, and more explicit disagreement.*

Definition 21.723 (Multi-theoretical explanation protocol). *A multi-theoretical explanation protocol records the explanandum, participating theories, assigned contributions, levels and scales, historical layers, explanatory interfaces, regions of competition and redundancy, evidential warrants, disagreement-preservation requirements, combination warrants, synthesis losses, and revision conditions of a joint explanation.*

Proposition 21.724 (Plural-explanation accountability principle). *A multi-theoretical explanation is stronger when a reader can identify which theory supports each explanatory step, how the steps are connected, which claims remain contested, and what evidence could revise the architecture.*

The protocol completes the movement from translation to coordinated explanation. Sections 21.25–21.27 specified what can be translated, what can be treated as equivalent, and what should remain in disagreement. The present section adds the conditions under which these differentiated theoretical contributions can explain one phenomenon together. The result is neither unrestricted eclecticism nor compulsory synthesis. It is a structured explanatory ecology in which complementary levels, competing mechanisms, nested boundary conditions, scale-specific processes, and historical layers can be coordinated while preserving their warranted distinctions.

The next section changes the direction of dialogue. Rather than asking how GRE can organize or coordinate other economic theories, Section 21.29 asks what GRE itself should learn from them. Multi-theoretical explanation supplies the immediate discipline for that inquiry: existing economics can correct GRE precisely where another theory provides a stronger mechanism, measurement strategy, historical account, normative distinction, institutional analysis, or domain-specific explanation.

21.29 GRE Revision through Economic-Theoretical Dialogue

Sections 21.12–21.28 reconstructed major economic traditions, developed translation and equivalence disciplines, preserved irreducible disagreement, and specified conditions for multi-theoretical explanation. The role of the present section is reflexive: it turns those comparative results back onto GRE itself. Its objective is to identify where established economic traditions possess domain-specific strengths that should constrain, refine, or correct GRE's concepts, methods, empirical practices, and disciplinary boundaries. The discussion proceeds through domain-specific strengths, mechanism specification, measurement and empirical operationalization, historical reconstruction, normative differentiation, institutional analysis, conceptual correction, and boundary revision. The method is comparative and self-revising. GRE is treated as an open research programme whose relational-generative vocabulary acquires credibility through disciplined exposure to stronger local explanations rather than through its ability to redescribe them in a common language.

The comparative programme therefore imposes obligations on GRE. A broad framework can be useful because it connects objects that specialized theories isolate, yet breadth can also obscure mechanism, measurement, historical specificity, normative distinction, or institutional detail. Existing economics provides accumulated techniques for narrowing those risks. Neoclassical analysis can discipline local choice and equilibrium arguments; Marxian political economy can sharpen historically specific accounts of class, accumulation, and exploitation; Keynesian and post-Keynesian analysis can clarify effective demand, money, uncertainty, and financial instability; institutional, behavioral, evolutionary, feminist, capability, ecological, commons, sociological, and digital-economy traditions each provide further specialized objects and methods developed in Sections 21.13–21.24. GRE should therefore learn through selective correction rather than assimilation.

Definition 21.725 (Disciplinary learning relation). *A disciplinary learning relation is a relation in which a theory or research programme revises its concepts, methods, evidential standards, scope conditions, or boundaries because another body of inquiry provides a more adequate account of a specified problem within an identified domain.*

Proposition 21.726 (Reflexive-dialogue principle). *Theoretical dialogue strengthens GRE only when the translation of other theories can generate revisions of GRE itself rather than functioning solely as a means of redescribing external theories in GRE vocabulary.*

This principle changes the direction of comparison. Sections 21.25–21.28 asked how theories can be translated, compared, preserved in disagreement, and coordinated. The present section asks what follows when another theory remains locally stronger after those operations. The answer is not automatic incorporation. It can be a restriction of GRE's claim, adoption of a method, refinement of a concept, addition of a missing variable or relation, revision of a formal representation, or recognition that the relevant problem belongs partly outside economics. Table 21.30 summarizes the principal forms of revision developed in the section.

Table 21.30: Principal forms of GRE revision through economic-theoretical dialogue

Revision domain	External contribution	GRE revision task	Main failure risk
Domain adequacy	Specialized explanatory success within bounded problems	State local scope and preserve specialized objects	Framework universalization
Mechanisms	More precise causal or generative pathways	Replace broad relational description with testable mechanism where warranted	Mechanism-free relational vocabulary
Measurement	Validated indicators, designs, and identification strategies	Connect relational constructs to observable evidence and uncertainty	Unfalsifiable abstraction
Historical reconstruction	Periodized categories and historically generated institutions	Index concepts and mechanisms to historical conditions	Historical flattening
Normative differentiation	Distinct evaluative criteria and moral objects	Separate descriptive generativity from normative judgment	Normative absorption
Institutional analysis	Rules, rights, governance, enforcement, and organizational detail	Specify institutional interfaces and implementation conditions	Institutional underspecification
Conceptual correction	Sharper concepts, distinctions, and counterexamples	Revise GRE definitions, formalism, and inferential scope	Vocabulary preservation at the expense of adequacy
Boundary revision	Evidence of domain resistance or disciplinary remainder	Reassign questions across GRE and adjacent fields	Disciplinary expansion without limit

21.29.1 Domain-Specific Strengths

A general framework should begin its learning by recognizing local superiority. The comparative sections of this chapter show that economic traditions are often strongest where their objects, methods, and historical purposes have been developed together over long periods. Neoclassical choice theory can be highly informative where preferences, constraints, and institutional rules are sufficiently stable for the problem under examination. Keynesian analysis can be more direct where aggregate demand, monetary conditions, expectations, and macroeconomic coordination dominate the explanandum. Institutional analysis can be more precise where rules, rights, governance, enforcement, and organizational forms constitute the central causal architecture. Feminist and care economics can reveal relations of dependency, unpaid labor, embodiment, and social reproduction that disappear under household aggregation. Ecological economics can establish biophysical constraints that a purely relational-economic vocabulary cannot infer on its own.

Definition 21.727 (Domain-specific strength). A *domain-specific strength* is a theory's

comparatively well-developed capacity to identify, explain, measure, or evaluate a specified class of phenomena under stated scope conditions.

The definition is comparative without requiring an overall ranking of theories. One theory can be stronger for price formation, another for care relations, another for financial fragility, and another for ecological throughput. Section 21.28 already established that these contributions can coexist within a multi-theoretical explanation. GRE should treat such local strengths as constraints on its own abstraction.

Definition 21.728 (Local theoretical deference). *Local theoretical deference* is the practice of allowing a domain-specialized theory to set the primary conceptual or methodological terms of inquiry where its explanatory adequacy is stronger for the specified problem and where GRE has not independently established a superior account.

Local deference does not make GRE redundant. GRE can still connect the specialized explanation to wider relational, temporal, generative, power, or value consequences. Its role changes from replacement to articulation. For example, a locally adequate model of market response can be embedded within a GRE account of how the market institution was generated and how its outcomes alter later capabilities. The local mechanism remains owned by the specialized theory unless GRE reconstructs it with equivalent or greater precision.

Proposition 21.729 (Domain-adequacy discipline). *GRE should claim explanatory priority only within domains for which its relational-generative reconstruction provides additional explanatory content, stronger evidential support, or clearer inferential control than the specialized theory it seeks to extend.*

This discipline protects the open programme from becoming a universal vocabulary whose apparent breadth substitutes for local explanatory work. It also converts comparison into a map of dependence: GRE can specify which parts of its analyses rely on price theory, institutional economics, political economy, behavioral evidence, ecological science, capability evaluation, or other specialized traditions.

Definition 21.730 (Borrowed explanatory module). *A borrowed explanatory module* is a concept, mechanism, measurement strategy, or model taken from another theory and retained with its original scope conditions and evidential requirements inside a wider GRE explanation.

Proposition 21.731 (Module-provenance condition). *When GRE uses a borrowed explanatory module, the source theory, preserved assumptions, modified assumptions, and added relational-generative interpretation should remain distinguishable.*

The condition prevents theoretical borrowing from becoming silent appropriation. It also preserves the possibility that evidence later supports the module while challenging the surrounding GRE interpretation, or supports the GRE extension while requiring revision of the imported model.

21.29.2 Mechanism Specification

Relational language can identify dependencies without yet explaining how a change propagates through them. Existing economics repeatedly demonstrates the importance of mechanism specification. Search frictions, marginal substitution, contractual incentives, balance-sheet feedback, habit formation, selection, bargaining, network effects, care dependence, institutional enforcement, and ecological throughput

describe different pathways even when each can be represented as a relation. GRE therefore gains explanatory precision when it distinguishes the existence of a relation from the mechanism by which that relation produces an outcome.

Definition 21.732 (Mechanism specification). *Mechanism specification* identifies the entities or configurations involved in a transformation, the state conditions under which it operates, the mediating process, the expected temporal sequence, and the observable or reconstructable consequences through which the proposed process can be evaluated.

Definition 21.733 (Relational-mechanism gap). A *relational-mechanism gap* exists when an analysis establishes that two or more configurations are related but does not specify the process through which the relation generates the claimed economic effect.

The gap is especially likely in broad statements about power, generativity, trust, institutions, or value. Saying that an ownership relation affects future opportunity is analytically useful, yet the claim becomes stronger when the pathway is specified: access can be restricted, investment altered, information withheld, bargaining positions changed, or legal authority exercised. Different mechanisms can produce similar manifestations and can respond differently to intervention.

Proposition 21.734 (Mechanism-priority condition). *Where a specialized economic theory provides a mechanism that explains the local transformation with greater specificity than a general GRE relation, the mechanism should be retained and the GRE relation should be treated as a higher-order context unless additional evidence warrants a different reconstruction.*

Mechanism priority is compatible with relational extension. GRE can ask how the mechanism itself was generated, what other relations condition it, and how its operation changes later possibilities. The extension should add explanatory layers rather than replace a precise process with a broader label.

Definition 21.735 (Mechanism-interface map). A *mechanism-interface map* records how a locally specified mechanism connects to wider GRE objects, including the relations that enable it, the constraints that bound it, the value consequences it mediates, and the future configurations it helps generate.

Proposition 21.736 (Mechanism-interface accountability). *A GRE extension of an established mechanism should identify which parts of the explanation are inherited, which interfaces are newly introduced, and which generative consequences remain hypotheses requiring separate support.*

This requirement is particularly important when GRE uses formal tools. A network, operator, field, transition kernel, or dynamic system can represent a mechanism only when its variables and transformations correspond to a substantively specified process. Formal sophistication cannot substitute for mechanism identification.

21.29.3 Measurement and Empirical Operationalization

GRE's broad objects create a demanding measurement problem. Relations, generative capacity, conversion interfaces, power, epistemic access, institutional stability, heterogeneous value, and future possibility are rarely observed directly. Existing economics offers a large repertoire of empirical strategies for constructing observable indicators, identifying variation, designing experiments, defining samples,

evaluating measurement error; and separating descriptive association from stronger causal claims. The lesson for GRE is procedural: every empirical use of a relational-generative concept requires an explicit evidential interface.

Definition 21.737 (Empirical operationalization). *Empirical operationalization* is the construction of a documented relation between a theoretical object and the observations, measurements, classifications, interventions, or records used to investigate it.

Operationalization does not collapse theory into measurement. Chapter 4's manifestation architecture already distinguishes relational reality from its observable manifestations. The present chapter adds a comparative discipline: other economic traditions can reveal where GRE's manifestations are too indirect, too aggregated, too endogenous to the process being studied, or too weakly connected to the concept claimed.

Definition 21.738 (Evidential interface). An *evidential interface* is the specified mapping between a theoretical claim and the empirical traces through which that claim can be supported, challenged, compared, or revised.

Behavioral and experimental economics, discussed in Section 21.17, is especially instructive because it makes design conditions part of the evidential object. Institutional and historical economics, Section 21.16, demonstrates the value of records and sequence-sensitive evidence. Capability and human-development approaches, Section 21.20, show how measurement can remain plural when the evaluative object cannot be reduced to income. Ecological economics, Section 21.21, further demonstrates that some economic claims require physical indicators whose evidential basis lies partly outside economics.

Proposition 21.739 (Operationalization-traceability condition). *An empirical GRE claim should permit a reader to trace how observations become indicators, how indicators relate to theoretical objects, which transformations or classifications intervene, and where uncertainty enters the inference.*

Definition 21.740 (Measurement remainder). A *measurement remainder* is the theoretically relevant content that the selected empirical indicators do not capture or distinguish within the stated observation regime.

Measurement remainders should be documented rather than hidden by a scalar index. A measure of network position can omit relation quality; a monetary value can omit care or ecological significance; an administrative category can omit informal participation; an observed choice can omit unavailable alternatives. These omissions do not invalidate measurement. They delimit its meaning.

Proposition 21.741 (Measurement-plurality condition). *Where a GRE object has materially heterogeneous manifestations, empirical adequacy may require several indicators whose disagreements are analyzed rather than compressed into a single metric by default.*

The resulting empirical programme should also inherit established identification discipline. Claims about relational causation, institutional effects, or generative consequences should distinguish descriptive reconstruction, mechanism evidence, intervention evidence, and counterfactual inference. GRE's epistemic humility becomes operational when claim strength follows the design and evidence actually available.

21.29.4 Historical Reconstruction

Many GRE categories are intended to be history-bearing, yet historical sensitivity is stronger when it is reconstructed rather than asserted. Classical political economy, Marxian analysis, institutional economics, evolutionary economics, feminist political economy, and economic sociology each demonstrate different ways in which economic objects emerge within historical sequences. The lesson is that history should enter GRE through periodization, category formation, institutional succession, path dependence, archival evidence, and changing causal relations rather than through generic references to historical context.

Definition 21.742 (Historical reconstruction). *Historical reconstruction* is the evidence-guided account of how an economic object, relation, category, institution, mechanism, or configuration emerged, stabilized, transformed, and acquired its later causal or interpretive significance.

Definition 21.743 (Historical indexation). *Historical indexation* specifies the period, institutional configuration, material conditions, and category regime within which an economic concept or mechanism is claimed to be adequate.

Historical indexation constrains formal generalization. A concept such as labor market, household, firm, platform, property, or money can persist across periods while the relations constituting it change. GRE should therefore avoid treating a stable label as evidence of stable relational structure.

Proposition 21.744 (Historical-category discipline). *A GRE category should be treated as historically portable only when the identity criteria required for comparison remain sufficiently stable across the periods being connected.*

Section 21.14 is instructive because Marxian categories derive part of their explanatory meaning from historically specific relations of production. Section 21.16 adds institutional path dependence, while Section 21.18 adds evolutionary routines and sequence-sensitive adaptation. GRE can connect these insights through generative spacetime, but the temporal formalism should not erase the historical content that gives the mechanisms their meaning.

Definition 21.745 (Historical mechanism inheritance). *Historical mechanism inheritance* occurs when a present economic mechanism depends on institutions, categories, infrastructures, rights, expectations, or relational patterns generated in earlier periods.

Proposition 21.746 (Inheritance-reconstruction condition). *Where present relational structure depends on historical inheritance, GRE should reconstruct the relevant sequence and persistence mechanism rather than representing the inherited condition as an unexplained initial state.*

Historical learning therefore changes the role of initial conditions in GRE models. Some conditions can be analytically fixed for a local problem, but a broader generative explanation should remain able to ask how they were produced and why they persisted. The answer may require methods and evidence developed more fully in history, sociology, law, political economy, or institutional research than in GRE itself.

21.29.5 Normative Differentiation

GRE's vocabulary of generativity, preservation, capability, relation, value, and future possibility creates strong normative temptations. The comparative dialogue

shows why those temptations require restraint. Capability approaches distinguish resources, functionings, capabilities, agency, and freedom. Feminist and care traditions distinguish recognition, dependency, care, social reproduction, and distribution. Ecological economics distinguishes biophysical feasibility from evaluative choice. Marxian analysis distinguishes exploitation and class relations from broader inequality. These distinctions show that an increase in generative capacity cannot by itself determine whether an outcome is just, legitimate, desirable, sustainable, or worthy of preservation.

Definition 21.747 (Normative differentiation). *Normative differentiation* is the practice of separating distinct evaluative objects and criteria before relating them, including welfare, capability, freedom, equality, recognition, care, justice, legitimacy, sustainability, and generative consequence.

Proposition 21.748 (Generativity-normativity separation). *A finding that an arrangement expands, preserves, or redirects future possibility does not by itself establish the normative desirability of that arrangement or of the possibilities generated.*

This proposition is a central correction to possible overextensions of GRE. Generativity is an analytical property of transformation. Normative judgment requires additional criteria concerning who gains possibilities, who bears costs, what kinds of relations are created, whether participation is legitimate, how non-human and future affected parties are considered, and whether the underlying conversions are acceptable.

Definition 21.749 (Normative interface). *A normative interface* specifies how a descriptive or explanatory GRE result is connected to an independently stated evaluative criterion without treating the criterion as derivable from the descriptive result alone.

Proposition 21.750 (Criterion-provenance condition). *When GRE makes a normative judgment, the evaluative criterion and its theoretical or ethical provenance should be stated separately from the relational-generative facts to which it is applied.*

Normative differentiation also limits aggregation. A policy can improve one capability while damaging another, increase aggregate output while worsening recognition, preserve an institution while entrenching domination, or create future technical possibilities while degrading ecological conditions. GRE's heterogeneous-value architecture can represent these tensions, yet representation does not settle them.

Definition 21.751 (Normative remainder). *A normative remainder* is evaluatively material content that survives relational translation because the relevant judgment depends on criteria not exhausted by GRE's descriptive or generative categories.

Proposition 21.752 (Normative-remainder preservation). *GRE should preserve normative remainders explicitly when translation into relational, capability, value, or generative language would weaken the source criterion or obscure a disagreement about what ought to matter.*

This principle carries forward Section 21.27. The purpose of dialogue is not to translate every normative theory into one GRE metric. It is to make the interfaces among distinct judgments more inspectable.

21.29.6 Institutional Analysis

Institutional specificity is another area where existing economics should discipline GRE. Relational descriptions can identify governance relations, yet economic outcomes depend on the concrete architecture of rights, rules, enforcement, membership, exit, authority, accounting, liability, information, and dispute resolution. Institutional economics, commons scholarship, cooperative economics, political economy, feminist economics, and platform analysis each show that these details can alter who can act, how value is converted, which risks are transferred, and which future trajectories remain feasible.

Definition 21.753 (Institutional specification). *Institutional specification* identifies the rules, rights, roles, decision procedures, enforcement mechanisms, jurisdictional boundaries, resource claims, and accountability relations through which an economic arrangement becomes operational.

Definition 21.754 (Institutional interface). An *institutional interface* is a rule-governed point at which subjects or organizations acquire, exercise, transfer, contest, or lose access, authority, resources, recognition, or obligations.

Institutional interfaces give substantive content to many GRE conversion interfaces. A conversion from data to revenue, labor to income, membership to voting authority, ownership to control, or public eligibility to service access is mediated by rules that can be documented. The relational-generative analysis becomes stronger when these rules are explicit.

Proposition 21.755 (Institutional-detail condition). *Where an economic effect depends on institutional rules, a GRE explanation should identify the operative rule architecture before attributing the effect to a more general relational property.*

Section 21.22 is especially instructive because commons and cooperative arrangements cannot be understood through a generic category of collective ownership. Membership, monitoring, rights, governance, reciprocity, and distribution differ across arrangements. Section 21.24 similarly shows that platform control depends on concrete interfaces, standards, data rights, algorithms, and contractual relations.

Definition 21.756 (Institutional implementation gap). An *institutional implementation gap* exists when a proposed relational or normative arrangement lacks a specified rule architecture capable of producing, maintaining, or enforcing the relations required by the proposal.

Proposition 21.757 (Implementation-adequacy principle). *Applied GRE should distinguish desirable relational configurations from institutionally feasible arrangements and should treat the design of rules, incentives, authority, monitoring, and revision procedures as independent analytical tasks.*

This distinction is important for policy and organizational design. A generatively attractive future state may be unreachable through the available institutions, or an institution designed to reach it may generate unintended power relations. Institutional analysis therefore constrains both feasibility and consequence.

21.29.7 Conceptual Correction of GRE

The strongest form of disciplinary learning occurs when dialogue changes GRE's own concepts. Comparative analysis can reveal that a GRE term is too broad, conflates distinct mechanisms, duplicates an established concept, or obscures a source tradition's

sharper distinction. Conceptual correction should therefore be treated as a normal result of the research programme rather than as evidence of theoretical failure.

Definition 21.758 (Conceptual correction). A *conceptual correction* is a revision to a GRE definition, distinction, relation, formal representation, or inferential rule prompted by evidence that the existing formulation is ambiguous, overbroad, under-specified, misleadingly novel, or inconsistent with stronger domain knowledge.

Several correction types follow from the preceding comparative sections. GRE should keep generative value distinct from established generative-value traditions and state its narrower contribution in heterogeneous conversion, circulation, capture, return, dissipation, and regeneration. Generative capacity should remain distinct from capability-theoretic freedom and agency. Criticality should remain distinct from generic crisis, instability, nonlinearity, or rapid change. Relational power should not absorb exploitation, authority, domination, bargaining power, or institutional control into one undifferentiated category. Manifestational equivalence should not become ontological or normative identity.

Definition 21.759 (Conceptual collision). A *conceptual collision* occurs when a GRE term and an established disciplinary term use similar language while carrying materially different identity criteria, mechanisms, evidential implications, or normative meanings.

Proposition 21.760 (Collision-resolution condition). *Where conceptual collision occurs, GRE should clarify the distinction, narrow its term, adopt established terminology, or state an explicit translation relation rather than relying on lexical similarity.*

Definition 21.761 (Conceptual redundancy). *Conceptual redundancy* exists when a GRE concept adds no material distinction, explanatory role, or inferential capacity beyond an established concept under the same domain and scope conditions.

Proposition 21.762 (Redundancy-revision principle). *A GRE concept that is substantively redundant should be removed, narrowed, or explicitly treated as a translation label unless retaining it serves a demonstrable cross-domain or formal function.*

Conceptual correction also concerns formalism. If an operator, graph, field, category, or dynamical representation imports assumptions that the substantive theory does not support, the representation should be revised or abandoned. The book's ontological suspension makes such correction easier: formal structures are methodological resources rather than metaphysical commitments.

Definition 21.763 (Revision trigger). A *revision trigger* is evidence, counterexample, competing explanation, measurement failure, historical finding, conceptual collision, or formal inconsistency that materially reduces the adequacy of a current GRE formulation.

Proposition 21.764 (Revision-responsiveness condition). *An open GRE research programme should record revision triggers and modify its claims when maintaining the existing formulation would require ignoring stronger evidence or a more precise disciplinary distinction.*

The principle gives operational meaning to epistemic humility. Revisability is not a general statement that future research may change the theory. It is a procedure for identifying when change has become warranted.

21.29.8 Boundary Revision of GRE

Dialogue finally revises the boundaries of GRE. The framework interfaces with political theory, law, sociology, history, ecology, education, aesthetics, computer science, and broader GR foundations. These interfaces are productive because economic processes participate in wider relational systems. They also create a risk that GRE expands until every relation with an economic consequence becomes part of economics. Existing disciplines provide a counterweight: some questions should remain primarily theirs even when GRE has reasons to connect to them.

Definition 21.765 (Disciplinary boundary). A *disciplinary boundary* is a revisable division of explanatory, methodological, evidential, or normative responsibility that identifies which problems a research programme treats as internal, which it addresses through explicit interfaces, and which it leaves primarily to adjacent fields.

Definition 21.766 (Boundary revision). *Boundary revision* is the reassignment of a problem, concept, method, or claim between GRE's internal programme and its interfaces with adjacent disciplines when accumulated inquiry shows that the previous assignment is inadequate.

Boundary revision can move in both directions. A topic initially treated as external can become economically central when it changes allocation, production, value conversion, institutional access, or future capability. Conversely, a topic initially analyzed inside GRE can require transfer to another field when its principal questions are juridical, ecological, ethical, educational, aesthetic, technical, or otherwise governed by evidence and standards GRE does not possess.

Proposition 21.767 (Interface-before-expansion principle). *When a problem materially intersects GRE but is governed by specialized concepts or evidential standards from another field, GRE should prefer an explicit interdisciplinary interface before expanding its own domain to absorb the problem.*

Definition 21.768 (Domain overextension). *Domain overextension* occurs when GRE claims explanatory or evaluative authority over a problem mainly because the problem can be represented relationally, even though the decisive mechanisms, evidence, or normative standards belong to another domain.

Proposition 21.769 (Boundary-evidence condition). *Expansion of GRE's domain should be supported by a demonstrated economic explanatory task, an identifiable contribution beyond existing disciplinary accounts, and an interface plan for preserving the concepts and evidence of neighboring fields.*

This condition applies equally to the broader GR framework. Relational representation is highly portable, yet portability does not establish disciplinary ownership. An ecological relation can be economically consequential while remaining scientifically grounded in ecology. A legal status can structure economic access while retaining juridical meaning. A moral claim can constrain institutional design without becoming an economic preference. GRE's boundary should therefore follow explanatory responsibility rather than representational reach.

Definition 21.770 (GRE revision ledger). A *GRE revision ledger* is a structured record of domain-specific strengths learned from other theories, adopted mechanisms and methods, measurement requirements, historical and normative corrections, institutional specifications, conceptual revisions, unresolved disagreements, and resulting boundary changes.

Proposition 21.771 (Cumulative-self-revision principle). *GRE's theoretical development should be evaluated partly by whether successive dialogue produces traceable corrections and sharper boundaries rather than only by whether the framework can accommodate an expanding range of phenomena.*

The revision ledger completes the reflexive task of this section. Existing economics contributes to GRE through more than source material or cases for relational translation. It supplies locally stronger mechanisms, mature empirical practices, historically grounded categories, normative distinctions, and institutional detail capable of changing GRE's own architecture. The resulting research programme becomes narrower in some places and more precise in others. Such revision is compatible with the book's broader aim because generative relational analysis is presented as an open programme rather than a closed replacement theory.

The next section examines the complementary risk on the translation side. Even after GRE has accepted correction from existing economics, GR itself can remain too powerful as a common language. Section 21.30 therefore identifies the limits of GR as a translation language and the conditions under which relational translation should stop.

21.30 Limits of GR as a Translation Language

Sections 21.25–21.29 developed a translation discipline, differentiated several equivalence relations, preserved irreducible disagreement, constructed multi-theoretical explanations, and required theoretical dialogue to revise GRE itself. The role of the present section is to test the common language used throughout that sequence. Its objective is to identify conditions under which GR's relational vocabulary ceases to clarify a source theory and begins to distort, assimilate, or overextend it. The discussion proceeds through relational overtranslation, loss of theoretical specificity, unwarranted equivalence, hidden normative assumptions, historical flattening, formal overreach, domain-specific resistance, and translation stopping conditions. The method is reflexive and diagnostic. GR is treated as one possible translation language whose adequacy varies by object, theory, domain, scale, historical setting, and inferential purpose.

The issue arises precisely because GR is portable. Objects from heterogeneous traditions can often be described through entities, relations, constraints, capacities, structures, processes, histories, manifestations, value conversions, and generative consequences. That portability can create genuine comparative insight. It can also create the appearance that a successful relational redescription has captured the source theory's constitutive content. The distinction between representational reach and translational adequacy is therefore central to the remainder of Chapter 21.

Definition 21.772 (Translation-language adequacy). *Translation-language adequacy is the degree to which a target language can represent the source theory's analytically material distinctions, mechanisms, historical conditions, evidential commitments, normative criteria, and inferential consequences for a stated comparative purpose.*

Proposition 21.773 (Translation-language limitation principle). *A translation language should be treated as locally inadequate when its use reduces the analyst's ability to preserve or test a distinction that is material to the source theory or to the problem under examination.*

Table 21.31: Principal limits of GR as a translation language

Limit class	GR translation risk	Diagnostic question	Appropriate response
Relational overtranslation	Distinct concepts collapse into generic relational language	Does the relational description preserve the source theory's identity criteria and mechanism?	Restore distinctions or keep the source vocabulary primary
Specificity loss	Historical, institutional, semantic, or methodological content becomes inaccessible	Which source-theoretical inferences disappear after translation?	Record the loss and restrict the translation claim
Unwarranted equivalence	Shared relational form is treated as substitutability	Which equivalence signature is actually supported?	Return to scoped correspondence or non-equivalent translation
Normative leakage	Evaluative criteria enter GR categories without explicit provenance	Which judgments are descriptive, evaluative, or theory-specific?	State normative interfaces and preserve remainders
Historical flattening	Historically generated categories appear transhistorical	Which conditions generated and sustained the source category?	Re-index concepts and mechanisms to historical conditions
Formal overreach	Mathematical representation adds unsupported structure	Which formal assumptions are empirically or theoretically warranted?	Weaken, revise, or remove the formal representation
Domain resistance	Specialized objects exceed GR's disciplinary or evidential competence	Which field supplies the decisive concepts and evidence?	Use an interdisciplinary interface and retain local authority
Stopping condition	Additional translation would increase distortion more than intelligibility	What material distinction would further mapping erase?	Stop translation and record the unresolved remainder

The proposition changes the standard of success. Adequacy requires more than assigning each source concept a GR term; the resulting representation should retain enough source-specific structure to support the intended inference. Table 21.31 summarizes the principal limit classes developed in this section.

21.30.1 Relational Overtranslation

GR begins from relations, histories, constraints, differences, structures, and processes because these coordinates can reveal economic formations that appear static when represented only through isolated objects. The same coordinates become problematic when relational description is allowed to substitute for the source concept itself.

A class relation, care relation, legal relation, ecological dependency, capability relation, network tie, contractual relation, and exchange relation can each be represented relationally while remaining analytically different kinds of relation.

Definition 21.774 (Relational overtranslation). *Relational overtranslation* occurs when a source-theoretical object is translated into sufficiently general GR language that its distinguishing mechanism, identity criterion, historical formation, evidential status, or normative significance becomes materially less visible.

Relational overtranslation is therefore different from ordinary abstraction. Abstraction is often necessary for comparison. Overtranslation occurs when the abstraction removes precisely the feature that gives the source theory explanatory force. Describing exploitation as an asymmetric relation, for example, can support comparison with other power relations, yet exploitation in Marxian analysis carries specific relations among labor power, surplus production, appropriation, and historically constituted production relations. A generic asymmetry representation cannot substitute for that structure. Similar caution applies to care, capability, ecological regeneration, fiduciary obligation, or legal authority.

Proposition 21.775 (Relational-sufficiency condition). *A relational translation is sufficient for a stated task only when the relations retained in the target language preserve the source distinctions required for the relevant explanation, comparison, or evaluation.*

Definition 21.776 (Relational compression). *Relational compression* is the reduction of several source-theoretical distinctions into a smaller set of GR relational coordinates for a specified comparative purpose.

Relational compression can be useful. A comparison of coordination systems may temporarily encode market exchange, hierarchical command, commons governance, and platform ranking through relations among access, authority, information, and allocation. The compression becomes unsafe when a later argument relies on distinctions that the compressed representation discarded.

Proposition 21.777 (Differentiation-preservation condition). *Where several source concepts map to the same GR coordinate, subsequent inference should preserve a record of their source distinctions unless the analysis establishes that those distinctions are immaterial to the question at hand.*

This condition places a practical limit on GR's apparent universality. A common language is valuable partly because it compresses. Its value declines when compression becomes irreversible and analysts can no longer reconstruct which theoretical distinctions entered the common representation.

21.30.2 Loss of Theoretical Specificity

A second limit concerns theoretical specificity. Economic theories are structured configurations whose concepts acquire meaning through their internal architecture. Their central categories derive meaning from relations among propositions, methods, evidential standards, historical problems, research communities, and normative commitments. Translation into GR can preserve selected relations while weakening this architecture.

Definition 21.778 (Theoretical specificity). *Theoretical specificity* is the set of distinctions, inferential relations, mechanisms, methods, historical conditions, and evaluative commitments that gives a theory its identifiable explanatory architecture within

a stated domain.

Definition 21.779 (Specificity loss). *Specificity loss* is the reduction in source-theoretical content that occurs when translation preserves a shared comparative structure while making one or more constitutive source distinctions unavailable for later inference.

Specificity loss can occur even when individual translated statements remain accurate. A Keynesian description of liquidity preference, uncertainty, and investment can be rendered through expectations, constraints, and temporal relations, yet the macroeconomic architecture linking money, effective demand, and investment can weaken if those concepts are translated independently. An institutional rule can become a generic constraint, obscuring the fact that its authority, enforceability, and jurisdiction are institutional rather than merely relational properties. A capability can become an opportunity relation, losing its evaluative connection to substantive freedom.

Proposition 21.780 (Source-architecture preservation). *Cross-theoretical translation should preserve enough of the source theory's internal architecture to reconstruct why its concepts have the inferential roles attributed to them.*

Definition 21.781 (Source-theory provenance). *Source-theory provenance* is the explicit record linking a translated concept, mechanism, criterion, or empirical claim to the theoretical architecture from which its meaning and warrant are derived.

Proposition 21.782 (Provenance-preservation condition). *A GRE reconstruction should preserve source-theory provenance when the translated element would otherwise appear to originate from GR or to carry a broader domain of validity than the source theory supports.*

Provenance also protects intellectual priority. Relational language is old and widespread across economics, sociology, institutional analysis, feminist theory, capability approaches, ecological thought, and political economy. GRE's contribution depends on how it reorganizes and extends certain problems while preserving the prior relational insights of other traditions. Source-theory provenance therefore supports both conceptual accuracy and responsible attribution.

21.30.3 Unwarranted Equivalence

Translation can also create equivalence too easily. Section 21.26 introduced equivalence signatures precisely because two theories can preserve the same relation, function, manifestation, or role while differing elsewhere. GR can increase the risk of overclaim because heterogeneous theories often become structurally similar after they are projected into a sufficiently abstract relational representation.

Definition 21.783 (Unwarranted equivalence). An *unwarranted equivalence* is a claim of substitutability, sameness of explanatory role, or structural correspondence that exceeds the preservation relation established by the available translation and evidence.

A market price and an administrative score can both mediate allocation. A household and a firm can both be represented as organized relational configurations. A care relation and a service transaction can both transfer time and capability. A legal right and a platform permission can both alter access. These similarities can be analytically useful. They do not establish that the paired objects share the same mech-

anism, institutional standing, history, normative meaning, or causal consequences.

Proposition 21.784 (Equivalence-evidence condition). *A GR translation should support an equivalence claim only at the dimensions explicitly preserved by the relevant equivalence signature and independently warranted by the comparison.*

Definition 21.785 (Translation-induced similarity). *Translation-induced similarity is apparent correspondence whose strength derives partly from the coarseness or shared structure of the target language and therefore exceeds the correspondence independently demonstrated among the source theories.*

Translation-induced similarity is especially likely when the target vocabulary uses highly general objects such as relation, constraint, capacity, state, process, or trajectory. Almost any economic theory can be expressed through some combination of those terms. The translation therefore establishes representability before it establishes theoretical correspondence.

Proposition 21.786 (Similarity-audit condition). *Where a strong theoretical correspondence appears only after projection into a more general GR representation, the analyst should test whether the correspondence survives reconstruction in the source theories' own vocabularies.*

The audit can reduce a proposed equivalence to a weaker translation relation, reveal a genuine local equivalence, or preserve the theories as non-equivalent descriptions of overlapping phenomena. Each outcome is compatible with productive theoretical dialogue.

21.30.4 Hidden Normative Assumptions

GR's generative vocabulary can make evaluative commitments appear descriptive. Terms such as capability, sustainability, resilience, participation, recognition, generativity, relational quality, or future possibility often carry positive associations in ordinary discourse. Their analytical use does not by itself establish that the represented outcome is desirable. Section 21.29 therefore separated descriptive generativity from normative judgment. The same separation is required within translation.

Definition 21.787 (Normative import). *A normative import is an evaluative criterion, priority, or presumption introduced into a translation from either the source theory, the target language, or the analyst's framing.*

Definition 21.788 (Evaluative leakage). *Evaluative leakage occurs when a normative import affects the translated description or comparison without being identified as an independent evaluative commitment.*

Evaluative leakage can operate in several directions. A capability-oriented source theory may bring a substantive concern with freedom into a GR representation. A care-ethical source may bring duties of attentiveness and responsiveness. Ecological economics may bring judgments about sustainability or intergenerational responsibility. Conversely, a GRE emphasis on preserving future generative capacity may privilege option creation over other goods unless the criterion is explicitly separated from description.

Proposition 21.789 (Normative-separation condition). *A cross-theoretical GR translation should identify the provenance of evaluative criteria and distinguish descriptive relational claims from judgments that depend on those criteria.*

Proposition 21.790 (Criterion-transparency condition). *When alternative normative*

criteria would rank the same translated configuration differently, the translation should preserve that evaluative plurality and keep the competing criteria explicit outside the common relational vocabulary.

This condition is especially important for heterogeneous value. GRE can represent partially incommensurable value forms and conversion interfaces, but representation does not determine how conflicts among them ought to be resolved. A translation language that silently turns values into comparable relational consequences would reproduce the commensuration problem it is designed to expose.

21.30.5 Historical Flattening

GR's abstract coordinates can travel across historical periods, which is useful for comparison and dangerous for explanation. Theories often contain categories whose meaning depends on historically specific institutions, technologies, legal forms, production relations, or social struggles. A relational translation can preserve the abstract relation while detaching it from the conditions under which the category became economically operative.

Definition 21.791 (Historical flattening). *Historical flattening* is the loss of historically constitutive conditions when a theory-specific category or mechanism is translated into a more portable representation and subsequently treated as if its identity and operation were stable across periods.

The risk can arise with capital, wage labor, household, market, firm, property, data, platform, care, institution, or even economy. A relational representation can identify ownership, exchange, authority, or dependency across many periods, while the concrete meaning of those relations changes with legal status, technical infrastructure, organizational form, and political order.

Definition 21.792 (Historical index). A *historical index* records the temporal, institutional, technological, legal, and social conditions under which a translated concept or mechanism has the identity and explanatory role attributed to it.

Proposition 21.793 (Historical-index condition). *Where a source concept is historically constituted, its GR translation should retain a historical index sufficient to prevent the translated category from acquiring an unsupported transhistorical scope.*

Definition 21.794 (Genealogical remainder). A *genealogical remainder* is source-theoretical content concerning the emergence, contestation, transformation, or institutional stabilization of a category that is not preserved by its synchronic relational representation.

Proposition 21.795 (Genealogy-preservation condition). *A relational comparison should preserve genealogical remainders whenever historical formation materially affects the meaning, mechanism, or scope of the translated object.*

Historical flattening also affects GRE's own concepts. Generative capacity, value conversion, relational power, and epistemic mediation can vary across historical configurations. Their abstraction is useful only if the framework remains able to explain how the relevant relations are instituted differently in different periods.

21.30.6 Formal Overreach

A further limit arises when GR's formal resources outrun the source theory or the evidence. Graphs, operator algebras, fields, dynamical systems, category-theoretic diagrams, event structures, and spacetime representations can clarify relational architecture. Their use also imports mathematical structure. Adjacency, continuity, composition, state spaces, transition rules, metrics, topology, or algebraic closure can become assumptions about the economic object even when the source material establishes only a qualitative relation.

Definition 21.796 (Formal overreach). *Formal overreach* occurs when a mathematical representation used for translation introduces structural assumptions, precision, comparability, or inferential consequences that exceed the theoretical or empirical warrant available for the source object.

Definition 21.797 (Representation excess). *Representation excess* is the set of formal properties possessed by a chosen representation that are not independently established as properties of the economic phenomenon being represented.

Representation excess is unavoidable in many models. The relevant question is whether the excess affects inference. A network model may encode binary edges because the data require them while the underlying relation is graded and multiplex. A field representation may assume local continuity where institutional change is discontinuous. An operator formalism may define composition rules for analytical convenience while the empirical transformations are only partially composable.

Proposition 21.798 (Formal-warrant condition). *A formal GR translation should distinguish properties required by the representation from properties independently supported for the source phenomenon, especially when the distinction affects substantive inference.*

Definition 21.799 (Formal retreat). *Formal retreat* is the deliberate replacement of a stronger formal representation with a weaker structural, qualitative, or partially specified representation when the stronger assumptions lack sufficient warrant.

Proposition 21.800 (Formal-retreat condition). *When representation excess materially determines a conclusion, GRE should weaken or abandon the formalism unless independent theory or evidence supports the additional structure.*

Formal retreat is compatible with rigor. It can increase rigor by making uncertainty and underdetermination explicit. Ontological suspension further supports this practice because mathematical usefulness need not be defended through claims about the ultimate ontology of economic reality.

21.30.7 Domain-Specific Resistance

Some objects resist GR translation because the decisive standards of adequacy belong to a specialized domain. Ecological processes depend on biophysical evidence. Legal relations depend on doctrine, jurisdiction, institutional authority, and interpretive practice. Educational processes depend on developmental, pedagogical, and institutional knowledge. Technical systems depend on engineering constraints and implementation detail. Ethical claims depend on normative argument. GR can connect these objects to economic relations without becoming the primary language in which their validity is established.

Definition 21.801 (Domain-specific resistance). *Domain-specific resistance* is the per-

sistence of analytically decisive distinctions, mechanisms, evidential standards, or validity conditions that a general GR translation cannot replace without relying on the specialized domain from which those standards originate.

Domain-specific resistance can be strong even when relational translation is easy. A legal entitlement can be represented as a relation of authority and access, yet whether the entitlement exists can turn on statutory text, precedent, jurisdiction, or procedural status. An ecological threshold can constrain a generative trajectory, yet its location requires ecological measurement and modeling. A machine-learning system can mediate economic allocation, yet its technical behavior can depend on model architecture, data processing, and evaluation procedures that economic relational analysis alone cannot determine.

Proposition 21.802 (Domain-resistance condition). *Where a translated claim depends on specialized validity conditions, GRE should retain the relevant domain's concepts, methods, and evidential authority at the interface while using the GR representation for the economic or relational consequences it can support.*

Definition 21.803 (Domain-autonomy remainder). *A domain-autonomy remainder is content whose validity continues to depend on a specialized discipline even after its economic or relational consequences have been translated into GRE.*

Proposition 21.804 (Interface-preference condition). *When domain-autonomy remainders are material, interdisciplinary interface construction is preferable to absorbing the source domain into GR's own vocabulary.*

This proposition extends the boundary revision discipline of Section 21.29. GRE can ask how ecological, juridical, technical, or educational structures alter economic access and future possibilities while leaving the underlying domain-specific claims under the standards of the appropriate field.

21.30.8 Translation Stopping Conditions

The preceding limits imply a positive stopping discipline. Section 21.25 defined a general translation stopping condition: mapping should stop where further translation would erase a material distinction. The present subsection specifies how that principle applies when GR is the target language. Stopping is warranted when additional relationalization would increase apparent unity while reducing theoretical specificity, evidential accountability, historical adequacy, normative transparency, or domain competence.

Definition 21.805 (GR cessation warrant). *A GR cessation warrant is a documented reason to suspend further translation into GR because the next mapping step would produce material overtranslation, specificity loss, unwarranted equivalence, normative leakage, historical flattening, formal overreach, or domain-authority displacement.*

Proposition 21.806 (Stop-before-assimilation principle). *GR translation should stop before the common language requires a source theory to surrender a constitutive distinction that remains relevant to explanation, evidence, evaluation, or disciplinary responsibility.*

Stopping does not terminate dialogue. It changes the form of dialogue. Theories can remain connected through explicit interfaces, partial translations, disagreement maps, and multi-theoretical explanation while retaining concepts that have no ade-

quate GR substitute.

Definition 21.807 (Non-translation record). A *non-translation record* documents a source concept, relation, mechanism, criterion, or domain claim that remains intentionally untranslated, the reason translation was suspended, the comparisons still permitted, and the evidence that could justify reopening the translation later.

Proposition 21.808 (Re-entry condition). A *suspended translation may be reopened when new conceptual distinctions, empirical evidence, formal tools, or domain knowledge reduce the previously identified loss without erasing the source-theoretical remainder*.

This re-entry condition keeps stopping revisable. It avoids turning present limits into permanent barriers. A richer target vocabulary may later preserve a distinction that GR currently compresses, or new evidence may establish a formal correspondence that was previously only analogical.

Definition 21.809 (Translation-language limit profile). A *translation-language limit profile* records, for a source theory or domain, the GR mappings that are adequate, the dimensions requiring source-language retention, the identified losses, the relevant cessation warrants, and the conditions for possible re-entry.

Proposition 21.810 (Meta-linguistic humility principle). *The quality of the distinctions GR preserves and the limits it records should be primary criteria for evaluating it as a translation language; breadth of relational redescription is a secondary criterion.*

The limit profile completes the metatheoretical sequence of Sections 21.25–21.30. Translation creates common coordinates; equivalence states scoped preservation relations; disagreement records constitutive differences; multi-theoretical explanation coordinates differentiated contributions; reflexive dialogue revises GRE; and the present section establishes that GR itself remains subject to translation failure. The resulting architecture is therefore intentionally incomplete. Some theoretical content can be translated, some can be coordinated without equivalence, and some should remain in its source language until a stronger interface becomes available.

This limitation is productive for the next stage of the book. A research programme should emerge from the questions, contradictions, empirical gaps, formal gaps, normative gaps, and domain tests that survive theoretical dialogue. Section 21.31 therefore turns from the completed translation audit to the research problems generated by that audit.

21.31 GRE Research-Programme Formation

Sections 21.12–21.30 reconstructed major economic traditions, tested translation across heterogeneous theoretical architectures, distinguished several forms of equivalence, preserved irreducible disagreement, developed multi-theoretical explanation, required dialogue to revise GRE, and identified limits of GR itself as a translation language. The role of the present section is to convert the results of that dialogue into a disciplined agenda for further inquiry. Its objective is to specify how newly revealed questions, contradictions, empirical gaps, formal gaps, normative gaps, domain-specific tests, and revision requirements can become organized components of a GRE research programme. The discussion proceeds through those seven sources of programme formation and closes with a research-programme architecture. The method is synthetic and prospective while remaining diagnostic: the section does not

settle the questions generated by dialogue; it identifies how they should be retained, differentiated, tested, and revised.

The preceding dialogue changes the meaning of a research programme. A programme cannot be defined only by topics GRE already knows how to describe. The comparative exercise has generated problems that arise precisely where GRE encounters concepts, mechanisms, evidential standards, normative criteria, historical formations, and domain-specific objects that resist easy incorporation. These encounters should become research objects rather than editorial inconveniences. The programme therefore includes both questions that extend GRE and questions that may constrain, fragment, or contract its claims.

Definition 21.811 (Research-programme formation). *Research-programme formation* is the organized conversion of unresolved theoretical, empirical, formal, historical, normative, and domain-specific problems into revisable research questions, test designs, model-development tasks, comparative inquiries, and framework-revision procedures.

Definition 21.812 (Dialogue-generated research object). A *dialogue-generated research object* is a problem, distinction, mechanism, remainder, contradiction, or uncertainty that becomes analytically visible through comparison among GRE and other theoretical traditions.

Proposition 21.813 (Dialogue-to-programme condition). *A result of theoretical dialogue warrants entry into the GRE research programme when it identifies a material uncertainty or disagreement that can be stated with sufficient precision to guide evidence, formalization, interpretation, domain testing, or framework revision.*

This condition prevents Chapter 21 from ending as a catalogue of similarities and differences. Translation has programme value when it changes the questions that later inquiry can ask. Table 21.32 summarizes the principal pathways developed below.

21.31.1 Questions Revealed by Translation

Translation is productive partly because it exposes questions that remain hidden inside a single theoretical vocabulary. A theory can appear internally complete while leaving unasked how its categories correspond to differently constructed objects, scales, histories, or value regimes. Sections 21.25 and 21.26 showed that translation and equivalence require explicit preservation criteria. Once those criteria are stated, the failure of a mapping can itself reveal a research question.

Definition 21.814 (Translation-generated question). A *translation-generated question* is a research question produced by an identified mismatch, remainder, ambiguity, or scope difference between source and target theoretical representations.

A translation-generated question differs from a generic literature gap. Its origin can be traced to a specific mapping attempt. Translating capability into a relational-generative vocabulary, for example, raises questions about whether future option creation should be treated as part of capability analysis, as a separate GRE extension, or as an interface between two evaluative architectures. Translating ecological metabolism into economic value language raises a different question: which material constraints can be represented through value relations and which require independently measured biophysical conditions. The research problem emerges from the

Table 21.32: Principal pathways of GRE research-programme formation

Programme pathway	Diagnostic object	Research output	Possible GRE consequence
Translation-generated questions	Unresolved distinctions exposed by mapping	Discriminating questions and comparative designs	New problem classes or narrower claims
Dialogical contradictions	Incompatible mechanisms or commitments	Contradiction maps and adjudication tasks	Mechanism revision or preserved disagreement
Empirical gaps	Missing observations, measures, or identification	Data strategies and evidential interfaces	Operationalization or empirical contraction
Formal gaps	Missing or excessive representational structure	Model tasks and formal-comparison tests	New formalism, weakened formalism, or formal retreat
Normative gaps	Unspecified evaluative criteria or affected parties	Normative-interface studies and contestation procedures	Criterion separation or revised governance claims
Domain-specific tests	Claims exposed to specialized disciplinary objects	Transfer tests and stress cases	Bounded generalization or domain deference
GRE revision	Dialogue-supported framework deficiency	Versioned revision records	Conceptual correction, extension, or contraction
Programme architecture	Relations among unresolved research tasks	Research streams, interfaces, and portfolios	Open and revisable programme development

mismatch rather than from an assumption that one vocabulary should absorb the other.

Proposition 21.815 (Question-provenance condition). *A translation-generated question should retain a record of the source concepts, target concepts, mapping attempt, and material remainder that produced it.*

Provenance matters because later reformulation can otherwise erase the reason a question was difficult. A broad question such as how institutions affect generativity can obscure whether the original difficulty concerned property rights, informal norms, enforcement, membership, care obligations, ecological limits, or platform control. Preserving the translation path maintains the discriminating structure of the problem.

Definition 21.816 (Discriminating research question). *A discriminating research question is one whose possible answers would differentiate among competing theoretical mechanisms, scope claims, representations, or evaluative interpretations.*

Proposition 21.817 (Comparative-leverage condition). *Where theoretical dialogue produces several plausible accounts of the same phenomenon, programme priority increases when a question can generate evidence or analysis that distinguishes among those accounts rather than merely restating their shared vocabulary.*

This principle gives Chapter 21 a problem-forming role. Questions about power,

value conversion, path dependence, care, uncertainty, platform intermediation, ecological capacity, or institutional reproduction should be designed so that different traditions can make meaningfully different contributions. The research programme then becomes partly a programme of constructing better questions: questions whose formulation preserves theoretical plurality while permitting some claims to become more precise, more limited, or more strongly supported.

Definition 21.818 (Question family). A *question family* is a set of related research questions generated by a common unresolved interface among theories, methods, scales, domains, or normative criteria.

Question families can organize research more effectively than isolated hypotheses. A value-conversion family, for example, could include empirical questions about conversion institutions, historical questions about the emergence of commensuration regimes, normative questions about legitimate conversion, formal questions about partial comparability, and domain questions about care, ecology, or data. The family preserves a common research object while allowing different methods and disciplines to enter through explicit interfaces.

21.31.2 Contradictions Revealed by Dialogue

Theoretical dialogue also reveals contradictions. Some contradictions arise between theories; others arise within GRE when concepts imported from different traditions are placed into the same architecture. Section 21.27 distinguished irreducible disagreement from failed translation. The present subsection treats contradiction as a source of programme formation: a contradiction should be localized, typed, and converted into a research task before any attempt at resolution.

Definition 21.819 (Dialogical contradiction). A *dialogical contradiction* is an incompatibility among claims, mechanisms, classifications, normative criteria, or scope conditions that becomes visible when two or more theoretical architectures are compared within a common analytical problem.

Definition 21.820 (Contradiction profile). A *contradiction profile* records the location, type, scale, historical scope, evidential basis, normative content, and current resolvability of a dialogical contradiction.

Contradictions can occur at several levels. A mechanism contradiction concerns incompatible causal accounts. A category contradiction concerns different identity criteria for an economic object. An evidential contradiction concerns different judgments about what observations warrant a claim. A normative contradiction concerns incompatible evaluative priorities. A scope contradiction arises when two claims appear incompatible only because they apply to different populations, periods, scales, or institutional conditions.

Proposition 21.821 (Contradiction-localization condition). *Before a contradiction is treated as a framework-level conflict, the analysis should test whether it can be localized to mechanism, category, evidence, normative criterion, scale, historical scope, or representation.*

Localization avoids premature synthesis and premature rejection. A neoclassical choice model and an institutional account of preference formation may conflict if both claim complete explanatory authority over the same process. They can also become complementary when one models choice inside a locally stable preference struc-

ture and the other explains how that structure is generated. The relevant research task is therefore to identify the conditions under which the two accounts compete and the conditions under which they occupy different explanatory layers.

Proposition 21.822 (Contradiction-productivity condition). *A dialogical contradiction becomes research-productive when it can be converted into an observation, comparison, historical reconstruction, formal test, or normative argument capable of changing the standing of at least one participating claim.*

Definition 21.823 (Framework-internal contradiction). *A framework-internal contradiction is an incompatibility among GRE commitments that becomes visible when concepts or mechanisms derived from different sources are jointly applied.*

Such contradictions deserve particular attention because they reveal where GRE has accumulated vocabulary faster than it has established integration. A framework can simultaneously emphasize open future formation, historical path dependence, formal tractability, ontological suspension, heterogeneous value, and normative pluralism. These commitments can coexist, but specific models may place them under tension. Research should record those tensions rather than resolving them through implicit hierarchy.

Proposition 21.824 (Internal-contradiction priority). *Where theoretical dialogue reveals an internal contradiction in GRE, programme priority should be given to clarifying the contradiction before GRE is extended further through the affected concepts or mechanisms.*

21.31.3 Empirical Gaps

GRE has developed a rich vocabulary for relational structures, heterogeneous value, power, generativity, historical trajectories, and future possibility. Dialogue with empirical economics, experimental economics, institutional research, ecological economics, capability studies, economic sociology, and domain-specific inquiry shows that conceptual richness creates a demanding empirical burden. Programme formation therefore requires identifying which GRE objects can currently be observed, which can be approximated, which remain latent, and which may be too weakly specified for empirical use.

Definition 21.825 (Empirical gap). *An empirical gap is a material disconnection between a theoretical claim and the observations, measurements, identification strategies, comparative cases, or interpretive evidence required to evaluate that claim within its stated scope.*

Definition 21.826 (Observability gap). *An observability gap occurs when a theoretically relevant object or relation lacks an adequate observational interface for the research purpose under consideration.*

Generative capacity illustrates the problem. It may be manifested through later option creation, capability expansion, network formation, institutional durability, knowledge production, ecological regeneration, or other consequences. A single indicator is unlikely to capture these heterogeneous manifestations across domains. The empirical programme should therefore begin by specifying what manifestation is expected, over what horizon, at what scale, and through which observation regime.

Proposition 21.827 (Empirical-interface condition). *A GRE claim enters an empirical research stream only when the theoretical object, observation regime, indicator or*

interpretive evidence, temporal window, and inferential limitation can be stated with sufficient precision for independent scrutiny.

Definition 21.828 (Identification gap). An *identification gap* is the remaining uncertainty about whether an observed pattern can be attributed to the proposed relational or generative mechanism rather than to alternative mechanisms compatible with the available evidence.

An identification gap differs from an observability gap. A relation can be well measured while its causal role remains uncertain. Network position, institutional membership, prices, policy exposure, or platform ranking can be observed with substantial precision while the mechanism connecting them to future capability or value conversion remains underidentified.

Proposition 21.829 (Evidence-design priority). *Where a central GRE mechanism is empirically underidentified, programme development should prioritize designs that distinguish plausible mechanisms over accumulation of additional descriptive indicators alone.*

Definition 21.830 (Empirical research ledger). An *empirical research ledger* records a GRE claim, its observable manifestations, available data or interpretive sources, identification requirements, measurement remainders, relevant alternative explanations, and current evidential status.

This ledger makes empirical openness concrete. Some claims may remain conceptual or heuristic because suitable evidence is unavailable. Others may become operational in particular domains before they become portable elsewhere. A research programme can accommodate both states if their evidential standing is explicit.

21.31.4 Formal Gaps

The dialogue also exposes formal gaps. GRE uses networks, dynamical systems, fields, operators, partial orders, category-theoretic constructions, history-bearing structures, and other mathematical resources selectively. Existing economic traditions show both the analytical power of formal discipline and the risks of imposing mathematical structure whose assumptions exceed the empirical or conceptual problem. A formal programme should therefore identify where formal representation is missing, where existing representation is insufficient, and where formal retreat is preferable.

Definition 21.831 (Formal gap). A *formal gap* is a mismatch between an analytically material theoretical relation and the formal representation currently available to express, derive, compare, or test that relation.

Definition 21.832 (Representational gap). A *representational gap* occurs when an existing formal model omits a distinction, dependency, temporal relation, scale coupling, or value structure required by the substantive problem.

Formal gaps should be diagnosed locally. A model of relational allocation may need higher-order relations. A model of historical generativity may need event order, path dependence, or changing state spaces. A model of heterogeneous value may require partial comparison or typed conversion rather than a single scalar objective. A model of institutional change may require endogenous rule modification. These needs do not imply that one mathematical architecture should contain them all.

Proposition 21.833 (Formalization-priority condition). *A formal gap warrants model*

development when additional formal structure is expected to clarify a mechanism, generate a discriminating implication, expose an inconsistency, improve empirical linkage, or make a scope condition explicit.

Definition 21.834 (Formal comparison task). A *formal comparison task* examines whether two representations preserve the same analytically relevant structures, behaviors, observables, or intervention consequences under an explicit equivalence signature.

Formal comparison connects Section 21.26 to the research programme. Several representations may be useful for the same economic object without being interchangeable. A network representation can preserve connectivity while a field representation captures distributed influence; an agent-based model can reproduce emergent patterns while an operator representation highlights transformation structure. The programme should ask what each representation preserves and what it suppresses.

Proposition 21.835 (Formal-plurality condition). *Where several formal representations preserve different material features of the same problem, GRE should retain representational plurality unless a stronger equivalence claim has been established for the intended inference.*

Definition 21.836 (Formal-retreat task). A *formal-retreat task* identifies mathematical assumptions whose removal would improve correspondence with the substantive problem or restore distinctions obscured by the current representation.

Formal programme development therefore includes subtraction. Removing an unnecessary metric, equilibrium condition, scalarization, Markov assumption, fixed topology, or ontological interpretation can be a substantive advance when the removed structure was carrying unsupported implications.

21.31.5 Normative Gaps

Normative gaps are equally important. GRE can describe heterogeneous values, conversion interfaces, power, capability change, participation, preservation, and future possibility. Those descriptions frequently create normative questions without settling them. Dialogue with capability, feminist, ecological, Marxian, commons, welfare, and care traditions makes visible several criteria that can conflict even when the descriptive analysis is shared.

Definition 21.837 (Normative gap). A *normative gap* is an unresolved evaluative question that remains after the relevant descriptive, causal, relational, or generative properties have been specified.

Definition 21.838 (Criterion gap). A *criterion gap* occurs when an analysis requires an evaluative judgment but has not specified the criterion, ordering principle, procedural standard, or source of normative authority by which that judgment is to be made.

A system can generate more future options while distributing them unequally. It can preserve a community while limiting exit. It can improve aggregate capability while degrading ecological conditions. It can produce efficient coordination through surveillance or concentrated control. These cases cannot be settled by a generativity metric alone.

Proposition 21.839 (Normative-research separation). *A GRE research question that contains an evaluative conclusion should separate the empirical or relational claim*

from the normative criterion required to reach that conclusion.

Definition 21.840 (Affected-party gap). An *affected-party gap* occurs when the set of subjects, communities, future persons, non-human beings, or ecological systems materially affected by an economic arrangement has not been adequately represented in the evaluative frame.

Affected-party gaps connect normative inquiry to power and epistemics. Some affected parties have limited voice, weak legal standing, low observability, or no direct participation in present decision processes. Normative research therefore includes questions about representation, proxy judgment, intergenerational responsibility, non-human affectedness, and the legitimacy of conversion among heterogeneous values.

Proposition 21.841 (Normative-interface research condition). *Where several normative criteria remain plausible, GRE should treat their interface, conflict, and decision procedure as research objects rather than silently selecting one criterion through model design.*

Definition 21.842 (Normative research ledger). A *normative research ledger* records the evaluative criteria invoked in a GRE inquiry, their provenance, affected parties, unresolved conflicts, conversion assumptions, procedural requirements, and remaining normative remainders.

This ledger maintains the distinction established in Section 21.29: generativity can inform normative judgment while remaining analytically separate from the grounds of that judgment.

21.31.6 Domain-Specific Tests

Theories often appear stronger in abstract comparison than in domain application. Chapter 19 showed that education, labor, finance, urban systems, ecological systems, platforms, communities, institutions, and other domains impose different mechanisms and evidential constraints. Theoretical dialogue therefore generates a programme of domain-specific tests: cases chosen because they expose GRE concepts to objects, scales, institutions, and evidence that the framework cannot define by itself.

Definition 21.843 (Domain-specific test). A *domain-specific test* is an inquiry that evaluates a GRE concept, mechanism, or scope claim within a domain whose specialized objects, evidence, institutions, and causal processes provide independent constraints on the analysis.

Definition 21.844 (Domain transfer test). A *domain transfer test* examines whether a GRE claim developed in one domain retains its meaning, mechanism, and evidential support when applied to another domain.

Transfer should not be presumed from shared relational vocabulary. Trust in finance, care, science, commons governance, and platform participation can each involve expectations and relations while depending on different institutional supports and failure modes. Similarity at one descriptive level may coexist with substantial domain remainder.

Proposition 21.845 (Bounded-generalization condition). *A GRE mechanism should be generalized across domains only to the extent that the mechanism's required conditions and relevant outcome relations survive domain translation with identifiable evidence.*

Definition 21.846 (Stress domain). A *stress domain* is a domain selected because its objects, constraints, temporalities, affected parties, or evidential practices are expected to challenge a GRE claim more strongly than the domain in which that claim was initially developed.

Stress domains are especially valuable for open programmes. A relational account developed in digital markets can be tested in care or ecology, where monetization, agency, temporality, and affectedness differ sharply. A generativity concept developed in education can be tested in finance, where option creation can coexist with fragility or unequal exposure. The purpose is not to demonstrate portability by default; it is to discover where portability fails and why.

Proposition 21.847 (External-correction condition). *When a domain-specific discipline identifies a material mechanism or constraint absent from a GRE account, the research programme should revise the GRE claim or establish an explicit domain interface before extending the claim further.*

Definition 21.848 (Domain-test portfolio). A *domain-test portfolio* is a deliberately varied set of empirical or interpretive cases used to evaluate the robustness, scope, and failure modes of a GRE concept across contrasting domains.

A portfolio should include cases with different scales, institutions, data conditions, value regimes, and temporal structures. This approach makes domain diversity an epistemic resource rather than a collection of illustrations.

21.31.7 Revision of GRE

The research programme becomes genuinely open when questions, contradictions, evidence, formal results, normative inquiry, and domain tests can alter GRE itself. Section 21.29 introduced theoretical deference, conceptual correction, boundary revision, and a GRE revision ledger. The present subsection places those elements into a recurrent programme cycle.

Definition 21.849 (GRE revision cycle). A *GRE revision cycle* is a documented sequence in which a framework claim is exposed to theoretical dialogue or inquiry, receives evidence or criticism, is reassessed against its scope and assumptions, and is retained, modified, differentiated, suspended, or withdrawn.

Proposition 21.850 (Revision-trigger condition). *A GRE claim should enter a revision cycle when new evidence, theoretical contradiction, domain failure, formal inconsistency, normative remainder, or translation-language limitation materially changes the support for its present formulation.*

Definition 21.851 (Revision class). A *revision class* identifies the principal form of framework change: clarification, differentiation, extension, mechanism replacement, empirical re-anchoring, formal retreat, domain contraction, interface creation, or claim withdrawal.

Revision classes make change legible. A failed domain transfer need not imply rejection of the original concept; it may justify contraction of scope. An empirical failure can indicate a measurement problem, an incorrect mechanism, or an overgeneralized claim. A normative challenge may require criterion separation rather than conceptual abandonment. The class should follow the diagnosed defect.

Proposition 21.852 (Versioned-revision condition). *Material revisions to GRE should preserve the prior claim, the reason for revision, the evidence or argument supporting*

the change, and the scope of the revised claim so that framework development remains historically inspectable.

Definition 21.853 (Framework debt). *Framework debt* is the accumulation of unresolved conceptual, empirical, formal, normative, or domain-specific problems that are repeatedly bypassed while dependent claims continue to expand.

Framework debt is analogous to a research liability. It does not require immediate resolution of every open question, but it should remain visible. A programme that continues to build on unstable distinctions can generate apparent theoretical breadth while increasing later revision costs.

Proposition 21.854 (Framework-debt condition). *Where several later claims depend on the same unresolved framework problem, programme priority should increase for that problem because its resolution has consequences across multiple research streams.*

Proposition 21.855 (Contraction legitimacy). *A well-supported contraction of GRE's domain, mechanism claim, or formal scope constitutes legitimate programme progress when it increases correspondence between claim strength and available support.*

This proposition is important for a generative research programme. Openness concerns the possibility of revision, including revision toward smaller claims. A framework can become stronger by learning where it should remain silent, where another discipline should lead, or where a prior generalization should become a local hypothesis.

21.31.8 Research-Programme Architecture

The final task is architectural. The questions generated in this chapter are heterogeneous: some concern theory reconstruction, others empirical identification, formal modeling, historical explanation, normative evaluation, domain transfer, or framework revision. A GRE research programme therefore requires relations among research streams rather than a single sequence of problems.

Definition 21.856 (GRE research-programme architecture). The *GRE research-programme architecture* is the organized set of research streams, interfaces, revision procedures, evidence regimes, domain tests, and open-problem records through which GRE develops while preserving theoretical plurality, epistemic humility, and disciplinary boundaries.

Definition 21.857 (Research stream). A *research stream* is a sustained family of related questions sharing a principal analytical object, method interface, domain, or revision problem while remaining connected to the wider programme through explicit dependencies.

Possible streams include relational economic architecture, heterogeneous value and conversion, generativity and future option formation, power and asymmetry, historical-relational dynamics, epistemic economy, AI capability asymmetry, ecological relations, institutional formation, empirical operationalization, formal representation, and normative interfaces. Chapter 22 can specify these streams in greater detail. The present chapter establishes how they should arise from dialogue rather than from a closed list of GRE topics.

Proposition 21.858 (Research-stream interface condition). *Where two research streams depend on a shared concept or mechanism, the programme should specify the interface and revision dependency rather than allowing each stream to stabilize*

incompatible local meanings unnoticed.

Definition 21.859 (Programme dependency). A *programme dependency* records that the standing of one research claim or stream materially depends on the resolution, specification, or evidential status of another programme object.

Dependencies make framework debt and revision propagation visible. A revised account of generative capacity may affect value, policy, education, AI, and sustainability research simultaneously. A new account of power may alter institutional and platform analyses. A change in the epistemic-event architecture may affect empirical reconstruction across several domains. Programme architecture should therefore support propagation of revisions rather than allowing local updates to remain isolated.

Definition 21.860 (Research portfolio). A *research portfolio* is a set of concurrent research streams selected to maintain productive variation across theoretical, empirical, formal, historical, normative, and domain-specific inquiry.

Proposition 21.861 (Portfolio-balance condition). A *GRE research portfolio* should avoid persistent dependence on one mode of inquiry when unresolved programme objects require evidence, interpretation, formalization, or normative analysis that the dominant mode cannot supply.

Portfolio balance does not require equal effort across methods. It requires that the programme retain access to the modes of inquiry needed to correct its own blind spots. A heavily formal programme can accumulate empirical and historical debt; a primarily interpretive programme can leave mechanism discrimination unresolved; a domain-rich programme can fragment conceptually if shared objects are not compared; a theoretically elegant programme can remain normatively opaque if evaluative criteria are left implicit.

Definition 21.862 (Open programme state). An *open programme state* is a versioned representation of GRE's current established claims, provisional hypotheses, active contradictions, empirical and formal gaps, normative remainders, domain-test results, revision dependencies, and unresolved research questions.

Proposition 21.863 (Open-programme continuity). *GRE remains an open research programme when its current architecture preserves both the claims it can presently support and the unresolved objects capable of revising those claims.*

Theoretical dialogue therefore closes Chapter 21 by producing a programme architecture rather than a final synthesis. Existing economics remains a continuing source of concepts, mechanisms, methods, evidence, criticism, and domain knowledge. GR remains a revisable translation language rather than a universal metalanguage. GRE remains an economic research programme whose development can include extension, differentiation, empirical strengthening, formal refinement, historical reconstruction, normative clarification, domain contraction, and theoretical deference. Chapter 22 takes this architecture as its starting point and develops the substantive research programme in explicit research streams.

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