

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, eco-

logical 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 translates those findings into the economic-order questions developed in Chapter 20. The sequence is therefore *translation, domain inquiry, comparative learning, economic synthesis*. It 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.

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

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.

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, creden-

tial 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 persons 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, lan-

guage, 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 ca-

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 connect-

ing 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 depen-

dency 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 autonomy, 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 desir-

able 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 con-

straint 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 Reminders

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 in-

stitutional 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 interactions 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 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 gen-

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

erative 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, elec-

tricity, 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, su-

pervised 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 perfor-

mance 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 increase 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 quan-

tities.

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 mech-

anism; 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 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

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

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 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 reproducibility 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 evi-

dence 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 recombability 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, intellec-

tual 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 platforms. 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 un-

certainty 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 intertem-

poral 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, 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 produc-

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

tion function. Legal entities remain important because contracts, asset partitioning, 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, avail-

ability within specified periods, and participation in coordinated production. The exact 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 coordina-*

tion 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 reproduction, 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. Cooperative 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 member-

ship 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 anal-

ysis 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 communities 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 access, 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

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

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, 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 per-

spective 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 implementing 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 mecha-

nisms alone.

Definition 19.52 (Situational relational capacity). *Situational 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.

Situational 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 situational 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 (Situational-capacity condition). *Assistance is more likely to support durable local generativity when it identifies the situational 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 access 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 participation 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 invis-

ible 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 meaning 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; regenera-

tion 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 knowledge, 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, cover-

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

age 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 submitted 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, main-

tain, 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, con-

textual 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 responsibilities 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 analyt-

ical 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 generativity. 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 de-

mand 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 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,

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

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 de-

pletion 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 respon-

sibilities; 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 mo-

bility. 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 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 technologies 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 (Srnicek 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.

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

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 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 interaction. 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 partic-

ipants.

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 pro-

tect 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 aver-

age 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, re-generated, 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, digitization, 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

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

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 availability 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 accom-

pany 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, eval-

uation 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 experi-

ences 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 vulnerability, 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 institu-

tions 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 taking 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 multiscalar. 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 ques-

tion: 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 different 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.

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

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, 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, childcare 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, credentials, 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 there-

fore 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 dis-

tant 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 transition 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, multiscalar, 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 con-*

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

figuration 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 hu-

mans, 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 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 main-

tenance 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 pro-

cesses 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 maintenance 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 capability 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 relations 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: 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

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 mean-

ings 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 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 en-

tering 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, attribution, 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 institu-

tional 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 accumulate 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, rela-

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

tions, 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 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 institutions 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 own-

ership 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 universal 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 sys-

tems, 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, institutional 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 in-*

formative 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 synthesize lessons for economic order. The next task is narrower than constructing an ideal society. It is to identify recurring institutional, governance, allocation, value, and AI-era implications that follow from the domain comparisons and to prepare the transition into Chapter 20, where possible generative relational economic orders can be examined directly.

19.14 Economic-Order Implications of Domain Synthesis

The domain studies of Chapter 19 establish a comparative basis for asking how Generative Relational Economics bears on economic order. The role of the present section is to convert the cross-domain findings of Sections 19.2–19.13 into a bounded set of implications for institutional architecture, governance, allocation, value, and AI-mediated economic organization. Its objective is narrower than specifying an ideal society or selecting a preferred institutional design. The section identifies recurring conditions that an economic-order analysis should make visible, records the questions that follow from those conditions, and preserves unresolved design choices for Chapter 20. The discussion proceeds synthetically: it first identifies recurring economic-order structures, then examines institutional capacity and relational infrastructure, governance and revisability, allocation and conversion, value circulation and return, AI-era conditions, and finally the design questions that define the boundary between domain synthesis and direct economic-order inquiry.

The comparative method matters because the eleven domains do not converge on one institutional blueprint. Education emphasizes capability formation and judgment; research emphasizes epistemic infrastructure and reconstructibility; organizations emphasize membership, contribution, and coordination; development and humanitarian practice emphasize conversion and transition capacity; welfare emphasizes continuity and recurrent protection; commons emphasize collective stewardship; platforms emphasize executable institutional architecture and recoverable exit; public institutions emphasize mandate-bound authority and capacity reproduction; migration emphasizes portability and multi-jurisdictional standing; ecology emphasizes biophysical constraint and regeneration; culture emphasizes interpretation, recognition, and transmission capacity. These findings support stronger claims about the dimensions an economic order should analyze than about the single arrangement it should adopt.

The resulting synthesis therefore treats economic order as a history-bearing con-

Table 19.14: Cross-domain implications for economic-order analysis.

Analytical dimension	Cross-domain finding	Economic-order question retained for direct analysis
Relational configuration	Outcomes depend on relations among subjects, institutions, infrastructures, and histories	Which relations should an order enable, protect, revise, or constrain?
Access and conversion	Formal resources or rights acquire practical effect through heterogeneous conversion pathways	Which infrastructures and conversion conditions make nominal access usable?
Capability and regeneration	Present functioning can depend on capacities that require learning, maintenance, care, and renewal	How should an order reproduce capabilities needed for later action and revision?
Dependency and power	Dependencies differ in criticality, visibility, substitutability, and control effects	Which dependencies are acceptable, diversified, contestable, or institutionally counterbalanced?
Maintenance and continuity	Repair, preservation, care, institutional memory, and ecological regeneration sustain future possibility	How should recurrent maintenance be valued and financed alongside novelty and expansion?
Participation and standing	Employment, membership, contribution, voice, representation, and affectedness often diverge	Which forms of standing and participation should accompany consequential economic relations?
Value and return	Value is heterogeneous and may circulate, convert, accumulate, dissipate, or fail to return to generative substrates	How should generated value be recognized, mediated, and recirculated under incomplete commensurability?
Temporal openness	Present arrangements reshape later option spaces through path dependence and irreversible commitments	Which commitments should remain revisable, and which long-horizon capacities require protection?
AI mediation	Artificial capabilities can alter production, knowledge, coordination, judgment, dependency, and institutional execution	Which human and collective capabilities, action spaces, and governance capacities should remain reproducible under AI?

figuration rather than a fixed list of institutions. Markets, firms, households, communities, platforms, public agencies, infrastructures, legal rules, knowledge systems, ecological relations, and cultural practices interact through pathways of access, conversion, contribution, maintenance, dependence, value realization, and institutional revision. The order relevant to GRE is constituted partly by these relations and by the capacities through which they can be reproduced, contested, and changed over time.

Table 19.14 summarizes the principal cross-domain implications. The table is deliberately non-prescriptive. Its third column identifies questions that the comparative evidence makes difficult to omit from economic-order analysis while leaving the institutional answers open.

Definition 19.176 (Economic-order implication). An *economic-order implication* is a cross-domain finding that identifies a relation, capacity, constraint, value problem, or temporal condition that materially structures economic participation and therefore warrants explicit treatment in the analysis of economic order without, by itself, determining a unique institutional design.

Definition 19.176 preserves the distinction between analytical implication and institutional prescription. Domain evidence can establish that administrative reach, maintenance, portability, ecological regeneration, or epistemic infrastructure matter economically while leaving open how those functions should be distributed among public institutions, markets, communities, firms, households, or hybrid arrangements.

19.14.1 Recurring Economic-Order Structures

The first implication of comparative domain work is that economic order should be described through more than ownership forms and allocation mechanisms. Across the domains, recurring structures appear around access, conversion, capability, infrastructure, dependency, participation, maintenance, value realization, and temporal openness. These structures do not form a universal institutional template. They form a recurring analytical grammar through which different institutional arrangements can be examined.

Access is a useful example. Educational access involves entry into learning relations and the practical conditions for participation. Welfare access depends on entitlement, information, documentation, administration, and service reach. Platform access can be separated into admission, functionality, visibility, transaction, and governance. Migration adds documentation, passage, residence, and portability. Cultural access can require interpretive capacity as well as physical or digital availability. The recurrence is therefore structural: formal inclusion acquires practical meaning through domain-specific conversion pathways.

Capability exhibits a similar pattern. Individuals can acquire or lose skills, health, mobility, epistemic competence, organizational standing, or the ability to navigate institutions. Collective entities can also possess capacities that are relationally distributed: research communities can verify and preserve knowledge; organizations can coordinate complex work; commons can sustain stewardship; public institutions can maintain administrative continuity; ecological configurations can regenerate functions; cultural systems can reproduce interpretive competence. Economic order consequently concerns both the distribution of immediately exercisable capacities and the relations through which capacities are generated, maintained, and regenerated.

Dependency is likewise recurrent without being uniform. A student may depend on educational infrastructure, a household on welfare or care systems, a worker on an employer or platform, a migrant on legal sponsorship, a community on shared infrastructure, an ecological economy on biophysical systems, and a research institution on data, software, or funding. Some dependencies can be supportive and desirable; others can become critical where exit, substitution, contestation, or correction are weak. The comparative result therefore directs analysis toward dependency profiles rather than toward a categorical preference for either independence or interdependence.

Maintenance provides a fourth recurring structure. Domain inquiry repeatedly shows that future possibility rests on activities that ordinary output measures can understate: care, repair, archival preservation, infrastructure upkeep, ecological restoration, software maintenance, institutional memory, teaching, and transmission of cultural practices. A generative economic analysis should therefore examine how an order recognizes and sustains the activities that reproduce its own relational and material substrates.

Proposition 19.177 (Recurring-structure condition). *Where a relational structure recurs across domains with identifiable correspondence, economic-order analysis should examine that structure explicitly while preserving the domain-specific mechanisms*

through which it is realized.

Proposition 19.177 prevents two opposite errors. One is to treat each domain as analytically isolated. The other is to infer that recurring vocabulary establishes one common mechanism. Economic-order synthesis requires an intermediate level: enough abstraction to see recurring relations and enough specificity to retain their different institutional realizations.

19.14.2 Institutional Capacity and Relational Infrastructure

The domain studies also reposition institutions and infrastructure within economic order. Infrastructure is not limited to physical capital. Educational systems, research archives, administrative procedures, legal registries, standards, digital interfaces, payment systems, care arrangements, professional communities, ecological monitoring, cultural institutions, and mobility networks can all function as relational infrastructures. They structure who can enter relations, what can be converted into practical capability, which histories remain accessible, and how costly coordination and revision become.

The institutional implication concerns capacity as much as formal mandate. A legal entitlement may exist where administrative capacity is too weak for practical delivery. A research institution may possess funding while lacking preservation, verification, or succession capacity. A platform may provide access while controlling visibility and portability. A public agency may retain statutory authority while losing technical or professional competence through outsourcing or personnel turnover. A community may possess formal resource rights without the monitoring, trust, or governance capacity needed for stewardship.

Institutional capacity is therefore typed. Fiscal resources, professional knowledge, legal authority, information, maintenance competence, technological expertise, coordination, public trustworthiness, institutional memory, and learning capacity can complement one another without becoming interchangeable. Economic-order analysis should ask which capacities a given arrangement requires, where those capacities reside, how they are reproduced, and what happens when one institutional site becomes a critical bottleneck.

The comparative domains also show that institutional boundaries are porous. Public functions can be executed through private software; community governance can depend on public law; research institutions can rely on commercial platforms; welfare administration can depend on digital identity systems; firms can govern work through algorithmic infrastructures; cultural circulation can depend on platforms whose rules are privately specified yet publicly consequential. Economic order is therefore constituted partly by interfaces among institutions rather than by formally separate sectors alone.

Definition 19.178 (Relational infrastructure of economic order). The *relational infrastructure of economic order* is the set of material, legal, administrative, informational, technical, social, and interpretive arrangements that make consequential economic relations practicable, reproducible, and revisable across time.

Proposition 19.179 (Institutional-capacity reproduction condition). *An economic ar-*

rangement that depends persistently on an institutional capacity should be evaluated partly by the arrangements through which that capacity is maintained, transmitted, re-generated, and revised.

The proposition does not imply that every capacity should be reproduced in every institution. Specialization can be efficient and generative. The analytical requirement is to identify where specialization creates opaque or fragile dependencies and whether replacement, learning, coordination, or recovery pathways exist when conditions change.

19.14.3 Governance, Contestability, and Revision

Governance appears across the domains as the organization of consequential rules, authority, standing, feedback, and revision. The comparative findings weaken any simple identification of governance with state regulation. Platform ranking systems, organizational procedures, commons rules, research funding criteria, professional standards, welfare eligibility systems, border regimes, cultural gatekeeping, and ecological stewardship arrangements all govern economic relations in different ways.

A recurring issue is the relation between rule execution and contestability. Digital platforms demonstrate that infrastructure can execute institutional rules directly through code, ranking, access controls, or interfaces. Public administration can similarly embed policy in forms, databases, classifications, automated decision systems, and procedural thresholds. Organizations execute authority through workflow systems and performance metrics. These arrangements can reduce coordination costs while also making the locus of rule formation less visible to affected participants.

Contestability therefore concerns more than formal appeal. It includes intelligibility of the relevant rule, ability to identify the decision locus, access to reasons or evidence where appropriate, practical routes for correction, protection against retaliatory loss of standing, and institutional capacity to learn from recurrent contestation. The applicable form differs by domain, but the comparative structure is stable enough to matter for economic order.

Revision is equally important. Ecological change, technological development, demographic shifts, migration, AI capability, and new forms of work can make previously workable rules inadequate. Yet continual revision can itself undermine predictability, trust, investment, and care relations. Adaptive governance therefore involves a temporal balance among continuity, feedback, experimentation, procedural stability, and revision.

Definition 19.180 (Governance revisability). *Governance revisability* is the institutionally supported capacity to identify consequential changes or failures, contest applicable rules or their execution, learn from evidence and affected positions, and modify governance arrangements while preserving sufficient continuity for coordinated action.

Proposition 19.181 (Contestable-revision condition). *Where economic governance materially shapes access, standing, dependency, or future capability, long-horizon generativity is strengthened when the governing arrangement includes practicable mechanisms for feedback, contestation, correction, and revision appropriate to the domain.*

This proposition is deliberately scoped. Some emergency or safety-critical contexts can require temporary concentration of decision authority or compressed procedures. The domain evidence from humanitarian practice and public institutions suggests that such arrangements are better analyzed through their justification, duration, review, and transition pathways than through a universal requirement for identical participatory procedures.

19.14.4 Allocation, Conversion, and Generative Investment

The comparative domains also change the meaning of allocation. Resources matter through the relations that convert them into functioning, participation, capability, infrastructure, knowledge, ecological regeneration, cultural transmission, or institutional continuity. Equal nominal allocation can therefore generate unequal practical effects, while unequal inputs can sometimes be required to secure comparable access or capability under heterogeneous conditions.

Conversion is especially visible in welfare, education, development, migration, public services, and digital platforms. Income can fail to secure capability where housing, health care, transport, documentation, care, or time are unavailable. Educational resources can fail to become learning where learners lack appropriate support or participation. Remittances can have different effects depending on household relations, markets, institutions, and local infrastructure. Platform access can fail to create market reach where visibility is algorithmically scarce. The economic-order implication is that allocation analysis should trace the pathway from resource or right to realized use and downstream capacity.

A second implication concerns the object of investment. Conventional investment analysis often emphasizes productive assets expected to yield later economic returns. The domain studies reveal additional objects whose return may be dispersed, indirect, or difficult to monetize: care infrastructure, public institutional capacity, ecological regeneration, knowledge preservation, educational judgment, community stewardship, interoperability, cultural transmission, and option-preserving infrastructure. These objects can be economically consequential because they alter later feasible relations and reduce the cost of adaptation or recovery.

GRE therefore uses *generative investment* as an analytical category for investments whose significant effects include the reproduction or expansion of capabilities, infrastructures, relations, institutional learning, and future option structures. The category does not imply that such investment is automatically desirable or that its return can be measured on one scale. Investment can generate harmful capacities, deepen dependency, or impose ecological and intergenerational costs. Evaluation still requires attention to subjects, values, constraints, incidence, and long-horizon effects.

Proposition 19.182 (Allocation-conversion condition). *Economic-order evaluation of allocation should distinguish the distribution of resources or formal rights from the conversion pathways through which they become practical access, capability, participation, protection, or other valued outcomes.*

Proposition 19.183 (Generative-investment condition). *Investment analysis within GRE should include effects on the reproduction and revision of capabilities, relational infrastructures, institutional capacity, and future option structures in addition to im-*

mediate output or monetized return.

These propositions prepare direct economic-order analysis without defining one allocation rule. Chapter 20 can therefore ask how resource allocation, relational infrastructure, capability formation, generative investment, option preservation, and adaptive policy might be combined under different institutional arrangements.

19.14.5 Value Plurality, Circulation, and Return

Value plurality is another recurring condition that becomes more concrete through domain translation. Education includes learning, curiosity, judgment, and participation. Research includes epistemic reliability, openness, preservation, and future inquiry capacity. Work includes livelihood, contribution, recognition, care, and organizational membership. Welfare includes security, continuity, dignity, access, and capability. Ecology includes regenerative function, affectedness, stewardship, and intergenerational possibility. Culture includes meaning, recognition, memory, aesthetic orientation, and interpretive capacity. These values can interact economically without becoming reducible to one common metric.

The comparative result reinforces the value architecture developed earlier in GRE. Economic order should make visible how value is generated, represented, converted, captured, circulated, returned, dissipated, and regenerated. Monetization is one possible representation and conversion mechanism among others. Administrative metrics, rankings, credentials, reputation systems, ecological indicators, cultural recognition, and scientific citation can also represent value while shaping behavior and access.

The domains further show that value capture and value return are relational. Platform ecosystems can capture data and attention produced through interactions among participants. Organizations can depend on maintenance, mentoring, and care that are weakly represented in performance metrics. Research institutions can benefit from shared knowledge infrastructures maintained elsewhere. Public systems can rely on unpaid or under-recognized care. Economic production can depend on ecological regenerative functions that are only partially priced. Cultural systems can depend on communities that maintain language, memory, and interpretive practices while downstream organizations capture monetary value.

These patterns motivate attention to *return* without implying one distributive formula. Return can take monetary, infrastructural, capability, institutional, informational, ecological, or participatory forms. A central question is whether value-generating relations reproduce the substrates from which they draw or progressively deplete them.

Definition 19.184 (Generative value return). A *generative value return* is a flow of resources, capability, infrastructure, recognition, knowledge, ecological restoration, or institutional support that contributes to maintaining or regenerating a relation or substrate involved in the production, realization, or transmission of value.

Proposition 19.185 (Value-return visibility condition). *Where an economic activity depends materially on relational, institutional, ecological, epistemic, or cultural substrates, economic-order analysis should make visible whether and how value returns*

to the capacities required for those substrates to persist and adapt.

The proposition is diagnostic rather than a complete theory of distributive justice. The appropriate form and magnitude of return remain normatively and institutionally contested. GRE contributes by keeping the relation between value extraction, capture, return, and regenerative capacity analytically visible under incomplete commensurability.

19.14.6 AI-Era Economic-Order Conditions

Artificial intelligence changes the economic-order problem because it can enter multiple layers identified across the domains simultaneously. AI can participate in production, research, education, administration, cultural generation, platform coordination, allocation, evaluation, prediction, monitoring, and institutional rule execution. Its significance therefore cannot be assessed only through labor substitution or aggregate productivity.

The domain studies sharpen several AI-era conditions. First, artificial capability is mediated through infrastructures of compute, data, energy, software, platforms, organizations, legal permissions, and human oversight. Capability asymmetry can therefore become economic power through access control, dependency, ownership, epistemic authority, or institutional mediation. Second, assistance can increase immediate performance without regenerating human or collective capability. Education and research make this distinction especially visible, but it also applies to administration, organizations, professional practice, and public institutions.

Third, AI can change scarcity. Symbolic and informational production can become abundant while attention, verification, provenance, trust, judgment, orientation, and consequential participation remain scarce. Cultural and epistemic domains make clear that production abundance can relocate rather than eliminate scarcity. Fourth, AI can fuse infrastructure and governance. Model-mediated interfaces may not merely support an institution; they can rank, classify, authorize, deny, recommend, schedule, or interpret within the same operational architecture.

Fifth, AI raises a long-horizon participation question. If human or collective participation is justified only by comparative productive necessity, increasing artificial capability can weaken the institutional basis for participation even where material provision remains adequate. The analysis of Chapter 18 therefore remains relevant at the order level: a society can be materially abundant while its members possess diminishing access to consequential problem formation, institutional revision, knowledge generation, care, culture, or collective self-organization.

Proposition 19.186 (AI-order configuration condition). *Economic-order analysis under advanced AI should evaluate the configuration of artificial capability, infrastructure, ownership, access, dependency, verification, participation, and institutional revision rather than infer social consequences from model capability or aggregate productivity alone.*

Proposition 19.187 (AI-era capability reproduction condition). *Where AI systems assume recurrent roles in consequential economic or institutional processes, analysis should examine whether the surrounding arrangement preserves or regenerates the hu-*

man and collective capabilities required for verification, contestation, adaptation, and future reorganization.

These propositions leave substantial design space open. Different economic orders can distribute AI infrastructure, ownership, access, oversight, and participation differently. The comparative contribution of Chapter 19 is to specify the dimensions along which those arrangements should be examined.

19.14.7 Economic-Order Design Questions

The completed domain cycle supports a set of design questions for direct economic-order analysis. These questions do not constitute a constitutional blueprint. They identify tensions and dependencies that recur sufficiently across domains to require explicit treatment when GRE turns from local applications to economic order as a whole.

A first group concerns *institutional location*. Which functions should be organized through markets, public institutions, communities, firms, households, commons, professional bodies, platforms, or hybrid arrangements? The domain studies show that function and institutional form should not be conflated. Stewardship can occur under several property regimes; public functions can be executed through private infrastructure; collective capacity can arise without a formal organization; digital platforms can perform quasi-institutional governance. The economic-order question is therefore which combinations of mandate, capacity, accountability, knowledge, and scale fit a particular function.

A second group concerns *distribution and conversion*. Which resources, rights, services, infrastructures, and capabilities should be distributed, and through which conversion pathways do they become practically usable? How should an order respond where equal formal treatment generates systematically unequal capability? How should it distinguish recurrent protection from one-time assistance, and livelihood security from participation in production or institutions?

A third group concerns *dependency and power*. Which dependencies are constitutive of a complex economy, which become critical, and which forms of counterpower, interoperability, portability, redundancy, or public provision reduce fragility? Where should exit be available, where is voice more important, and where are both insufficient because affected parties lack practical standing or because ecological and intergenerational effects exceed present membership?

A fourth group concerns *value and return*. How should heterogeneous values be represented when complete aggregation is unavailable? Which procedures can mediate conflict among monetary, capability, ecological, epistemic, cultural, and relational values? How should value generated through shared or inherited substrates return to the infrastructures and capacities on which future generation depends?

A fifth group concerns *time*. Which institutions require continuity, and which commitments should remain revisable? Which forms of maintenance preserve option space, and which forms of preservation create lock-in? How should an order evaluate irreversible ecological change, long-lived infrastructure, institutional path dependence, intergenerational inheritance, and radical technological uncertainty?

A sixth group concerns *participation*. Which forms of economic participation matter beyond employment, consumption, and ownership? The domains point toward participation in knowledge, care, institutions, communities, culture, stewardship, and rule formation. Under AI-era productive abundance, these relations may become more rather than less important for sustaining generative capability and collective self-revision.

Definition 19.188 (Generative economic-order question). A *generative economic-order question* asks how an institutional arrangement shapes the production, conversion, distribution, maintenance, regeneration, and revision of relations, capabilities, values, infrastructures, dependencies, and future option structures across heterogeneous subjects and temporal scales.

Proposition 19.189 (Economic-order openness condition). *The cross-domain evidence developed in Chapter 19 supports treating economic order as an open design and research problem whose evaluation includes present outcomes together with capability reproduction, institutional learning, value return, dependency structure, ecological and intergenerational effects, and the preservation of revisable future possibilities.*

The proposition closes Chapter 19 without selecting a final institutional arrangement. The domain studies have established that economic order is expressed through heterogeneous relations whose mechanisms cannot be collapsed into one domain or one metric. They also show that recurrent structures are sufficiently stable to support a common set of analytical questions. The next chapter takes those questions as its starting point and examines economic order directly: synthesis, evaluation, policy, institutions, infrastructure, participation, value recirculation, plural values, productive abundance, radical capability asymmetry, adaptive governance, and open economic futures.

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