

# Credibility in Evolving Cooperative Relations

## *A Preliminary Discussion of Generative-Relational Dynamics*

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### Abstract

This exploratory study asks under which conditions heterogeneous generative-relational (GR) subjects can construct cooperative arrangements that are jointly feasible, institutionally accountable, and compatible with participants' protected capacities. It distinguishes three problems: constructibility of coexistence, generative credibility, and normative compositionality. A task-relative formal representation connects actors, dependencies, relational histories, commitments, evidence, power, remedies, and normative interfaces. Conditional propositions and finite counterexamples demonstrate how individual feasibility can diverge from joint feasibility, observable compliance from continuing capacities, and local agreement from compositional consistency. Building on established international-relations, relational-peace, capability, and institutional scholarship, the study develops an auditable GR-augmented assessment procedure. Six praxis chapters specify safeguards and evaluation protocols for peacemaking, preventive diplomacy, international cooperation, and interpersonal, organizational, and public trust. Documentary comparisons of the Montreal Protocol, Paris Agreement, BBNJ Agreement, and Aarhus Convention examine implementation support, transparency, institutional formation, and contestation. These case studies provide institutional evidence while leaving the comparative effectiveness of GR open. A proposed research design compares GR-augmented analysis with competent existing methods under common evidence, authority, resource, and safety constraints. The contribution is a conditional formal and methodological synthesis; its explanatory distinctiveness and practical benefit require independent investigation.

**Keywords:** generative-relational theory; transnational cooperation; generative credibility; peacemaking; institutional trust.

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The paper welcomes critical examination, scholarly disagreement, and reproducible evaluation. Its formal examples are conditional constructions. Its illustrative scenarios are fictional, while the four comparative treaty studies discuss actual institutional arrangements through cited documentary sources. Readers should distinguish treaty provisions, recorded administrative practices, independent empirical assessments, and the paper's proposed interpretations. Practical adoption calls for additional consultation, professional judgement, and direct evidence from the relevant setting.

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## Discussion Paper Note

This manuscript develops an exploratory generative-relational (GR) account of credible transnational cooperation and the evolution of trust across heterogeneous subjects. Its principal research problems concern the constructibility of coexistence, generative credibility, and the compatibility of normative obligations across interconnected institutions. These problems are investigated through formal representations of relational histories, generative conditions, commitment performance, evidence, power, accountability, and protected capacities for continued participation. The aim is a clearer account of the conditions under which cooperation can remain feasible and open to informed contestation and institutional transformation.

The investigation builds on substantial established scholarship in international relations, credible commitments, relational peace, peacebuilding, capability theory, formal institutional analysis, and public accountability. Contributions associated with Keohane, Ostrom, Barnett and Duvall, Acharya, and other scholars provide important foundations. Ron Eglash's work on generative justice offers a related inspiration concerning value creation and circulation; the present GR formalism, institutional comparisons, and praxis proposals remain separate exploratory developments. The paper's conceptual distinctions and finite counterexamples demonstrate conditional possibilities, while its comparative and practice-oriented claims require assessment against competent existing approaches.

The complete manuscript contains forty substantive sections, including six dedicated praxis chapters on peacemaking, preventive diplomacy, international cooperation, and interpersonal, organizational, and public trust. Four documentary case studies examine the Montreal Protocol, Paris Agreement, BBNJ Agreement, and Aarhus Convention. The examples outside the documented institutional cases are hypothetical. This release presents neither original field interventions nor verified causal estimates of GR's incremental effect. Independent formal critique, source-level verification, practitioner assessment, and empirical study are appropriate next steps. The manuscript is offered as a discussion paper for constructive criticism rather than as a validated governance theory or professional guide.

## Notices

**Research scope.** Independent exploratory discussion manuscript, release candidate v0.29 (2026), comprising forty sections. Formal examples and praxis protocols are proposals for investigation. The four treaty studies rely on cited documentary materials; fieldwork, interventions, and comparative empirical validation have not been conducted for this manuscript.

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# 1 Introduction

Transnational cooperation increasingly depends upon arrangements whose material and institutional consequences extend beyond the parties immediately negotiating them. Environmental observation, scientific exchange, public-health coordination, energy systems, computational infrastructures, and maritime governance all involve commitments that distribute access to knowledge, equipment, decision-making authority, and opportunities for institutional revision. An agreement may achieve its stated performance targets while changing the relative capacities of its participants to sustain livelihoods, challenge interpretations, build alternatives, or alter the terms of cooperation. Such differences matter for political analysis even when the agreement enjoys apparent stability. They also matter for practice: actors seeking peace or institutional trustworthiness require ways to understand the relationships through which cooperation becomes feasible and the conditions through which it remains acceptable to those affected.

Consider an illustrative transnational marine-observation consortium. Several states and scientific organizations establish a shared monitoring service that reliably produces environmental measurements. The consortium meets its reporting deadlines, its participants fulfill their formal commitments, and the resulting knowledge improves operational coordination. Yet one member may retain exclusive control of the computational infrastructure, model updates, calibration standards, and downstream access arrangements. Another member gains dependable measurements while gradually losing the practical ability to verify those measurements independently, develop alternatives, or participate in changes to the service. Both experiences can arise within a functioning agreement. The example is hypothetical, and it supplies neither evidence of misconduct nor a presumption that all asymmetries are illegitimate. It poses an analytical question: what kinds of cooperative change can remain invisible when institutional assessment concentrates on delivered outputs, compliance, and reported confidence?

International-relations scholarship already explains cooperation under uncertainty, the politics of institutional dependence, norm translation, and the historical constitution of collective capacities. Institutionalists analyze credible commitments and information (Keohane, 1984); accounts of structural and institutional power examine the distribution of agency (Barnett and Duvall, 2005); and norm-localization, relational-peace, and collective-capability research demonstrate that rules, relationships, and capacities evolve through interaction (Acharya, 2004; Söderström et al., 2021; Ibrahim, 2006). The present inquiry therefore asks for a narrower increment: whether explicit generative mechanisms, protected continuations, and compositional tests identify a consequential institutional constraint overlooked by an otherwise competent approach. Section 3 details the intellectual precedents, and Sections 24–25 develop the proposed tests.

This paper investigates a narrower possibility: whether a *generative-relational* (GR) representation can expose differences among cooperative arrangements that remain indistinguishable under specified conventional indicators, establish conditions for constructing viable relations among heterogeneous systems, and identify failures that arise when locally acceptable normative translations are composed into wider institutions. The relevant generativity refers to the historically and materially situated capacities through which actors and institutions can produce actions, knowledge, value, rules, and further relational possibilities. A generative system is described through relations, states, admissible transformations, constraints, and situated interpretations. The framework leaves open the ontological status of its underlying spacetime representation; relational histories and change indices serve as explicit modeling conveniences rather than assertions that every subject inhabits an identical primitive temporal ontology.

Three analytical problems organize the investigation. The first concerns *constructible coexistence*. Given subjects with heterogeneous generative rules, evidential standards, and normative constraints, which relational couplings can make a jointly viable arrangement possible? A fixed bargaining model commonly selects among a represented set of options. A GR formulation permits an interaction to transform which options can be articulated or implemented, although such endogenous option formation has

its own substantial predecessors in evolutionary and institutional research. The specific contribution sought here is a typed description of feasible couplings and their transformation conditions, together with criteria for distinguishing genuine joint viability from a collection of individually tolerable but jointly incompatible continuations. The analytical challenge is to specify whose constraints apply, how incompatibilities are represented, and what a valid constructive witness would demonstrate.

The second problem concerns *generative credibility*. Two cooperative trajectories may be equivalent with respect to measured compliance, outputs, or institutional reliability while producing divergent distributions of generative possibilities. Let  $h$  denote a represented relational history and  $\mathcal{O}_R(h)$  the observations made available by an explicitly defined reporting regime  $R$ . Let  $\mathcal{F}_i(h; \mathcal{B})$  denote the admissible continuation structures available to participant  $i$  from a declared relational boundary  $\mathcal{B}$ . It is possible to investigate pairs of histories  $h_1, h_2$  for which

$$\mathcal{O}_R(h_1) = \mathcal{O}_R(h_2), \quad \mathcal{F}_i(h_1; \mathcal{B}_1) \not\approx \mathcal{F}_i(h_2; \mathcal{B}_2). \quad (1)$$

Here  $\simeq$  denotes an equivalence relation to be specified for the application, rather than a presumed universal ordering of human or institutional possibilities. Equation (1) describes a *research distinction*; it is neither an empirical finding nor an assertion that unequal continuation sets necessarily establish injustice. Its significance is that a credible performance record may underdetermine the configuration of dependence, control, voice, and available alternatives. The theoretical work must show whether the proposed additional representation improves explanation relative to established accounts of structural power, capability, and exit or voice.

The third problem concerns *normative compositionality*. Institutions commonly connect obligations translated between different legal, cultural, and technical vocabularies. Pairwise translation may be useful for cooperation while its composition across several institutions produces disagreement or inconsistency. For partial translations  $\tau_{AB}$ ,  $\tau_{BC}$ , and  $\tau_{AC}$  among three normative representations, the relation

$$\tau_{BC} \circ \tau_{AB} \not\equiv \tau_{AC} \quad (2)$$

may indicate a substantive difference, an undefined composite, or merely distinct presentations of an equivalent obligation. Its meaning therefore depends upon specified domains, semantic interpretations, and criteria of normative preservation. Abstract institutional logics and the study of boundary objects already offer major precedents (Goguen and Burstall, 1992; Star and Griesemer, 1989). A GR investigation would need to establish the further relevance of the transformations of participants' generative conditions and of power over authorized interpretation. Where three bilateral arrangements cannot be composed into an acceptable multilateral one, the problem becomes practical as well as formal: mediators and institutional designers need procedures for detecting incompatibility, eliciting the positions of affected actors, and modifying arrangements without erasing legitimate disagreement.

The common subject of these three problems is the transformation of *cooperative possibility*. Existing institutional arrangements delimit which actions, claims, observations, and revisions are accessible to participants. Those delimitations are themselves generated and altered through social, material, ecological, and technical relations. The term *credible* retains its established association with warranted expectations about particular commitments. This paper also proposes the distinct, provisional category of *generative credibility*: an appraisal of how an arrangement's claimed reliability is situated within its effects on participants' capacities to reproduce, question, and transform the relations governing their activity. It is an analytical extension requiring independent justification. It does not authorize treating a particular distribution of capacities as universally optimal, nor does it collapse reliability, legitimacy, justice, and trust into one score.

A GR analysis also needs to distinguish the objects over which its claims range. A state or international organization can be a juridical and political participant; a community may be represented through several institutional channels; a scientific consortium can act through delegated rules; and an artificial system may influence decisions without acquiring legal personhood or independent normative

authority. These objects have different kinds of histories, dependencies, capacities, and accountability relations. For each, the proposed analysis identifies generative conditions, enabling and constraining relations, admissible transformations, and situated norms, while recording the provenance and uncertainty of descriptions. The resulting map is an instrument for inquiry, open to challenge by those it represents. It offers no warrant for an observer to declare that a model exhaustively captures another subject's history or values.

The inquiry's practical orientation is constitutive of its research design. In peacemaking, it asks which relations continue to reproduce insecurity or exclusion and which institutionally protected changes could create acceptable forms of coexistence. In preventive diplomacy, it examines how provisional agreements can disclose and address failures of normative composition across agencies and jurisdictions. In international cooperation, it asks whether jointly produced services also sustain participants' capacities for independent verification, meaningful contribution, and revision. In interpersonal and organizational settings, it distinguishes trust earned by conduct from trust elicited through strategic presentation. In public institutions, it connects reliability and responsiveness with a person's practical ability to obtain explanations, challenge decisions, and secure effective remedy. These applications are candidates for systematic comparison with competent mediation, governance, and accountability methods. Increasing expressed trust is neither their sole measure nor an overriding objective; safety, consent, justified disagreement, rights, and the integrity of evidence remain independent criteria.

Methodologically, the study combines conceptual reconstruction, bounded formal modeling, counterexamples, and a comparative programme of documentary inquiry. The formal models are intended to make assumptions, inferential distinctions, and failure conditions explicit. They do not establish causal effects through notation alone. Historical institutional studies and selected environmental regimes provide material for examining the relationship between compliance, differentiated capacity, evidential access, and revision authority. A prospective research design will compare proposed GR diagnostics with familiar baselines, including bargaining analysis, structural-power accounts, capability-oriented evaluation, and participatory institutional assessment. Evidence of redundancy, superior rival explanations, or counterexamples to the GR propositions would materially qualify the framework. Practical protocols developed within the paper are likewise proposals for situated evaluation; any high-risk peacebuilding or public-sector intervention would require local expertise, informed participation, legal and ethical safeguards, and independent assessment.

The paper proceeds from historical and conceptual foundations to the GR metamodel, propositions and counterexamples, six situated praxis domains, and four institutional case studies. The conclusion specifies the limits of the formal and documentary findings and the empirical tests required for claims of practical benefit.

## 2 Transnational Interdependence and the Historical Formation of Cooperative Obligations

The present inquiry requires a historical account of the relations through which cooperative commitments become both desirable and difficult to sustain. Transnational interdependence involves more than simultaneous exposure to external events. It arises when the activities of one party alter the opportunities, resources, risks, or conditions of action available to another, often through chains of production, circulation, communication, and governance. Such relations differ in degree, direction, reversibility, and public visibility. A treaty obligation is a juridically articulated response to some of these relations; many material dependencies also exist without a corresponding treaty or with only fragmented mechanisms for allocating responsibility. Understanding credible cooperation therefore begins with the historical production of interdependence and with the unequal capacities through which participants attempt to govern it.

Trade, migration, war, religious and scientific exchange, imperial expansion, and ecological change

have repeatedly connected political communities with different forms of authority and production. The institutional consequences have varied, including negotiated reciprocity, hierarchy, coercion, exclusion, and more distributed exchange. An account that treats contemporary multilateral institutions as the inevitable culmination of progressively greater cooperation would obscure this variability. Historical relations can generate opportunities for joint action alongside relationships of dispossession and unequal dependency. The same channel that circulates knowledge or material resources can consolidate an intermediary's power to control access, pricing, legitimacy, or mobility. Accordingly, the analysis should distinguish the formation of a relationship from the evaluation of the terms on which that relationship is maintained.

The expansion of industrial production, long-distance communications, transportation, and later digital networks changed the scale at which actors could affect one another. Material specialization can increase total productive output while linking dispersed operations to concentrated logistical, financial, or technical infrastructures. These links differ from ordinary bilateral exchange because alterations at one location may propagate through several institutions whose participants have limited authority over the resulting effects. The analytical unit is thus frequently a distributed configuration of dependencies: producers and users; regulators and regulated organizations; scientific laboratories and data repositories; communities and ecological processes; international bodies and their implementing agencies. Treating these relationships as a single homogeneous market or a single collective actor would conceal their internal distribution of control.

The institutionalist literature addressed an important aspect of the problem: cooperation among actors with distinct interests can be supported by arrangements that reduce uncertainty, communicate information, and stabilize expectations even in the absence of a centralized world government. Keohane (1984) developed this explanation within the political economy of international regimes, while later research explored how institutional design responds to different cooperation problems (Koremenos et al., 2001; Abbott and Snidal, 2000). Such work provides a disciplined account of why commitments and common procedures can matter. Yet the empirical fact that an arrangement supports repeated interaction leaves open several further questions: which actors obtain control over essential operational capacities, how standards become authoritative, and whether participating communities retain meaningful routes to revise the institutional terms affecting them.

These additional questions arise particularly clearly when obligations require participants to reorganize domestic capacities or technological systems. The Montreal Protocol provides a documented instance of an environmental regime whose implementation was supported by a financial mechanism. Adopted in 1987, the Protocol developed arrangements addressing differentiated costs of compliance. The parties' 1990 decision established an interim financial mechanism, including a Multilateral Fund operating from January 1991, to support eligible developing-country parties through agreed incremental costs, technical cooperation, and technology transfer (Ozone Secretariat, 1990; Multilateral Fund for the Implementation of the Montreal Protocol, n.d.). The historical significance for the present argument is limited but instructive: commitments can depend on whether actors have the material and institutional means required to fulfill them. A credible obligation can therefore be partly a question of how capabilities are reproduced through the cooperative arrangement, alongside questions of incentives, monitoring, and legal form. Establishing the actual causal contribution of assistance to particular outcomes requires separate empirical investigation.

Environmental governance also illustrates differences between the creation of a shared reporting language and the distribution of capacities to produce the evidence that enters it. International obligations may depend upon measurements, administrative reporting, scientific models, and professional review. The authority of any reported result involves more than its numerical accuracy: methods must be reproducible within specified limits, institutional procedures must determine how results are accepted, and participants may require opportunities to challenge data and interpretation. An agreement that mandates reporting thereby creates demands for instruments, expertise, records, communication channels, and judgments of relevance. Those demands can be borne unevenly across participants. The

epistemic infrastructure of cooperation becomes part of its material and political architecture.

The BBNJ Agreement, adopted in 2023 and in force since 17 January 2026, places marine research, environmental protection, benefit sharing, and capacity-building within an evolving transnational institutional arrangement (United Nations, 2026a; United Nations Treaty Collection, 2026). It illustrates the need to distinguish treaty obligations from operational capabilities: technical and institutional arrangements remain under development as the first Conference of the Parties approaches in January 2027 (United Nations, 2026b). Sections 21 and 36 address the institutional interfaces and the evidence of implementation in greater detail.

A further historical distinction concerns the relationship between dependence and authority. International legal commitments arise through particular sources and procedures; the presence of ecological or productive interdependence does not itself settle a legal duty, allocate a remedy, or confer decision-making authority. Normative justification must likewise be argued with reference to declared principles, rights, and situated obligations. A GR account can map how a relationship produces vulnerability or capacity, but the transition from descriptive relationships to binding commitments requires mediating institutional and ethical reasoning. This separation matters in transnational cooperation, where parties may disagree over how environmental burdens, historical responsibilities, and present technical capabilities should influence their contributions. Their disagreement may be durable without eliminating every practical opportunity for joint action.

The historical formation of cooperation also changes the meaning of exit and voice. In a narrow exchange, a participant may be able to substitute one partner for another. In a complex infrastructure, alternative routes can require substantial resources, expertise, compatibility, and time. Withdrawal may disrupt services on which the withdrawing participant and others rely. Conversely, the existence of nominal consultation procedures may offer little influence over technical standards, procurement, or institutional revision. Hirschman (1970) remains a fundamental point of reference for analyzing exit, voice, and loyalty in organizational and political contexts. The proposed GR extension asks how successive institutional choices change the resources through which exit or voice is practically generated. This extension demands attention to indirect control, shared facilities, knowledge dependencies, and possible alternatives, rather than merely recording whether a withdrawal clause or participation body formally exists.

A shared scientific data system illustrates the dilemma: its joint observational capability may expand while maintenance, authorized access, and independent verification remain concentrated. Whether that concentration is justified depends on the actual legal, technical, economic, and remedial safeguards, together with the alternatives available to participating institutions. The detailed dependency analysis belongs to Sections 15 and 29.

This history suggests a research focus on *the reproduction of cooperative possibility*. Institutions govern present obligations while also influencing what participants can later propose, verify, negotiate, and implement relative to a given relational boundary. Their effects unfold through material production and ecological constraints, through the circulation and recognition of knowledge, and through the authority to make or revise rules. The designation “reproduction” draws attention to continuing activities that maintain capacities, rather than presuming that cooperation ought always to expand. Maintaining a vital service, preserving a viable ecological process, or ensuring accessible remedies may be as important as creating an additional option. The GR perspective becomes useful only if these dimensions can be specified in ways that yield analytical or practical distinctions unavailable, or less accessible, through established approaches.

The next step is to examine those established approaches directly. Institutionalism explains important conditions of credible commitment; theories of structural and productive power explain the constitution of capacities; work on heterogeneous knowledge describes translation and coordination; and scholarship on institutional learning and participation offers practical tools. By comparing these explanations before formalizing the GR model, the paper can identify a narrower research gap and avoid treating an existing insight as an original theoretical result.

### 3 Theories of Cooperation, Institutions, and Political Power

A generative-relational investigation of cooperation should begin by identifying what established approaches already explain. The paper's three proposed problems—constructible coexistence, generative credibility, and normative compositionality—touch research traditions with substantial empirical and conceptual depth. Their relevance cannot be assessed through broad claims that conventional theories view actors as isolated or static: institutionalism, constructivism, political economy, and social theory have long investigated interaction, changing preferences, institutional histories, and relational power. This section therefore reconstructs a set of complementary explanations and identifies the additional burden of proof carried by the GR proposal.

Rationalist institutional analysis offers mechanisms through which cooperation can be maintained among actors who face informational and strategic constraints. Regimes may facilitate information sharing, lower transaction costs, and alter the incentives associated with compliance and defection (Keohane, 1984). Analyses of institutional design investigate features such as membership, scope, centralization, control, and flexibility in relation to the cooperation problem being addressed (Koremenos et al., 2001). The distinction between hard and soft law further directs attention to the different degrees of obligation, precision, and delegation embedded in institutional arrangements (Abbott and Snidal, 2000). These traditions already distinguish credible cooperation from generalized friendship, and they furnish indispensable comparative baselines for the present research. GR analysis would add value only when a formally specified representation of changing generative conditions alters the explanation of institutional choice, observable performance, or the practical accessibility of cooperative alternatives.

Power-centered perspectives help identify a second constraint on novelty. Barnett and Duvall (2005) distinguish forms of compulsory, institutional, structural, and productive power; their account expressly recognizes the constitution of actors' capacities through social relations. A proposed theory that simply defines power as the unequal distribution of opportunities would closely restate this precedent. The further GR question is whether two arrangements that are equivalent under a declared account of performance or institutional control generate different *structures of admissible continuation*, such as different capacities for independent scientific reproduction, lawful collective action, or institutional redesign. An explicit equivalence test is essential: if established structural-power analysis already distinguishes the cases with equal precision and fewer assumptions, the GR representation is redundant for that application.

Historical and constructivist research supplies a third body of relevant explanation. Acharya (2004) shows how local actors reconstruct circulating norms in relation to prior identities and normative practices. Such scholarship directly challenges any suggestion that normative diversity or the mutual transformation of rules is newly discovered here. Research on boundary objects likewise studies how heterogeneous communities cooperate through shared objects that are stable enough for coordination and flexible enough for distinct local uses (Star and Griesemer, 1989). The present paper's narrower concern is the compositional validity of translations when several cooperative interfaces are joined. Pairwise compatibility does not, by itself, establish global compatibility. Yet formal techniques for heterogeneous institutions have already examined satisfaction-preserving translation and the composition of different logical systems (Goguen and Burstall, 1992). A GR application consequently needs explicit types, domains of definition, competing semantic interpretations, and examples in which changes to material or institutional generative conditions affect the result.

The relational peace literature creates an especially direct comparison. Söderström et al. (2021) provide an account of peaceful relationships through observable interaction, subjective recognition, and the character of relationships. Brigg (2025) disputes the reduction of relational inquiry to relations among already constituted actors and distinguishes thinner from thicker commitments to relational ontology. The distinction is material to the present paper. Treating a state or community as a node in a graph is a declared analytical cut, not a proof that its identity is ontologically prior to relations.

Conversely, claiming that relations constitute subjects does not exempt a proposed mechanism from specifying observable consequences. The GR model therefore allows a subject boundary, a generative mechanism, or a legally recognized competence to change across documented configurations, while leaving ultimate ontology suspended. Its additional explanatory burden is to show when that endogeneity changes a diagnosis compared with a competent relational peace account.

An additional contemporary comparison sharpens this concern. Lakitsch (2026) develops a pluriversal and non-anthropocentric orientation to international peace practice, in which heterogeneous human and ecological relations require attention to epistemic difference and the limits of external intervention. This precedent is unusually close to the present manuscript's proposed attention to heterogeneous subjects and ecological coexistence. Consequently, recognising more-than-human relationships, preserving locally situated normative accounts, or describing peace as an evolving relational accomplishment cannot themselves function as GR novelty claims. What remains open is a narrower question of *operation*: can a task-relative representation identify, with less error or greater practical consequence than such relational approaches, a typed cross-institutional incompatibility or an inaccessible protected continuation? The answer requires explicit baseline reconstruction, independent assessment, and attention to the political costs of translating situated experience into a formal inventory. The provisional use of an analytical subject boundary in this manuscript is a modeling convention, with its validity tested against affected participants' self-understandings and legal standing; it is never a metaphysical verdict on what a human, institution, or ecological entity ultimately is.

A second constraint comes from collective capability scholarship. Ibrahim (2006) explicitly analyzes the formation of collective agency and capacities through social structures. A description of shared knowledge, group empowerment, or community capacity is therefore insufficient to distinguish GR. The narrower candidate increment lies in evaluating jointly authorized but differently distributed *continuation structures*, such as the practical ability to reconstitute a service, obtain a remedy, or alter the rules of cooperation after an institutional interface fails. Capability, procedural-justice, structural-power, and systems-engineering accounts may already recover these facts. The paper treats that possibility as a substantive competing explanation and not simply a terminological disagreement.

The study of collective action and governance similarly resists a simplified contrast between centralized institutions and relational alternatives. Ostrom (1990) analyzes diverse institutional arrangements for governing shared resources, while Ostrom (2010) examines polycentric responses to collective-action problems involving environmental change. Institutional effectiveness, monitoring, accessible conflict-resolution mechanisms, and adaptation have therefore been analyzed well beyond a unitary command model. Furthermore, Hirschman (1970) gives an influential account of how exit and voice respond to organizational deterioration. These findings suggest that any assessment of "generative capacity" should examine concrete arrangements already studied through capability, governance, and organizational theories. The meaningful question is whether a GR representation exposes a change in participants' feasible means of voice, remedy, verification, or institutional creation that a competent baseline overlooks.

Practical peacebuilding and public-trust research adds an essential normative check. The United Nations guidance on mediation recognizes preparedness, consent, impartiality, inclusivity, national ownership, and adherence to relevant legal and normative frameworks as significant principles (United Nations, 2012). The United Nations–World Bank study on conflict prevention attends to the relationship between exclusion, institutional processes, and development conditions (United Nations and World Bank, 2018). OECD work investigates reliability, responsiveness, integrity, openness, and fairness as drivers of trust in public institutions (OECD, 2024b). Each provides practical instruments and criteria that a GR-based intervention must respect and compare against. A language of relational transformation supplies no independent justification for coercive dialogue, suppression of dissent, or institutional publicity campaigns directed at improving reported trust without correcting underlying conduct.

The resulting research gap is specific and conditional. It concerns whether heterogeneous cooperative systems can be represented through explicitly typed generative possibilities so that (i) a viable

coupling can be constructed or ruled out under declared constraints, (ii) compliance-equivalent histories can be distinguished by their admissible continuations, and (iii) incompatible compositions of normative translations can be diagnosed with consequences for institutional design. The GR approach would then require a clear inference from representations to interventions: for example, a design that protects meaningful verification alternatives, a mediation sequence that identifies an unrecognized incompatibility among commitments, or a revision procedure that restores a harmed participant's practical capacity for legitimate claim-making.

There are three corresponding failure conditions. The first occurs when the formal objects remain too weakly specified to constrain interpretation: any observed outcome can then be redescribed as "generative change." The second occurs when a familiar explanatory framework reaches the same result with equal specificity and stronger empirical support. The third occurs when a proposed GR intervention proves impractical, unsafe, legally inadmissible, or inferior to established methods in a sufficiently comparable context. These possibilities define the research as an inquiry open to qualification. Its contribution depends on demonstrable distinctions and bounded practical use, rather than on the generality of the terms through which cooperation is described.

Having established these comparative requirements, the manuscript can define its actors and relational objects more precisely. The subsequent sections distinguish cooperation from trust and legitimacy, and then specify what counts as a generative condition, an admissible transformation, an observational regime, and a normative interface. Only on that basis can the formal problems and their consequences for peacebuilding, international cooperation, organizational conduct, and public trust receive rigorous investigation.

## 4 Distinguishing Cooperation, Trust, Reliance, Credibility, and Legitimacy

The proposed analysis requires a disciplined separation of phenomena that often appear together in descriptions of successful cooperation. An intergovernmental arrangement can achieve coordinated performance while its participants continue to distrust one another. A ministry may rely upon a contracted data service while questioning the service provider's intentions. A public authority may implement its declared rules reliably while affected persons contest the fairness of those rules or the institution's authority to impose them. Conversely, actors can express confidence in a familiar institution whose practices are systematically unreliable or exclusionary. Treating these situations as different degrees of a single variable called "trust" would erase distinctions essential to explanation and institutional design. The present section develops a domain-sensitive vocabulary whose terms will subsequently enter the GR representation as different kinds of objects, judgments, and relations.

*Cooperation* refers provisionally to coordinated activities involving two or more actors whose actions are mutually responsive in pursuit of a partially shared or compatible undertaking. The actors may possess different purposes, unequal resources, and heterogeneous understandings of the undertaking. Coordination can be episodic or institutionally repeated; it can depend on contracts, shared routines, incentives, common technical standards, personal relationships, or external mediation. Its empirical identification requires specifying the joint activity and the criterion by which the activities are considered coordinated. Such a criterion can be descriptive without certifying the activity's desirability. Coordinated collusion, organized exclusion, and the joint implementation of harmful policies demonstrate that cooperation by itself entails neither justice nor public benefit. In the institutionalist tradition, cooperation is already analyzed under strategic uncertainty and decentralized enforcement (Keohane, 1984; Abbott and Snidal, 2000). The present inquiry retains these accounts as explanations of coordination while examining the productive and normative relations in which it occurs.

*Reliance* describes an actor's practical dependence upon the behavior, capacities, or outputs of another actor or system for the fulfillment of a particular task. Reliance can be compelled by infrastructure

design and may coexist with explicit distrust. A coastal laboratory relying on an external environmental database can plan its daily operations around the availability of that service, even while maintaining independent verification precisely because it distrusts the provider's governance. Reliance is therefore identifiable through operational dependencies, substitution costs, and exposure to disruption. In many circumstances, reliance attaches to instruments, technical services, or institutional routines for which the language of interpersonal expectation would be misleading. Philosophical accounts of trust debate the conditions that distinguish trust from ordinary reliance, especially whether betrayal, expectations of goodwill, or perceived obligations belong to the former (Hardin, 2002; McLeod, 2020). The paper adopts an operational distinction without presuming that these debates admit a single culturally neutral resolution.

*Trust* is understood here as a directed and situated disposition or judgment through which one subject accepts some vulnerability to another subject's discretionary conduct in a specified domain, on the basis of expectations that are meaningful to the trusting subject. The expectations may concern competence, responsiveness, fidelity to an undertaking, care, reciprocal interest, professional standards, or adherence to procedures; they need to be elicited rather than inferred from an externally imposed motive taxonomy. The familiar organizational model of Mayer et al. (1995) distinguishes willingness to be vulnerable from trust's antecedents and the subsequent act of risk-taking. Hardin (2002) emphasizes the other's encapsulation of the trusting party's interest, while philosophical discussions address broader questions of goodwill and betrayal (McLeod, 2020). These differences are analytically relevant: an agreement can secure action through insurance, adjudication, or technical verification while the participants retain sharply different views about one another's trustworthiness.

For the purposes of formalization, a judgment of trust is represented as a typed relation

$$T_{i \rightarrow j}^d(h; \mathcal{E}_i, \mathcal{N}_i), \quad (3)$$

where  $i$  is the evaluating subject,  $j$  the object of the trust judgment,  $d$  the relevant task or domain,  $h$  a represented relational history,  $\mathcal{E}_i$  the evidence accessible to  $i$ , and  $\mathcal{N}_i$  the standards under which  $i$  interprets vulnerability and acceptable conduct. Equation (3) denotes a contextual judgment rather than a universal numerical probability. A scalar assessment may be useful for a particular empirical design, subject to declared measurement assumptions; the notation itself entails neither scalarization nor comparability between subjects. The arrow is consequential:  $T_{i \rightarrow j}^d$  and  $T_{j \rightarrow i}^d$  can differ, as can a single subject's trust in the same institution for technical accuracy, confidentiality, lawful adjudication, or distributive fairness. One subject may express apparently inconsistent attitudes across domains that become intelligible when evaluated in relation to different forms of vulnerability.

*Distrust* deserves a separate analytical category. Low expressed trust may arise from inadequate information, limited exposure, unfamiliarity, a preference for independent verification, or adverse experience. Distrust can involve an affirmative expectation of exploitation, deception, negligence, or procedurally unfair conduct. Institutional responses should vary accordingly. More information may help a party whose uncertainty concerns technical performance; it may expose an already vulnerable party to additional risk when confidentiality is weak or when an institution has a documented history of retaliation. A mediation process can legitimately proceed through bounded, monitored arrangements while participants retain distrust. There is no general warrant for demanding emotional reconciliation as a condition of safe coordination.

*Trustworthiness* identifies properties of an actor's conduct, dispositions, capacities, and circumstances insofar as these offer reasons for warranted trust in a declared domain. A person or institution can be deemed trustworthy by one standard and evaluated differently under another, especially when obligations conflict. A medical facility may provide accurate laboratory results while maintaining inaccessible complaints procedures; the former establishes evidence of technical competence, while the latter concerns procedural trustworthiness. The distinction between trust judgments and trustworthiness is established in political research (Levi and Stoker, 2000) and in O'Neill (2002)'s analysis of accountability and public trust. Trustworthiness cannot be reliably produced by requesting greater con-

fidence from the public. It requires practices that justify expectations and enable informed assessment. Even when trustworthiness is demonstrated, some persons may reasonably retain cautious reliance or distrust because their vulnerabilities and histories differ.

*Credibility* applies to an asserted fact, forecast, promise, or institutional commitment and concerns the support available for expecting it to hold under specified conditions. A commitment may be credible because actors face incentives for compliance, because its implementation is technologically feasible, because reliable evidence can be independently examined, or because breaches can be remedied. These are distinct credibility grounds. We use  $Cr_R(c \mid h)$  as schematic notation for an appraisal of commitment  $c$  under observational and institutional regime  $R$  given a history  $h$ . It is not generally a probability, and its evidential content must be supplied by a concrete investigation. A government statement regarding future delivery of shared environmental measurements may be highly credible with respect to scheduled transmission while remaining silent about who will be able to correct the model, contest its classifications, or lawfully establish an alternative service.

*Legitimacy* addresses the justification of an institution's authority, the acceptability of its procedures and decisions, and the standing of the persons and groups affected by them. Empirical beliefs about legitimacy should be distinguished from normative arguments about justified authority; a population can recognize an authority as legitimate under certain conditions while observers contest its conformity with rights or legal obligations. Procedural-justice research offers substantial antecedents, including the connection between people's evaluations of legal authority and their experiences of fair procedure (Tyler, 2006). For transnational cooperation, a legitimacy inquiry may involve competence under applicable law, representation, reason-giving, proportionality, access to challenge, and the distribution of benefits and burdens. A well-enforced and predictable arrangement can be illegitimate. Likewise, a procedurally legitimate institution may face severe resource shortages and struggle to meet demanding performance commitments. These differences should remain visible in institutional evaluation.

The several concepts can now be compared using a single hypothetical episode. Three public laboratories establish a marine-monitoring consortium. One laboratory depends operationally on a remote computational service (reliance). The members exchange synchronized measurements and conduct joint assessments (cooperation). A member accepts that its partner will handle an undisclosed sample responsibly (trust in a specified domain). The partner has a consistent record of secure handling and communicates limitations accurately (evidence of trustworthiness). The measurement schedule is independently auditable and backed by resources (credibility of a commitment). Delegated governance powers are authorized, the affected communities can challenge decisions, and applicable rights are respected (possible grounds of legitimacy). Any one description can change while others remain comparatively stable. The same episode thus supports a multidimensional record rather than a verdict that "trust increased."

A further distinction concerns *repair* and *reconciliation*. Repair refers to actions taken in response to a failure or injury: explanation, restoration of access, correction of decisions, compensation where appropriate, changed rules, and procedures for preventing recurrence. Reconciliation may involve renewed confidence, restored social affiliation, or a shared willingness to continue a relationship. Repair may be owed even when reconciliation is unwanted or unsafe; a party can accept compensation and decline future cooperation. This distinction protects the ability of affected subjects to refuse, withdraw, or pursue legally available remedies. It also avoids treating the continued operation of an agreement as evidence that earlier injuries have been resolved.

For empirical design, these concepts require separate observations. Cooperation may be described through joint actions and delivered outputs; reliance through dependency paths and feasible substitutes; trust through domain-specific, ethically elicited expectations; trustworthiness through corroborated conduct and institutional capacities; credibility through commitment-specific evidence, feasibility, and assurance; and legitimacy through both institutional authorization and contestable assessments of justification. Observed responses must be interpreted in their political and social context. Public survey answers may register political attitudes or pressures rather than institutional performance, and reliance

on an indispensable provider can produce sustained usage even when trust is weak (Levi and Stoker, 2000; OECD, 2024b; O'Neill, 2002). The GR claim is correspondingly modest at this stage: a relational representation that preserves these differences is a prerequisite for evaluating transformations of cooperative possibility, though such differentiation has ample precedent in existing scholarship.

The distinctive analytical work begins when these judgments are related to changes in feasible action. Institutional trustworthiness may remain stable while a participant loses the capacity to challenge a provider's standards. Alternatively, a new independent audit may expand a participant's practical freedom while leaving trust judgments unchanged for some time. The resulting divergence motivates an explicit investigation of the subjects and generative conditions involved. Section 5 turns to those objects, retaining the distinction between factual dependence, attributed normative obligations, and justified authority established here.

## 5 Heterogeneous Generative-Relational Subjects and Their Conditions of Agency

A theory of transnational cooperation begins with the actors whose undertakings become institutionally consequential. Standard models often represent these actors as states, firms, organizations, or individuals equipped with preferences, strategies, resources, and expectations. Such representations can be effective for the questions they address. The present investigation additionally asks how a subject's capacities to take action, reproduce its activities, interpret evidence, and participate in changing a cooperative arrangement depend upon relations that may themselves be transformed by that arrangement. The term *generative-relational subject* (GR subject) designates the situated bearer of a represented set of generative capacities and relational conditions. Its role is analytical: the ascription of this type within a model establishes neither moral standing nor legal personhood, and the criteria for such standing require independent argument.

Different entities can be modeled as GR subjects for different purposes, provided the selection is made explicit. A person is embodied and institutionally situated, with material needs, memories, capacities for judgment, and constraints arising from employment, citizenship, care relations, and vulnerability. A community may sustain shared practices, collective meanings, and political representation without possessing a single undivided will. A state acts through complex legal competences, public bodies, delegated agents, and changing coalitions; its treaties and policies are generated through institutional procedures. A research consortium may have technical resources and binding internal decisions while depending on participating laboratories for data collection and on external infrastructures for energy or computation. Firms and civil associations similarly act through governance structures, people, assets, and normative arrangements. In each case, the analytically relevant unity must be defended with respect to the question asked.

The notion of a subject therefore requires a *boundary convention*. Denote by  $\mathcal{B}_i$  the declared boundary under which a researcher identifies subject  $i$  and attributes certain activities or constraints to it. For an international organization, the boundary might include its treaty-defined mandate, budgetary powers, secretariat, and authorized decision procedures. For a coastal community, the boundary might be provisionally assembled through members' self-descriptions, representative bodies, customary institutions, and conflicts concerning representation. These boundaries can overlap and remain contested. A community representative's agreement is not automatically equivalent to informed agreement by all affected individuals. Likewise, a government's signature does not remove the need to assess legal obligations and the rights of persons affected by implementation. A GR analysis should record both the analytical utility and the political consequences of every boundary selected.

A subject's *generative conditions* consist of the relationally situated resources, constraints, competencies, rules, and dependencies through which it can produce an action or sustain a practice. For a small environmental laboratory, these may include trained personnel, instruments, access to a coastline,

calibration records, electricity, software permissions, lawful data-processing authority, and a stable means of contesting methodological errors. For a diplomatic organization they may include delegated authority, languages of negotiation, access to reliable communication channels, protection of confidential exchanges, and standing to propose an amendment. The relations are heterogeneous: physical energy availability, juridical authorization, tacit expertise, ecological processes, and political recognition are not interchangeable inputs. Treating them as separate typed conditions makes it possible to describe situations in which improving one condition exacerbates constraints elsewhere.

Production and reproduction must be distinguished. A participant may successfully perform an assigned task during one reporting cycle while losing access to the means necessary to perform that task independently in subsequent cycles. A state may receive high-quality marine forecasts while becoming unable to commission independent model verification. A community organization may deliver consultation responses while its volunteers exhaust their time and resources without receiving meaningful authority over decisions. A technical consortium may maintain the regular release of data while underinvesting in local calibration expertise, ecological monitoring, and the means to replace failing components. The question is therefore both what an arrangement produces and how it modifies the conditions through which relevant activities can be reproduced or transformed. A representation of those conditions extends output-based analysis; it must still demonstrate empirical advantage relative to established capability and structural-power perspectives (Barnett and Duvall, 2005; Hirschman, 1970).

The historical dimension follows from the same distinction. A subject's capacity to interpret a commitment can be shaped by previous failed agreements, colonial and administrative legacies, technical dependencies, changes in political representation, and remembered experiences of exclusion or repair. Historical relations are often differently described by participants, and each description may have distinct evidentiary and normative significance. The model should preserve provenance, contestability, and uncertainty rather than converting competing histories into a fictitious uncontested narrative. Recognition of another party's relational history means making a serious effort to understand the conditions, claims, and experiences relevant to negotiation; it does not require endorsing the claims, subordinating legal standards to them, or accepting an actor's description as exhaustive. Where histories involve severe injustice or ongoing violations, the procedures of recognition must respect rights, protection needs, and applicable law.

A second source of heterogeneity concerns *normative configurations*. Some subjects justify cooperation primarily through legal obligations, others through shared custom, scientific responsibility, organizational policy, reciprocity, security, care, environmental stewardship, or combinations of these. A single actor may simultaneously occupy several norm-governed roles: an official is bound by statutory duties, professional standards, institutional instructions, and interpersonal responsibilities. These obligations can conflict. A productive representation does not assign all actors a common utility function and assume that every value difference can be resolved by compensation. Instead, it can specify partially overlapping domains in which translation is feasible, identify residual disagreements, and distinguish descriptive accounts of norms from their moral or legal justification. Constraints arising from fundamental rights, safety obligations, and lawful procedural requirements remain applicable even when local norms differ.

Epistemic heterogeneity presents analogous difficulties. Scientific observers may disagree over a measurement's uncertainty, a regulator may prioritize legal admissibility, and an affected community may possess observations embedded in local practices that established reporting forms omit. The difference can concern vocabulary, evidentiary standards, observational access, or the actual phenomena registered. Knowledge exchange therefore requires identifying both interpreters and the conditions under which an interpretation can be challenged. Boundary-object research has long examined practical coordination across different social worlds (Star and Griesemer, 1989); the GR proposal seeks the further description of how sustained translation changes each participant's ability to produce and authorize knowledge. That possible increment must be demonstrated rather than assumed.

Power enters at the level of generative conditions, as well as at the level of observed decisions. Access to financing, platforms, protected data, laboratory instruments, official recognition, enforceable rights, legal counsel, and alternative suppliers can determine which actions remain practically available. An actor may formally retain a right to leave a cooperative project while being unable to exercise it without losing indispensable services. Another may nominally enjoy equal voting power while lacking the resources required to evaluate technical proposals. Existing concepts of structural and institutional power capture significant parts of these arrangements (Barnett and Duvall, 2005). A GR study adds analytic value only where its explicit mapping of relational dependencies and admissible transformations provides a stronger explanation, an independent counterexample, or a safer institutional design choice.

At the collective level, agency is mediated rather than singular. An international scientific institute cannot be identified with the preferences of its director; a ministry's public commitment may depend on procurement divisions, field personnel, and independent regulators; and a coalition's spokesperson may be accountable to some members but excluded from the perspectives of others. Thus the same cooperative structure can enlarge a collective's bargaining power and narrow the participation of individuals within it. A useful cross-scale analysis asks whose actions become possible, who bears the cost of the newly established procedure, who may introduce evidence or seek a remedy, and which authority has the power to revise rules. Apparent group-level consent must be interpreted with reference to actual authorization, representation, and opportunities for dissent.

Artificial agents and ecological systems introduce different classification challenges. Software agents may generate documents, coordinate physical robots, optimize logistics, or act under delegated authority within a consortium. Their actions can reshape the options and vulnerabilities of human participants. In the present paper, such systems may be represented as operative components or, for carefully declared analytic purposes, as heterogeneous GR subjects. Neither representation establishes consciousness, moral status, or legal personality. Attributable responsibilities remain with relevant designers, operators, deployers, contracting parties, and public authorities as specified by applicable law and governance arrangements. Ecological processes are essential generative conditions and can constitute a recognized object of representation, care, or legal protection; the question of their independent subjecthood or standing is distinct and requires explicit treatment. These distinctions prevent a broad mathematical category from silently equalizing political membership or moral entitlements.

The idea of *capacity* also demands methodological restraint. An abstract count of available actions would often be misleading: the presence of ten administratively permitted choices can matter less than the practical accessibility of one lawful means of obtaining medical treatment or challenging an unlawful decision. Some possibilities require extensive resources, collective coordination, or exposure to unacceptable risks. Others are formally available but culturally unintelligible to participants, incompatible with their legitimate commitments, or unsupported by evidence. Accordingly, an applied analysis should represent feasible capacities as typed and constrained continuations, rather than interpreting greater cardinality of options as automatically better. The paper's later account of generative credibility will address the structure, accessibility, and normative status of possibilities, with sensitivity to different subjects' own interpretations.

Consider again the illustrative marine-observation consortium. If its members are treated as identical nodes linked by data transfers, the mapping may faithfully identify network connectivity while missing the dependence of one member's entire calibration practice on a centrally controlled model. If the model instead represents authorized laboratory procedures, staff competencies, data licenses, appeal mechanisms, and substitute services, it can reveal a further difference between two technically functioning networks. The second representation becomes relevant to negotiation when it identifies a change that can be acted upon: a supported independent calibration path, transparent uncertainty records, delegated correction authority, training commitments, or a verifiable exit procedure. Each proposal has costs, security constraints, and possible distributive consequences. The value of the representation depends on its usefulness for a concrete decision, not on the complexity of its ontology.

The same principle applies to peacemaking. Parties to a dispute may state incompatible territorial, historical, legal, or security claims. A GR-informed mediator could seek a carefully bounded account of the material and institutional processes reproducing insecurity—for example, information bottlenecks, failures of notification, unauthorized resource access, or inability to contest a technical designation. Such analysis can help identify an arrangement whose feasibility depends on changing a relationship rather than merely repartitioning a resource. It cannot replace consent, impartial process, legal safeguards, or context-specific conflict analysis, all central to established mediation guidance (United Nations, 2012). The method’s proposed benefit is a more precise representation of feasible transformations subject to those safeguards.

These observations motivate a set of minimal requirements for the formal metamodel. It should accommodate plural subjects and contested boundaries, subject-relative capacities and norms, non-identical histories and partial interpretations, relations operating across scales, and explicit changes in the conditions that make actions feasible. It should also retain a sharp distinction between descriptive modeling and normative judgment. A model may report that a party’s options have narrowed; whether that outcome is acceptable depends on lawful obligations, the circumstances of consent, the distributions of risk and benefit, and substantive standards that demand separate justification. Section 6 constructs a preliminary representation adequate to state these questions while keeping its mathematical commitments bounded.

## 6 From Generative-Relational Metamodels to Situated Institutional Analysis

The preceding sections supply the conceptual constraints on a generative-relational (GR) account of cooperation. To make the framework analytically consequential, its primitives must be specified well enough to distinguish configurations and rule out some interpretations. The intended metamodel is general in the limited sense that several kinds of subjects and relational processes can be represented using a common *organization of questions*. It is not a declaration that every historical, ecological, technical, and legal process shares a single physical dynamics, that all norms have a common measure, or that a complete description of social life is attainable. The formal definitions below are provisional research objects. They serve to expose missing assumptions and organize later constructive propositions and empirical comparisons.

Let  $I$  index the subjects relevant to an inquiry, with each subject selected under a documented boundary convention  $\mathcal{B}_i$ . For a subject  $i \in I$ , define a minimal descriptive configuration

$$G_i = (\mathcal{M}_i, S_i, \alpha_i, \mathcal{R}_i, \mathcal{N}_i, \mathcal{E}_i, \mathcal{B}_i). \quad (4)$$

$S_i$  is a set or suitably structured space of represented states;  $\mathcal{M}_i$  identifies generative structures, mechanisms, rules, or admissible parameterizations;  $\alpha_i : \mathcal{M}_i \times S_i \rightarrow S_i$  denotes a basic change operation where such a mapping is appropriate;  $\mathcal{R}_i$  collects subject-relevant relations and dependencies;  $\mathcal{N}_i$  identifies locally relevant normative constraints and evaluative practices; and  $\mathcal{E}_i$  specifies evidentiary access and interpretation. This uses the GR metamodel’s change signature explicitly. The modeler must state what counts as a state and what is contained in the mechanism variable. The later institutional eight-tuple is a task-relative projection of this configuration, rather than a replacement for its generative mechanisms. Projection loses information: an institutional role, a measurement result, and an accessible response path may be observed while the mechanisms producing them remain only partly identified. A defensible formal claim must identify which omitted mechanisms can be disregarded for the stated comparison and which would defeat the inference. When action depends on interaction, uncertainty, or an evolving mechanism, the deterministic signature is only a local schematic. Its typed extension may take the form  $\hat{\alpha}_i : \mathcal{M}_i \times S_i \times U_i \rightsquigarrow S_i \times \mathcal{M}_i$ , with  $U_i$  representing external inputs or interactions and  $\rightsquigarrow$  permitting an appropriate relation or stochastic kernel. The extension matters because

a cooperative episode can change the mechanisms by which subsequent states become accessible.

The distinction between a mechanism, a state change, and a trajectory should be kept explicit. A function  $f$  that associates conditions with an outcome, a physical derivative such as  $\dot{x}$  that characterizes a rate of change under a chosen coordinate description, and a historically interpreted path  $\gamma$  are different objects. An agent's received data may change while the rules controlling how data can be verified remain fixed; a governance reform may change the rules even when measured output remains stable. Confusing these events would obscure precisely the difference the paper seeks to investigate. Where continuous fields, hybrid systems, or discrete institutional events are used,  $\alpha$  should be instantiated through the corresponding mathematically appropriate dynamics rather than forced into one universal ordinary differential equation.

Relations carry typed roles. Let  $\mathfrak{R}$  contain, among others, productive dependencies, technical interoperability, delegated decision authority, legal obligation, information access, ecological constraint, social recognition, and available recourse. An edge from institution  $i$  to institution  $j$  may mean that  $i$  supplies observations to  $j$ , that  $j$  controls a server indispensable to  $i$ , or that  $i$  has a legally enforceable claim against  $j$ . These relations have different domain types and consequences. A useful configuration is consequently a directed, attributed, and possibly higher-order relational structure rather than an unlabelled graph. Rules determining whether a scientific dataset can be reproduced may depend jointly on several institutions, a licensing authority, trained personnel, and physical equipment; representing the relation through a hyperedge or a constraint over several nodes may be more faithful than a collection of pairwise associations.

For a cooperative configuration involving several subjects, write

$$\mathbf{X} = (\{\mathbf{G}_i\}_{i \in I}, \mathfrak{R}, H, \mathcal{C}, \mathcal{P}, \mathcal{J}), \quad (5)$$

where  $H$  is a represented relational history,  $\mathcal{C}$  is a set of commitments and their conditions,  $\mathcal{P}$  describes relevant power and resource distributions, and  $\mathcal{J}$  records available institutional procedures, authorities, and remedies. The symbol  $\mathcal{J}$  is deliberately separated from  $\mathcal{N}_i$ : enacted institutional arrangements and participants' interpretations of their normative requirements are related but can diverge. In a case study, the researcher must specify which components are observed, which are inferred, which are disputed, and which remain outside the available evidence. An unexplained relational variable contributes little; its type should connect it to a document, competent testimony, a measurement record, an organizational rule, or a well-described uncertainty.

The subject index  $I$  and its boundaries are themselves revisable components of an inquiry. A cooperative transformation may produce a new joint decision body, dissolve an ineffective intermediary, recognize a previously excluded community representative, or change the competence of an existing organization. Formally, it can induce a typed boundary update  $(I, \{\mathcal{B}_i\}) \rightsquigarrow (I', \{\mathcal{B}'_j\})$ , subject to applicable law and representational legitimacy. A model that holds  $I$  fixed may be appropriate for an operational audit but will miss precisely these changes. Empirically, recognition of an actor is neither proof of the actor's consent nor a license to assign it obligations. This convention distinguishes an analytical map of interactions from a stronger, independently defended thesis about the ontological constitution of subjects (Brigg, 2025).

The history  $H$  is treated as a relationally ordered object, for example  $H = (V_H, \prec_H, \lambda_H)$ , with events  $V_H$ , an application-appropriate precedence or dependence relation  $\prec_H$ , and attributed event descriptions  $\lambda_H$ . This representation allows causal, procedural, and evidentiary ordering without assuming that one global linear chronology is available or metaphysically primitive. Local clocks and calendars can be employed when useful, particularly for verification and contractual deadlines. Distinct participants may interpret the same event through incompatible records or contextual understandings. Their epistemic representations can be expressed as partial maps

$$\rho_i : H \rightarrow \hat{H}_i, \quad (6)$$

where  $\hat{H}_i$  is the account available to or constructed by subject  $i$  and  $\rightarrow$  indicates that some events or

attributes may be inaccessible. The equation does not presume that an investigator has complete access to the ground-truth  $H$ ; in empirical applications,  $H$  itself is a disciplined construct under uncertainty, open to revision through evidentiary challenge. The modeled relational spacetime serves as a formal convenience. The analysis suspends claims about its ultimate ontological status and keeps its ontic assumptions separate from the epistemic representations used in inquiry.

To characterize generative possibility, consider a boundary  $\mathcal{B}$  and a declared class  $\mathcal{R}$  of relevant changes, with each member encoding a proposed sequence or network of operations, resources, and conditions. Let  $\text{Adm}_i(\kappa \mid h, \mathcal{B})$  record whether continuation  $\kappa$  is physically, institutionally, and normatively admissible to participant  $i$  under a history  $h$ . The normative component must be indexed to identifiable rights, obligations, and interpreters; a legal permission is distinct from a practical capability or a subject's endorsement. Define the typed continuation set

$$\mathcal{F}_i(h; \mathcal{B}, \Theta_i) = \{\kappa \in \mathcal{R}_i : \text{Adm}_i(\kappa \mid h, \mathcal{B}, \Theta_i)\}, \quad (7)$$

where  $\Theta_i$  declares feasibility thresholds, evidentiary standards, and constraints for a particular research question. A continuation may include procedural acts such as submitting a challenge, technical acts such as reconstructing a model, or cooperative acts such as entering a revised agreement. It is often useful to attach conditions under which a continuation remains reachable, rather than treating membership in the set as an unconditional capability. Equally, normative admissibility must be specified by an authority with a defined scope; an investigator's preferred outcome cannot silently replace applicable law or the affected subject's rights.

Equation (7) makes a distinction between *observable output* and *accessible continuation* possible. Let  $\mathcal{O}_R(H)$  denote an observation produced by reporting regime  $R$ , which may record service uptime, delivery schedules, treaty submissions, consultation counts, or public satisfaction measures. Two arrangements can satisfy  $\mathcal{O}_R(H_1) = \mathcal{O}_R(H_2)$  while differing in an identified participant's ability to verify, exit, appeal, or reproduce a service. A meaningful comparison requires stating the equivalence relation used for continuation structures—for example, equivalence of reachable authorized procedures under a specified resource budget, of substitutable service functions, or of accessible revision rights. Mere inequality of abstract set sizes is insufficient. Moreover, more choices do not invariably imply improvement: a party can knowingly accept limits on one choice to gain dependable protection against risk. These qualifications keep the later generative-credibility problem open to counterexamples rather than predetermined by terminology.

*Coupling* provides the central operation for constructible coexistence. Suppose  $i$  and  $j$  possess configurations  $G_i$  and  $G_j$ . A proposed coupling  $\kappa$  specifies an interface among their admissible activities: material transfers, shared observation procedures, translation rules, delegated responsibilities, dispute arrangements, or jointly governed infrastructures. It may change both subjects' generative structures, and it may create a shared institution with new powers and liabilities. A simple joint configuration is written  $X' = \text{Couple}_\kappa(X)$ , whenever the operation is defined. A proposed agreement is *jointly viable* over a declared horizon and scope when there exists a compatible combined continuation satisfying the coupled system's resource, safety, procedural, and relevant normative constraints. This requires a common witness within the joint relational configuration; individually admissible plans do not suffice when they demand the same exclusive resource, impose inconsistent obligations, or presuppose incompatible accounts of authority.

One can state a preliminary constructibility question without assuming its answer:

$$\exists (\kappa, \pi) \text{ such that } \pi \in \mathcal{F}_I(\text{Couple}_\kappa(X); \Theta), \quad \pi \models \mathcal{V}_I, \quad (8)$$

where  $\mathcal{F}_I$  is an explicitly constructed *joint* feasible-continuation structure and  $\mathcal{V}_I$  denotes the declared viability and rights constraints. The notation  $\pi \models \mathcal{V}_I$  means that the combined continuation satisfies those constraints under a specified interpretation. In real disputes, participants may differ over the constraints themselves or challenge a proposed interpreter's authority. Then the research task includes describing the scope of unresolved normative disagreement and the procedures for handling it.

Equation (8) neither guarantees the existence of a solution nor implies that an outsider is entitled to impose one. A constructed witness can establish feasibility under assumptions; it cannot alone establish political legitimacy or adequate consent.

A schematic example illustrates why the joint requirement matters. Two laboratories each possess an individually feasible plan to analyze a shared ecological dataset. One plan requires exclusive control over the data's raw identifiers during calibration; the other demands immediate public release of exactly those identifiers. The plans cannot be implemented simultaneously under the assumed confidentiality obligations. A workable coupling might introduce an authorized, independently auditable transformation of the raw data and a jointly accepted protocol for releasing derived measurements. Its feasibility depends on technical sufficiency, lawful authority, and the actual purposes of the laboratories. The example is a constructed problem, not a general prescription for disclosure. If confidentiality or rights constraints rule out every acceptable transformation, an admissible cooperative witness may be absent; refusal or postponement can be the correct practical outcome.

The formal treatment of normative interfaces follows the same discipline. Let  $\mathcal{L}_i$  denote a typed normative or evidential language used by a participant and  $\tau_{ij} : \mathcal{L}_i \rightarrow \mathcal{L}_j$  a task-bounded partial translation. A translation may preserve a designated class of obligations or observations while leaving other expressions uninterpretable. Composition requires compatible domains, and equality of translated strings is weaker than preservation of legal effect, practical enforceability, or normative meaning. Existing formal institution theory offers powerful resources for analyzing structure-preserving interpretations of heterogeneous logical systems (Goguen and Burstall, 1992); the present research must learn from those resources. A GR-specific inquiry asks how relations of authority and the changing capacity to implement commitments affect whether translations can be combined. A translation accepted in a bilateral committee may become unsustainable after a third party acquires review authority or a data infrastructure changes ownership. The resulting problem concerns both semantics and transformation of the conditions under which a translated obligation can be enacted.

Power in this metamodel has at least three distinct entrances. First, it affects the set of available actions through material resources, legal status, and infrastructure control. Second, it affects the observation map: who is able to produce evidence, whose testimony is admitted, and which reports circulate across organizations. Third, it affects the authority to determine or revise the institutional constraints themselves. These mechanisms should be measured separately. For example, an independent audit might improve access to evidence while leaving the distribution of decision authority untouched. An amendment procedure may formally offer equal rights while requiring technical expertise available only to some members. A model that labels both "epistemic inequality" without an operational account would contribute little beyond established power research. A better analysis traces the relevant path from a concrete dependency to a blocked or accessible continuation (Barnett and Duvall, 2005; Hirschman, 1970).

Value creation and circulation fit into the same representation without requiring a universal value metric. A cooperative undertaking can produce services, scientific knowledge, environmental improvements, income, public legitimacy, or social relationships; these products can be appropriated, distributed, maintained, or reinvested through different institutional arrangements. A historical-material analysis should distinguish the resources enabling production from the value allocated by agreements and the conditions through which participants may continue to produce. The generative perspective in Eglash (2016)'s account of generative justice is an acknowledged inspiration for treating value creation and circulation as connected. The formal organization and questions advanced here remain independently specified, and their relevance to particular cases must be evaluated on their own terms. A distribution of immediate economic benefits may differ from a distribution of scientific competence, decision rights, or long-term access to ecological infrastructure.

The bridge from the formal representation to practice is a *relational and capacity trace*: specify an authorized decision problem, map affected subjects and typed dependencies, establish the competent conventional assessment, and test whether a GR extension changes the set of protected, practically

executable options. Marine observation, mediation, and public-service complaints each offer potential tests, with distinct legal and professional safeguards. The purpose of this section is to identify the analytic operation; its application protocols, adverse conditions, and comparative evaluations appear in Sections 26–32.

Several limits require explicit acknowledgment. The state space and admissible continuations will frequently be only partially known. A model can be sensitive to contested boundary decisions, irreversible harms, unequal capacities to participate in data collection, and changes outside the observation window. Stronger formal conclusions will depend on assumptions about resource conservation, reachability, consistency of normative interpretations, and authority for institutional changes. Where these assumptions are unrealistic, the model should expose the uncertainty rather than conceal it through numerical precision. Independent safety assessment and affected-party consent matter especially when an intervention concerns violent conflict, personal vulnerability, or ecological risks.

The framework is useful only insofar as it helps answer a question left unresolved by a competent alternative model. It must therefore be subject to comparison: holding the same historical evidence and policy constraints fixed, does the GR representation identify a relevant difference in implementable choices, generate a defensible counterexample to an existing account, or lead to a better justified and evaluable intervention? Failure to meet these tests is a reason to simplify or reject the added apparatus. These requirements give the subsequent investigation its discipline. A cross-scale application therefore requires a common, explicitly limited unit of inquiry: a task domain, an affected subject or legitimately authorized representative, a description of the institutional and material relations relevant to that task, and an evidence cut at which the description is assessed. The subject-level generative mechanism  $\mathcal{M}_i$ , its change operation, and the task-specific institutional projection must be connected by declared correspondence maps. A community's capacity to maintain a livelihood, a state's treaty competence, and a robot's delegated actuation are typed differently even when represented in one relational model. Their observational reconstruction remains an epistemic claim supported by records and testimony, while the assumed relational ontology is a modeling convenience. Section 24 makes these correspondences operational and Section 26 translates them into reviewable field records.

The next section addresses partial recognition and translation across normative and epistemic systems; later sections examine the three proposed theoretical results and their practical implications for peacemaking, diplomacy, transnational infrastructure, organizational conduct, and warranted public trust.

## 7 Recognition and Partial Translation Across Normative and Epistemic Systems

Relations between heterogeneous generative-relational subjects frequently depend on interpretations that are neither shared in advance nor made identical through cooperation. A scientific institution may recognize data quality by traceable calibration and reproducibility; an affected community may foreground experience, situated testimony, and the distribution of environmental risk; an administrative authority may require evidence admissible within a specified procedure. All three can be concerned with the same cooperative undertaking while asking different questions about its adequacy. Translation among these forms of judgment is a practical achievement with conditions, costs, and potential failures. Treating differences in vocabulary as the whole problem would conceal disagreements about evidence, authority, material dependency, and the legitimate scope of collective action.

The present section develops recognition and translation as bounded operations within the GR configuration of Section 6. The proposed extension is deliberately narrower than a universal theory of intersubjective understanding. Its purpose is to identify when a claim, obligation, observation, or institutional procedure can travel between partially heterogeneous systems; when the translation remains indeterminate; and when individually workable interfaces fail to constitute an acceptable joint arrange-

ment. Three distinctions guide the inquiry: representation and authorization, pairwise acceptability and joint feasibility, and continuity of a translated expression and continuity of the generative conditions that make its implementation possible.

## Recognition as a situated epistemic and practical relation

Recognition begins with an account of how a relevant participant is constituted within a particular inquiry. The analyst should specify who is treated as a subject, whose standing is in dispute, which forms of action or dependence are consequential, and which representatives are entitled to express or contest particular claims. Different social institutions can recognize the same person as a rights-holder, beneficiary, employee, claimant, witness, or member of a community. These are distinct institutional roles. The GR vocabulary of heterogeneous subjects does not confer legal personality, moral status, or adjudicative authority upon every system capable of producing an output. Such status must be justified in its relevant legal, political, ethical, and empirical setting.

Recognition also concerns a participant's historically situated trajectory. Its description can include the relations sustaining its livelihood or functions, the experiences shaping its expectations, the capacities that make an agreement practicable, and the costs of interruption or exclusion. The investigator can record an institution's formally declared responsibilities alongside a community's accounts of how these responsibilities are encountered in practice. The resulting descriptions may contain unresolved disagreement. That disagreement should remain visible, with provenance and uncertainty recorded, instead of being transformed into apparent consensus by the choice of a shared vocabulary. This conception is compatible with established work on boundary objects and translations across social worlds (Star and Griesemer, 1989); it identifies a further requirement for the present project: connect each translated claim to an accessible or inaccessible continuation in the participants' relational configurations.

Recognition cannot be equated with endorsement. An account of an actor's normative reasoning may be necessary for a peace process even when particular proposed actions would violate rights or expose other participants to foreseeable harm. Likewise, recognizing that an organization depends materially on an exploitative arrangement explains one condition of its conduct without making the arrangement legitimate. In a responsible praxis, recognition provides information for interpretation and negotiation, while applicable safeguards, consent, procedural standing, and obligations continue to constrain admissible interventions. An inquiry that silently replaces the affected participant's interpretation with the mediator's categories undermines the very relation it seeks to improve.

## Task-relative interfaces and partial translations

Let  $q$  identify a bounded cooperative task, such as validating a marine measurement, interpreting a safety report, hearing a grievance, or negotiating a limited information-sharing commitment. For each participant  $i$ , let  $L_i^q$  be a typed collection of task-relevant expressions. Its elements may denote factual propositions, measurement records, requests, commitments, procedural classifications, or normative claims. These types should remain distinguishable: a measured concentration, a request for access, and a legal duty to disclose information are not interchangeable because they happen to concern the same observation.

A provisional translation interface between  $i$  and  $j$  is represented as

$$\tau_{ij}^q : D_{ij}^q \subseteq L_i^q \multimap L_j^q, \quad (9)$$

where  $D_{ij}^q$  is the declared domain on which the proposed translation can be responsibly used. More complex applications require a relation, a typed span through an intermediary representation, or a set-valued mapping, especially where several target expressions are defensible. The partial-function

notation provides only the simplest case. Crucially, a translator's assertion that  $\tau_{ij}^q(u)$  is an acceptable rendering of  $u$  does not by itself establish that the institutions attach the same rights, obligations, remedies, or epistemic force to the two expressions.

The translation record should therefore be enriched by a local warrant

$$W_{ij}^q(u) = (p, a, s, e, r), \quad (10)$$

where  $p$  records provenance and the interpreter's role,  $a$  the competent authority or authorization,  $s$  the intended scope and expected use,  $e$  the evidentiary conditions or validation procedure, and  $r$  the available contestation and revision path. These are typed fields rather than numerical components of a single confidence score. An interpretation can be accurate for descriptive communication while remaining unlicensed for adjudicating a claim. A translation may preserve the operational meaning of a technical instruction while changing whose confirmation becomes necessary for its use. Since authority can depend on legal order and organizational position, the warrant can be valid in one procedural setting and invalid in another.

This framework bears a limited analogy to the formal theory of institutions developed by Goguen and Burstall (1992). In a logical institution, sentence and model translations are governed by a satisfaction condition that supports reasoning across changes of signature. That mathematical achievement does not establish that social norms are reducible to formal sentences or that human authorities agree upon a satisfaction relation. Where an agreement can be represented as a formal specification, the apparatus offers powerful discipline: the researcher must define the relevant signatures, interpretations, preservation requirements, and model class. Where obligations remain open-textured, politically contested, or historically revisable, a proposed translation must instead state the narrower empirical and procedural invariants it is expected to preserve. The choice of such invariants is itself an object of institutional deliberation.

A practical interface may conserve different things. A calibration protocol seeks an evidentiary relation between observations and standards; an exchange of humanitarian information may aim to preserve a protected purpose, a consent restriction, and a right to correction; a diplomatic declaration may preserve limited actionable commitments while allowing distinct grounds for accepting them. For each task, the analyst should explicitly state the preservation target. *Partial agreement* can then be intelligible without assuming that participants share an ultimate valuation of all relevant goods. This gives the cooperative process room to retain justified disagreement, including decisions to leave a topic outside the present arrangement.

### Composition, path dependence, and global compatibility

A transnational arrangement frequently contains more than one interface. Suppose subjects  $A$ ,  $B$ , and  $C$  participate in a connected process and render an expression  $u \in L_A^q$  through different institutional routes. When each map is defined, the two paths may produce

$$\tau_{BC}^q(\tau_{AB}^q(u)) \quad \text{and} \quad \tau_{AC}^q(u). \quad (11)$$

A path-comparison statement becomes meaningful only if both results lie in compatible target types and if the researcher specifies an equivalence relation  $\sim_C^q$  for the task. The desirable condition may be

$$\tau_{BC}^q(\tau_{AB}^q(u)) \sim_C^q \tau_{AC}^q(u). \quad (12)$$

The relation  $\sim_C^q$  need not imply identity of wording, metaphysical meaning, or normative justification. It might indicate that the two paths authorize the same bounded procedure, preserve the same confidentiality condition, or permit equivalent opportunities to contest an evidentiary conclusion. Failure of Equation (12) is a diagnostic possibility, rather than a proof that the original speakers disagree or that the institution is unjust.

At least three different sources of failure must be separated. First, the composite may be *undefined*: an expression accepted at the  $A$ – $B$  interface lies outside the declared domain of the  $B$ – $C$  interface. Second, a composite can be defined yet yield a *different interpretation*: wording survives transfer while permitted use, evidentiary standing, or the relevant class of persons changes. Third, the translations can each appear adequate in isolation while the *combined obligations are incompatible*. The last case concerns the joint feasibility of a configuration, and cannot be solved merely by choosing a better dictionary. Even a perfectly recorded translation cannot make mutually inconsistent enforceable requirements simultaneously satisfiable.

An elementary finite example demonstrates this separation. Suppose the proposed multilateral configuration contains three binary procedural design variables  $x_A, x_B, x_C \in \{0, 1\}$ , describing whether three institutional reporting interfaces use a specified disclosure channel. Each bilateral agreement separately imposes

$$C_{AB} : x_A = x_B, \quad C_{BC} : x_B = x_C, \quad C_{AC} : x_A \neq x_C. \quad (13)$$

Every pairwise constraint has an admissible assignment, and each can be honored in its own bilateral arrangement. Their conjunction is unsatisfiable:

$$\text{Sat}(C_{AB}) \wedge \text{Sat}(C_{BC}) \wedge \text{Sat}(C_{AC}) \quad \text{but} \quad \neg \text{Sat}(C_{AB} \wedge C_{BC} \wedge C_{AC}). \quad (14)$$

Here  $\text{Sat}(C)$  means that  $C$  has at least one feasible assignment within its declared domain; it does not imply that the three constraints admit one common assignment. This is a basic fact about constraint satisfaction, offered as a transparent counterexample rather than a novel theorem about diplomacy. It shows why bilateral compatibility alone supplies insufficient evidence for multilateral feasibility.

A substantive GR result would require more: the constraints must be grounded in participants' generative conditions and translated commitments, and a justified intervention must alter the reachable configurations in a way that the established institutional baseline has failed to characterize.

For example, a marine-observation consortium might encounter conflict among obligations for prompt public reporting, protection of sensitive community-level information, and independent scientific reproducibility. The appearance of contradiction may stem from treating disclosure as a single binary activity. A revised interface could introduce an independently governed verification procedure, tiered authorization, aggregated releases, or participant-controlled redaction, subject to applicable law and legitimate scrutiny. Each intervention changes the available institutional operations and possibly the generative mechanism  $\mathcal{M}_i$  in Equation (4). Such redesign may expand the set of collectively feasible continuations. Yet some combinations of obligations remain genuinely incompatible; others require a lawful change to the governing commitment rather than technical workarounds. The analyst must document who may authorize a change, whose rights are implicated, and which alternatives leave essential safeguards intact.

This example also illustrates a caution about modeling *normative heterogeneity*. Different information practices can be compatible for a particular operational task while retaining important moral or legal differences. Conversely, a common descriptive language can conceal materially incompatible duties. Treating all disagreements as translation failures risks mistaking disputes about legitimate distribution or historical injury for semantic uncertainty. An exploratory model should keep these causal explanations open and test them using institutional records and accounts from affected parties.

## Translator power and the evolution of generative conditions

Translation is performed through particular people, organizations, software tools, and conventions. Their resources and authority affect which claims enter the process and whose descriptions become authoritative. Merry (2006) analyzes how intermediaries carry and transform transnational human-rights ideas across social contexts, demonstrating the importance of local knowledge and the ambivalent

power of the translator. Work on norm localization likewise analyzes active reconstruction, rather than passive reception, of transnational norms (Acharya, 2004). These established observations impose a methodological obligation: the GR account must locate the intermediary within the field of power and material dependency instead of presenting translation as a neutral transport between abstract vocabularies.

Consider a cooperative reporting standard administered by an external technical provider. Local experts may receive translated summaries while access to raw observations, metadata, or interpretive software remains centralized. The representation can be sufficiently clear to permit nominal participation, yet affected participants may lack the capacity to reproduce an analysis or challenge its conclusions. This is an instance in which successful linguistic translation and effective epistemic agency diverge. The additional GR question concerns which continuation operations remain accessible after an interface is adopted: obtaining independent evidence, appointing an expert, exercising a legal challenge, or participating in future revision. A change in those operations is distinct from a change in the wording of a report.

Because the interaction can transform the participants, a translation interface is indexed to a configuration and history, not simply to immutable cultures: one may write  $\tau_{ij}^{q,h,X}$  when those dependencies matter. Training, institutional reform, coercion, new infrastructure, or changed professional roles may alter the domain and warrant of a later translation. The same expression may acquire a different institutional effect after governance rights are redistributed. The resulting co-evolution can be studied in repeated negotiations and administrative reforms, while preserving the difference between an observed change in language, an enacted change in rules, and a material change in capacity. Historical trajectories are not reducible to a fixed before–after binary; available records may describe partially ordered episodes, dependencies, and revisions distributed across actors and settings.

The fact that a proposed interface increases cross-system intelligibility does not settle whether its use is appropriate. Making sensitive information legible to an institution may increase the capacity for surveillance as well as accountability. Standardization may lower coordination costs while marginalizing local knowledge or concentrating control in a dominant provider. Translation can also render an otherwise inaccessible remedy usable. The normative evaluation depends on identifiable rights, purposes, risks, authorizations, and impacts, with special attention to participants who cannot safely disclose personal histories or take part in public consultations. A serious research programme must preserve protected uncertainty and legitimate silence as possible outcomes, rather than make maximal transparency its default metric.

## Constructing provisional normative interfaces in practice

An applied GR inquiry should proceed from a specific contested task. It first records the participants and their competent representatives, the histories and dependencies relevant to the task, and the existing legal and practical safeguards. It then distinguishes the statements to be translated by type: observations, classifications, commitments, procedures, and claims of authority. Parties can identify a limited domain of shared action while documenting points of divergence, uncertain interpretations, and claims whose disclosure would create risk. The analyst should identify what is already handled by established mediation, stakeholder consultation, legal interpretation, participatory monitoring, or institutional-design techniques. Only then is an additional GR representation warranted.

A practical translation register would associate each consequential claim with its origin, affected subjects, intended audience, interpreter, type, agreed scope, evidentiary dependencies, authorization, expected action, and path for correction. Repeated translations could be audited for domain errors, shifts of meaning, and inconsistent downstream obligations. In a multilateral process, the resulting register could support a joint-constraint review, documenting which obligations must hold simultaneously and which can be renegotiated by competent actors. The review should state the costs of satisfying each requirement, the resources necessary for participants to exercise a right, and the possi-

bility of retaliation or loss of access. It should also record the standpoint of participants who are absent or whose representation is contested.

In peace mediation, a translation register can clarify what parties understand by a limited verification or notification commitment, how a report becomes contestable, and which confidential information is protected. Its implementation remains subject to consent, impartiality, inclusion, legal safeguards, and conflict sensitivity; these requirements are familiar from the United Nations guidance for effective mediation (United Nations, 2012). A technically sophisticated model cannot repair a mediation process whose legitimacy or safety is compromised. The GR contribution would have to be demonstrated through an incremental finding: a hidden interface dependency, an inaccessible remedy, or a concrete jointly feasible transformation overlooked by a competent conventional method.

In international scientific cooperation, translation can be tested against reproducibility and participation. An agreement may use one phrase for “shared access” while participants understand it as access to published outputs, raw measurements, executable code, or authority to revise standards. Recording the separate meanings allows an empirical test of whether changes to interface governance alter research reproduction, disagreement resolution, and participants’ continuing competence. In organizational and public-trust contexts, a corresponding inquiry traces how a policy promise is translated into frontline eligibility rules, appeal procedures, and operational resources. Effective translation may improve warranted trustworthiness when it gives an affected person a real route to correct an institutional decision. A rise in favorable survey responses alone would not establish such improvement.

These applications also expose counterexamples. Many tasks already possess stable technical interfaces and enforceable obligations; adding a GR register might produce only administrative overhead. Some disagreements are distributive conflicts with perfectly understood positions. In others, a provisional shared vocabulary could create superficial agreement while insulating an unequal decision procedure from challenge. Translation can even become harmful when cross-institutional records increase risks for vulnerable participants. The possibility of such outcomes justifies explicit comparison to established practice, evaluation of burden and safety, and an available decision to suspend or discontinue the GR intervention.

The section’s provisional contribution is therefore a research architecture for the *bounded composition of translated cooperative possibilities*. The architecture brings together partial epistemic access, typed normative interfaces, institutional authorization, and changes in reachable generative operations. Existing scholarship supplies substantial antecedents for each component, and the finite compatibility example itself is elementary. Its prospective analytical value lies in tracing a specific discrepancy between locally satisfactory coordination and globally admissible continuation, then identifying whether a lawful, ethically warranted change in a subject’s relations or mechanisms can address it. The next section extends the analysis from translated commitments to the creation, circulation, and reproduction of value and capacity within those relations.

## 8 Co-Produced Value, Circulation, and the Return of Generative Capacity

A cooperative relation changes what participants can produce, access, maintain, and govern. The consequences cannot be inferred solely from the success of an agreed transaction. A scientific consortium can publish valuable measurements while leaving some members unable to operate the instrumentation or verify its computational pipeline. A development partnership can meet expenditure and delivery targets while changing the distribution of essential technical expertise. A community agreement can generate useful public information while allowing one institution to decide which grievances count as actionable evidence. These possibilities connect the analysis of trust and commitments to the political economy of the cooperative relation itself.

The task is to distinguish the generation of valued products, their circulation among subjects, the

conditions enabling their production, and the ways those conditions are reproduced or constrained through cooperation. The investigation inherits historical-material concerns about labor, ownership, infrastructure, and institutions. The generative perspective articulated in Eglash (2016)'s work on generative justice is an intellectual inspiration for attending to where value is generated and how its circulation can sustain the producers of value. The present GR metamodel, the criteria of admissible continuation, and the empirical hypotheses below are specified independently. Their distinctive value remains to be demonstrated through comparison with established political-economic and institutional analyses.

### Production and value across heterogeneous domains

Let  $\mathcal{Q}$  be a set of analytically distinguished value domains. These may include monetary income, material goods, public services, verifiable knowledge, ecological conditions, organizational capabilities, cultural goods, or locally recognized forms of collective agency. For an activity  $a$  occurring within a relational configuration  $X$ , define a typed production account

$$P(a, X) = \{(q, o_q, c_q, p_q) : q \in \mathcal{Q}_a\}, \quad (15)$$

where  $o_q$  identifies the relevant output or effect,  $c_q$  its constitutive or enabling conditions, and  $p_q$  the provenance or method of assessment. This notation is an inventory of heterogeneous observations and judgments, rather than a vector of commensurable utilities. A scientific publication, a functioning public remedy, and an ecologically sustained habitat have distinct criteria of significance and may be evaluated by distinct competent communities. Converting all of them into one exchange value would conceal normative disagreements that may be central to the cooperative relationship.

The diversity of environmental valuation illustrates the point. The IPBES assessment of the diverse values of nature provides established conceptual and policy arguments for recognizing plural values and the limitations of narrowly framed valuation methods (IPBES, 2022). The GR investigation adds an analytical question about *conditions of continuation*: how do particular practices of valuation and governance alter the participants' capacity to sustain, learn about, and participate in managing those valued relations? An environmental outcome can improve according to one metric while groups who depend on the ecosystem lose access to relevant knowledge or decision procedures. Conversely, a locally valued activity may face legitimate ecological limits. The model must permit both possibilities and preserve the applicability of conservation requirements, human rights, and lawful authority.

A historical-material account should identify the actual work and resources through which an output is generated: labor and expertise, energy, instruments, computational systems, organizational authority, environmental processes, maintenance arrangements, finance, and access to accumulated knowledge. Each resource may be controlled by a different subject. A model attributing production entirely to the institution whose name appears on an agreement would overlook these distributed conditions. Equally, agency is not exhausted by ownership of a resource. The ability to operate or repair an instrument, convene a legitimate meeting, reproduce a calculation, or refuse an unsafe intervention may be decisive even where formal titles and budgets are unchanged.

### Circulation, appropriation, and the control of productive conditions

Let  $\mathcal{T}$  denote typed transfers and permissions within the joint configuration. A transaction may transfer ownership, authorize limited use, license software, disclose data, delegate decision authority, share training resources, or provide access to an independent appeal. Different transfers change different relations. We can represent a transition schematically as

$$X' = \Phi(X, a, \mathcal{T}, \mathcal{J}), \quad (16)$$

where  $\Phi$  is an empirically specified change process,  $a$  a cooperative activity, and  $\mathcal{J}$  the applicable institutional rules. Equation (16) does not prescribe one economic dynamics; it reminds the investigator that production and circulation can also modify norms, technical access, collective competence, and governing authority. A transfer that supplies a scientific result without permitting its independent validation has different generative consequences from one that includes appropriate access to procedures, skills, and repair capacity. Those differences can matter even when the delivered report is identical.

Appropriation should be described with similar care. Control over the use of data, the capture of revenue, the legal right to license a discovery, and the practical ability to set standards are different kinds of power. They may coincide in one institution or be distributed among several. A cooperative arrangement may intentionally centralize some functions for efficiency, safety, or equitable provision. Such concentration is not inherently exploitation. Its assessment depends on the legitimate purpose of the arrangement, the informed consent and rights of affected participants, the availability of accountable oversight, the distribution of burdens, and feasible alternatives. Relational power theory provides a substantive precedent for treating capabilities and positions as socially constituted (Barnett and Duvall, 2005); the present inquiry must identify a more precise effect on reachable operations if it is to add analytical value.

The distinction between circulation and return is especially important. A subject may receive a portion of immediate economic output while remaining dependent on another actor for the conditions of subsequent production. An international project may distribute publication credit but centralize access to calibration facilities. A public-service contractor may satisfy delivery targets while leaving the responsible public authority without the staff or records necessary to monitor or replace the service. Monetary compensation, recognition, intellectual-property rights, and operational autonomy may change in different directions. Their relationship cannot be resolved in advance by a universal rule that more distributed ownership is always preferable; instead, the relevant questions concern viable options, governance, and justified obligations in context.

### Generative return as a typed capacity question

The GR framework can characterize return without positing a homogeneous substance called generative value. For a subject  $i$ , history  $h$ , budget of feasible resources  $b$ , and declared domain  $d$ , let

$$\mathcal{F}_i^d(h; b, \Theta_i) = \{\gamma \in \mathcal{F}_i(h; \mathcal{B}_i, \Theta_i) : \text{Cost}_i(\gamma) \preceq_d b\}, \quad (17)$$

where  $\preceq_d$  is an explicitly chosen and justified feasibility relation for that domain. The set may include the ability to operate a laboratory, maintain local observations, obtain an independent review, enter a successor agreement, or exercise a remedy. Neither the cardinality of  $\mathcal{F}_i^d$  nor an assumed scalar potential is sufficient to capture the quality of the options: the investigator must specify the practically important functions, resource requirements, legal permissions, and safeguards.

A *generative return inquiry* then asks whether the cooperative arrangement changes the accessibility of designated continuation classes. One may select a finite set  $K_i^d$  of substantively relevant functions and use a binary or qualified reachability relation

$$R_i^d(\gamma \mid X, h, b) = \begin{cases} 1, & \text{if } \gamma \text{ is feasibly accessible under declared conditions,} \\ 0, & \text{if its infeasibility is demonstrated under those conditions,} \\ ?, & \text{if evidence remains insufficient.} \end{cases} \quad (18)$$

The question mark is an epistemic marker, not a probability assignment. A richer implementation may employ interval costs, competing institutional interpretations, or conditional paths. The important step is making explicit which capacity could be exercised, by whom, and under what conditions. For the purpose of comparative study, the relevant difference can be a change in one essential function, even where many other capacities remain unobserved.

This representation avoids the presumption that maximal available choice is universally desirable. Cooperative subjects often accept binding limits to secure safety, predictability, conservation, mutual assurance, or vulnerable parties' rights. An independently negotiated and reviewable restriction may be justified; an apparently equivalent limit imposed through concealed technical dependence may raise different concerns. The model's task is to describe the feasible continuation and decision process sufficiently to support normative evaluation by competent participants and institutions. That evaluation remains open to disagreement and documented uncertainty.

### A performance-equivalent comparison

Consider two hypothetical international marine-observation partnerships,  $P$  and  $Q$ . They operate with the same stated monitoring task and, within a declared reporting window, achieve equivalent delivery rates, validated measurement accuracy, and publicly reported expenditures. Suppose the reporting map  $\mathcal{O}_R$  accordingly satisfies

$$\mathcal{O}_R(H_P) = \mathcal{O}_R(H_Q). \quad (19)$$

The equality is conditional on the selected indicators and observation window, and does not suggest that the partnerships are identical in every other respect. In  $P$ , the host agency receives reports from an external operator but has limited access to calibration procedures, executable reconstruction workflows, replacement parts, and the records required to contest a disputed result. In  $Q$ , the same outputs are delivered through a different arrangement that additionally provides an accessible independent validation pathway, appropriately governed technical documentation, locally maintainable equipment where feasible, and a documented capacity to participate in revisions. Assume the costs, legal permissions, technical skills, and institutional responsibilities needed to operate the additional pathways have been examined rather than merely promised.

Under these stipulations, the partnerships may differ in a designated reachability test. For instance, take  $\gamma_{\text{review}}$  as the continuation "submit a disputed measurement to an adequately independent and competent review and receive a reasoned, contestable determination." One may find

$$R_{i,P}^{\text{review}}(\gamma_{\text{review}}) = 0, \quad R_{i,Q}^{\text{review}}(\gamma_{\text{review}}) = 1, \quad (20)$$

under the same legitimate constraints and feasible budget. The point is a possible empirical distinction: arrangements can be equivalent under a narrow performance record and distinguishable under a capacity-sensitive representation. The inequality remains hypothetical. It is neither a theorem that all decentralized arrangements are superior nor evidence that an actual project has failed its obligations. The specified continuation must be independently verified, with particular care for the independence, cost, and accessibility of the review procedure.

This example can be challenged. The external operator in  $P$  might offer an effective low-cost independent appeals channel, rendering the hypothesized capacity difference false. The greater technical demands of  $Q$  might draw scarce staff from essential public services, making its overall effects less favorable. Security or privacy law may legitimately restrict access to some data. Observed equality may also disappear once the reporting regime includes resilience, accessibility, or grievance performance. These counterexamples specify what an empirical study must control for. A GR advantage should be claimed only where its capacity trace identifies a meaningful difference that a competent established assessment does not already record.

### Historical cooperation, differentiated obligations, and ecological limits

International environmental regimes supply examples of why capability and implementation conditions have long mattered in institutional design. The Montreal Protocol's Multilateral Fund provides financial and technical support for eligible parties' implementation obligations, including technology

transfer through specified agencies; the mechanism exemplifies a historically established recognition of differentiated implementation capacities (Multilateral Fund for the Implementation of the Montreal Protocol, n.d.; Ozone Secretariat, 1990). The present paper should therefore avoid asserting that the importance of capacity building is a GR discovery. A prospective contribution would be a disciplined comparison of *which* capacities were enabled or constrained by particular support arrangements, how these changed the feasible continuation structures, and whether those differences help explain otherwise puzzling patterns of compliance, dependence, or institutional adaptation.

Ecological production also imposes constraints that cannot be negotiated away as if all values were institutional preferences. Extraction, monitoring, conservation, and autonomous infrastructure can generate costs for other species, habitats, and people whose interests are weakly represented in a given agreement. An arrangement with large financial returns and high reported participant satisfaction might nevertheless damage ecological conditions required for continued productive activity. The relevant empirical account should therefore incorporate independently warranted ecological thresholds, transparent uncertainty, and forms of representation appropriate to affected humans and ecological relations. These constraints may restrict the set of admissible continuations and challenge the preferences of powerful participants. The GR model should explain whose material conditions are affected without claiming that an ecosystem has the same legal or phenomenological status as a human participant.

The same issue extends across scales. The continued functioning of a transnational monitoring platform may depend on local technicians, electricity supplies, satellite links, software maintainers, public budgets, regulatory permissions, and trust in the resulting knowledge. A decision to outsource maintenance can improve current efficiency while concentrating vulnerability to later service interruption. A community-level capacity initiative can enrich local knowledge but become ineffective when no funding exists for equipment maintenance or when the responsible institution lacks authority to incorporate the results. Analytical completeness requires following the dependency chain beyond the project's immediate accounting boundary, then being explicit about where the feasible investigation ends.

## From political-economic diagnosis to evaluable cooperative design

A practical application begins by describing outputs and declared benefits, then reconstructing the actors and conditions through which those benefits are generated. It follows important transfers and authorizations, examines concentration of control, and identifies continuation classes that participating groups themselves regard as significant: maintenance, independent evidence, local professional competence, enforceable participation, acceptable exit, or justified institutional revision. The investigator should explain how these functions connect to applicable rights, public purposes, and ecological safeguards; the GR framework cannot supply the legitimate objective independently of such processes. A baseline evaluation using cost–benefit analysis, political-economy mapping, participatory assessment, or institutional capacity evaluation must be documented before proposing an added method.

In transnational cooperation, a capacity-sensitive intervention might revise a grant to include supervised technical transfer, joint stewardship of a verifiable dataset, a viable independent review route, or maintenance funding. In peacemaking, it might examine whether parties can actually access the procedures needed to contest a contested report without facing retaliation. In public organizations, it might compare the availability of grievance remedies and replacement capacity under two delivery arrangements with similar reported service levels. Each intervention has foreseeable trade-offs: expense, delay, data-security exposure, procedural burden, and risks of reinforcing local elites or external dependencies. Decisions about redistribution and legal responsibility require authorized deliberation and appropriately independent review.

Prospective assessment should separately track delivery performance, observable capacity changes, and the quality of rights-protecting process. A before-and-after narrative is inadequate when selection effects, changing conditions, or unmeasured institutional reforms could explain the difference. Where

possible, comparative cases or staged implementation can provide stronger evidence, subject to feasibility and ethical approval. The analyst should report negative results: cases in which conventional capacity-building tools already identify the relevant deficits, in which a GR account contributes no distinct prediction, or in which the proposed intervention imposes more burden than benefit.

An important practical distinction concerns public trust. An institution may communicate its achievements in an effort to generate favorable opinion. A GR-informed evaluation asks whether affected persons can actually rely on the promised service, understand the applicable rules, contest a harmful determination, and exercise relevant participatory rights. Those conditions relate to established scholarship on political trust and trustworthiness (Levi and Stoker, 2000; O'Neill, 2002). Improvement in warranted institutional conduct may coexist with declining survey confidence as formerly hidden failures become visible. A trust-building policy should therefore be assessed for genuine public accountability rather than persuasive success.

The connection to the earlier translation analysis is direct. A benefit-sharing promise may circulate through multiple institutions, acquiring different operational meanings; a nominal training provision can lack the funds and authority required to make a skill usable; an accessible formal remedy may be disabled by unavailable evidence. These are points where translated commitments and material reproduction meet. The substantive research question is whether the coupled analysis identifies failures of joint feasibility or capacity return that remain unexplained by otherwise suitable institutional methods. The framework's next task is to trace these effects through relational histories and contested records of institutional performance.

## 9 Relational Histories, Institutional Memory, and the Production of Evidence

The effects of an agreement are frequently assessed through records produced by the same institutions whose performance is being evaluated. A treaty body receives national submissions; a scientific consortium publishes certified measurements; a local organization maintains a register of complaints; a mediator works with several narratives of a contested episode. These records are indispensable to cooperation. They are also selective products of technical capabilities, institutional mandates, professional routines, interpretive conventions, and unequal access. A generative-relational (GR) account of trust must therefore represent how knowledge of cooperation is produced and retained, as well as the conduct to which that knowledge refers. The central difficulty is epistemic: the history that matters for assessing a relation and the history available to a particular observer can diverge.

Organizational memory and historically situated learning are established subjects of research. Levitt and March (1988) describe organizational learning as an experience-dependent process through which interpretations become encoded in routines; Walsh and Ungson (1991) examine the acquisition, retention, and retrieval of organizational memory. Feldman and March (1981) show why information acquisition can also acquire symbolic significance within organizations. The investigation here builds on these findings and on the provenance discipline developed for digital information. Its proposed contribution is a particular joint representation of contested institutional memory, the power to produce evidence, and the reachability of institutionally meaningful continuations. Such integration is useful only if it reveals a consequential difference left unexamined by competent archival, organizational-learning, accountability, and audit methods.

### Events, records, claims, and authorized determinations

The relational history  $H$  of Section 6 contains represented events and their attributed dependencies. An event might be a sensor reading, a refusal to provide an agreed dataset, an exchange of assurances, an allegation of retaliation, a disbursement, an ecological disturbance, or a formal decision. An event

*record* is an artifact constructed through a recording practice; an *evidentiary claim* asserts a proposition about an event, relation, or rule; and an *institutional determination* is the outcome of a procedure with a specified jurisdiction and evidentiary standard. These four categories serve different functions, even when a document contains more than one of them.

For a specified inquiry, let  $E_H$  denote the set of modeled events and let  $\mathcal{D}$  denote evidentiary artifacts. A partial registration relation takes the form

$$\text{reg} : E_H \times \mathcal{A} \times \mathcal{Q} \rightharpoonup \mathcal{D}, \quad (21)$$

where  $\mathcal{A}$  is a set of relevant recording agents or instruments and  $\mathcal{Q}$  contains recording conditions, including authority, technical standards, time resolution, retention rules, and access restrictions. The partial arrow recognizes that some events generate several records while others leave no accessible trace. It is not assumed that a record is a faithful copy of an event or that the investigator can directly inspect the underlying  $E_H$ .

A minimally useful evidence entry can be represented as

$$d = (\text{id}, \text{source}, \text{scope}, \text{assertion}, \text{method}, \text{access}, \text{version}, \text{challenge}), \quad (22)$$

with every field interpreted relative to the applicable investigation. The entry records provenance, asserted content, how that content was obtained, permissions governing its use, version history, and any recorded challenge. Additional attributes may include observed uncertainty, custodial transfers, translation transformations, and applicable privacy safeguards. This is a prospective research schema rather than a claim to replace technical provenance standards. The W3C PROV data model already specifies structured entities, activities, agents, derivations, and provenance bundles (World Wide Web Consortium, 2013); it offers a practical baseline against which any GR-specific extension should be evaluated.

A claim  $c$  may cite several records and may itself be challenged. Formally, an inquiry can represent the linkage by an attributed graph

$$K = (\mathcal{D}, \mathcal{C}_H, \mathcal{Z}, \mathcal{L}), \quad (23)$$

where  $\mathcal{C}_H$  is a set of claims about history,  $\mathcal{Z}$  consists of authorized determinations, and  $\mathcal{L}$  contains typed relations such as *supports*, *contradicts*, *derives from*, *translated by*, *withheld under*, and *adjudicated in*. An entry labeled *supports* expresses the role assigned to evidence under a stated standard; it does not certify truth. A judgment labeled *adjudicated in* identifies a procedurally authoritative outcome and its scope, which may remain subject to lawful appeal. The difference between epistemic warrant and institutional legal force is integral to this representation.

### Institutional memory as a distributed, revisable practice

Institutions preserve more than documents. Training, operating procedures, tacit craft skills, software, personnel networks, archives, and shared routines encode interpretations of earlier experience. The continuity of such practices may survive staff turnover, while their original reasons may become difficult to reconstruct (Levitt and March, 1988; Walsh and Ungson, 1991). Some memories remain locally accessible, some are centralized, some are lost, and some are actively disputed. In a transnational project, participants may maintain distinct catalogs, measurement protocols, translations of obligations, and accounts of decision authority. Their memories should be represented as multiple partial reconstructions rather than merged into a purportedly neutral institutional narrator.

Let  $\hat{H}_i$  be subject  $i$ 's represented history as in Equation (6). Its relation to the common analytical history may depend on a configuration  $X$ :

$$\rho_i^X : H \rightarrow \hat{H}_i, \quad \hat{H}_i = \text{Interpret}_i(\text{Access}_i(K; X), \mathcal{E}_i, \mathcal{N}_i). \quad (24)$$

The second expression is schematic and does not presume that human interpretation is a deterministic computational function. It makes explicit that the available evidence, interpretive competence, and normative frame may vary among participants. The institutional configuration also influences what evidence can be produced: it distributes instrument access, technical authorization, communication channels, resources for contesting a claim, and protection against retaliation. The evidence available to the institution is thus partly a product of the relation being assessed.

The risks extend beyond record deletion or concealment. A technically complete log may omit the categories required to identify a grievance. A multilingual treaty implementation process may convert a substantive concern into a narrow administrative code. A project may preserve precise sensor measurements while losing the contextual knowledge needed to recognize equipment failure. A complaint register may contain every accepted filing while excluding people unable to access the filing procedure. In each case, retention can be extensive while the space of *recordable claims* remains constrained. The epistemic consequence cannot be inferred from document volume or data completeness alone.

These limitations also arise when parties act in good faith. A national statistical office, a regional scientific institute, and an affected coastal community may use different spatial scales, definitions of damage, evidentiary thresholds, and archival practices. A representation that converts all submissions into a single harmonized table might enable comparison while discarding information salient to a participant's claim. Section 7 established that translation warrants and task-relative interpretive limits matter. The present account adds a historical dimension: retained translations and archived determinations can constrain which questions later participants know how to ask.

### Observational equivalence and the limits of a performance record

The difficulty can be stated without assuming any comprehensive access to historical truth. Let  $\mathcal{H}$  be an explicitly bounded class of candidate histories and let  $\Omega_{i,q} : \mathcal{H} \rightarrow \mathcal{O}_{i,q}$  be the observation procedure available to observer  $i$  for task  $q$ . Define observational equivalence by

$$H_1 \sim_{i,q} H_2 \iff \Omega_{i,q}(H_1) = \Omega_{i,q}(H_2). \quad (25)$$

The relation is relative to the declared observer, task, and observation procedure. If a claim  $\psi$  has a different truth value or warranted status on two histories in the same equivalence class, then  $\psi$  is not identifiable from that observation alone. This is an elementary consequence of an observation map, rather than a new theorem. It nevertheless places a discipline on empirical claims made from limited institutional records.

For illustration, suppose a cooperative monitoring project reports a complete quarterly dataset and an identical number of formally accepted appeals in two hypothetical configurations. In  $H_1$ , one independent verification request is delayed by a documented power failure and subsequently resolved. In  $H_2$ , the same request is blocked by an unauthorized intermediary and never enters the official appeal register. If the public observation  $\Omega$  records only dataset delivery and registered appeals, the two histories can be indistinguishable under  $\Omega$ . Their implications for institutional accountability and the actual reachability of independent review nevertheless differ. Further admissible evidence, such as securely obtained request logs, independent testimony, or an authorized investigation, may distinguish the explanations. The researcher's task is to seek that evidence while protecting subjects against foreseeable disclosure, security, and retaliation risks.

The example connects directly to Section 8. A capacity-sensitive claim about a participant's ability to obtain review cannot be justified by a delivery statistic alone. Yet the reverse is also important: a missing record does not establish wrongdoing. An adequate protocol distinguishes *unknown*, *disputed*, *procedurally established*, and *empirically corroborated* statuses, and makes its inference limits visible. Verification procedures may themselves create burdens or expose vulnerable persons; independent review must therefore be competent, proportionate, lawful, and appropriately protected.

## Power, credible testimony, and the governance of historical records

Evidence has both informational and institutional conditions of production. One organization may own the servers and measurement instruments, another may define the reporting template, and a third may authorize publication or resolve disputes. This distribution determines which actors can correct a record, demand reasons, preserve an alternative account, or challenge an adverse finding. Influence over institutional memory is consequently a particular configuration of technical, economic, procedural, and interpretive power. It is already well within the scope of scholarship on organizational knowledge and structural power; the GR formulation aims to trace its consequences for specific generative continuations rather than merely relabel such influence.

For a claim type  $q$  and subject  $i$ , define the institutional capacity of *evidentiary recourse* in the same typed manner as earlier reachability functions:

$$R_{i,X}^q(\gamma) = \mathbf{1}\{\gamma \in \mathcal{F}_{i,X}^{q,\text{recourse}}\}. \quad (26)$$

Here  $\mathcal{F}_{i,X}^{q,\text{recourse}}$  consists of admissible continuations through which subject  $i$  can submit, substantiate, and obtain competent review of a  $q$ -claim under specified safeguards. The predicate is conditional on realistic resources, jurisdiction, language access, and procedural protection. Merely creating a portal or publishing a right of appeal does not establish the predicate. Its assessment must include whether an individual can invoke the process without disproportionate expense or credible fear of reprisal. This is a specified operational test, with legal and ethical standards supplied by the relevant institutions rather than invented by the metamodel.

In peacemaking, a practical consequence is the careful establishment of shared evidentiary procedures that preserve distinct narratives and protect witnesses. A mediator might record which assertions are jointly accepted, which remain disputed, and which require confidential independent examination; the process should be shaped by consent, impartiality, inclusion, and applicable law (United Nations, 2012). An agreed chronology can help participants coordinate, but it can also reproduce exclusion if historically affected groups lack standing to challenge its categories. Sensitive testimony may need controlled access, separation from publicity, and procedures that avoid coercive extraction of personal histories.

In international scientific cooperation, parties might maintain provenance-preserving datasets, versioned explanations of methodological changes, and separately administered review pathways. In public administration, organizations might test whether complaints rejected at intake are themselves traceable in suitably protected aggregate form, and whether changes to eligibility rules can be appealed. The suitable intervention depends on legal authority and expected harms: retaining more personal data may violate privacy, and universal disclosure may endanger witnesses or critical infrastructure. Public accountability includes justified limits on access alongside genuinely independent mechanisms for reviewing such limits.

## Research strategy and implications for generative credibility

A prospective assessment could select paired institutional arrangements with similar published compliance outcomes but different evidence-governance structures. Investigators would map the provenance of selected decisions, the fraction and types of claims that reach formal registration, whether independent procedural review is practically reachable, and whether participants can correct recognized errors. Disaggregating by institution, language, resource position, and affected population would help test whether the formal guarantees distribute practical opportunity unequally. A comparison group using established audit, procedural-justice, and organizational-memory methods would be essential to establish whether the GR representation adds analytical value.

The distinctive hypothesis is conditional: where a narrowly defined performance measure leaves material differences in evidentiary recourse unidentified, a combined model of relational history, epis-

temic access, and admissible continuations may identify them. The hypothesis fails when existing institutional evaluations already capture the relevant differences, or when the GR representation cannot be operationalized without unacceptable speculative inference. Data-protection, consent, and independent oversight are conditions of inquiry, especially in conflict settings.

The result is a transition in the analytical argument. Cooperation generates products and dependencies, and it also generates the records by which the quality of those products and dependencies is assessed. Those records become part of the interpretive histories from which trust, distrust, and future commitments are formed. Section 10 therefore studies trust as a historically situated change process while retaining the separation between subjective confidence, warranted trustworthiness, and the institutional conditions governing what can be known.

## 10 The Historical Dynamics of Trust and Distrust

Trust often appears in diplomatic and organizational accounts as a condition that facilitates cooperation. Yet cooperative activity can begin under suspicion, inherited hostility, or merely transactional reliance. Conversely, a longstanding relationship of interpersonal trust can sustain exclusion, informal collusion, or an unfair institutional arrangement. A credible theory must distinguish the development of a participant's trust from the development of the trustee's trustworthiness, the observed reliability of a joint project, and the distribution of the conditions enabling continued action. It must also explain why similar evidence can have different effects depending on relational history and who is authorized to interpret the evidence.

These concerns have substantial precedents. Rousseau et al. (1998) synthesize disciplinary accounts of trust across risk and interdependence; Lewicki et al. (1998) develop an explicit framework for simultaneous trust and distrust; Kramer (1999) surveys the organizational conditions shaping trust and distrust. Work on political trust and public accountability emphasizes trustworthiness, conduct, and the evidentiary basis of institutional confidence (Levi and Stoker, 2000; O'Neill, 2002). An account of dynamic trust therefore becomes a possible GR contribution only when coupling historically situated evidentiary access, changed generative mechanisms, and feasible cooperative continuations yields testable distinctions beyond these established explanations.

### Directed, domain-sensitive, and differently warranted expectations

Let  $i$  be a potentially trusting subject,  $j$  a potentially trusted subject or institution, and  $d$  a specified domain of interaction. The relation  $i \rightarrow j$  should be understood as directed:  $i$ 's assessment of  $j$ 's competence in disaster data sharing need not match  $j$ 's assessment of  $i$ 's capacity to honor a diplomatic undertaking. Nor does an assessment in one domain automatically transfer to others. A state might regard another as a reliable partner for technical monitoring while disputing its position on a security matter; a patient might trust a public hospital's clinical competence while questioning the fairness of its complaint process.

For descriptive purposes, represent a subject's relevant assessment at an evidentiary cut  $c$  by

$$T_{i \rightarrow j}^{(d,c)} = (\theta_{i \rightarrow j}^{d,c}, \delta_{i \rightarrow j}^{d,c}, v_{i \rightarrow j}^{d,c}, \omega_{i \rightarrow j}^{d,c}). \quad (27)$$

Here  $\theta$  indexes reported or inferred trust,  $\delta$  indexes reported or inferred distrust,  $v$  denotes relevant exposure or vulnerability, and  $\omega$  denotes the warrant and evidentiary limitations of the assessment. The components are *typed* and may be qualitative, interval-valued, ordinal, or partially ordered, depending on the research design. No universal scalar trust index is presumed. A researcher should avoid treating a respondent's survey answer as if it measured all four components, or treating distrust simply as  $1 - \theta$ . In some domains there is reason for confidence in technical competence and simultaneous reason for distrust regarding secrecy or misuse of information.

The symbol  $c$  denotes a locally specified evidentiary cut through the partially ordered relational history, not a privileged metaphysical present. An empirical study may use ordinary calendar dates to construct comparable observations while allowing different record-producing processes to overlap. The model requires only that the relevant information dependencies and claims of precedence be described. It is equally important to distinguish institutional actors from the people speaking on their behalf. A ministry, public service, scientific consortium, and automated coordination system can generate observable conduct through different organizational and technical mechanisms; claims about their trustworthiness require domain-appropriate standards and accountable human or legal institutions where applicable.

A descriptive trust state and an evaluation of warranted trustworthiness remain analytically separate. Write  $W_j^{d,c}$  for an evidence-sensitive assessment of performance, integrity, competence, and applicable safeguards under a specified standard. The same institution may be genuinely trustworthy in a narrow domain yet encounter widespread public distrust because affected people have experienced unresolved injustices elsewhere. Alternatively, reported public confidence may remain high despite documented weaknesses in independent review. The objective of a public-trust intervention is to improve institutional conduct and the conditions for warranted judgment, leaving individuals free to retain criticism or distrust.

### A path-dependent process of relational updating

Let  $c$  be an event together with the claims and evidentiary status through which subject  $i$  encounters it. At a chosen level of analytical resolution, define a local update operator

$$\mathsf{T}_{i \rightarrow j}^{d,c'} = \mathcal{U}_{i,j,d} \left( \mathsf{T}_{i \rightarrow j}^{d,c}, \text{Interpret}_i(c; \hat{H}_i, \mathcal{E}_i, \mathcal{N}_i), \mathcal{J}, \mathsf{X} \right). \quad (28)$$

The operator is a placeholder for an empirical psychological, sociological, organizational, or institutional process. It might describe a sequence of interviews, an update in a bounded behavioral model, or an observed decision to increase safeguards. Its meaning depends on the unit of analysis and methodology; an institution does not possess a single human psychology. The notation forces the theorist to specify where an observed event becomes a participant's interpreted evidence and what institutional constraints govern the response.

Because interpretations can change the context in which later evidence arrives, event-update operators may be order-sensitive:

$$\mathcal{U}_{c_b} \circ \mathcal{U}_{c_a} \neq \mathcal{U}_{c_a} \circ \mathcal{U}_{c_b} \quad \text{for some admissible configurations.} \quad (29)$$

For example, a documented failure followed by a competent, lawful correction may have a different effect from an initially reassuring correction followed by a newly discovered failure, even when the final public record lists the same two event categories. The claim of order sensitivity is an analytical possibility, not evidence for a general psychological rule. Relevant confounders include the gravity of the violation, delay, changing exposure, access to alternatives, reputational context, and who experiences the remedy. A controlled comparison must specify these differences before attributing an effect to the ordering itself.

### Persistence, asymmetry, and changing mechanisms of trust

Different histories can generate comparable observed trust reports while leaving different vulnerabilities or beliefs about repair. A community may report confidence in a public agency because its staff have repeatedly solved practical problems; another community may report the same confidence while facing severe dependence on that agency as the only available provider. Reliance induced by limited exit options should be separated from freely accepted exposure. Even where a standard survey

assigns the two relationships the same rating, their options under service failure, disagreement, and institutional reform may differ substantially.

The inverse pattern is also possible. Two parties may remain equally skeptical, while one agreement supplies well-defined channels for verification and safe withdrawal and another creates exposure to unilateral interruption. Their expected cooperation may differ despite similar expressed distrust. This observation recalls established distinctions among trust, contract, institutional assurance, and structural power. The GR question is whether an account of *reachable responses to specified contingencies* improves an analysis already attentive to those distinctions.

One analytically important dynamic is persistence. Let  $\mathcal{H}_i^d$  be a subject's set of retained interpretations relevant to domain  $d$ . Even if an institution reforms, the accessibility and salience of records supporting an earlier distrust may remain high. A reform can change the actual conditions of recourse while leaving reported attitudes relatively stable; public exposure of previously concealed wrongdoing can initially lower reported trust even as accountability improves. This produces possible *hysteresis* between an institution's practices and reported confidence. Similar patterns are widely discussed in psychological and institutional scholarship; the present account requires observed evidence before claiming a particular persistence mechanism.

Rather than deducing a universal monotonic relationship, the investigation can distinguish three trajectories: a change in observed conduct; a change in participants' accessible evidence and interpretive capacities; and a change in their actual options for continuing, challenging, or leaving the relationship. These trajectories may reinforce one another, diverge, or occur at different rates. A technically reliable shared infrastructure can increase confidence while concentrating unilateral control over maintenance. A new transparency mechanism can initially surface failures and reduce confidence while improving long-run accountability. The GR representation is useful if it keeps these mechanisms separately identifiable.

### A coupled feedback between trust, records, and institutional authority

The preceding section showed that evidentiary access is produced by institutional relations. The present section adds a reciprocal path: trust and distrust can also affect what evidence is subsequently recorded, circulated, or contested. A scientific partner who doubts another institution may demand independent calibration; a dependent partner may refrain from challenging a suspicious measurement for fear of losing access; a regulatory organization may respond to public distrust through wider disclosure or, in a less accountable configuration, through narrower control of information. These responses alter subsequent evidentiary access and sometimes the institution's operating rules.

For successive analytically defined cuts  $c, c'$  of a relational history, the relation can be represented schematically as a coupled process:

$$\hat{H}_i^{c'} \in \mathcal{A}_i(K^{c'}, X^{c'}), \quad (30)$$

$$T_{i \rightarrow j}^{d,c'} \in \mathcal{U}_{i,j,d}(T_{i \rightarrow j}^{d,c}, \hat{H}_i^{c'}, X^{c'}), \quad (31)$$

$$X^{c'} \in \mathcal{F}(X^c, \{T_{k \rightarrow \ell}^{d,c}\}, \mathcal{J}^c, \mathcal{I}^c), \quad (32)$$

where  $\mathcal{A}_i$  describes permitted acquisition and interpretation of evidence,  $\mathcal{U}$  represents possible trust-related responses,  $\mathcal{F}$  contains admissible institutional changes, and  $\mathcal{I}^c$  denotes exogenous influences or initiatives. The set-valued notation accommodates multiple outcomes. It does not assign causal identification from an algebraic expression. The three lines emphasize that trust, institutional configuration, and obtainable histories may be endogenously coupled; they also clarify why a once-off survey often cannot identify the direction of influence.

A possible *self-sealing configuration* occurs when an institution's monopoly over evidence prevents the documentation of claims needed to challenge that monopoly. Repeated official assurances

can coexist with a shrinking practical opportunity for independent examination. Conversely, a cross-institutional review arrangement may allow warranted correction without requiring parties to endorse one another's entire narratives. These mechanisms invite a discriminating comparison with familiar concepts of information asymmetry, capture, auditing, and procedural justice. The GR formulation should only claim added value when its explicit continuation and translation constraints provide a new empirical contrast or intervention criterion.

### **Trust repair, relational repair, and the right to remain distrustful**

A breach can concern technical competence, integrity, rights, or contested interpretations of an obligation. An appropriate response depends on the kind of allegation and what the available evidence establishes. Experimental work on individual organizational trust repair has found that responses to alleged competence and integrity violations differ in important ways (Kim et al., 2004); these findings should not be directly extrapolated to international peace processes or public institutions without independent evidence. Institutional repair may involve correction of data, restoration of access, legal remedy, protection from retaliation, personnel or governance changes, and the creation of an independently verifiable continuation. Public relations messaging and expressions of regret are distinct from these measures.

Trust repair and relational repair should therefore be kept separate. A party may regain safe access to an essential service, obtain compensation, or secure an appeal route while remaining distrustful of the actor responsible for the original failure. Such an outcome can count as meaningful institutional repair. Reconciliation, forgiveness, and confidence involve additional judgments that cannot be demanded as conditions of receiving a lawful remedy. In conflict settings, repair protocols must consider safety, applicable human rights and humanitarian law, consent, and the risk that renewed contact could expose participants to further coercion. The United Nations mediation guidance provides established process standards concerning consent, impartiality, inclusivity, and international normative frameworks (United Nations, 2012).

A prospective evaluative design should measure several outcomes separately: the accessibility and quality of procedures, correction of substantiated failures, compliance with lawful obligations, participants' available alternatives, and reported trust or distrust. This separation allows a finding that an institution became more accountable while public confidence remained low. It also avoids rewarding efforts that increase favorable opinions through selective disclosure. Where evidence permits, observations should be repeated across interactions and compared with interventions grounded in conventional procedural justice, organizational learning, and trust-repair theory.

### **Implications for peacemaking, cooperation, and public institutions**

A peacemaking process may begin by identifying a narrow domain in which parties can record and verify limited shared commitments. The parties can agree on what counts as evidence, who can challenge an account, the protection owed to witnesses, and how unresolved disagreements will be carried into later deliberation. Success would be assessed through safety, voluntary participation, the operation of verification and remedy mechanisms, and the continued feasibility of constructive contact, rather than through an imposed expectation of mutual confidence. Consent and legal constraints remain primary.

In transnational scientific cooperation, the analogous procedure is a jointly governed evidence register with a clear provenance chain, protected independent review, and provision for maintaining essential technical capacity. In organizational public trust-building, a government agency may distinguish complaints that are filed, complaints that reach review, and people who could not file at all; it can publish lawful aggregate findings and support independent scrutiny without exposing personal or security-sensitive information. The 2024 OECD trust survey identifies responsiveness, integrity, openness, fairness, and perceived opportunities for public voice among significant topics in public

trust, giving established empirical comparators for assessing any proposed GR-specific measurement (OECD, 2024b).

For each domain, the research design must specify a pre-existing practice against which the GR-informed intervention is compared, the practical function that the additional analysis is intended to reveal, and conditions under which the intervention should be suspended. For instance, a shared archive would be inappropriate if it exposed victims, compromised diplomatic confidentiality protected by law, or placed critical ecological infrastructure at risk. More extensive observation can increase institutional power as well as accountability. An ethically credible theory must investigate that possibility within its own mechanisms.

The provisional result is a dynamic problem rather than a universal recipe for producing trust. Relational histories shape which actions and interpretations are available; institutional arrangements shape which histories can be substantiated; and assessments of trust and distrust can influence subsequent choices of evidence, engagement, and governance. The proposed explanatory gain of GR is the ability to relate these changes to the transformation of participants' feasible and normatively admissible continuations. Section 11 will examine how limited, protected cooperation can be deliberately constructed under incomplete trust, and under what circumstances such attempts should be declined, constrained, or revised.

## 11 Establishing Cooperation under Incomplete Trust

The historical account developed above distinguishes trust, independently warranted trustworthiness, reliable performance, and available institutional remedies. A further question is constructive: under what conditions can subjects undertake a limited common activity while substantial distrust remains justified? In diplomacy this can arise when a pair of governments maintains technical channels despite incompatible security assessments. In ecological research it arises when organizations require each other's observations while disputing data ownership or the neutrality of the coordinating body. A public agency and an affected community may cooperate on a bounded service improvement even as the community retains justified doubts about the agency's record. The occurrence of cooperation in these circumstances does not establish reconciliation. Its relevant achievement may be the creation of an admissible arrangement in which exposure is sufficiently constrained for a narrow action to proceed.

Research on institutions and credible commitments already explains much of this pattern. Information, repeated interaction, contingent performance, monitoring, and constraints on defection appear in the literature on international cooperation (Keohane, 1984; Koremenos et al., 2001). Work on settlement after civil conflict emphasizes the special vulnerability arising when implementation changes the relative capacity of parties to protect themselves; third-party guarantees can address some such commitment problems, subject to their credibility and context (Walter, 1997). Confidence- and security-building measures developed within the OSCE include notification, consultation, information exchange, and verification mechanisms (Organization for Security and Co-operation in Europe, n.d.). These precedents make bounded confidence-building an established practice. A GR analysis must demonstrate a further explanatory gain through its explicit treatment of changing generative conditions, the composition of obligations, or the practical accessibility of subsequent choices.

### Protected cooperative continuations as a research object

Take a coupled configuration  $X$  of heterogeneous subjects and a limited cooperative project  $d$ . Let  $\kappa$  specify permitted couplings among participants' structures,  $\pi$  a proposed sequence or partially ordered family of joint activities, and  $\sigma$  a safeguard arrangement comprising any combination of monitoring, resource partitions, independent adjudication, confidentiality controls, emergency exits, and restoration procedures. Let  $\Omega(\kappa, \pi, \sigma)$  denote the set of contingencies regarded as materially relevant to the

decision; it may remain only partially known. We define a *protected cooperative continuation* relative to specified participants  $I$ , evidentiary baseline  $E$ , and safeguards  $\sigma$  as a feasible continuation satisfying all the following requirements: admissibility under applicable nonwaivable norms, informed and uncoerced authorization by parties competent to consent, specified limits on foreseeable exposure, a credible path for challenging disputed performance, and preservation of any critical capabilities explicitly required by the arrangement.

A schematic constructibility question is

$$\begin{aligned} \exists (\kappa, \pi, \sigma) \text{ such that } \pi \in \mathcal{F}_I(\text{Couple}_\kappa(X); \Theta, \sigma), \\ \pi \models \mathcal{V}_I, \quad \text{Consent}_i(\kappa, \pi, \sigma; E) = 1, \\ \mathcal{D}_i(\kappa, \pi, \sigma; \Omega) \preceq_i b_i \quad \text{for every directly participating } i \in I. \end{aligned} \quad (33)$$

Here  $\mathcal{F}_I$  is a set of jointly feasible activities;  $\mathcal{V}_I$  represents the applicable viability and normative constraints;  $\mathcal{D}_i$  is a typed description of foreseeable exposure to relevant harms and losses of agency;  $b_i$  is a context-dependent admissible boundary established through competent deliberation and binding protections; and  $\preceq_i$  is a defensible, potentially partial comparison of exposure profiles. The expression does not imply that consent alone renders an activity ethical, that every harm admits a numerical threshold, or that standards can be waived by the party with greater bargaining power. Fundamental rights, protection of civilians, and lawful duties constrain the feasible set independently of local preferences. Where no defensible ordering  $\preceq_i$  can be defined, the exposure relation should be documented qualitatively and the formal criterion restricted to what can actually be assessed.

The index  $I$  covers parties undertaking the project, while  $\mathcal{V}_I$  must also consider affected nonparticipants through representation and external safeguards. A third-party mediator cannot simply declare that a community has consented because an organization speaking in its name has signed a memorandum. Authorization, representation, and the possibility of withdrawal are institutional questions requiring independent examination. The condition in Eq. (33) is a proposed *decision screen*, rather than a theorem of successful cooperation: an existential witness cannot ensure that its components can be discovered, funded, sustained, or defended against strategic misrepresentation.

## A bounded construction and its limits

A stylized marine-observation consortium illustrates the logical structure. Institution  $A$  operates coastal sensor stations; institution  $B$  supplies analysis software and offshore instruments. They disagree over the use of historical measurements and the ability of either institution to publish politically sensitive findings. A comprehensive data federation would require trust that neither party presently regards as warranted. A narrower undertaking may be considered: both parties independently calibrate a limited shared sample; a jointly chosen evaluator compares results; access is restricted to a purpose-specific environment; each party retains its source measurements and a competent route to dispute the evaluator's account; and continuation beyond the pilot requires a fresh authorization. Such a pilot may generate an interpretable performance record even without changing either party's overall view of the other's intentions.

The practical difference between this arrangement and an ordinary reversible pilot is assessed at the level of *effective generative capacity*. Could  $A$  maintain its own measurement process after withdrawing? Could  $B$  verify results without surrendering protected technical knowledge? Can either contest a wrong result without dependence on the other party's permission? Does withdrawing trigger the loss of essential ecological monitoring, professional competence, or access to the local community? If access can be terminated unilaterally, the mere presence of an exit clause fails to establish an effective alternative. Where critical capacity is at stake, the proposal may require a transition plan, independent escrow, portable standards, local technical training, or a different design altogether. These are candidate design measures to be evaluated against conventional contract and governance alternatives, rather than prescriptions implied mechanically by GR vocabulary.

A useful distinction separates *operational reversibility* from *generative restorability*. Operational reversibility means a pilot can be stopped or its formal instructions undone. Generative restorability asks whether participants can recover the material, epistemic, and institutional capacities required for meaningful subsequent action. An organization may recover the files it uploaded and nonetheless discover that it has retired essential equipment, trained no replacement personnel, or bound itself to proprietary interfaces. One may therefore describe a stop operation  $r$  that restores a nominal state while failing to restore the earlier set of admissible continuations:

$$r(\text{State}(\pi; X)) \simeq \text{State}(X) \quad \text{yet} \quad \text{Reach}_i^{\text{adm}}(r(\pi; X)) \not\simeq \text{Reach}_i^{\text{adm}}(X). \quad (34)$$

The signs  $\simeq$  indicate equivalence under separately declared observational criteria; they cannot be read as claims of identical physical or historical states. The second comparison concerns future admissible possibilities relative to a chosen domain, a boundary convention, and a bounded investigative horizon. This counterexample is conceptually possible even where standard performance indicators and contractual milestones show a successful pilot. Its empirical value depends on documenting the purported lost capabilities and showing why established due diligence did not already identify them.

### Reciprocal steps, assurance, and the danger of asymmetrical sequencing

A common implementation strategy begins with a limited commitment, obtains verifiable performance evidence, and conditions a subsequent extension on a review of risk and feasibility. Reciprocal sequencing can reduce uncertainty, but the sequence may impose highly unequal costs: one party might disclose complete data at the outset while another offers only a promise of future analysis. The effective structure must therefore record what becomes difficult or impossible for each participant after every step. It matters who can halt the process, what survives withdrawal, and how independent verification is paid for. Nominal symmetry of steps is insufficient where the economic, technical, security, or institutional consequences of the same step differ substantially.

For a staged pathway  $\pi = (\pi_1, \dots, \pi_m)$ , define  $C_i(k)$  as the participant's admissible continuation set after stage  $k$ , conditional on what has actually been transferred, built, or dismantled. A capacity-sensitive review asks whether the stage creates new accessible alternatives, leaves critical alternatives available, or makes participation dependent on subsequent favorable conduct by another actor. The sets may be incompletely ordered or noncomparable. Consequently, neither  $|C_i(k)|$  nor a simple numerical increase should be treated as a universal measure of freedom or justice. Some agreed restrictions protect rights and ecological conditions; some nominally numerous choices are unusable. The object is to establish material and normatively defensible differences in the continuations that relevant subjects can *actually undertake*.

Independent assurance can also relocate vulnerability rather than eliminate it. A mediator, auditor, verification platform, or guarantor may acquire extraordinary influence over evidence and access. Its own incentives, competence, funding, mandate, and accountability must therefore be assessed. The classic insight about third-party guarantees in peace settlements concerns credible protection amid implementation risks (Walter, 1997); it cannot be generalized into an endorsement of every external intermediary or into a claim that monitoring alone secures peace. In cases involving threatened persons, disclosure of evidence, compulsory joint activity, or even an invitation to negotiations can create acute safety risks. Consent, confidentiality, trauma-informed practice, applicable law, and independent safeguarding govern what a project may attempt (United Nations, 2012; United Nations Sustainable Development Group, 2022).

### What would count as a distinctive GR result?

The preceding conditions can be represented using ordinary contract design, game-theoretic assurance, stakeholder analysis, and conflict-sensitive mediation. The GR apparatus adds research value only if

it identifies an overlooked change in generative possibilities, an incompatible composition of apparently acceptable commitments, or a material divergence between formal options and implementable alternatives. A prospective comparative design could give practitioners the same initial evidence, assess one plan with established mediation and risk-assessment methods, then assess it with the GR relational-capacity trace. Independent reviewers would examine whether the latter detects additional consequential implementation dependencies without disproportionate cost, false positives, or intrusions on protected information.

Possible measures include pilot completion, verified performance, the incidence and severity of adverse events, availability and actual use of remedy channels, preservation of independent service capacity, meaningful withdrawal, participant assessments collected without coercion, and the administrative burden of safeguards. Counterfactual comparison is difficult because intervention changes the relationship being measured. Methods might include matched historical comparisons, preregistered simulations, or process tracing with countervailing cases; none by itself establishes causality. A finding that conventional assurance fully captures the relevant constraints would count against the need for a specialized GR representation in that setting.

In peacemaking, the practical aim of limited cooperation may be safe communication, verified humanitarian access, or a protected information exchange, with success defined relative to lawful obligations, safety, consent, and achievable objectives. International cooperation may use purpose-limited, independently verifiable pilots to test interfaces while distributing the capacity to govern later stages. Public institutions may begin by solving a narrowly specified service failure and publishing independently reviewable evidence of correction. In all three domains, low reported trust need not be artificially raised before a lawful and protected action becomes possible. Equally, unwillingness to cooperate may be justified. The analysis cannot make a rights-violating or coercively imposed relation acceptable by redescribing it as a generative coupling. The next section examines why these protective conditions become unevenly available under asymmetrical power.

## 12 Unequal Power and the Distribution of Cooperative Vulnerability

Cooperative agreements are often expressed through formally reciprocal commitments: each party promises a contribution, accepts verification, and retains a right to review the arrangement. The practical effects of these rules may nonetheless be unequal. One participant controls the essential infrastructure, another supplies labor or locally situated knowledge, and a third authorizes the categories through which success is publicly evaluated. The actors' observed decisions then reflect both their expressed preferences and the conditions under which alternatives are accessible. An agreement may remain formally voluntary while participation becomes increasingly difficult to suspend without losing critical services or social standing. Understanding this difference requires analysis of the reproduction of power through the cooperative relation itself.

The scholarship already provides a substantial foundation. Barnett and Duvall (2005) conceptualize power through compulsory, institutional, structural, and productive effects that shape actors' capacities. Hirschman (1970) distinguishes exit and voice as responses to deteriorating organizational conditions. Political economy and critical institutional analysis have long examined unequal dependence and the distribution of benefits. The contribution proposed here is therefore narrower than "power is relational." It concerns a formally explicit, historically situated investigation of how particular powers transform the set of *admissible and implementable continuations* open to each subject, and how that transformation can remain hidden under comparable records of contractual performance.

## Disaggregating control and effective alternatives

For inquiry-specific resources or functions  $q \in Q$ , define  $P_{ij}^q$  as a typed relation expressing how subject  $i$  can condition subject  $j$ 's access to, interpretation of, or use of  $q$ . Examples of  $q$  include finance, computation, physical space, legal standing, maintenance, communication channels, evidence, agenda setting, revision powers, and viable routes of withdrawal. This is a collection of relations rather than a vector whose components can automatically be summed. A court's lawful power to review a decision, a corporation's control over a database, and a community's practical ability to refuse a harmful activity have distinct sources, limits, and normative meanings.

The analysis should distinguish at least four modes through which a control relation can matter. First, an actor may directly grant or deny a resource needed for action. Second, an institution may define eligibility criteria, burdens of proof, or authorized representatives. Third, a technical architecture may make alternative pathways prohibitively costly or incompatible. Fourth, control over classification and evidence may shape what other participants can demonstrate and what public observers recognize as reasonable conduct. These modes intersect and can change as the cooperative system develops. Attention to them is consistent with established relational accounts of power (Barnett and Duvall, 2005); a GR representation needs to explain which specific continuation is blocked, enabled, or redirected by each mechanism.

Let  $\text{Reach}_i^{\text{adm}}(X \mid h, \sigma)$  denote the set of feasible and normatively admissible continuations open to  $i$  under institutional configuration  $X$ , documented history  $h$ , and safeguards  $\sigma$ . This is a research construct indexed by a context-specific boundary and investigative horizon. It includes implementability constraints such as trained personnel, budget, access to essential tools, safety, and authorized revision routes. Formal legal rights can be present in  $X$  without producing an executable element of  $\text{Reach}_i^{\text{adm}}$ . Conversely, a legally guaranteed capability may remain executable under difficult material conditions and should be evaluated by the standard applicable to the particular right rather than by an abstract option count.

A partial comparative relation can be defined for a fixed set of protected purposes  $D_i$  and baseline conditions:

$$X' \succeq_{i,D_i} X \iff \text{Reach}_i^{\text{adm}}(X \mid D_i) \subseteq \text{Reach}_i^{\text{adm}}(X' \mid D_i), \quad (35)$$

subject to an explicit equivalence between the continuation descriptions. This deliberately stringent relation means the later configuration preserves all comparable admissible possibilities of the earlier one and possibly adds others. Actual cases frequently produce incomparability: a new cooperative project may improve disaster warnings while imposing new confidentiality limits; accessible options can be lost and gained together. Inclusion alone also cannot represent quality, costs, dignity, environmental thresholds, or the content of nonwaivable rights. For those reasons, Eq. (35) is a sufficient descriptive test for one kind of capacity preservation under stipulated comparability assumptions, not a complete normative criterion.

## Vulnerability as a relation across adverse contingencies

A subject's vulnerability arises partly from the consequences of another actor's action, the subject's exposure to adverse events, and the practical means available to respond. A relatively wealthy organization can be vulnerable to technical lock-in, while a materially poor community can possess effective social networks or alternative sources of knowledge. Control and vulnerability are therefore multi-dimensional and context-specific. For each plausible adverse contingency  $\omega$ , let  $\mathcal{L}_i(\omega \mid X)$  record a typed loss profile, and let  $\mathcal{Q}_i(\omega \mid X)$  record feasible protective, corrective, or exit actions. Vulnerability analysis must ask both what harm may occur and which responses the subject can actually mobilize.

Consider a pilot with a nominal sixty-day termination right. If a local authority can terminate the agreement only by losing the sole functional flood-alert service, termination may be formally available yet incapable of protecting its most important continuing obligation. If the external partner owns the

calibration history and holds exclusive software credentials, the local authority may also be unable to substantiate whether the service was defective. The agreement might report excellent system uptime while the local party has limited power to audit, maintain, or change the service. That divergence makes practical vulnerability different from contractual risk classification.

Two safeguards can reduce the divergence: an accessible independent route to review disputed technical claims, and a funded transition capacity that keeps the critical service functioning if the arrangement changes. Their relevance must be demonstrated through practical tests: can an independent team reproduce a result using appropriately protected data; can local maintainers operate essential functions; can complaints reach a competent decision-maker; can termination proceed without endangering affected residents? These provisions may introduce privacy, cybersecurity, financial, and governance burdens. They must be compared with less demanding safeguards rather than assumed beneficial by definition.

An asymmetry in capabilities does not, by itself, prove exploitation or illegitimacy. Participants may knowingly authorize differentiated responsibilities, specialist authority, or limited delegation because these structures serve common purposes. Conversely, an identical allocation of legal obligations may place an unreasonable burden on an under-resourced party. Assessment therefore requires the origins of the asymmetry, the legitimacy of the consent and governance process, distributive effects, viable alternatives, and any applicable legal obligations. Special caution is required where affected people are absent from negotiations. A state, company, scientific authority, and local community cannot be assumed to possess identical powers to authorize the surrender of others' rights.

### A counterexample to performance-based equivalence

Suppose two transnational partnerships,  $X_A$  and  $X_B$ , attain the same measurement accuracy, service availability, financial reporting, and recorded fulfillment of contractual milestones over the observed evaluation window. Under a reporting map  $\rho$ , they appear equivalent:

$$\rho(X_A) = \rho(X_B). \quad (36)$$

In  $X_A$ , participating institutions retain tested local maintenance capabilities, independently auditable data pathways, and review procedures with enforceable responses. In  $X_B$ , one organization controls the sole functioning analysis service, the evidence register, and all effective authorization for changes. For some specified participant  $i$ , the accessible continuations differ:

$$\text{Reach}_i^{\text{adm}}(X_A \mid D_i) \not\approx \text{Reach}_i^{\text{adm}}(X_B \mid D_i). \quad (37)$$

The second expression is meaningful only when the continuation descriptions and observational horizon are defined consistently. It states an illustrative possibility, not an observed empirical result. Conventional dependency analysis, contract auditing, or capabilities approaches may detect the same divergence. The specific GR test is whether formal reconstruction of the evolving generative conditions detects a relevant mechanism that these established approaches omit under a fair comparison using the same available evidence.

A further difficulty arises when participants' expressed preferences are endogenous to the relation. Suppose an affected organization reports satisfaction after its alternative technical staff have left and its access to independent evidence has narrowed. Its satisfaction may be sincere, strategically expressed, shaped by reduced expectations, or both. Without independent evidence, the analyst cannot infer which explanation applies. A defensible study triangulates participants' own accounts, organizational records, practical demonstrations of alternatives, and procedures that protect participants from retaliation for disagreement. The goal is to preserve the subjects' interpretive agency while investigating the material conditions shaping available choice.

## Power-conditioned consent and the burden of cooperation

Consent to an arrangement, the ability to refuse it, and the capacity to alter it are related but distinct. Consent procedures can be procedurally valid within a specified legal framework while revealing unresolved distributional concerns; some duties cannot be waived even by explicit agreement. In a transnational project, the difference between a promise to “allow review” and the real means to request, finance, and complete review can be decisive. The stronger partner may pay little to provide a standard report while the weaker partner must hire an independent expert, obtain translation, navigate jurisdictional barriers, and risk losing future funding to contest it. Formal reciprocity in textual rights can consequently reproduce unequal costs of accountability.

One research device is a *remedial path audit*: trace an affected party’s concrete complaint from the experience of a problem to receipt of an intelligible explanation, permission to submit evidence, review by a competent and sufficiently independent body, a reasoned determination, and the ability to implement correction without disproportionate retaliation. For each transition, record time, cost, information dependency, safety risk, and institutional veto points. This device overlaps with established access-to-justice and procedural-accountability methods; its GR-specific extension is to trace whether using the remedy itself reduces the party’s capacity to participate in subsequent cooperation. A technically functioning remedy can be costly enough to destroy the complainant’s ability to continue the underlying project.

A similar method applies to preventive diplomacy. When negotiating an information-sharing or confidence-building measure, parties should identify not only what each will disclose but also which disclosures expose particular communities, witnesses, negotiators, or infrastructures to foreseeable retaliation. The OSCE’s information exchange and verification measures provide institutional precedents for reciprocal assurance (Organization for Security and Co-operation in Europe, n.d.). These mechanisms work in historically specific security settings and do not automatically transfer to civil conflict, community mediation, or confidential public services. The United Nations and World Bank (2018) account of conflict prevention highlights exclusion concerning power, security, justice, and resources, supplying a crucial substantive comparator to any GR account of asymmetric vulnerability.

## Implications for differentiated duties and public trust

A capacity-sensitive account may motivate differentiated cooperative obligations. A participant that controls the only essential infrastructure can have distinctive responsibilities concerning continuity, access, security, and protection from arbitrary withdrawal. An institution exercising exclusive authority to classify evidence may require stronger review mechanisms. Yet the distribution of duties must be grounded in law, consent, specific foreseeable harms, negotiated commitments, and defensible ethical reasoning. Asymmetry in power alone neither defines a legal obligation nor authorizes paternalistic intervention. Where parties contest the applicable standards, the disagreement belongs within the normative-translation and institutional-revision analysis rather than being silently resolved by a modeler.

For international scientific cooperation, the GR-informed proposal could be a capacity-impact assessment alongside the usual technical, financial, environmental, and data-protection reviews. For peacemaking, it could be a confidential vulnerability trace that checks whether proposed steps alter the parties’ abilities to remain safe or take part in a subsequent settlement. For public institutions, it could be a practical audit of whether members of the public can access a promised remedy without unreasonable costs and without forfeiting an essential service. Each intervention must be compared with a competent standard method and evaluated through observed changes in safe access, effective remedies, retention of protected capabilities, and independent accountability. Confidence surveys can contribute evidence about subjective experience but cannot substitute for evidence of warranted trustworthiness (OECD, 2024b; Levi and Stoker, 2000).

The central analytic point of this section is therefore conditional. Cooperation redistributes more than outputs and declared obligations: it can change the resources, interfaces, interpretations, and authorizations through which participants continue to act. A theory of generative credibility should identify the relevant pathways and demonstrate that the proposed GR analysis adds discriminating power beyond existing concepts of structural power, dependency, exit, and voice. This requires attention to both legitimate specialization and coercive concentration, to empirical uncertainty, and to the possibility that more extensive monitoring itself becomes a new source of domination. The next section turns to the forms of commitment through which these asymmetric relationships acquire legal, institutional, and informal expression.

### 13 The Formation of Credible Commitments Across Legal and Informal Arrangements

A cooperative relationship may acquire a recognizable structure through a treaty, an administrative agreement, an organizational protocol, a negotiated undertaking, or a repeated practice whose participants develop expectations of its continuation. These arrangements vary in legal status, precision, authority, and public accessibility. Their consequences also vary in ways that are only partially visible in the wording of the commitments themselves. A promise to exchange information is operationally different when the promised information can be produced locally, when its production depends on a single external platform, and when the recipient lacks any means of checking its completeness. The present section develops a capacity-sensitive account of commitment formation that can accommodate this heterogeneity while maintaining legal distinctions. Its object is the relation between a commitment's normative status, its performance conditions, the evidence by which performance becomes recognizable, and the transformations of agency induced by continued implementation.

#### Legal form, political undertaking, and situated expectations

International law supplies indispensable distinctions. The 1969 Vienna Convention on the Law of Treaties (VCLT) defines its treaty category in relation to written international agreements between states governed by international law; its Article 26 articulates the rule that treaties in force bind their parties and must be performed in good faith. Article 31 sets out the general rule of interpretation by reference to terms, context, object, and purpose, with additional provisions addressing subsequent agreements and practice (United Nations, 1969). The Convention's scope and its own temporal applicability require attention when other actors or arrangements are involved. A GR description of heterogeneous relationships therefore must preserve the applicable legal regime, the status of each actor, and the authority by which an undertaking is concluded. A researcher's description of an arrangement as an "institutional commitment" supplies no legal force of its own.

Treaty obligations, politically binding commitments, organizational rules, private contracts, personal assurances, and social expectations may interact without becoming interchangeable. The literature on legalization already distinguishes obligation, precision, and delegation; varying these attributes can make negotiated cooperation possible under uncertainty (Abbott and Snidal, 2000; Koremenos et al., 2001). A softer agreement may provide a framework for experimentation and later specification, whereas a more precise legal instrument may create enforceable rights or clearer grounds for attribution. Neither classification guarantees compliance, fair distribution, or public legitimacy. Political statements can organize consequential conduct even when they lack treaty status; a legally binding treaty can remain difficult to implement in the absence of material or administrative capacity.

The OSCE Vienna Document illustrates a politically binding arrangement encompassing military-information exchange, prior notification, observation, inspections, and evaluation visits (Organization for Security and Co-operation in Europe, 2011). Its institutional significance includes patterned in-

formation flows and opportunities for scrutiny alongside the political nature of its commitments. It would be mistaken to infer that every exchange generates mutual confidence or that the existence of inspections ensures their successful performance under adverse political circumstances. The analytical task is to examine a particular arrangement's actual access rules, execution history, and surrounding security conditions. This example supports a distinction between the status of an undertaking and the practical architecture through which its credibility is pursued.

Informal and local commitments require equal conceptual care. A ceasefire-related channel between community representatives, an internal whistleblowing guarantee, or a research consortium's data-access policy may influence the risks borne by persons who did not draft the original text. Formal signatories, persons whose actions are regulated, beneficiaries, and those exposed to the resulting harms may be different sets. A state representative's authority to enter an agreement cannot automatically be extended into authority to surrender the rights of an affected community. A public body's policy may also be subject to duties imposed by law irrespective of the preferences of its negotiating partners. GR analysis should retain these distinct authorizations rather than collapsing everyone affected into a single consensual subject.

### A typed commitment and its executable conditions

For an institutional configuration  $X$  and relevant history  $h$ , consider a commitment token represented as

$$c = \langle I_c, J_c, q_c, \mathcal{O}_c, \mathcal{K}_c, \mathcal{W}_c, \mathcal{R}_c, \delta_c \rangle. \quad (38)$$

Here  $I_c$  identifies the undertaking actors and their roles;  $J_c$  is the applicable normative or legal regime, including any authority and jurisdiction requirements;  $q_c$  specifies the action, restraint, entitlement, or standard at issue;  $\mathcal{O}_c$  specifies the domain and triggering circumstances;  $\mathcal{K}_c$  comprises the material and organizational capacities needed for performance;  $\mathcal{W}_c$  records permissible evidence of fulfillment or breach;  $\mathcal{R}_c$  identifies review, remedy, or revision arrangements; and  $\delta_c$  describes duration, transitions, or termination conditions. These entries constitute an investigative schema, rather than a claim that a real commitment is exhausted by eight fields. The distinction between an obligation and its operational conditions is especially important: an actor may remain legally responsible even when a missing capability makes compliance difficult, subject to the actual law governing that situation.

Let  $\text{Perform}(c, X, h)$  denote the collection of implementations admissible under the relevant legal and normative regime that realize the performance specified by  $c$ . Let  $\text{Enabled}_i(X, h)$  describe the actions genuinely implementable by actor  $i$ , given personnel, resources, licenses, data access, and permissible authority. A minimal performance-feasibility question is whether an admissible implementation exists whose actor-specific operations lie in the corresponding enabled sets:

$$\exists p \in \text{Perform}(c, X, h) \quad \text{such that} \quad p_i \in \text{Enabled}_i(X, h) \quad (i \in I_c). \quad (39)$$

This existence condition concerns factual feasibility relative to specified assumptions. It is distinct from treaty validity, binding force, enforceability, or justification. It also differs from the probability that a feasible performance will occur. Treating these matters separately avoids turning a philosophical account of generativity into a substitute for legal interpretation or empirical inquiry.

The operational substrate  $\mathcal{K}_c$  often extends beyond parties formally named in  $I_c$ . For example, a bilateral marine-observation agreement might rely on third-party satellite connectivity, a privately maintained calibration library, a laboratory with scarce personnel, and permits issued under another legal regime. These dependencies create a *commitment-support relation*: a given undertaking remains performable through a network of technical, social, and institutional operations. Its nominal bilateral form may conceal a multilateral or ecological implementation structure. Mapping that relation can help locate failure points before an incident occurs, provided that the mapping observes confidentiality, security, and applicable limits on information access.

### Three forms of credibility and their possible divergence

The term “credible commitment” has a long history in game theory and international relations. It often refers to arrangements making fulfillment believable despite incentives to defect or uncertainty about future conduct. The proposed GR investigation does not claim to discover this problem. It instead distinguishes three questions that can become empirically separable. First, *performance credibility* concerns evidence supporting the expectation that specified actions will be fulfilled. Second, *evidential credibility* concerns the accessibility, integrity, and contestability of the basis for deciding whether fulfillment occurred. Third, *generative credibility* concerns how the arrangement affects participants’ capacities to continue participating, executing obligations, challenging decisions, or constructing admissible alternative relationships.

For an actor  $i$  and commitment  $c$ , write the context-indexed assessment as

$$\mathcal{C}_i(c \mid \mathbf{X}, h) = (\mathcal{C}_i^{\text{perf}}, \mathcal{C}_i^{\text{evid}}, \mathcal{C}_i^{\text{gen}}). \quad (40)$$

The components represent families of judgments and evidence, rather than scalar quantities with a common unit. *Generative credibility* is introduced as a provisional analytical term; it does not replace a legal standard of good faith, and it should never be used to infer that an arrangement is invalid simply because some options become unavailable. Specialization, delegated authority, and voluntary mutual commitments can legitimately restrict future options. The research question is whether consequential changes in admissible and implementable capacities remain visible, authorized, contestable, and susceptible to appropriate institutional response.

Consider two public scientific partnerships with identical delivery logs and audit certificates. In the first, each institution maintains verified routes for local calibration, accessible explanations of critical classifications, and a lawful means of obtaining correction. In the second, evidence and technical authority depend on one supplier whose unilateral withdrawal would also disable the service. Both may have high recorded performance. The credible expectation of continuing collective service, however, depends on distinct structures, and one participant’s capacity to contest an erroneous determination may differ substantially. Sections 8 and 12 provide the broader relational setting for this comparison. A testable increment beyond ordinary contract and dependency analysis would require the GR capacity trace to reveal a consequential mechanism that well-specified conventional methods fail to recover from equivalent evidence.

**A typed distinction across the three credibility questions.** Performance credibility refers to warranted expectations regarding a specified commitment  $c \in C$  and its observation procedure  $O$ ; evidential credibility concerns the relation between the admissible histories  $H$  and the records that can support or challenge such expectations; generative credibility concerns the protected continuations and competent remedial or revision operations available to affected subjects. These three assessments therefore require different evidence and need not agree. A high reported compliance rate is evidence relevant to the first question only within its sampling and classification conditions. An independently demonstrated audit trail may support the second, while an interruption test or a documented case of executable review may support the third. Each assessment should state its unit, time horizon, legal scope, and uncertainty before being carried into the praxis instruments in Section 26.

### Composing commitments within a changing relational system

Commitments form networks. Several undertakings may each be intelligible and feasible in isolation, while their execution jointly exceeds a scarce resource, demands contradictory actions, or allocates incompatible authority. This issue connects the partial-translation analysis in Section 7 to the practical management of commitments. Let  $\mathcal{C}^* = \{c_1, \dots, c_m\}$  denote an indexed family of undertakings and

$\text{JointPerform}(\mathcal{C}^*, X, h)$  the set of implementations meeting their applicable obligations simultaneously, with shared capacity, authorization, and temporal constraints enforced. Then

$$[\forall c \in \mathcal{C}^*, \text{Perform}(c, X, h) \neq \emptyset] \not\Rightarrow \text{JointPerform}(\mathcal{C}^*, X, h) \neq \emptyset. \quad (41)$$

The implication fails even in elementary resource-allocation systems. Suppose a laboratory can perform one protected calibration procedure within a critical window. Two agreements, each assessed separately, require that laboratory to conduct distinct, exclusive calibrations during that same window. Each undertaking is individually executable; their conjunction is not. Appropriate rescheduling, additional certified capacity, or authorized modification can change joint feasibility, while unilateral reinterpretation may violate applicable duties. The example is a countermodel to naive pairwise screening, not a newly discovered impossibility in formal logic or operations research.

A specifically GR-oriented extension asks how joint execution and attempts at repair *alter the generative structures* of the participating systems. Temporary sharing may train new local personnel, create portable calibration standards, or redirect political authority over the definition of acceptable measurements. Alternatively, one agreement may quietly establish a technical interface that renders previously independent methods unusable. The feasible set of later commitments can thereby change. A static inconsistency check detects the immediate clash; a historically indexed generative analysis would additionally trace the rule-changing effects of the proposed solution. Whether that extension improves prediction or institutional design is an open comparative question.

The law of treaties already addresses conflicts among successive treaties in specified circumstances, including Article 30 of the VCLT; those doctrines must govern legal analysis where applicable (United Nations, 1969). Equation (41) concerns implementability and logical or operational compatibility, and supplies no alternative rule of priority among legal obligations. Two compatible legal obligations may be jointly difficult to perform because of an engineering bottleneck, while two operationally feasible courses of conduct may nevertheless be prohibited by law. Keeping these distinct avoids a misleading inference from feasibility to permissibility.

## The formation of commitments as GR praxis

For peacemaking, the initial task may be to identify a limited action that parties can undertake safely under a mutually understood protocol. The protocol should specify actors authorized to act, applicable human-rights and humanitarian-law constraints, secure communication routes, independent or mutually acceptable observation, procedures for reporting incidents, protections against retaliation, and conditions for revision. UN mediation guidance stresses preparedness, consent, impartiality, inclusion, national ownership, and relevant law; these are safeguards with an established practice literature, rather than GR inventions (United Nations, 2012). A generative inquiry can add an explicit question: which capacities of protected persons and institutions will the protocol strengthen, expose, or foreclose as it is repeatedly used? A mediator should also examine whether the arrangement's own process can become an instrument of exclusion or surveillance.

For international scientific cooperation, the corresponding exercise may begin with a commitment register whose entries specify data provenance, maintenance responsibilities, evaluation authority, interoperable formats, capacity transfer where appropriate, and a funded transition procedure. The aim is to expose relationships between the promised service and the infrastructure required to keep it meaningful. An agreement to provide a disaster-warning forecast, for instance, becomes operationally credible only to the degree that observations, models, alerts, and public responsibilities remain executable under plausible disturbances. Technical contingency planning cannot settle normative disagreements on its own. Representatives of affected populations may require legally meaningful avenues to question acceptable risk, access decisions, and corrective action.

For organizations and public authorities, a similar method can separate a broad announcement from operational commitments that members of the public can evaluate: which service will be delivered,

which evidence will become available, who can invoke review, what response is mandatory, and what capacity is available to perform the promised correction? Warranted confidence may grow as institutions demonstrate reliability and responsiveness. Public disagreement or refusal to trust may also remain justified. The institutional objective is accountable performance and lawful treatment, not the suppression of criticism or optimization of approval statistics.

A prospective evaluation should compare this GR-informed commitment tracing with a competent baseline combining legal review, dependency analysis, conflict-sensitive assessment, and ordinary risk engineering. Suggested endpoints are documented implementation failures, overlooked capacity dependencies, jointly incompatible obligations, incidents in which formally available remedies cannot be exercised, protection of affected persons, and the resources consumed by the method itself. The hypothesis would gain support if it detects additional consequential mismatches at acceptable cost and without coercive disclosure. It would be weakened where the baseline identifies the same risks equally well. The next section moves from the architecture of commitments to the production of assurance and verification, where the relation between credible evidence and distributed agency becomes particularly sharp.

## 14 Assurance, Verification, and the Boundaries of Institutional Enforcement

An undertaking can be precisely specified and formally binding while its fulfillment remains difficult to establish. Conversely, actors sometimes cooperate through recurring assurances that function in the absence of a strong coercive enforcement body. This difference invites a distinction between the institutional production of assurance, the verification of propositions about performance, and the exercise of authority in response to the resulting judgments. The distinction matters in peacemaking, international environmental cooperation, scientific consortia, and relations between public institutions and the people they serve. A dependable institution requires suitable evidence and practical corrective capacities, but the form and sufficiency of these arrangements are conditioned by applicable law, unequal resources, protected information, and the risks that scrutiny itself may create.

### Three institutional operations: assuring, verifying, and enforcing

*Assurance* concerns the arrangements that make future conduct sufficiently predictable for a specified decision under uncertainty. Guarantees, repeated performance, joint procedures, credible explanations, capacity assistance, and reliable access to a problem-solving forum can contribute to assurance. *Verification* concerns the authorized and methodologically defensible assessment of whether an observable claim is supported by relevant evidence. *Enforcement* concerns the exercise of powers that attach consequences to obligations or determinations. These operations may be organized together, but their purposes and legitimacy conditions differ. The prospect of a sanction can alter conduct without producing accurate evidence; a technical audit can substantiate a proposition while carrying no independent authority to compel correction. Assurance may arise from a trusted relationship or well-designed contingency measures and can remain fragile when it depends on a single actor's continued goodwill.

The classical literature already offers competing explanations of compliance and monitoring. In their managerial account, A. Chayes and A. H. Chayes (1993) argue that shortfalls in international compliance require attention to ambiguity, implementation capacity, and institutional processes as well as incentive-centered enforcement. Common-pool resource research examines monitoring and graduated responses within situated governance arrangements (Ostrom, 1990). GR analysis should work with these precedents. Its possible increment lies in tracing how assurance operations transform the subject-specific possibilities of generating evidence, meeting commitments, obtaining review, and sustaining practical agency. A detailed map of these operations could expose an arrangement that is

highly monitored yet inaccessible to the people most exposed to failure.

An agreement may require periodic disclosure but provide no lawful avenue for affected persons to see the underlying measurements. Another may offer public reporting while withholding technical documentation essential for independent replication. In a third, inspectors may have comprehensive access but possess inadequate means to initiate the repair of a dangerous facility. These are distinct configurations of observation, verification, authority, and response. Evaluating them requires specifying *who can make which claim, using which evidence, before which forum, with what practicable consequence*. Statements that “transparency builds trust” are too indeterminate to answer those questions.

### Evidence chains and actor-relative epistemic access

Drawing on the epistemic and historical distinctions developed in Sections 9 and 10, define an assurance trace for a claim  $q$  as a structured sequence

$$A(q) = (e \xrightarrow{g_1} r \xrightarrow{g_2} w \xrightarrow{g_3} d \xrightarrow{g_4} a), \quad (42)$$

where  $e$  is an event or state of affairs,  $r$  a preserved record,  $w$  a warranted evidential interpretation,  $d$  an institutional determination, and  $a$  a response or authorized action. Each arrow  $g_k$  specifies the mechanisms that permit the next operation: a measurement procedure, a custody record, an inferential standard, a review rule, or an implementation capability. This is an analytic decomposition rather than a universal chronological sequence. In real institutions, investigation, response, monitoring, and reinterpretation can iterate, and some lawful decisions rely on multiple independent evidence paths.

Let  $\mathcal{E}_i(q \mid X)$  denote the admissible observations and verification procedures available to subject  $i$  for a claim  $q$ , given configuration  $X$ . An evidential path may be adequate for one authority while inaccessible to another, even when the latter bears the consequences of the determination. Sensitivity, personal-data protection, investigatory confidentiality, security classification, and legitimate scientific restrictions may justify limits on direct access. Accordingly, the relevant institutional question is whether there exists an adequate *authorized pathway* for a meaningful challenge or independent check, which might be mediated through a court, ombudsperson, technical auditor, protected representative, or other competent reviewer.

For a specified set of material claims  $Q_i^*$  affecting subject  $i$ , consider the conditional coverage test

$$\begin{aligned} w &\in \mathcal{E}_{i \rightsquigarrow f}(q \mid X), \\ \forall q \in Q_i^* \exists (w, f, a) : & \quad f \in \text{Forum}_i^{\text{adm}}(q \mid X), \\ & \quad a \in \text{Response}_f^{\text{feas}}(w, q \mid X). \end{aligned} \quad (43)$$

Here  $w$  is an authorized evidential pathway,  $f$  a competent and practically accessible forum, and  $a$  at least one lawful and feasible responsive action, which may include reasoned rejection of a claim after proper consideration. The arrow in  $\mathcal{E}_{i \rightsquigarrow f}$  indicates that protected intermediated access can satisfy the criterion where direct disclosure would be unlawful or unsafe. This is a deliberately demanding *institutional design screen*, rather than a universal legal entitlement to any particular remedy. Which claims are material, who has standing, what procedural guarantees apply, and which responses are appropriate must be determined by the relevant legal and normative regime. The criterion also cannot establish that an actual response will be effective or fair merely because it is feasible on paper.

The different arrows in Equation (42) can fail separately. A sensor produces valid observations, but the files are lost. Records are intact, but their calibration history is unavailable to reviewers. A report is credible, but the institution lacks jurisdiction to order a correction. An order is issued, but its implementation depends on a supplier that has ceased operation. Treating all four breakdowns as a generic “trust deficit” would obscure different intervention choices. A generative analysis adds a further question: does correcting one failure create enduring access to a newly independent evidentiary route, or does it deepen another actor’s monopoly over the conditions of verification?

## Comparing institutional verification regimes

Existing institutions illustrate meaningful diversity without supplying a simple ranking. The Organisation for the Prohibition of Chemical Weapons (OPCW) administers declaration and inspection activities under the Chemical Weapons Convention, supported by technical verification and laboratory capacities (Organisation for the Prohibition of Chemical Weapons, n.d.). The instruments and authorized purposes of this regime arise from a specific legal setting and particular security risks. Its example illustrates how an institution can combine declared information with inspections and technically specialized assessment. It does not establish that intensive inspection is suitable for every institutional domain or sufficient by itself to settle political disputes.

The OSCE Vienna Document uses exchanges of military information, notifications, observation, inspections, and evaluations as confidence- and security-building measures (Organization for Security and Co-operation in Europe, 2011; Organization for Security and Co-operation in Europe, n.d.). Here, access and predictability form part of a politically negotiated assurance architecture. Its performance is contingent on the conduct of participating states and changing regional conditions. Verification opportunities should be distinguished from demonstrated verification success, just as a formal obligation to exchange information should be distinguished from accurate and complete reporting. The availability of such measures can support diplomatic risk reduction while leaving fundamental political disagreements unresolved.

The Paris Agreement offers a contrasting architecture. Its Article 15 establishes a facilitative, expert-based, transparent, non-adversarial, and non-punitive mechanism that attends to differing national capabilities and circumstances. The Paris Agreement Implementation and Compliance Committee identifies means of facilitating implementation and compliance; it does not act as a penalty-imposing tribunal (United Nations Framework Convention on Climate Change, n.d.). These features show why enforcement cannot be equated with sanctions. Technical reporting, consultation, recommendations, and institutional support can have practical effects, although their effects require case-specific evaluation. The Paris regime also distinguishes reporting and process obligations from the substantive content of nationally determined contributions; claims about actual legal compliance must specify the relevant provision and applicable procedure.

The regimes differ in purposes, legal bases, authority, available resources, affected populations, and security requirements. A cross-case comparison can illuminate distinct assurance pathways, while direct transfer of one regime's design to another would require justification. Importantly, the presence of an independent verification body is insufficient to guarantee accessibility to every affected community; conversely, direct publication of all raw data could compromise safety, privacy, or legitimate confidentiality. The quality of verification must be evaluated together with protection, public accountability, and the capacity to respond to evidence.

## The verification–agency divergence

Consider two hypothetical cross-border flood-warning partnerships that publish identical monthly reliability scores and undergo equally frequent technical assessments. Each partnership has an independent evaluator with permission to examine the raw signal stream. In arrangement *A*, the local authority additionally retains calibration documentation, trained maintainers, an accessible route for residents to challenge missed warnings, and the authority to commission an alternate provider under specified conditions. In arrangement *B*, the evaluator alone can examine the raw signal stream, all corrective actions depend on approval from the external provider, and local staff can access only the resulting score. The systems can produce observationally equivalent assurance summaries while supporting different relations of agency.

Let  $\rho_A(X)$  denote an externally published assurance report, and let  $\text{TraceReach}_i(X; Q_i^*)$  capture the

admissible assurance and correction paths open to  $i$  for material claims. It is possible that

$$\rho_A(X_A) = \rho_A(X_B) \quad \text{while} \quad \text{TraceReach}_i(X_A; Q_i^*) \neq \text{TraceReach}_i(X_B; Q_i^*). \quad (44)$$

This constructed counterexample shows a limitation of the chosen reporting map. It does not prove that existing audits or theories overlook the divergence: competent access-control analysis, resilience engineering, and administrative law may already reveal it. The GR hypothesis is sharper. A history-aware mapping of generative conditions might identify additional risks arising from the way repeated verification changes personnel competence, data independence, evidential authority, or opportunities for institutional revision. Such an incremental advantage would need to be demonstrated against suitably informed competing methods.

A possible adversarial test would supply the same sequence of documents and performance records to two independent groups. One group uses an established assurance and institutional-risk protocol; the other uses that protocol supplemented with a pre-registered GR trace of the capacities needed for evidentiary challenge and response. Blind evaluators would score consequential failure pathways identified before the simulated disturbances, false alarms, intervention burden, effects on protected persons, and whether the proposed responses are legally and technically executable. If the supplemental trace improves neither detection nor response, its specialized complexity would lack justification in that application. If it identifies a failure invisible only because the baseline was deliberately weakened, that too would fail to establish novelty.

### Limits of enforcement and the ethics of institutional response

Enforcement authority should be assessed through the applicable law and the practical consequences of its use. Sanctions may create incentives, but they can also impose costs on third parties, disrupt vital services, or intensify conflict. Independent observation may produce useful evidence while placing sources or witnesses at risk. Stronger monitoring may shift power toward actors who control the instruments, repositories, and standards used to verify performance. An institution seeking a more credible cooperative arrangement therefore must examine proportionality, reviewability, foreseeable effects, and the practical capacities of those subject to intervention.

A useful decision sequence begins by clarifying the obligation and forum, then separating incapacity, ambiguous interpretation, error, concealment, and deliberate breach as competing possibilities. This is a diagnostic separation, not a presumption that any suspected failure is innocent or culpable. Where urgent protection is necessary, a lawful protective response may precede exhaustive explanation. Where disagreement concerns a disputed measurement, a protected independent review may be more appropriate than immediate punitive escalation. Where a partner lacks the means to comply, appropriately designed capacity assistance may increase the feasibility of performance. These approaches have longstanding precedents in managerial compliance and effective mediation; GR would need to contribute a more precise reconstruction of what each pathway does to the continued capacities and vulnerabilities of the affected subjects (A. Chayes and A. H. Chayes, 1993; United Nations, 2012).

In public trust-building, the practice of displaying a report should be distinguished from demonstrating that disputed findings can lead to a competent response. A public agency might release full statistics about complaint completion while giving affected people no usable means to correct an erroneous decision. It might also provide a formal appeals process that fails in practice because filing costs exceed a person's resources. A GR assessment would trace evidentiary access, effective representation, institutional authority, and executable relief without assuming that every criticism must be accepted. The aim is an institution whose claims and reasons can be tested appropriately, and whose lawful decisions remain accountable.

In peacemaking, assurance must preserve consent and the safety of vulnerable people. Reporting mechanisms may need protected intermediaries, delayed disclosure, or strict restrictions on identifiable information. An apparently efficient exchange of information can become dangerous when one party

can target those who supplied it. Independent monitoring is valuable only within a credible safeguard architecture and an appropriate legal mandate. Mediation practice emphasizes informed consent, impartiality, inclusion, and attention to international normative frameworks (United Nations, 2012). A purported peacebuilding mechanism that violates those conditions cannot be justified solely by a predicted rise in cooperation or public confidence.

### A prospective protocol for evaluating assurance architectures

A practical evaluation can be organized around a bounded set of claims rather than an abstract trust index. Investigators would document the applicable commitments; identify the affected subjects and their standing; describe the provenance and reliability of evidence; test who can commission a review; examine the lawful powers available to respond; and verify whether corrective actions remain executable during adverse events. Indicators could include time to resolve a disputed claim, the fraction of material claims with tested review pathways, access barriers for affected groups, reproducibility of protected technical assessments, continuity of essential services during disputes, restoration of wrongful losses where law permits, and the distribution of training and maintenance capacities. Where quantitative figures are available, their collection methods and denominators should be disclosed.

Every measure requires interpretation. Faster resolution can conceal premature dismissal; a larger number of complaints can reflect improving access rather than worsening institutional integrity; greater formal access to data can coexist with an inability to understand it. Evaluation should therefore combine administrative records, legally appropriate independent audit, documented process tracing, and safeguarded accounts from affected participants. Comparable cases should be chosen for institutional purpose and operating conditions rather than superficial similarity of labels. Disconfirming cases—including arrangements in which intensive verification increases insecurity or in which lighter monitoring supports reliable cooperation—are particularly important.

The resulting inquiry treats institutional credibility as a changing relation among obligations, evidential capacities, review authority, and practical responses. It leaves open the relative merit of particular regimes and respects that legitimate institutional design may balance values that cannot be reduced to a universal ranking. The following section considers how shared infrastructures themselves become both means of cooperation and sources of new dependency, extending the assurance analysis from procedural architecture to the material conditions of continuing institutional agency.

## 15 Shared Knowledge and Productive Infrastructure as Both Resource and Dependency

The institutional problems of assurance and verification extend into the infrastructures through which cooperative relations become materially possible. A treaty may assign duties, yet an environmental monitoring system must still gather observations, transmit measurements, preserve calibration histories, maintain models, and produce judgments that relevant participants can use. A scientific partnership may distribute publications and computing credits while only one partner can maintain the instruments, authorize access to raw data, or approve methodological changes. Infrastructure is consequently a productive resource and an arrangement of authority. Its governance shapes both what cooperation can generate and what each participant can continue to do when the shared arrangement encounters a failure, disputed decision, or change of ownership.

The preceding distinction between performance credibility, evidential credibility, and generative credibility (Section 13) provides the organizing question. Suppose a common platform reliably delivers observations or predictions. What does this reliability establish about its participants' abilities to reproduce those outputs, correct a flawed classification, change the governing rules, or maintain essential services following withdrawal of another participant? The answer depends on the particu-

lar infrastructure and on the legally and practically accessible paths for exercising these capacities. Here GR can be useful only where the relational specification identifies a difference left unresolved by competent infrastructure-governance and organizational analyses.

### Knowledge infrastructures are historically organized productive relations

Infrastructure is broader than a physical apparatus. A shared ocean-observation arrangement may depend on seafloor instruments, surface vessels, telemetry, electrical power, cloud storage, calibration standards, competent technicians, research permits, licensing terms, local knowledge, contractual liability, and forums for contesting decisions. Some components are readily substitutable and others become bottlenecks within the relevant time or resource budget. The arrangement's outputs are generated by the connected activity of these heterogeneous components, rather than by the information platform alone. Its history matters: successive design decisions determine which organizations acquire expertise, which data formats become habitual, and which participants can maintain the system without another participant's permission.

Infrastructure studies and the theory of boundary objects already describe how heterogeneous communities coordinate through standards and shared representations (Star and Griesemer, 1989). Common-pool and polycentric governance research examines the institutional arrangements that enable collective resource management (Ostrom, 1990; Ostrom, 2010). The FAIR guiding principles address the findability, accessibility, interoperability, and reusability of research data (Wilkinson et al., 2016). The CARE principles insist that data governance also address collective benefit, authority to control, responsibility, and ethics, particularly in Indigenous data contexts (Carroll et al., 2020). These foundations prevent a claim that GR has newly discovered infrastructural dependence or the political character of data stewardship. They also provide concrete baselines for evaluating any proposed GR diagnosis.

The economic structure of the arrangement may distribute short-term outputs and long-term productive capacities differently. Research participants can receive equivalent processed datasets while acquiring very different capacities to repair sensors, check a computational model, renegotiate access terms, or establish a lawful successor infrastructure. Monetary compensation for contribution and technical dependence can also evolve independently. These considerations extend the value-circulation account in Section 8: control over the conditions of continued production is an analytically distinct object from the allocation of already produced goods. The normative assessment nevertheless remains situated. Concentrating specialized expertise may be efficient, safely regulated, and voluntarily accepted; duplicating complex equipment can create ecological damage or unjustified expense. The relevant questions concern the legitimacy of the arrangement, its exposure to identifiable disruptions, and the availability of proportionate alternatives.

### A typed infrastructure-dependency representation

Let  $\mathcal{K}$  denote a cooperative infrastructure with a declared analytical boundary. Represent its components and relations by

$$\mathbf{K} = (V_K, E_K, \lambda_K, \mathcal{A}_K, \mathcal{C}_K), \quad (45)$$

where  $V_K$  contains resources, actors, facilities, and information artifacts;  $E_K$  contains typed dependency links or hyperedges;  $\lambda_K$  attributes technical and normative properties to them;  $\mathcal{A}_K$  identifies permissions and authorities; and  $\mathcal{C}_K$  describes capacities, maintenance conditions, and resource costs. The graph is a modeling convenience, with hyperedges or constraint systems needed where several components must act jointly. A dependency may indicate physical energy supply, informational interoperability, contractual authorization, certification authority, or lawful access to a grievance procedure. Only relations causally or institutionally relevant to the specified activity should enter the model.

A feasible operational path for participant  $i$  and task  $d$  can be represented as a task-typed realization  $p \in \mathcal{P}_i^d(K, h; B)$ , where  $h$  is the documented relational history and  $B$  is a resource, time, safety, and legal budget. Membership requires the necessary permissions, competencies, inputs, and protected rights for completing the task. Different tasks generate distinct sets: one participant may have an accessible path for reading an environmental forecast, but lack a path for validating the forecast, changing the classification rule, or obtaining an authorized institutional correction. Write these capacities as

$$\mathbf{P}_i(K, h; B) = (\mathcal{P}_i^{\text{operate}}, \mathcal{P}_i^{\text{verify}}, \mathcal{P}_i^{\text{maintain}}, \mathcal{P}_i^{\text{contest}}, \mathcal{P}_i^{\text{revise}}). \quad (46)$$

The tuple is intentionally typed rather than a single scalar score. A researcher should specify what a path can actually accomplish, including its jurisdiction and required authority. Formal data-access permission may be insufficient if software, calibration records, network connectivity, trained staff, or an affordable review procedure are missing. The presence of a backup copy similarly establishes little if the backup remains encrypted under a single actor's exclusive control or cannot be operated with available expertise.

For a task  $d$ , define a *dependency cut*  $D \subseteq V_K \cup E_K$  relative to participant  $i$ , a disruption class  $\Delta$ , and a declared budget  $B$  if disabling the capacities represented by  $D$  removes all admissible realizations of the task for that participant under at least one specified disruption  $\delta \in \Delta$ . This is an analytical borrowing from network reliability, not a new graph-theoretic result. What the GR specification potentially adds is the requirement to distinguish a physical cut from an *authorization cut*, an *evidential cut*, and a *remedial cut*. An institution may possess multiple servers yet have only one body authorized to approve an appeal. It may have independent technical operators yet rely on a single actor to issue the license needed for continuity.

A task-level robustness question can therefore be stated as

$$\text{Robust}_i^d(K; \Delta, B) \iff \forall \delta \in \Delta \exists p \in \mathcal{P}_i^d(K \mid \delta, h; B). \quad (47)$$

The formula defines a stringent, scenario-relative property. It neither assumes that every imaginable disruption should be survived nor imposes complete independence as a moral requirement. Scenario selection, resource limits, acceptable degradation, and applicable rights must be documented; some emergency measures legitimately prioritize collective continuity over unilateral choice. Where the task itself changes through learning or institutional revision, the admissible path set and its underlying mechanism must be updated rather than treated as permanently fixed.

### A counterexample: resilient output with fragile cooperative agency

Consider a constructed transnational marine-observation partnership comprising two coastal institutions and one shared computing operator. In configurations  $K_A$  and  $K_B$ , two geographically separate servers deliver identical forecasts, dataset products, and availability metrics during an agreed observation period. Under the selected reporting regime  $R$ , both configurations satisfy

$$\mathcal{O}_R(K_A) = \mathcal{O}_R(K_B). \quad (48)$$

In  $K_A$ , each coastal institution can submit a disputed classification to an authorized independent reviewer, access a protected calibration archive, and operate a lawful successor process if the computing operator exits. In  $K_B$ , the two servers still provide redundant computation, while their credentials, calibration archive, and revision permissions all depend on an exclusive authorization held by the operator. Under a specified loss of that authorization, feasible paths for verification and continuation persist in  $K_A$  and disappear in  $K_B$ .

This is a logical counterexample to the inference from ordinary output redundancy to participant-specific institutional robustness. It is constructed by stipulation and makes no empirical claim about

an existing marine consortium. Its usefulness is conditional on whether an actual infrastructure assessment would otherwise omit the relevant authorization relations. Standard cybersecurity, disaster-recovery, and data-governance methods may already identify such dependencies. A GR representation becomes informative only if it clarifies how authorization, knowledge reproduction, and institutional revision jointly shape the accessible continuation set, or if its comparative implementation produces a defensibly different design decision.

The example also cautions against equating organizational autonomy with desirable governance. Independent access to sensitive marine-location information could expose protected ecological sites or vulnerable communities. An authorized reviewer may need confidentiality duties, conflict-of-interest safeguards, secure processing, and restrictions on downstream disclosure. The capacity worth preserving is the capacity to achieve legitimate, bounded purposes using procedures consistent with applicable law and ethical obligations, rather than unrestricted control over every input.

**From access rights to effective continuations.** A technical access permission, a contractual permission to retain copies, a competent right to publish an interpretation, and the funded ability to operate replacement equipment produce different continuation possibilities. In the notation of Section 24, the relevant test is therefore a protected query on  $\mathcal{R}_i^{(d)}(X; \Theta)$  under a documented provider failure or authorization change, with its observation scheme and safety restrictions specified independently. An account of dependency should record the party capable of altering each interface and the lawful recourse available if that interface fails. The result may confirm an ordinary resilience or institutional-capability analysis. Its status as an additional GR finding depends on an independently adjudicated distinction beyond that competent baseline.

### Institutional practices for shared environmental and scientific systems

The World Meteorological Organization’s Unified Data Policy supplies a concrete institutional comparator. Its distinction between *core* and *recommended* Earth-system data, together with commitments concerning international exchange, illustrates how shared scientific production requires differentiated rules rather than a blanket norm of unrestricted distribution (World Meteorological Organization, 2021). GR analysis should ask what further obligations or implementation capacities are needed to make access practically usable: data formats, durable metadata, interpretation competence, local maintenance, lawful reuse, and the ability to challenge materially consequential errors. These questions belong alongside, rather than above, existing meteorological and data-governance standards.

A prospective capacity-impact assessment for a shared scientific infrastructure could proceed through five operations. First, specify the legitimate tasks and public purposes supported by the arrangement, identifying relevant affected people and competent institutional authorities. Second, map the physical, informational, and procedural dependencies necessary for those tasks, including who can withdraw or alter a crucial authorization. Third, use applicable data-governance, security, and operational-resilience practices as the baseline, documenting uncertainty and protected information. Fourth, compare feasible designs—such as interoperable replicas, trained local maintenance teams, independently reviewable calibration records, conditional escrow, delegated authority, or purpose-limited third-party access—against the baseline. Fifth, monitor whether the selected arrangement actually improves lawful task continuity, evidential review, and remedy access without creating disproportionate cost, privacy intrusion, environmental burden, or security risk.

Peacemaking and preventive diplomacy offer a related but more sensitive application. A technical confidence-building project may propose a jointly managed record of ceasefire incidents or environmental damage. The same infrastructure could expose sources, generate disputes over classification, or become a symbol of unilateral surveillance. Protected review procedures, consent-based access, adversarial testing of interpretation, and explicit rules for correcting reports may reduce some risks. Other contexts may justify limiting the collection itself. A GR-oriented capacity trace asks whether

the actors can sustain a safe and bounded relationship after a challenge to the records; it must never assume that data sharing is sufficient for reconciliation or that an observer may demand disclosures that threaten participants.

The analytical contribution of this section is a distinction among infrastructure output, operational redundancy, and the typed continuations available to each participant. Its empirical value remains open. A useful test compares conventional infrastructure assessments with the added capacity and authorization trace under the same facts and resource constraints. If both methods detect the same relevant bottlenecks and recommend equally defensible safeguards, the GR vocabulary offers organizational synthesis rather than demonstrated incremental explanatory power. The following section examines the evidential side of these infrastructures: how records become claims, whose judgments become actionable, and where accountability may be interrupted.

## 16 Evidential Accountability and Control over What Can Be Known

Cooperative institutions act on descriptions of the world. Their descriptions may include atmospheric concentrations, contested incidents, ecological indicators, laboratory results, public complaints, financial records, or the performance of an algorithmic service. Every consequential description depends upon choices concerning observation, sampling, classification, interpretation, and the authority to accept or challenge a conclusion. Section 14 distinguished assurance, verification, and enforcement. The present inquiry makes a related and more specific problem central: *which persons and organizations can participate in generating, disputing, correcting, and using the evidence by which institutional decisions are justified?* This question connects knowledge production to the distribution of practical authority and to the reproduction of cooperative capacity.

An institution may publish accurate aggregate reports while leaving a particular community unable to contest the classification governing its livelihood. A government service may explain a decision in ordinary language without enabling an affected person to correct a material error in the underlying records. Conversely, an institutional promise of unrestricted disclosure may expose witnesses, personal information, protected scientific sites, or confidential negotiation. Therefore, evidential accountability requires specification of lawful access, competent interpretation, review authority, practical remedy, and limits on disclosure. The objective is warranted trustworthiness and contestable decision-making; trust responses recorded in surveys are a distinct empirical outcome (OECD, 2024b; O'Neill, 2002).

### How evidence is produced across heterogeneous institutions

The production of a claim involves a sequence of distinguishable operations. Observation establishes a record under specified instruments or testimony procedures; sampling selects a subset of conditions; measurement or coding maps observations into an informational format; classification places the resulting representations within categories; interpretation assigns a claim relative to a question; institutional determination gives some claims operative standing; and an authorized response may revise a decision or address an identified harm. In practice, these operations are frequently distributed across separate institutions, governed by different legal rules, and revised through feedback. An automated model may enter at several stages, while accountable humans and institutions remain responsible for their authorized decisions under the applicable governance regime.

The W3C PROV data model provides an established vocabulary for recording relationships among entities, activities, and agents (World Wide Web Consortium, 2013). Its existence is important for delimiting our contribution: a provenance graph by itself is already available without GR. The additional task is to connect the provenance of a claim with the practical conditions of legitimate challenge, institutional correction, and continuation of participation. A complete-looking audit trail can still lead to an inaccessible forum. Conversely, a community may have a viable remedial route through quali-

fied intermediaries even when broad public access to all source materials is inappropriate. We should model such alternatives rather than assume that one mode of access suits all knowledge systems.

For a claim  $q$ , consider an evidential process represented as a typed sequence

$$e_0 \xrightarrow{\mu_1} e_1 \xrightarrow{\mu_2} e_2 \xrightarrow{\mu_3} q \xrightarrow{\mu_4} d \xrightarrow{\mu_5} a, \quad (49)$$

where  $e_0$  is a recorded observation,  $e_1$  a curated or calibrated representation,  $e_2$  an interpreted evidential object,  $d$  an institutional determination, and  $a$  an available action. Each  $\mu_k$  is supplied with provenance, a declared domain of validity, a responsible actor or institution, an uncertainty representation where applicable, and any governing access or authority conditions. The chain is schematic: actual evidential relations may branch, combine independent sources, or return to earlier transformations. An analyst must avoid mistaking the availability of  $d$  for proof that the premises or transformations are uncontested or that  $a$  can actually be carried out.

The epistemic representation  $\rho_i$  from Section 6 may grant participant  $i$  access to some components of this process and leave others inaccessible. Access has at least four distinguishable meanings: permission to inspect an object, practical ability to interpret it, standing to contest its role in a determination, and capacity to obtain an appropriate response. A decision-maker may be required to protect sensitive identities while providing an intelligible statement of reasons. The investigator must consequently distinguish a withheld record from an unreviewable decision, and withheld public access from properly authorized independent access.

### A task-specific criterion for effective evidential contestation

Let  $\mathcal{Q}_i$  denote the claims that can materially affect participant  $i$  in a declared institutional setting. For  $q \in \mathcal{Q}_i$ , define  $\text{Route}_i(q \mid X, B)$  as the set of authorized, practically executable procedural continuations by which the participant or an accountable representative may present a relevant challenge, have it considered by a competent forum, obtain reasons, and access an available correction or remedy if the challenge is substantiated. The continuation is conditioned by resource budget  $B$ , language needs, evidential access, applicable law, privacy and safety safeguards, and the forum's actual authority. An institution may provide an explanation without offering a review route, or may provide review without the capacity to implement a correction.

An intentionally demanding reference property is

$$\text{Contestable}_i(\mathcal{Q}_i; X, B) \iff \forall q \in \mathcal{Q}_i^{\text{reviewable}}, \text{Route}_i(q \mid X, B) \neq \emptyset. \quad (50)$$

The superscript “reviewable” is essential: the reference class must be established by applicable rights, jurisdiction, and justifiable procedural scope, rather than by the author's preference. The condition expresses the availability of a meaningful route, not a guarantee that a challenge succeeds. It is also stronger than a claim of administrative transparency. In empirical settings, the route may be partially observable, vary with the category of affected person, and fail because of cost, threatened retaliation, or lack of technical representation. The presence of a formally published procedure therefore supplies necessary documentary evidence but does not by itself establish its effective accessibility.

The criterion does not license compelled disclosure or indefinite appeal. National security, witness protection, medical privacy, ecological protection, and the rights of other participants can justify substantive restrictions and carefully designed substitutes such as a security-cleared reviewer, aggregated evidence, confidential hearings, anonymized inspection, or a purpose-limited auditor. The adequacy of substitutes depends on independence, technical competence, safeguards, accountability, and meaningful authority to act. A claim that the route is available must be sensitive to the fact that some people cannot pay for expert review, communicate in the institution's chosen language, or safely appear in an adversarial process.

## The evidence–agency divergence

A simple constructed comparison isolates a potential failure of inference. Suppose institutions  $A$  and  $B$  publish the same corrected environmental indicator series and use the same stated decision criteria. Their public reports and sampled accuracy under reporting regime  $R$  are indistinguishable:

$$\mathcal{O}_R(X_A) = \mathcal{O}_R(X_B). \quad (51)$$

Both institutions have a legitimate reason to protect the identities of field witnesses. In  $A$ , an accredited independent reviewer can inspect suitably protected source records, correct an erroneous sampling designation, and transmit a binding or otherwise effective finding to the decision-maker. In  $B$ , the published categories are generated with similar recorded accuracy, yet the only available challenge consists of submitting a comment to the same office that controls the disputed evidence; that office has neither a duty to explain its treatment of the objection nor an operative correction process. For an affected participant  $i$  whose livelihood is governed by the category, the two systems may therefore satisfy

$$\text{Route}_i(q \mid X_A, B) \neq \emptyset, \quad \text{Route}_i(q \mid X_B, B) = \emptyset. \quad (52)$$

The example demonstrates a conditional divergence between reported evidential performance and effective contestability. It is neither a claim about a real institution nor a novel theorem. Existing administrative law, procedural justice, and audit scholarship often identify comparable deficits. The specific GR question is whether incorporating the participant's changing access to lawful continuation improves the assessment of cooperative credibility beyond conventional procedural review.

A reverse comparison is equally necessary. Suppose a transparency reform publicly releases exact coordinates of a protected nesting site or identifying information about a vulnerable witness. General public access increases, but the safety conditions that supported observation and participation can deteriorate. Future witnesses may withdraw; ecological harm may rise; and the available evidence may become less representative. A model treating disclosure as a monotonically desirable variable would reach the wrong conclusion. GR analysis must instead specify whose rights, capacities, and duties are affected, which knowledge remains appropriately restricted, and whether authorized independent scrutiny provides a workable alternative.

## Classification, partial translation, and multilateral evidence

Evidence can be distorted at the interface between institutions. A coastal community might classify a marine area using seasonal ecological knowledge, while a government registry describes the same space through legal zoning and an international research consortium uses a statistical habitat category. Each classification has a purpose and jurisdiction; none can be presumed to be a universal replacement for the others. The partial translations  $\tau_{ij}$  examined in Section 7 may preserve measurement units without preserving normative significance, evidential burden, or the standing of the originating knowledge holders.

For a proposition  $q$  that is meaningful in language  $\mathcal{L}_i$ , two admissible translation routes can produce different institutional claims:

$$\tau_{jk}(\tau_{ij}(q)) \quad \text{and} \quad \tau_{ik}(q). \quad (53)$$

The relevant question is whether both expressions are defined and preserve the particular attributes needed for the receiving institution's decision: measurement comparability, evidential provenance, normative standing, and affected-party rights. A discrepancy may reflect a mapping error, a legitimate difference in purpose, or an institutional conflict over whose categories govern. The latter cannot be resolved by syntactic translation alone. A review process may need parallel classifications, documented non-equivalences, and a mutually authorized rule for acting under uncertainty. Such arrangements would be prospective design hypotheses requiring comparison with existing boundary-object practices and domain-specific scientific standards (Star and Griesemer, 1989; Merry, 2006).

The FAIR and CARE frameworks provide useful constraints for such proposals. Discoverability and interoperability are valuable for collaboration, while the legitimate authority of knowledge holders and obligations concerning collective benefit can restrict reuse in ways that must be honored (Wilkinson et al., 2016; Carroll et al., 2020). Distinct data systems and normative regimes may therefore need negotiated interfaces rather than unrestricted integration. The availability of technical transformation is a different matter from authorization to perform it, and neither alone settles who should govern its consequences.

### From GR diagnosis to an accountable evidential practice

An implementable GR-informed audit should begin with one consequential claim and a clearly defined institutional decision. Identify the affected participants and rights holders, the decision's legal and practical effects, and a plausible error or disagreement that the decision procedure must be able to address. Reconstruct the evidence chain: who observes, samples, processes, classifies, interprets, stores, circulates, and uses the result. For each transformation, record documented uncertainty and the authority to inspect, question, or amend it. Select a competent comparator—a provenance audit, an access-to-justice assessment, a data-protection impact assessment, an administrative-law review, or a conflict-sensitive mediation procedure—before applying additional GR concepts.

The GR increment is a *continuation trace*: for a specific affected participant, determine whether a lawful and affordable route from the alleged error to a meaningful correction remains reachable, and identify which material, informational, or institutional dependencies prevent it. The analysis should distinguish failures caused by missing evidence from those caused by missing authority, and both from cases in which a disclosure would impose unacceptable safety or rights risks. Candidate interventions can include protected data enclaves, accredited independent review, documented translation interfaces, accessible technical assistance, community-led validation when authorized, or revision of a decision rule. Each carries costs and risks, and an apparent improvement to one participant's access may diminish others' privacy or safety.

For peacemaking, the trace might examine a contested incident report used to determine compliance with a provisional local agreement. With the parties' consent and suitable protection of sources, a competent independent channel could review a limited class of disputed events and issue reasons or corrections according to agreed procedures. The outcome of interest would be the safety, fairness, and usefulness of that process, including its ability to preserve continued dialogue under disagreement. A higher reported level of trust is neither the sole nor the required indicator. Where accurate classification is impossible without endangering people, the warranted practical response may be to narrow the evidential claim or suspend the proposed intervention.

For public institutions, the procedure might audit a disputed eligibility decision, identifying whether the individual can access intelligible reasons, bring corrective evidence, obtain review, and receive an effective remedy. For an international scientific consortium, it might inspect a consequential calibration or model-version change and whether member organizations can independently reproduce the change's effects under lawful access terms. In both cases, additional documentation and review should be compared against the baseline for error correction, protected rights, time to remedy, staff burden, cost, and the retained ability of affected participants to continue engaging with the institution.

This section's proposed contribution is therefore conditional and evaluable. Evidential accountability is treated as a coupled relation among knowledge production, authority, contestability, and the feasible continuations of affected subjects. Its novelty must be established through comparative explanatory or practical results, since related insights are already found in provenance standards, procedural justice, data sovereignty, and institutional trust research. The subsequent analysis of participation, representation, and revision authority will ask whether the institutions that construct evidence also afford affected subjects meaningful standing to transform the rules through which evidence gains public force.

## 17 Participation, Representation, and Institutional Revision Authority

The evidential arrangements of Section 16 determine whether consequential claims can be examined and challenged. Yet a further question remains when the claims themselves are accurate: *who is entitled and practically able to participate in choosing the purposes, distributions, and governing rules of cooperation?* A community may receive a faithful explanation of an environmental-risk assessment and still lack any meaningful means of influencing where protective infrastructure is installed. A scientific partner may reproduce every calculation and still be excluded from decisions concerning access conditions or the future use of its contributions. Meaningful participation therefore requires analysis of the institutional relationship between a contribution and the authority empowered to respond to it.

Participation and representation have extensive legal, democratic, and organizational histories. The right to participate in public affairs is recognized in international human-rights law, although its legal scope, holders, and implementation differ from consultation rights established in other settings (United Nations Human Rights Committee, 1996). The Aarhus Convention relates environmental information, public participation, and access to justice, while the OECD's guidelines distinguish participation methods and emphasize designing a process around decisions that participants can genuinely influence (United Nations Economic Commission for Europe, n.d.; OECD, 2022). The *ILO Indigenous and Tribal Peoples Convention*, No. 169, specifies duties of consultation through representative institutions for parties to that Convention, under the conditions set out in its provisions (International Labour Organization, 1989). These sources provide stronger, more specific grounds than a general assertion that GR requires participation. They also caution against treating legal status, consultation duties, and the authority to decide as interchangeable.

The GR inquiry begins from the consequences of these institutional arrangements for the continuation of agency. Its distinctive question is whether a participant can affect not merely the current choice within a fixed menu but, where appropriately authorized, the rules through which future choices, evidence, and standing become possible. This proposition does not confer a universal veto on all affected persons. Decision authority requires legal and normative justification, practical competence, safeguards against capture, and attention to other affected rights and interests. The formal model instead seeks to specify which pathways exist, which are blocked, and what those differences mean for later cooperative possibilities.

### Contributions, standing, and consequential participation

A public meeting, signed consultation sheet, stakeholder survey, or invitation to testify may record procedural activity. Its significance depends on the decision context. Participants may be able to supply information without being authorized to initiate a review; they may propose alternatives without receiving reasons for rejection; they may elect representatives without being able to scrutinize how those representatives exercised delegated authority. Conversely, a consequential consultation can legitimately yield a decision that some participants oppose, provided the applicable rights and procedures are respected. An outcome favorable to every participant is neither a possible universal standard nor the definition of participation.

For a specified institution  $J$ , decision domain  $d$ , and subject  $i$ , consider a typed participation profile

$$\Pi_i^{J,d} = (\mathcal{A}_i, \mathcal{I}_i, \mathcal{P}_i, \mathcal{Q}_i, \mathcal{U}_i, \mathcal{F}_i). \quad (54)$$

Here  $\mathcal{A}_i$  denotes legally and practically accessible modes of entry,  $\mathcal{I}_i$  usable information and interpretive assistance,  $\mathcal{P}_i$  admissible proposals or testimony,  $\mathcal{Q}_i$  routes for obtaining responses and review,  $\mathcal{U}_i$  powers to authorize or implement changes under the applicable rule, and  $\mathcal{F}_i$  the available follow-up capacities, including continuing participation after an adverse decision. These are *sets of realizable activities*, not scores assigned to a person's political or moral importance. Their specification must state

whether the activity belongs to the person directly, to an authorized representative, or to an independent body protecting the person's interests.

We can then ask whether a contribution is connected to a competent decision process. Let  $p$  denote an admissible intervention by  $i$ ,  $\text{Trace}_J(p)$  the institutionally authorized sequence of its reception, consideration, decision, and follow-through, and  $B_i$  a declared resource, time, accessibility, and safety budget. The criterion

$$\text{CPart}_i(p \mid J, d, B_i) \iff \exists \gamma \in \text{Trace}_J(p; B_i) : \text{ReviewableResponse}(\gamma) \wedge \text{Implementable}(\gamma) \quad (55)$$

is a deliberately limited *procedural reachability* test. It establishes that a legitimate, consequential route exists for a considered response and possible follow-through, rather than that the actor will prevail or that her proposal must change the outcome. A reviewable rejection may satisfy it. The quality of consideration, representational fairness, equality of legal standing, and appropriateness of the decision require independent substantive assessment. The terms *ReviewableResponse* and *Implementable* therefore refer to documented powers and actions, not self-certification by the institution.

This formalization also identifies a basic failure mode. Imagine two international marine-project councils that hold the same public meetings, collect the same number of comments, and issue equally polished consultation reports. Council  $A$  must respond to materially relevant objections, disclose permissible reasons, and may adjust binding operating rules through a recorded procedure. Council  $B$  publishes a summary, while an exclusive operator retains unreviewable authority over future access rules. Their *observed consultation outputs* can be equal although the admitted continuation sets differ for an affected participant. This counterexample does not claim that traditional participation research overlooks tokenism; it shows how a GR model might connect the difference to subsequent capacities for inquiry, contestation, and institutional co-creation. A method comparison would be necessary to establish an incremental contribution.

## Representation, mandate, and the limits of delegated authority

A heterogeneous cooperative setting rarely permits every affected person to negotiate every decision directly. States act through accredited officials, communities may designate councils, professional bodies appoint technical delegates, and organizations authorize managers to enter agreements. Delegation can expand effective participation by coordinating expertise and reducing the costs of collective decision-making. It can also concentrate agenda control, silence internal minorities, or convert a representative's ability to speak into a presumption that the represented have consented to every subsequent use of their knowledge or resources. These possibilities call for a relational account of authorization, continuing accountability, and the scope of the representative's mandate.

Let  $r$  be a representative and  $C$  a set of represented subjects. A mandate is described relative to domain  $d$  by

$$\text{Mandate}(r, C, d) = (\text{Basis}, \text{Scope}, \text{Obligations}, \text{Reporting}, \text{Challenge}, \text{Termination}). \quad (56)$$

A representative's authority can be established by election, law, customary governance, contract, appointment, or another recognized process, with different consequences in different settings. The model records how that basis was established, what decisions it authorizes, to whom and how the representative must account, how the mandate may be challenged, and whether termination or replacement is practically possible. It must also identify people affected by the representative's actions who are *not* members of  $C$ . A state delegate, for instance, represents a government or state within a given diplomatic process; that role does not erase the distinct rights and interests of communities affected by implementation.

The distinction is especially important in relations involving Indigenous peoples and local knowledge. Where ILO Convention No. 169 applies, its provisions about appropriate consultation through

representative institutions and the people's own institutions impose relevant legal constraints; those requirements should be interpreted in their jurisdictional and factual context rather than inferred from a generic GR model (International Labour Organization, 1989). An external facilitator must avoid selecting a convenient interlocutor and treating the encounter as a substitute for community-authorized representation. Within a community, the legitimacy of a specific representative may itself be disputed. A conflict-sensitive process should investigate those disputes using suitable, lawful means that protect privacy, safety, and internal autonomy, with attention to the risks of transferring power to an outside arbiter.

Heterogeneous representation extends to interests for which a conventional human delegate structure is incomplete: future generations, ecological processes, shared public infrastructures, and automated systems that participate operationally in institutional activity. Representation of those interests requires an explicit account of who is empowered to articulate, review, or protect them. A protected species is not thereby assumed to possess the same legal status as a human claimant, and an artificial system that executes a delegated task is not thereby assigned legal personhood. Distinct analytic categories—ecological condition, affected human right-holder, accountable organization, operational agent, and legally recognized representative—must remain visible. Their rights and duties depend on applicable law and justified normative commitments, while the GR representation remains a method for mapping dependencies and impacts.

### Revision authority as a transformation of institutional generative conditions

Participation can concern a decision under existing rules or a justified modification of the rules themselves. The latter is particularly significant for our metamodel. A transnational research consortium may allow comments on a dataset while prohibiting participating communities from proposing changes to the category system that determines which observations count as relevant. A public agency may review a person's case without enabling correction of a repeatedly defective eligibility rule. These institutions can process individual claims while reproducing a mechanism that produces the same kinds of disputes. The distinction resembles familiar theories of institutional reform and organizational learning; the GR framing must make the relation to changes in the generative mechanism precise.

In the representation of Section 6, a subject or institution has a state  $S$  and generative organization  $\mathcal{M}$  with a local change map  $\alpha : \mathcal{M} \times S \rightarrow S$ . Ordinary authorized operations can change  $S$  while holding the relevant institutional mechanisms  $\mathcal{M}$  fixed. A rule revision, by contrast, can alter  $\mathcal{M}$ , the domain of admissible operations, and possibly the normative and epistemic interfaces of multiple participants. A schematic joint transformation is

$$\hat{\alpha}_J : (\mathcal{M}_J, S_J, u_i) \rightsquigarrow (\mathcal{M}'_J, S'_J), \quad u_i \in \mathcal{U}_i^{\text{rev}}(J, d), \quad (57)$$

where  $u_i$  is a proposed revision proceeding through a lawful institutional procedure. The relation  $\rightsquigarrow$  includes possible rejection or qualified adoption and does not attribute unilateral power to the proposer. Any accepted revision must respect superior legal duties, basic rights, the competences of affected authorities, and relevant environmental or safety limits. A change that increases the institution's willingness to accept one actor's submissions while depriving others of appeal may constitute a transformation without being an improvement.

We should distinguish three institutional interfaces: the *agenda interface*, which determines who may place an issue for consideration; the *adoption interface*, which determines who may authorize a rule change and under which voting or other procedures; and the *implementation interface*, which determines whether adopted changes can be executed and independently reviewed. An institution may advertise an open proposal portal while reserving agenda scheduling to a single actor. It may adopt equitable rules whose implementation depends entirely on a party that is permitted to ignore them. The locus of revision authority therefore spans the complete chain rather than residing solely in a formal constitution or charter.

A useful analytic object is a participant-specific *revision reachability set*  $\mathcal{W}_i^{J,d}(\mathbf{X}; B_i)$  containing institutionally permitted, executable trajectories that begin with the participant's admissible submission and culminate in consideration of a potential rule change. The associated outcomes include reasoned rejection, qualified amendment, implementation, and appeal as allowed by the governing scheme. Comparison across institutions should ask how these sets differ, how they change after a participant makes use of a particular route, and how costs, threats, or technical dependencies shape access. It would be a mistake to rank institutions using only the cardinality of  $\mathcal{W}_i$ : some changes may be harmful, redundant, rights-incompatible, or practically impossible. The relevant test is whether protected purposes and legitimately held claims have safe, meaningful, accountable avenues for deliberation and change.

### An institutional participation audit for transnational cooperation

A practical GR-informed audit would begin by identifying the decision, legal authority, and affected participants; documenting how stakeholders and representatives were selected; and identifying who is absent or unable to participate safely. It would then trace one or more material proposals from initiation to receipt, evidence review, reasoned response, possible institutional action, and implementation monitoring. For each step, the auditor would record the applicable competence, information requirements, translation and accessibility needs, delays, costs, conflict-of-interest protections, retaliation risks, and the availability of challenge or independent review. A capacity trace would ask what exercising the procedure does to the affected participant's ability to continue contributing, obtaining services, controlling sensitive information, or pursuing lawful alternatives.

Consider an oceanic-observation partnership that proposes a shared environmental hazard index. Fishers, local authorities, scientific institutions, and affected communities may hold different kinds of knowledge and bear different exposure to false classifications. One viable arrangement could combine a technically independent index review with authorized community submissions and a clearly scoped rule-change mechanism. The revision authority for scientific thresholds, legal safety standards, and public resource allocation might appropriately rest with distinct bodies. The GR task would be to trace where these competences interact, where interpretations are translated imperfectly, and whether an affected participant has an effective way of challenging an error that propagates across several decision systems. Legal rules, protected ecological interests, and the authority of communities to govern their own information would limit the arrangement's design.

For public trust-building, publication of participation metrics should be supplemented with records of reasoned responses, implemented corrections, and the actual accessibility of challenge pathways. For peacemaking, participatory design must safeguard consent, protect people who face retaliation for speaking, and clarify which negotiators have authority to bind which parties. The presence of a representative does not establish that absent persons have waived their rights. The objective is credible and accountable institutional conduct; public approval may remain contested. A safe right to decline participation or criticize the process can be a sign of institutional respect rather than its failure.

The research contribution is a proposed integration of participation, representation, and institution-changing authority into the GR continuation framework. Each ingredient has established precedents in public law, democratic theory, participatory governance, and the study of institutional power. What remains to be demonstrated is whether jointly tracing authorized influence, mechanism revision, and the reproduction of participants' capacities identifies failures or feasible remedies overlooked by competent standard assessments. Section 18 advances this inquiry by examining the actual path from a contested claim to an accountable determination and usable response.

## 18 Disagreement, Contestability, and the Institutional Path from Claim to Decision

Disagreement is a normal possibility within cooperation among heterogeneous subjects. Participants can accept a shared technical objective while disagreeing about a datum, the allocation of responsibility, the interpretation of a commitment, the boundary of a community, or the procedures for responding to an alleged breach. Some disagreements expose factual mistakes; others concern legitimate differences in values, institutional competence, or authority. Their presence therefore establishes neither failure of cooperation nor the adequacy of any specific remedial procedure. The institutional problem is how an affected subject can make a consequential claim, have it considered under an appropriate normative framework, and access an accountable response while protected rights, safety, and the continued possibility of cooperation are taken seriously.

The previous two sections established, respectively, the need to connect evidence with an available corrective authority and the need to connect participation with institutionally consequential consideration. A dispute pathway joins these two problems. Existing legal and institutional standards supply much of the normative content. The Aarhus Convention connects environmental information and participation with review mechanisms, while the United Nations Guiding Principles on Business and Human Rights specify effectiveness criteria for non-judicial grievance mechanisms, including legitimacy, accessibility, predictability, equitability, transparency, rights-compatibility, continuous learning, and dialogue where appropriate (United Nations Economic Commission for Europe, n.d.; United Nations Human Rights Council, 2011). Those standards concern particular domains and retain their own legal and institutional significance. GR adds value only if the joint representation of claims, powers, histories, and feasible continuations yields a discriminating explanation or a defensible additional design constraint.

### A claim is an institutional event with a relational history

A claim may report a measurement error, describe lived experience, allege a violation, seek recognition, or demand alteration of a rule. It acquires procedural significance through the history of interactions, jurisdictional boundaries, relevant sources of evidence, and the language in which it becomes intelligible to an authorized forum. A complaint form or automated portal might translate a person's account into a standardized category and inadvertently discard the very aspect that makes the claim consequential. An organization may receive a grievance in one jurisdiction while the authority needed to implement a remedy resides in another. These are failures of interpretation, authorization, or institutional coordination with potentially different remedies.

For a particular dispute  $q$ , specify a typed claim record

$$D_q = (\text{Claimant, Affected, Object, Grounds, Evidence, Forum, ApplicableNorms, RequestedResponse}). \quad (58)$$

The record allows a complainant and an affected party to differ, as in a protected representative submission. The forum's competence, standing requirements, available procedures, and lawful types of remedy must be established independently; defining a field called Forum creates no jurisdiction. ApplicableNorms can contain several overlapping systems, including treaty obligations, domestic law, organizational rules, community standards, and rights whose priority is contested. Translation between them may be partial, as examined in Section 7. Claims should also be characterized by uncertainty and confidentiality constraints where applicable.

The minimum procedural path can be described as a family of state transitions:

$$\begin{aligned} q &\xrightarrow{\eta_1} \text{Notice} \xrightarrow{\eta_2} \text{Reasons/Evidence} \xrightarrow{\eta_3} \text{Submission} \\ &\xrightarrow{\eta_4} \text{Consideration} \xrightarrow{\eta_5} \text{Determination} \xrightarrow{\eta_6} \text{Response}. \end{aligned} \quad (59)$$

Here the arrow labels denote conditional institutional operations rather than a universal chronology. Different authorized procedures may merge or reorder operations, receive an urgent claim before full documentation, provide confidential reasons, or require independent external adjudication. The account must distinguish a reasoned refusal from the absence of any response, and a valid adverse decision from a failure to hear the case. An emergency protective action may appropriately precede final fact-finding, subject to applicable standards of review. Thus the figure is an analytic checklist, not a legal prescription replacing procedural requirements.

### Effective pathways require compatible competence, protection, and follow-through

The existence of each stage on a website or institutional diagram establishes little about whether an affected subject can traverse the whole procedure. A helpline may receive calls but lack authority to require records; an ombuds institution may obtain records but issue only recommendations; a court may issue a binding order whose implementation depends on an agency with scarce resources. The barriers can also be cumulative. Translation fees, legal assistance, attendance requirements, exposure of identity, and delays may each be manageable separately while their combined effect makes review inaccessible for the relevant claimant.

Let  $\mathcal{J}_q$  denote permissible jurisdictions and review bodies, and let  $B_i$  denote the claimant's accessible resource and safety budget. For each institutional step  $k$ , define a relation  $\eta_k$  whose domain and codomain specify the requisite procedural object, responsible authority, standing, and admissible transformations. A *protected, actionable route* exists relative to a particular claim and institutional context if

$$\text{Route}_i(q \mid X, B_i) \neq \emptyset \quad \text{and} \quad \exists \gamma \in \text{Route}_i(q \mid X, B_i) : \text{Lawful}(\gamma) \wedge \text{Safe}(\gamma) \wedge \text{Reviewable}(\gamma) \wedge \text{ResponseCapable}(\gamma). \quad (60)$$

Lawful requires applicable standing, competence, and rights safeguards; Safe is relative to foreseeable and mitigable threats, including retaliation or disclosure; Reviewable identifies a competent mechanism for scrutinizing the consequential determination under applicable rules; and ResponseCapable requires an authorized and practically possible response, including reasoned rejection where appropriate. Availability of an avenue does not guarantee a favorable outcome, comprehensive enforcement, or full elimination of risk. The criterion becomes meaningful only after its predicates and acceptable thresholds are defined for the domain in question.

The concept of *procedural composition* supplies a useful diagnostic. Let  $R_k$  be the set of admissible transitions from stage  $k$  to stage  $k + 1$  under the stated competence and protection conditions. The existence of each  $R_k$  separately does not imply that a joint route exists. A determination produced through  $R_5$  may fall outside the jurisdiction of the implementing body responsible for  $R_6$ . A multilingual submission mechanism may issue documents in a format that the appeal body refuses to recognize. A complaint may be reviewable only after identifying a witness whose confidentiality the claimant has a duty to protect. In formal terms,

$$(\forall k \, R_k \neq \emptyset) \not\Rightarrow R_n \circ \dots \circ R_1 \neq \emptyset. \quad (61)$$

This is a simple and established property of relational composition, not a new mathematical theorem. Its possible analytical importance is that institutional evaluations often audit components separately. A GR investigation asks whether the *composed* pathway remains executable for a specified subject, and whether the attempt to use it changes the subject's future access to knowledge, services, or cooperative membership.

### A constructed counterexample: competent forums without usable correction

Consider a coastal environmental-monitoring partnership in which a local association contests an automated designation of a fishing area as unsuitable for access. Institution  $A$  owns the sensor archive

and can review calibration; institution *B* has statutory authority over access decisions; institution *C* provides an international project-level grievance channel. Each reports an operating procedure. *A* may correct measurement records but cannot revise the legally operative designation. *B* will reconsider the designation only when presented with a certified correction issued by a body that is no longer accredited under a changed technical standard. *C* accepts the association's complaint and issues recommendations but lacks authority to modify either the certification process or *B*'s decision. Every institution has a nominally active review function; their permissible procedures have no complete route to the correction requested.

This construction illustrates a *compositional accountability gap*. It does not show that the claimant's substantive interpretation is correct, nor that every institution has violated a legal obligation. A competent assessment must first establish jurisdiction, the validity of the technical standard, relevant administrative and judicial remedies, and whether an alternative authorized route exists. The model also distinguishes a missing remedy from an unlawful one: a claimed power to reverse *B*'s decision in violation of applicable law would be a false solution. A feasible response might involve lawful recognition of an alternative accredited expert, a coordinated referral, a protected evidence-transfer protocol, or an authorized review of the governing standard itself. Whether any remedy is justified depends on the actual facts and institutions.

A further counterexample concerns *procedural expansion with increased vulnerability*. Suppose a project doubles the available channels for reporting abuse, but each new channel requires public identification and transmits raw complaints to the organization whose conduct is disputed. The number of nominal routes increases, while for participants facing retaliation the number of *safe* routes may decrease. The relationship between procedural availability and justified trustworthiness is therefore non-monotonic without assumptions about confidentiality, independence, competence, and participant safety. The same risk appears where a respondent can manipulate an informal mediation process to discover evidence or pressure a complainant into withdrawal. Appropriate safeguards might include protected intake, independent representation, purpose-limited disclosure, or referral to a rights-compatible forum. In some disputes mediation is unsuitable; coercion or serious rights violations may require independent protective or adjudicative processes.

### Normative translation, reason-giving, and legitimate dissent

A disagreement may involve distinct normative vocabularies. A government ministry may describe an action as compliant with a permit, while affected residents describe it as destructive of a livelihood and researchers classify it as increasing ecological risk. Partial translation can connect these accounts while preserving their irreducible differences. A forum should make explicit which kinds of claims it can adjudicate and which require coordination with other decision bodies. A determination that a permit condition has been satisfied does not necessarily answer a complaint about cultural harm; a community's assertion of harm, in turn, does not automatically settle every legal or scientific question. Explanations should respect the epistemic capacities of the participants and clarify the recognized bases for action or refusal.

Reason-giving has several possible effects. It can reveal the evidence and normative standard that governed a decision, assist an appeal, make institutional error legible, or show why the institution lacks legal authority to grant a request. These effects are valuable even when agreement or interpersonal trust remains absent. Reasons can be challenged; they can also require confidentiality for witnesses or personal information. The response should be assessed for accuracy, lawful authority, intelligibility, impartiality, and actionable follow-through, rather than popularity or its power to elicit expressions of gratitude. A person may legitimately distrust an organization after receiving a procedurally sound determination. Conversely, a popular decision may rest on defective evidence or an inaccessible review process.

Disagreement can also expose the limits of the institutional model itself. Repeated disputes may

indicate a defective classification system, misallocated competence, an inadequate representation mandate, or disagreement concerning the appropriate legal and normative frame. Where authorized, an institution might therefore direct recurring grievances into a rule-revision process, linking Section 17 with institutional learning. The transition from individual case correction to system-level revision must be justified and privacy-protective. A database of complaints is not a license to publish sensitive accounts or to treat every complainant as a willing participant in policy experimentation.

### A practical claim-to-decision audit across six cooperation settings

The proposed practical method is a *claim-to-decision audit* paired with an evaluation of continued generative capacity. It begins with a legitimate objective, a representative set of consequential claims, and a domain-appropriate baseline drawn from existing access-to-justice, grievance, public-participation, or mediation practice. The analyst traces each claim's stages, responsible bodies, competence boundaries, document transformations, protected identities, estimated costs, decision timelines, and actual implementation. Affected participants should be able to correct the researcher's description of their own practical barriers, within ethical and safety constraints. The study then compares alternative pathway designs, recording whether participants can pursue an accessible and legitimate response and whether the process preserves their capacity to participate, maintain needed services, and pursue independent remedies.

In *peacemaking*, an appropriately mandated third-party process might develop a confidential channel for disputing incident classifications under a provisional cessation-of-hostilities arrangement, with carefully limited disclosure and independent oversight. Participation would depend on consent and conflict-sensitive protections; a mechanism must avoid becoming a tool for intelligence gathering or coercion. In *preventive diplomacy*, bilateral or multilateral working groups may define procedures for handling contested monitoring data and escalating disagreement to a competent forum before the dispute undermines a wider cooperative agreement. Sovereignty, treaty terms, and international legal commitments establish relevant constraints.

In *international cooperation*, development and scientific partnerships may benefit from documented pathways for challenging data-use decisions, resource allocations, and project closures. In *interpersonal and community relationships*, the framework can serve as a modest heuristic for describing expectations and responding to grievances, while leaving participants free to set boundaries or discontinue harmful relationships; a formal institutional apparatus is rarely appropriate to ordinary personal disagreement. In *organizational relationships*, employee voice, accessible explanations, protected reporting, competent investigation, and actual corrective authority may be examined as distinct capacities, with particular attention to the risks of retaliation and managerial conflicts of interest. In *public trust-building*, an administrative decision might be audited from notice to reasons, appeal, remedy, and follow-through, measuring accuracy, equity of access, effective correction, and protected rights. Public communication is assessed for its fidelity to institutional reality, rather than as a substitute for it.

These applications require different normative baselines. A right to appeal an administrative determination, the procedural design of a labor grievance, a treaty's dispute-settlement clause, and a voluntary community mediation process cannot be unified into a single legally binding template. Empirical comparisons should use task-specific indicators: accessible claim submission, procedural fairness, frequency and correction of material error, competent and timely outcomes, actual implementation, risk of retaliation, institutional cost, and participants' retained capacity to act. Changes in reported trust may be explored alongside these measures without treating greater trust as proof of legitimate improvement. Ethical evaluation should also monitor unintended effects: overformalization, administrative overload, chilling effects on testimony, insecure storage, and displacement of rights-based remedies by less accountable processes.

The contribution pursued here is therefore *compositional and historical*: a valid claim route depends

on the compatibility of evidential, procedural, normative, and remedial operations across institutions and on its effects upon the continuing possibilities available to affected subjects. Existing procedural-justice and grievance theories already explain many of the same failures. The GR representation earns explanatory standing only if its typed continuation analysis identifies a relevant dependence, normative-translation failure, or mechanism-level transformation that a competent baseline misses, or improves a justified decision under conditions that can be independently assessed. The next section considers what follows when a breach is substantiated and the response must extend beyond determination toward remedy and relational repair.

## 19 Breach, Remedy, and Relational Repair

A cooperative arrangement becomes most revealing when a participant alleges that an undertaking has been broken, an institutional act has caused injury, or a jointly maintained mechanism has produced an unjustified result. The earlier discussion traced the passage from claims to reasoned determinations. A favorable determination, however, is only one moment in a much longer remedial relationship. The responsible body may possess authority to find a violation while lacking the means to restore a livelihood; a technical correction may arrive after the loss of an irreplaceable archive; a public acknowledgement may address historical misrecognition while leaving control of an essential infrastructure unchanged. These situations expose differences among the identification of wrongdoing, the assignment of responsibility, the selection of an appropriate response, the delivery of that response, and the transformation of conditions that contributed to the harm.

The existing law of remedies provides indispensable starting points. The United Nations Basic Principles and Guidelines adopted in General Assembly resolution 60/147 identify restitution, compensation, rehabilitation, satisfaction, and guarantees of non-repetition in their specific field of gross violations of international human rights law and serious violations of international humanitarian law (United Nations General Assembly, 2005). Their scope and relation to binding obligations depend on the relevant sources of international and domestic law. The United Nations Guiding Principles on Business and Human Rights, in a distinct field, emphasize access to effective remedy and effectiveness criteria for non-judicial grievance mechanisms (United Nations Human Rights Council, 2011). These instruments already make clear that a remedy reaches beyond apology and public communication. The present investigation neither reclassifies a GR concept as an existing legal right nor proposes a universal substitute for legal doctrine. Its additional question concerns how remedial operations change the *feasible relational continuations* of affected subjects and their counterparties.

### Identifying the object of repair across distinct forms of injury

For an episode  $b$ , let  $B_b$  record an alleged breach or injury together with the institutionally relevant information required to assess it:

$$B_b = (\text{Affected, Acts, Duties, Harms, Evidence, Competence, Findings}). \quad (62)$$

The entry Duties is indexed to applicable legal and other normative sources; its mere presence creates neither a duty nor a finding that a violation occurred. The Findings component may contain a substantiated determination, a provisional assessment, a disagreement between competent bodies, or unresolved facts. The object  $B_b$  is therefore a typed investigative record, rather than a single moralized event. The model must distinguish personal injury, collective loss, ecological damage, failure of contractual performance, procedural wrong, and epistemic misclassification. A mistaken scientific designation may be corrected through data governance, while an intentional attack on civilians engages legal and moral duties whose gravity cannot be represented as a variant of ordinary project non-performance.

Consider a marine-observation cooperation agreement. One institution's inaccessible raw-data archive may prevent another from independently checking a hazard warning. The resulting harm can

include an erroneous decision, a lost opportunity to challenge that decision, immediate economic loss, and a new dependence on the archive owner. Correcting the warning addresses one aspect of the episode. Restoring lawful compensation addresses another. Reconstituting the capacity to reproduce measurements, preserve evidence, and seek review addresses a further aspect. These tasks may be undertaken by different authorized bodies, with different obligations and resources. An accurate account of the breach must preserve those distinctions even when public discussion groups them under a single demand for “trust repair.”

An affected subject’s expressed needs and testimony are consequential evidence, while questions of causation, responsibility, and legally due remedies require appropriate standards. A mediator, adjudicator, technical auditor, and community representative have different mandates. Their complementary functions can be organized through an explicit competence map, with safe referral procedures where jurisdiction is divided. A finding by a competent body may authorize action by another body; where the receiving body lacks an enforceable duty to act, the gap should be disclosed as an institutional limitation rather than quietly replaced by an aspirational promise.

### A multidimensional account of remedial operations

Let  $\mathcal{Q}_b$  denote responses available under the governing normative framework and the competent institutions’ powers. We distinguish possible remedial operations by their object: cessation of ongoing injury, factual correction and recognition, material restitution or compensation, rehabilitation and accessible support, restoration of procedural and productive capacities, accountability, and institutional modification directed at recurrence. Different categories overlap, and the appropriate combination depends on the nature of the violation, proportionality, affected persons’ rights, and applicable legal rules. This is an analytic classification of possible operations rather than a new universal schedule of reparation.

For a chosen response  $r \in \mathcal{Q}_b$ , a provisional remedial transition can be represented by

$$X_b \xrightarrow[\mathcal{J}, \mathcal{N}, \text{Authority}]{r} X_{b,r}, \quad \hat{\alpha}_{b,r} : (\mathcal{M}, S, H) \rightsquigarrow (\mathcal{M}', S', H'), \quad (63)$$

where the notation follows the change-operator distinction of Section 6. The response can change a represented state  $S$ , a generative mechanism  $\mathcal{M}$ , or both; the history  $H'$  retains the injury and its remedial record rather than resetting the relation to an imagined state of innocence. A sum of compensation may improve immediate material conditions while leaving a discriminatory eligibility rule untouched. A legal reform may alter that rule while leaving persons already injured without adequate individual remedy. A proper evaluation must trace both levels.

The capacity-sensitive question is whether a rights-compatible and practically delivered remedy makes relevant continuations accessible again. For affected subject  $i$ , let  $\mathcal{F}_i^{\text{protected}}(h; \Theta_i)$  be the typed set of continuations satisfying explicit feasibility, safety, and normative constraints. For a selected protected purpose  $d$ , one can examine

$$\mathcal{R}_i(r; b, d) = \left\{ \kappa \in \mathcal{F}_i^{\text{protected}}(h_{b,r}; \Theta_i) : \kappa \text{ realizes an admissible response to } b \text{ in domain } d \right\}. \quad (64)$$

The set may contain restoration of access to a service, continuation of research under independently auditable conditions, safe pursuit of a claim, or voluntary termination of the relationship with essential property and records intact. Its size alone provides no measure of justice. Some possibilities are harmful, impractical, or legally prohibited; other protected capacities, such as the ability to avoid renewed contact, are valuable precisely because they remove coercive exposure. The test must therefore specify protected purposes, evidence for actual reachability, and the people authorized to determine whether a proposed response is acceptable.

We may distinguish three evaluations. *Normative adequacy* asks whether a remedy meets relevant legal and ethical duties. *Delivered effectiveness* asks whether the responsible institutions actually execute the required acts and provide the promised relief. *Generative consequences* asks how that delivery

changes the affected subjects' accessible continuations and their dependence on others. The three can agree or diverge. A remedy could be legally correct but delayed by resource constraints; it could be promptly delivered yet leave significant vulnerabilities because the law itself addresses only a narrower harm. The GR analysis records these differences and supports evaluation; it cannot by itself invalidate the governing legal standard.

### A constructed counterexample: compensation-equivalent remedies with divergent continuations

Suppose two transnational scientific partnerships have each wrongfully terminated a community's access to an environmental dataset. Both subsequently acknowledge the violation, pay an identical amount of compensation, and restore an equivalent public dashboard. Their visible remedial outputs are consequently identical under a reporting protocol  $O_R$ :

$$O_R(H_{b,r}^{(A)}) = O_R(H_{b,r}^{(B)}). \quad (65)$$

Partnership  $A$  additionally returns a documented local data copy, provides portable calibration procedures, funds the lawful transition of trained personnel, and supplies access to an independent dispute procedure. Partnership  $B$  operates the dashboard only through a proprietary interface; the community remains unable to reproduce results, seek correction of future classifications without the operator's approval, or transfer the service on reasonable terms. The equality of reported payments and service availability is consistent with different sets of practically accessible continuations:

$$\mathcal{F}_i^{\text{protected}}(H_{b,r}^{(A)}; \Theta_i) \neq \mathcal{F}_i^{\text{protected}}(H_{b,r}^{(B)}; \Theta_i). \quad (66)$$

Here the example is constructed, and the existence of distinct continuation sets follows from the stipulated constraints. It establishes the insufficiency of a particular reporting equivalence, not the empirical superiority of a specific GR intervention. A skilled rights-based or capabilities-oriented evaluation may already identify the problem. The proposed incremental value is an explicit test of which institutional, informational, and material transformations produce the divergence, including combinations that become visible only when the full multi-institutional path is traced.

A second counterexample concerns apparently comprehensive reform. Imagine that an institution changes its complaint procedure after a harmful disclosure of confidential testimony. Future claimants can now use a protected intake route, and the institution has implemented genuine safeguards. The original claimant's identity, however, has already been exposed, with durable consequences for safety and employment. A mechanism-level reform can reduce prospective risk while leaving the earlier harm only partly remediable. Analytically, the transition  $\mathcal{M} \rightsquigarrow \mathcal{M}'$  may improve the future admissible paths of other users, while an affected person's relevant continuations remain unavailable. This is one reason why the idea of complete restoration should be handled with care. Physical injury, loss of life, irreversible ecological destruction, and destroyed social relationships may involve losses that are incapable of full restoration or meaningful commensuration.

The conclusion is conditional: there can be *remedial output equivalence without remedial continuation equivalence*. Stronger claims require specifying which continuations have normative standing, which remedies are legally owed, and what observations would distinguish an effective restoration of capacity from dependence concealed by a service metric. Compensation may remain indispensable even when capacity restoration is possible. A continuation analysis must never be used as a reason to withhold compensation or other legally required forms of reparation.

### Repair, reconciliation, and the persistence of legitimate distrust

Repairing a cooperative relation should be distinguished from obtaining expressions of forgiveness, reconciliation, or confidence. A person may accept compensation and an independently enforceable

safety guarantee while deciding to avoid further interaction. Communities may recover institutions capable of representing their interests while rejecting a proposed political narrative of mutual reconciliation. Where public authorities have violated rights, procedural and substantive duties remain applicable irrespective of recipients' reported confidence. The historically situated trust representation in Section 10 allows a decrease in vulnerability, restoration of legally protected options, and persistence of distrust to be modeled as compatible outcomes.

We can therefore define *relational repair* modestly as a set of normatively justified and effectively implemented transformations responding to an established injury, which improve identified protected conditions or correct a wrongful relation. This definition is intentionally plural: the content and validity of repair depend on the legal domain, affected subjects, factual findings, and their rights. The definition makes room for legitimate separation, independent recourse, and permanent disagreement. It also recognizes that a party with considerable power may seek rhetorical reconciliation primarily to restore reputational standing; official narratives should not determine the success of a remedy in the absence of evidence that the affected person's protected interests were addressed.

For a negotiated settlement, consent is necessary in the relevant sense, yet an agreed result is not automatically free from coercion or consistent with higher-order rights. In a conflict setting, an agreement may satisfy representatives while excluding witnesses and affected groups from meaningful protection. The United Nations Guidance for Effective Mediation emphasizes consent, impartiality, inclusivity, national ownership, and international normative frameworks (United Nations, 2012). These principles constrain the practical use of GR terminology. A mediator should be cautious about requesting direct contact between parties when a safe separation or independent judicial route is appropriate, and particular care is needed when severe harms or threats of retaliation make informal reconciliation inappropriate.

**A remedy outcome has several evidentiary meanings.** A decision ordering compensation is a recorded legal or administrative outcome; an executed payment is a different observation; restored access to service is another; restoration of a participant's independent ability to verify, maintain, appeal, or exit is a further capacity claim. The first three do not logically entail the fourth. To evaluate the fourth, the researcher must state the pre-intervention comparison set, the relevant protected continuation query, and the institution or affected person competent to verify its availability. An estimate of a remedy's causal effect additionally requires a defended counterfactual and attention to concurrent reforms. The practical record in Section 26 should preserve these classifications rather than compress them into an undifferentiated label of successful repair.

### The feedback from individual remedies to institutional transformation

Repeated injuries can reveal a defect in the rules that generate institutional outcomes. Yet the existence of many complaints alone does not establish which rule is defective: reporting rates depend on accessibility, risk, institutional attention, and the populations affected. A competent investigation distinguishes a wrong decision, defective evidence, inadequate implementation, jurisdictional conflict, and a harmful rule. When the mechanism is defective, individual remedial responses may be paired with a lawful process of revising that mechanism. The interface to Section 17 is explicit: claims can supply grounds for proposing revisions to  $\mathcal{M}_J$ , while the legal authority to adopt them remains with the designated body and protected participants retain access to appropriate proceedings.

One possible diagnostic is a *remedy-to-rule trace*: (i) record the established injury and its evidentiary uncertainties; (ii) identify the authority responsible for immediate relief; (iii) establish what relief has actually been provided; (iv) test whether the underlying error-generating condition persists; (v) identify the independent, legally competent path for systemic correction; and (vi) examine whether the combined response preserves or improves affected participants' protected capacities. The stages form a revisable audit, since urgent protection may precede final adjudication and several agencies may need

to act together. Procedural propriety, privacy, physical safety, and accountability for retaliation must be checked at every stage.

In preventive diplomacy, the trace may concern correction of a mistaken border-monitoring report: the parties could establish a jointly authorized procedure for preserving contested observations, applying independent review, issuing a corrected finding, and adjusting verification arrangements with consent. In international development, the trace may examine whether restitution for a failed data-sharing commitment includes recovery of practical local control and accessible external review. In organizations, the analogue is an employee grievance whose remedy provides individual protection and addresses the mechanism that allowed retaliation. For public agencies, it may involve both rectifying an administrative decision and revising the classification procedure responsible for recurring error. The correct measures differ substantially across these settings; a universal numerical trust score would obscure more than it would explain.

A rigorous empirical test should compare the GR continuation trace against competent established remedial, administrative-law, organizational-learning, and conflict-sensitive assessments. Candidate observations include actual delivery of awarded remedies, subsequent access to essential services and records, recurrence rates after exposure adjustment, independent appeal availability, implementation costs, and self-reported safety and autonomy. A qualitative process trace could establish whether a specific bottleneck was detected through the combined dependency and revision analysis; a controlled or matched comparison might then evaluate whether a feasible institutional change improved outcomes. Negative results would be informative if conventional approaches already capture all significant gaps or if the added analysis imposes burdens without practical benefit.

This section thus advances a deliberately narrow GR proposition: a remedy's immediate performance and its effects on future accessible relations are analytically separable. That proposition becomes valuable when a concrete institutional design or legal evaluation needs both dimensions. The next section studies how repeated remedies, disputes, and contacts can alter the normative interfaces through which participants evaluate and coordinate cooperation, including cases where apparent agreement reflects coercion rather than legitimate learning.

## 20 Norm Co-Evolution, Provisional Anchors, and Institutional Learning

Cooperation among heterogeneous generative-relational subjects frequently proceeds under incomplete agreement concerning the grounds of obligation. A diplomatic counterpart may recognize the procedural validity of a shared inspection without accepting every interpretation of sovereignty underlying it. A scientific partnership may accept a protocol for exchanging marine measurements while its members retain different commitments concerning open knowledge, collective stewardship, and local control over sensitive information. Two organizations may agree on how to respond to an identified injury while continuing to disagree about its moral description. Such arrangements can be operationally meaningful because agreement on a bounded procedure and agreement on a comprehensive normative worldview are different achievements.

Norm research already provides developed accounts of emergence, diffusion, localization, and contestation. Finnemore and Sikkink's account of international norm dynamics connects norm emergence, cascades, and internalization with varying motives and mechanisms (Finnemore and Sikkink, 1998). Acharya's localization analysis explains the active reconstruction of transnational ideas in relation to prior local beliefs and institutions (Acharya, 2004). Research on organizational learning and experimentalist governance examines recursive revision of policies and goals through performance review, locally situated knowledge, and institutional feedback (Levitt and March, 1988; Sabel and Zeitlin, 2008). The present work uses these traditions as intellectual foundations. Its prospective addition is to ask how changes in *normative interfaces*, *translation relations*, and *institutional generative mecha-*

nisms jointly change the continuations accessible to differently situated participants. Repeated inter-  
action alone establishes neither legitimate learning nor normatively desirable convergence.

### Provisional anchors as bounded commitments across normative systems

The GR configuration of Section 6 includes a subject-indexed normative component  $\mathcal{N}_i$ . This component should represent norms in a broad descriptive sense, including practices of justification, recognized obligations, institutional interpretations, and disputed standards, while reserving the validity of legal rules and protected rights for the competent normative sources. Normative heterogeneity consequently has several forms: subjects may assign different meanings to the same word, weigh compatible considerations differently, recognize distinct authorities, or disagree substantively about what ought to be done. These differences have different practical consequences. A glossary may address terminological disagreement; shared verification can sometimes reduce factual uncertainty; an incompatible claim about legal jurisdiction requires an authorized process rather than simply a better translation algorithm.

For a bounded cooperative domain  $d$ , define a *provisional normative anchor* as a typed institutional object

$$A_d = (\text{Scope, Parties, Grounds, Rules, Evidence, Review, Revision, Protection}). \quad (67)$$

The fields specify, respectively, the activities covered, participating authorities and affected parties, the claimed sources of legitimacy, operational commitments, interpretation and evidentiary procedures, review mechanisms, lawful means of revision, and safeguards for rights and vulnerability. A treaty provision, a community-authorized research arrangement, or an internally adopted organizational procedure may instantiate some of these fields, with different binding force. An anchor is *provisional* because its scope and terms are subject to specified authorized revision, rather than because commitments or protected rights can be casually disregarded. Some obligations constrain revision itself; legal hierarchy and jus cogens, where applicable, cannot be made optional by stipulating a local compromise.

This conception differs from the familiar ideal of a fully shared normative order. Participants can agree on a procedure for verifying whether a boundary-monitoring report was transmitted accurately while disagreeing about the larger settlement to which that report may eventually contribute. They can agree on protected storage of testimony while preserving different accounts of the historical event. The anchor coordinates selected operations without collapsing normative plurality into a single ranking of interests. Its quality depends in part on its rights-compatibility, the competence and representativeness of those making it, its evidential reliability, and its effects on vulnerable persons who were unable to participate directly.

The term “first contact” should be used with care. Diplomatic, organizational, human–AI, or cross-species contact seldom occurs on a blank historical surface: infrastructures, classifications, power inequalities, and inherited practices may already structure the encounter. A GR analysis maps the relational history actually relevant to the contact. When an autonomous system joins a consortium as an operational delegate, the competent human or institutional authority should initially be made explicit; operational capacity alone provides no settled conclusion about independent legal or moral personhood. An anchor can be opened to novel forms of participation as justified capacities and statuses are clarified, while existing rights and accountability remain secured.

### Distinguishing adaptation, co-creation, and coerced convergence

An observed change in normative language can arise through several different processes. A participant may voluntarily adopt a standard after reflection; jointly governed work may produce a rule that neither party previously used; an institution may adopt an external term while preserving its earlier practical assumptions; or a dominant party may compel public conformity by threatening essential resources.

These events can lead to similar documents but carry different implications for legitimate participation and the distribution of generative capacity. The distinction matters for peacebuilding, where apparent consensus can conceal exclusion or material dependence, and for organizational trust, where measured agreement can increase even as employees lose the capacity to dissent safely.

Let  $c$  denote an analytic cut through the represented relational history and  $X^c$  its corresponding configuration. A schematic norm-and-mechanism update is

$$(\{\mathcal{N}_i^{c'}\}, \mathcal{M}_J^{c'}, \mathcal{A}_d^{c'}) \in L_J(\{\mathcal{N}_i^c\}, \mathcal{M}_J^c, \mathcal{A}_d^c, \hat{H}^c, \mathcal{P}^c, \mathcal{U}^c), \quad (68)$$

where  $L_J$  is a set-valued learning-and-revision relation,  $\hat{H}^c$  records available and contested evidence,  $\mathcal{P}^c$  relevant power conditions, and  $\mathcal{U}^c$  authorized proposals or interventions. The expression represents dependence among processes; it is neither an empirical law nor a claim that all institutions learn through the same function. The change from cut  $c$  to  $c'$  can include norm reinterpretation, policy revision, authority redistribution, new resources, or resistance to an attempted change. The update must be assessed through documentary histories and, where appropriate, protected testimony.

To evaluate whether apparent co-creation is meaningfully voluntary, the analyst should examine each participant's *protected refusal continuations*. These consist of safe, legally admissible alternatives available when a proposed norm or partnership is declined. Where a partner may formally reject a new standard yet doing so would trigger an unlawful loss of essential services or expose witnesses to retaliation, the formal signature of agreement supplies weak evidence of consent. Conversely, the presence of bargaining incentives or unequal resources does not automatically invalidate an agreement. The relevant question concerns the nature of pressures, duties, available protections, and independently substantiated opportunities for participation. A sound assessment investigates these conditions without presuming the epistemic or moral superiority of any cultural system merely because it possesses greater technical or institutional power.

A useful distinction is between *norm compatibility*, *translation compatibility*, and *generative compatibility*. The first asks whether the applicable obligations can jointly be satisfied. The second asks whether claims and obligations retain the relevant meanings as they move across institutional interfaces. The third asks whether the arrangement's operations sustain practical capacities required to carry out, challenge, and lawfully revise those obligations. The third can fail even when a formal translation is accurate and the declared norms are jointly satisfiable. For example, a data-sharing convention could authorize an Indigenous community's prior review of sensitive records in a formally correct way while making that review dependent on a server inaccessible to the community and on a specialist available only at the discretion of another partner. The formal agreement would require a supporting material and institutional design before it could be treated as genuinely executable.

### The composition problem across multiple provisional agreements

Section 7 considered partial translations among normative and epistemic systems. Their dynamics become especially important when agreements develop through several bilateral interfaces. Let  $\tau_{ij}^c$  be an authorized partial translation from the relevant normative language of  $i$  to that of  $j$ , under an explicit domain and historical cut. The translations are generally partial and may differ when composed:

$$\tau_{CA}^c \circ \tau_{BC}^c \circ \tau_{AB}^c(x) \not\approx x, \quad (69)$$

where  $\approx$  is a declared equivalence relation over the aspects of meaning material to the agreement. Path dependence can arise from domain restrictions, different legal competences, changes in policy, or transformations of the objects being translated. Equation (69) indicates a possible failure of interpretation invariance; it is distinct from a contradiction among duties. An actual institutional conflict requires showing that incompatible obligations or actions result under the governing authorities and constraints.

To make the difference concrete, suppose three institutions  $A$ ,  $B$ , and  $C$  coordinate a shared environmental archive.  $A$  is authorized to disclose sensitive data to  $B$  for narrowly specified scientific verification.  $B$  has a general public-transparency policy requiring publication of the datasets it uses to issue official determinations.  $C$ , which certifies  $B$ 's determinations for a regional alert system, requires publicly reproducible evidence. Each bilateral procedure can appear workable when considered in isolation:  $A$  can transmit protected evidence to  $B$ ;  $B$  can use an ordinary public dataset to justify an alert to  $C$ ; and  $C$  can certify reports that satisfy its transparency rule. The joint transaction becomes problematic when the protected dataset is required for  $B$ 's determination and  $C$ 's certification. Direct publication may violate  $A$ 's binding restrictions, while withholding every independently reviewable evidentiary basis may defeat the public-certification condition.

This is a *constructed composition problem*. It establishes no real-world breach, and the exact legal consequences depend on jurisdiction and the applicable data-protection, access-to-information, and regulatory rules. It illustrates how a consortium's pairwise compliance check can miss a globally infeasible implementation. A well-designed response may involve public disclosure of nonsensitive derived measurements, authorized protected verification by an independent reviewer, separated evidence tiers, or reconsideration of certification criteria through a lawful rule-revision procedure. A proposed technical solution must be evaluated for accuracy, privacy, safety, and actual reviewability; techniques such as access control or secure computation have different threat models and cannot guarantee meaningful legal accountability merely by being deployed.

The GR contribution is a prospective *joint feasibility test over changing normative interfaces*. For anchor family  $\mathcal{A} = \{A_d\}$  and authorized operations  $\Pi_J$ , write

$$\mathcal{C}_J(X^c, \mathcal{A}^c) = \{\pi \in \Pi_J : \pi \in \mathcal{F}_J(X^c; \Theta_J), \pi \models \mathcal{A}^c, \pi \models \mathcal{V}_J\}, \quad (70)$$

where  $\mathcal{V}_J$  includes declared non-derogable and other applicable protective constraints. A feasible common continuation requires a joint admissible operation; separately feasible bilateral operations are insufficient. A claim of infeasibility must be conditional on the specified operation class, resources, competence assumptions, and translation maps. Changing legitimate rules, redistributing technical capacity, or adding an authorized reviewer may enlarge  $\mathcal{C}_J$ ; abandoning a binding right or excluding an affected population solely for convenience is an impermissible shortcut. The question is whether a lawful and ethically justified transformation makes a jointly feasible arrangement available.

### Path dependence, learning, and the possibility of institutional lock-in

Normative change also modifies the institutions that determine which proposals can be entertained. An organization may adopt a reporting category for efficiency and later make employment, funding, and evidentiary standing depend on that category. The resulting procedure influences what counts as a complaint and which aspects of a person's experience are recorded; subsequent review may rely on those records as if they were complete. Through repeated use, an apparently provisional standard can acquire infrastructural force. Participants who lack access to alternative records may find it increasingly difficult to challenge the standard on which their institutional participation depends.

This possibility can be expressed as a feedback between a classification mechanism  $\mathcal{M}_J^c$ , the evidence it generates  $\hat{H}^c$ , and the set of accessible revision operations  $\mathcal{U}_i^{\text{rev}}(X^c)$ :

$$\mathcal{M}_J^c \longrightarrow \hat{H}^{c'} \longrightarrow \mathcal{U}_i^{\text{rev}}(X^{c'}) \longrightarrow \mathcal{M}_J^{c''}. \quad (71)$$

The arrows describe a candidate feedback structure and do not require equally spaced time steps or a privileged present. An institutional mechanism may make its own defects less observable, thereby reducing the practical accessibility of the corrections those defects demand. A reform can also break this cycle by admitting protected alternative evidence, independent reclassification, or an authorized revision procedure. The causal significance of either pathway requires case-specific evidence.

These problems have clear precedents in organizational learning, institutional path dependence, and experimentalist governance. In particular, processes that revise goals and metrics in response to local implementation evidence are well established (Levitt and March, 1988; Sabel and Zeitlin, 2008). A GR account deserves separate standing only if tracking the typed relations between revision authority, evidential access, normative translation, and participants' generative capacities reveals a practically consequential mechanism or supplies a better comparative test. It should be open to the finding that existing institutional frameworks already describe the mechanism adequately.

### A GR-informed protocol for situated normative learning

A provisional implementation protocol can be stated as a set of investigable tasks rather than as a universal mediation recipe. An authorized facilitator or institutional analyst first identifies the subjects and affected communities, the legal and normative limits of the process, the domains in which cooperation is sought, and the protections required for people who decline involvement. The analyst then documents the distinct interpretations of obligations and evidence, identifies a bounded set of operational commitments that are genuinely available for negotiation, and checks the joint feasibility of those commitments across all relevant institutions. Where translation remains incomplete, the record should identify what is shared, what remains disputed, and which institution has authority to make a consequential determination.

A review cycle can then examine actual conduct and its consequences for participants' capabilities. Its questions include: Which provisional commitments were performed? Which interpretations changed? Who controlled the observations supporting claims of success? Which participants acquired or lost access to resources, alternative partners, records, and institutional revision? Can a dissatisfied participant safely refuse a proposed extension or obtain review from an independent competent authority? An authorized review body may amend the anchor, record continuing disagreement, narrow the scope of cooperation, or end the arrangement under the governing conditions. Publicly recorded reasons should respect lawful confidentiality and the protection of vulnerable participants.

In *peacemaking*, such a procedure might support narrowly defined humanitarian coordination between parties who retain incompatible historical accounts. A protected provisional anchor could specify the permissible uses of monitoring data, procedures for resolving disputes over incident records, and explicit protections against retaliation. The process should be assessed against established conflict-sensitive mediation practices, including consent, legal constraints, and meaningful inclusion (United Nations, 2012). In *preventive diplomacy*, the same approach might govern the updating of incident-classification protocols while preventing changes to a technical glossary from silently reallocating political authority. The prospective advantage would be the early detection of translation and authority conflicts across connected forums.

For *international scientific and ecological cooperation*, the protocol could support jointly revisable data dictionaries and evidence-review procedures that recognize different knowledge systems and protect lawful control of sensitive information. In *interpersonal or community trust*, its transferable lesson is modest: participants may establish bounded expectations and revise them with mutual consent while preserving a legitimate freedom to disengage. Ordinary relationships should not be burdened with institutional machinery unless the circumstances warrant it. In *organizations*, a change to a performance or grievance classification may be evaluated for its effects on safe reporting, dissent, and access to independent correction. In *public institutions*, the analogous question is whether participatory rule revision alters the conditions of warranted trustworthiness through better services and accountable decisions, irrespective of whether reported confidence immediately rises.

The research design must separate three empirical processes: *normative articulation* (what participants say the rules and values are), *institutional adoption* (which authorized rules and procedures change), and *practical consequence* (which operations and protections actually become feasible). Documentary comparison, process tracing, confidential interviews when ethically appropriate, and care-

fully defined administrative indicators may reveal differences among these levels. Candidate measurements include the number of materially conflicting rule interpretations that reach a competent review, elapsed time to a rights-compatible determination, changes in independent evidential access, instances of retaliatory pressure, practical accessibility of refusal, and recurrence of specified harms. A rise in stated normative convergence accompanied by declining protected alternatives could indicate coerced conformity or reporting bias rather than successful co-creation; competing explanations should be tested before drawing that conclusion.

The theoretical result pursued here is thus a conditional model of norm co-evolution as *coupled transformations of generative mechanisms, normative interfaces, and the feasibility of joint continuations*. Its distinctive value would lie in identifying when an apparently acceptable local normative adjustment generates a conflict at the level of a connected institutional system, or when apparent normative learning modifies participants' capacities in ways obscured by agreement statistics. The next section examines how such processes interact with polycentric authority, sovereignty, and overlapping jurisdictions, which may distribute the ability to learn and revise across institutions that cannot command one another.

## 21 Polycentric Authority, Sovereignty, and Transnational Coordination

Institutional cooperation commonly connects authorities whose competences originate in different legal and social orders. A coastal monitoring programme may involve a national regulator, a regional scientific organization, a research consortium, a local community's representative institutions, and an international body. The participating entities may agree to exchange information while retaining distinct mandates for environmental assessment, resource allocation, enforcement, privacy protection, and dispute resolution. Their cooperation consequently depends on the fit among powers that are neither identical nor freely transferable. A technical agreement can coordinate records without establishing jurisdiction to authorize an intervention; a scientific recommendation can influence a public decision without itself acquiring the binding force of that decision. This difference becomes consequential when a reported ecological hazard requires action spanning several institutional domains.

Polycentric governance offers a developed point of departure. Ostrom describes how multiple centers of decision-making can support experimentation, learning, and action at different scales, while also facing problems of coordination, certification, leakage, and strategic behavior (Ostrom, 2010). Young's work on institutional fit, interplay, and scale situates environmental governance within interactions between institutions and ecological processes (Young, 2002). Raustiala and Victor describe overlapping, partly nonhierarchical international regimes and their possible legal inconsistencies (Raustiala and Victor, 2004); the literature on orchestration distinguishes indirect governance through intermediaries from delegation with stronger hierarchical control (Abbott, Genschel, et al., 2016). These analyses already explain much of the terrain. The purpose of the GR extension is narrower: to specify how an authority configuration changes the *jointly accessible continuations* of cooperating subjects, and to ask whether an apparently functioning set of institutions provides an end-to-end route from an acknowledged need to an authorized, reviewable, practically executable response.

### Competence, jurisdiction, and authority as typed relations

The collective configuration  $\mathcal{X}$  of Section 6 includes institutional and power relations. To investigate polycentric governance, let  $\mathcal{L}$  denote a set of authority-bearing institutions,  $\mathcal{D}$  a set of decision domains, and  $\mathcal{O}$  a set of possible official operations. Define the typed authority configuration

$$\mathfrak{A} = (\mathcal{L}, \mathcal{D}, \mathcal{O}, \text{Comp}, \text{Del}, \text{Rev}, \text{Exec}), \quad (72)$$

where  $\text{Comp} \subseteq \mathcal{L} \times \mathcal{D} \times \mathcal{O}$  records asserted and, where verified, legally or otherwise valid competences; Del records permitted delegations or assistance relations; Rev records routes of appeal, review, and

authorized amendment; and Exec records the practical means through which a valid decision can be implemented. A record of asserted competence must be distinguished from a legal determination of competence. International law, domestic constitutional arrangements, treaty participation, customary rights, and community mandates may supply relevant sources, and an analyst's diagram confers no authority on anyone.

A governance *path* is a sequence of typed operations connecting an identified claim or condition to a potential remedy or coordinated action:

$$q \xrightarrow{\ell_1, o_1} d_1 \xrightarrow{\ell_2, o_2} \dots \xrightarrow{\ell_k, o_k} a. \quad (73)$$

Every edge must be supported by the relevant competence, lawful information-sharing basis, admissible evidential transformation, and practical capacity. The existence of an organizational chart or memorandum supplies only partial evidence that such a path is available. An instruction to "refer the matter to the appropriate authority" may conceal a missing recipient, a forum lacking jurisdiction, an unfunded implementation obligation, or an affected community without a safe right to challenge the outcome. A rights-compatible route must also preserve the restrictions attached to protected information, review, and participation. Technical interoperability and lawful transferability are separate properties.

For a declared problem  $q$ , define  $\Pi_{\mathfrak{A}}(q)$  as the set of governance paths satisfying the competence, procedural, and execution constraints specified for the case. Let  $\mathcal{V}(q)$  express the applicable protections, including rights and relevant procedural requirements. The *actionable response set* is

$$\mathcal{Q}(q; \mathbf{X}, \mathfrak{A}) = \{a : \exists \pi \in \Pi_{\mathfrak{A}}(q), \pi \rightsquigarrow a, \pi \models \mathcal{V}(q), a \in \mathcal{F}_I(\mathbf{X}; \Theta)\}. \quad (74)$$

This notation extends the joint-feasibility analysis in Section 6. The notation  $\pi \rightsquigarrow a$  means that the path terminates in an executable response of the specified kind. A nonempty set establishes only conditional reachability relative to the modeled authorities, resources, and constraints. It does not establish institutional legitimacy, factual correctness of the original claim, or the desirability of the available responses. Those require independent assessment.

### How functioning institutions can produce a collective accountability gap

A constructed example makes the compositional issue visible. Institution  $A$  operates a marine observation station, is obliged to protect the location of a sensitive ecological site, and may deliver a protected alert to  $B$ . Institution  $B$  administers a regional warning platform and can publish a warning only when the evidential basis has passed an authorized certification process. Institution  $C$  is authorized to certify open datasets, but its mandate excludes confidential material received from  $A$ . Each institution performs its own task:  $A$  securely transmits the alert;  $B$  requests certification;  $C$  correctly declines to certify evidence outside its competence. Nevertheless, the combined process may lack a lawful route to publish a timely warning. The system can satisfy each local procedure while failing the collective response requirement.

One may write  $\text{LocalOK}_A = \text{LocalOK}_B = \text{LocalOK}_C = 1$  for the three stipulated local assessments, while  $\mathcal{Q}(q; \mathbf{X}, \mathfrak{A}) = \emptyset$  for the desired warning action. This result is possible because local institutional compliance and joint reachability are distinct predicates. It does not establish that the actors violated any law. Depending on the actual instruments, the appropriate response might be an authorized confidential certification procedure, a validated public derivative of protected data, a different competent reviewer, or a lawfully adopted emergency process. If none of those options can satisfy both the evidential requirement and the confidentiality obligation, the consortium may have to revise its design or refrain from the requested action. The analytic purpose of the example is to reveal a missing institutional composition, not to presume that openness always overrides confidentiality.

A second, opposite failure mode arises when many bodies each possess some plausible competence. Duplicated review may permit forum shopping, contradictory determinations, or repeated demands on

vulnerable communities. Redundant authorities may also be useful: they can provide independent review, continuity during institutional failure, and alternative access for persons whose claims were dismissed. The relevant diagnostic question concerns the *quality and distribution of connected pathways*, including whose paths remain accessible when one authority fails. Counting decision centers alone cannot resolve the question.

The proposed GR result is a conditional *compositional authority gap*: individual competence and routine local performance can coexist with the absence of a feasible, legitimate joint continuation for a specified need. The result resembles established work on regime complexity and institutional interplay. A distinctive GR contribution would require evidence that modeling the connected paths together with the subjects' material, epistemic, and remedial capacities predicts failures or reveals remedies that conventional jurisdictional and process-mapping analysis misses. We should therefore test the construction against those competent baselines instead of treating the change of notation as proof of novelty.

### **Sovereignty, subsidiarity, and the distribution of decision power**

The distribution of authority is shaped by legal sovereignty and political relationships. A state may consent to international obligations while retaining domestic implementation responsibilities; a municipal agency may possess local competence under domestic law; an Indigenous people's rights and representative institutions may require specific forms of consultation, participation, or consent depending on the legal instrument and situation. Private certifications and scientific committees may inform decisions without possessing state authority. The GR representation must preserve these legal differences. Describing multiple entities as "subjects" is an analytic choice about relational participation, rather than a claim that they possess identical legal personality, jurisdiction, or rights.

Subsidiarity can guide institutional design when decisions should be located near the affected people and ecological processes, subject to the resources and lawful authority required. A purely local solution may be inadequate for a pollutant or migratory population crossing borders; a distant centralized solution may overlook fine-grained knowledge, meaningful representation, and harms concentrated in particular places. Institutional allocation should therefore examine the geographic and functional reach of the problem, the competence of each forum, and the conditions under which cross-scale escalation becomes appropriate. Authority that is formally distributed can remain materially concentrated if only one participant can finance laboratories, maintain communication systems, or interpret admissible evidence.

To describe this possibility, let  $Q_i(q)$  be the subset of actionable pathways accessible to an affected participant  $i$ , including lawful means to initiate review or obtain a reasoned response. It is possible for the collective path set  $Q(q)$  to expand while  $Q_i(q)$  becomes practically inaccessible because filing costs, translation requirements, security risks, or resource dependence rise. A reform that adds an international review body can therefore increase formal oversight and simultaneously burden the people who need that body most. This possibility should be evaluated empirically, considering existing alternatives and genuine costs. It would be premature to interpret every concentration of expertise as wrongful centralization: specialization sometimes improves safety and protects scarce capabilities. The question concerns the institutions and safeguards that govern specialization.

### **The BBNJ Agreement as an emerging arena of institutional interplay**

The BBNJ Agreement, in force since 17 January 2026, provides an emerging example of institutional interplay among marine science, conservation, domestic authorities, sectoral bodies, and regional arrangements (United Nations, 2026a; United Nations Treaty Collection, 2026). Its operational institutions were still developing in October 2026, with the first Conference of the Parties scheduled for January 2027 (United Nations, 2026b). The question here concerns the composition of competent

authorities; Section 36 addresses the treaty's specific institutional provisions and documentary record.

A prospective area-based management episode could be traced from admissible evidence and consultation through the legally competent bodies to implementation and review. The inquiry would document whether affected participants can access the authorized channels of representation, scientific review, and correction. Such a trace must follow the operative treaty text and subsequent decisions, leaving unformed procedures explicitly unresolved.

### **A practical coordination and accountability protocol**

A GR-informed transnational-coordination exercise can begin with a specific decision or harm rather than an abstract call for stronger cooperation. The participating institutions first define the legal and geographic scope of the issue; identify rights-holders, affected communities, responsible public authorities, competent scientific bodies, and relevant private operators; and record the source and limits of each mandate. They then document a complete, authorized path from evidence to a potentially executable response, including protected information transfers, independent review, practical resources, and remedies. The exercise should identify alternative lawful paths in the event of a failure and the cost and risk of using each path for differently situated participants.

During a bounded simulation, an institution can submit a fictional contested alert or grievance and trace where it is accepted, translated, delayed, referred, or rejected. Recorded reasons permit analysts to distinguish an evidential deficiency from a lack of competence or practical resources. The process is then reviewed by persons qualified to address each relevant legal and operational domain, with safeguards for communities whose knowledge or circumstances have been represented by others. Potential changes include interoperable but access-controlled records, recognized review channels, shared funding for independent monitoring, clearly defined escalation thresholds, and published explanations of the competent forum. Participation remains subject to meaningful consent and appropriate protection from retaliation.

Candidate observations include completion rates for end-to-end response pathways, time spent at inter-institutional interfaces, incidence of contradictory decisions, lawful access to review for vulnerable claimants, practical implementation of remedies, and the ability to sustain a response during infrastructure failure. A comparative design should ask whether this capacity-sensitive route analysis adds useful information beyond ordinary process mapping, interagency memoranda, and polycentric governance evaluations. Its value may be greatest where technical infrastructures, institutional mandates, and transnational dependencies change together. Section 22 extends this analysis to the ecological processes and interests that institutional diagrams can overlook precisely because they lack direct access to the forums that govern them.

## **22 Ecological Interdependence and the Representation of Absent Interests**

Transnational cooperation operates within ecological relations that sustain and constrain its material activities. Ocean currents connect distant coastal regions; migratory populations traverse jurisdictions; changes in water chemistry affect organisms, fisheries, and human livelihoods through mechanisms occurring at different spatial and temporal scales. An institution may regulate a particular activity within a defined jurisdiction while its consequences propagate through ecological systems whose functional boundaries differ from that jurisdiction. The resulting governance problem concerns the relationship among ecological processes, the subjects affected by them, and the representatives authorized or entrusted to speak on behalf of interests that cannot participate directly in a decision.

Environmental institutions have long confronted problems of cross-scale fit and ecological interdependence (Young, 2002; Ostrom, 2010). The 2024 IPBES Nexus Assessment synthesizes interconnec-

tions among biodiversity, water, food, health, and climate change (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2024). The Kunming–Montreal Global Biodiversity Framework addresses ecosystem integrity and connectivity, genetic diversity, rights and participation, and the distribution of benefits in biodiversity governance (Convention on Biological Diversity, 2022). The United Nations Declaration on Future Generations, adopted in 2024, articulates responsibilities concerning the interests of generations whose members cannot participate in current institutional deliberation (United Nations General Assembly, 2024). Such instruments establish a substantive context for this section. The proposed GR addition is to examine how the *generative conditions of ecological relations* alter the feasible continuations of human institutions, while carefully distinguishing scientific descriptions of ecological processes from ethical judgments about their significance and legal determinations of standing or rights.

### Ecological processes as structured constraints on cooperation

Let an ecological system within a stated modeling boundary be represented by

$$E = (Z, \beta, \mathcal{F}, \mathcal{K}, \mathcal{U}, \Omega), \quad (75)$$

where  $Z$  is a space of ecological states,  $\beta$  a class of transition operators grounded in relevant physical and biological models,  $\mathcal{F}$  material and energetic flows,  $\mathcal{K}$  observed or modeled relational structure,  $\mathcal{U}$  uncertainties in measurements and modeling, and  $\Omega$  declared viability or protection constraints. The formal choice of components does not imply that an ecosystem is a single intentional agent. Ecological dynamics may be represented through population models, conservation equations, coupled differential systems, stochastic processes, or empirically grounded simulation, depending on the question. Conservation laws and biological mechanisms should be treated according to their respective scientific status. Normative judgments about acceptable risk and protection cannot be inferred directly from the equations.

For a proposed human intervention trajectory  $\pi$  and uncertain ecological parameters  $\theta \in \Theta_E$ , write  $z_{\pi, \theta}(\lambda)$  for the associated ecological states along a chosen indexing parameter  $\lambda$  and  $H$  for an explicitly defined evaluation range. Define a conditional ecological admissibility set

$$\mathcal{F}_E(\Theta_E, H, \Omega) = \left\{ \pi : \forall \theta \in \Theta_E, \forall \lambda \in H, z_{\pi, \theta}(\lambda) \in \Omega(\lambda) \right\}. \quad (76)$$

This is a deliberately demanding robust-feasibility formulation. Where the uncertainty class is too broad, researchers may use a transparent chance constraint, scenario family, or risk-sensitive criterion with justified thresholds. The choice requires explanation: greater stringency may exclude useful actions, while weak thresholds may conceal irreversible degradation. The indexing parameter and horizon are modeling conventions; no privileged ontological division of past, present, and future follows from them. Different ecological processes call for different characteristic scales, delays, and histories, and the policy assessment must state those choices.

Ecological feasibility enters the cooperative construction as a further constraint on the jointly admissible operations of Section 6:

$$\mathcal{C}_{I,E} = \{ \pi \in \mathcal{F}_I(X; \Theta_I) : \pi \in \mathcal{F}_E(\Theta_E, H, \Omega), \pi \models \mathcal{V}_I \}. \quad (77)$$

The notation is useful only when the model translates a planned activity into physically meaningful ecological effects and when the chosen viability conditions are justified by evidence, law, and ethical analysis. A collective agreement may satisfy its procedural duties while the intervention it authorizes undermines ecological functions essential to its participants; an ecologically promising intervention may nevertheless infringe the rights of a community whose access to livelihood resources is curtailed without lawful justification. These possibilities require joint assessment. Reducing all considerations to a single unit of “generativity” would erase important scientific and normative differences.

## Ecological dependency and the limits of observable institutional success

A major difficulty arises when the indicators used to judge success operate on different scales from the ecological processes being governed. A marine-protection programme may report the number of areas designated, the volume of monitoring data collected, or compliance with administrative deadlines. These measurements can be reliable within their defined purposes while leaving gaps concerning ecological connectivity, species interactions, ecosystem functioning, and long-range cumulative impacts. Likewise, short-range measurements of fish abundance can be insufficient to infer the integrity of a changing food web, the replenishment of habitat, or the resilience of the affected population under additional stressors.

Consider two hypothetical programmes  $P$  and  $Q$  with equivalent reported compliance records over an initial assessment window:

$$\mathcal{O}_H(P) = \mathcal{O}_H(Q), \quad \mathcal{F}_E^P(\Theta_E, H', \Omega) \neq \mathcal{F}_E^Q(\Theta_E, H', \Omega). \quad (78)$$

Here  $H'$  is an explicitly declared evaluation range or scenario family that captures additional mechanisms, scales, or disturbances. The equality is observational, relative to the selected institutional indicators, while the inequality represents a hypothesis that further ecological modeling or evidence could differentiate the interventions' admissible continuations. The statement makes no empirical claim about a real conservation area. Its prospective GR contribution is to connect differences in ecological continuations with differences in institutional authority, measurement selection, and productive dependency. Established ecological risk assessment already recognizes mismatches among proxies, ecosystems, and governance scales; a GR analysis should show incremental value beyond that existing discipline.

A constructed comparison clarifies the limits. Programme  $P$  establishes sensors sufficient for a designated water-quality indicator while retaining exclusive control of calibration and reducing local capacity to monitor additional variables. Programme  $Q$  measures the same indicator to the same accuracy, provides equivalent alerts, and also enables relevant local institutions to maintain instruments, undertake independent validation, and request investigation of unmeasured ecological changes. The two programmes can have equal contractual performance and different distributions of epistemic and generative capacity. The ecological outcomes may also differ, though this requires independent evidence rather than inference from governance design alone. The operational claim is modest: an assessment should record how the distribution of ecological knowledge and maintenance capacity affects the ability to detect, interpret, and respond to change.

The GR account therefore distinguishes three components: the ecological transition mechanisms; the institutional observability of those mechanisms; and the capacity of affected subjects to act on the resulting evidence. These components form a coupling rather than a causal identity. Improved observation can reveal deterioration without preventing it. Expanded community participation can enhance accountability while leaving a biophysical intervention insufficient. Strong ecological safeguards may require restrictions that are defensible even when participants prefer a less stringent regime. Appropriate institutional design must reason through these differences explicitly.

## Representation, standing, and the heterogeneous status of absent interests

Several categories of interests may be absent from a deliberative forum for different reasons. A person may be excluded by cost, coercion, disability barriers, or jurisdictional rules. A child or a person affected across generations may lack direct participation in a particular decision. An animal population or ecosystem may undergo consequences of a policy without possessing a recognized institutional voice. A scientific proxy, community delegate, guardian, or specialized public body may communicate information or advocate on behalf of such interests, subject to different sources of authorization. The appropriate procedures depend on the nature of the represented subject and applicable law.

It is useful to separate four questions. *Ontological status* asks what kind of entity or relational system is under consideration. *Moral considerability* asks whether and why its interests warrant ethical protection. *Legal status* asks whether the relevant jurisdiction recognizes rights, duties, legal personality, or standing. *Representational authority* asks who is entitled to present evidence, participate, or make binding claims on its behalf. Treating these questions as interchangeable would lead to invalid inferences. Scientific evidence of ecosystem interdependence does not automatically establish legal personhood; the assignment of a legal representative does not settle the philosophical status of the represented entity. Stone's foundational proposal to consider standing for natural objects demonstrates a distinct legal-philosophical tradition with which a GR analysis must engage rather than claim to invent (Stone, 1972).

For an interest category  $u$ , a representative arrangement can be characterized by

$$P_u = (\text{Basis}_u, \text{Scope}_u, \text{Evidence}_u, \text{Duties}_u, \text{Review}_u, \text{Conflict}_u). \quad (79)$$

The fields identify the source of appointment or authority, the scope of representation, the evidence used to formulate a claim, duties of care or fidelity where applicable, review or replacement procedures, and conflicts of interest. This is a diagnostic structure rather than a universal legal test. A committee that advises about ecosystem impacts performs a different role from a litigation guardian, an elected official, an Indigenous representative institution, or a treaty-authorized scientific body. Legitimacy depends on the relevant legal and normative basis and on the actual practices through which affected people and interests are represented.

Representation also produces an epistemic problem. Forecasts for future generations involve uncertainty about social and ecological trajectories, technologies, institutional choices, and changing needs. The 2024 Declaration on Future Generations provides a political and normative point of reference, rather than a mathematical solution to intergenerational choice (United Nations General Assembly, 2024). A GR approach can compare the constraints a decision places on different admissible trajectories, while leaving their evaluation open to explicit ethical principles and public reasoning. For non-human interests, empirical knowledge about species and ecosystems can inform measures of exposure, population persistence, welfare, and ecological function. Decisions about which interests count and how to weigh them require normative justification with appropriate attention to scientific uncertainty and the existing legal framework.

Representatives may themselves acquire concentrated power. An organization claiming to protect a vulnerable population or ecosystem can control evidence, set priorities, and influence funding without adequate accountability. Independent review, public reasons where safe and lawful, transparent conflict-of-interest rules, and procedures allowing legitimately affected human communities to challenge representation can reduce these risks. For subjects unable to communicate in institutional language, epistemic pluralism and scientific assessment remain crucial, but pluralism does not erase differences in evidence quality or empower an analyst to pronounce on a community's behalf without authorization. The GR emphasis on heterogeneous histories and partial translation should deepen scrutiny of representation, especially when ecological knowledge and local livelihoods are entangled.

### International instruments and the practical ecology of transnational cooperation

The Kunming–Montreal Global Biodiversity Framework provides useful institutional reference points through its attention to ecological integrity, connectivity, adaptive potential, participatory planning, and the rights of Indigenous peoples and local communities (Convention on Biological Diversity, 2022). The BBNJ Agreement, in force since January 2026, provides an emerging setting for studying the connections among environmental impact assessments, area-based management measures, scientific expertise, and capacity building (United Nations Treaty Collection, 2026). These instruments differ in legal structure, operation, and scope. Their commitments should be read in the context of their operative texts, applicable decisions, and the legal status of each participant. The purpose of citing

them here is to identify prospective institutional mechanisms, without asserting that they currently deliver the outcomes contemplated by a hypothetical GR design.

A praxis protocol for transnational ecological cooperation can proceed through linked investigations. First, the participating institutions identify the ecological processes affected by a planned activity, including physical and biological dependencies that cross the designated jurisdiction or management boundary. Second, they define scientifically defensible observation variables, model limitations, and uncertainty scenarios, and distinguish ecological thresholds from administratively convenient indicators. Third, they specify the rights-holders and affected populations, the channels for locally relevant and appropriately protected knowledge, and the lawful arrangements through which less directly represented interests are considered. Fourth, they identify which competent authorities can authorize, monitor, revise, or halt the relevant activity. Fifth, they test whether potential grievances and emergent ecological warnings can reach a reviewable and practically executable response across the connected institutional system.

For oceanic observation, one may evaluate whether marine robots, shared sensing networks, and data infrastructures support diverse ecological measurements while permitting independent scientific scrutiny and legitimate local control over sensitive data. For diplomatic cooperation over a transboundary ecological risk, parties may establish provisional technical exchanges despite wider disagreement, provided that the exchange protects persons and interests that could be exposed through the arrangement. For public institutions, the method would assess whether environmental consultations change what officials can know and lawfully do, including the ability to revise an intervention when newly available evidence indicates harm. Accountability should be demonstrated through records of decisions, implementation, and remedy rather than solely through favorable trust ratings.

Candidate empirical measurements include ecological state indicators with stated uncertainty, cross-jurisdictional data compatibility, access to independent scientific review, representation challenges resolved with reasons, changes to monitoring coverage after affected-community input, response time to ecological threshold crossings, and long-range feasibility under specified disturbance scenarios. The ecological indicators require domain expertise and validation; procedural metrics alone cannot demonstrate improved environmental outcomes. A comparative design can ask whether the GR coordination and continuation analysis detects additional actionable vulnerabilities beyond established ecological impact assessment, adaptive management, environmental justice, and polycentric-governance methods. Failure to improve decision quality would limit the proposed framework's practical claim.

This section accordingly advances a cautious, testable proposition: cooperation may be institutionally credible within a bounded reporting system while altering ecological and social conditions that determine the feasibility of continued coexistence. The most useful GR contribution would consist in identifying these discrepancies early, tracing the institutional and material mechanisms that produce them, and supporting legally and ethically accountable correction. Section 21 has shown why institutional competence and full response reachability can diverge; the following section examines how AI-mediated observation and autonomous infrastructures may further reshape those relations, including the authority assigned to machine-generated evidence and decisions.

## 23 AI-Mediated Cooperation and Responsibility in Autonomous Infrastructures

Intelligent systems increasingly mediate interactions that cross institutional, disciplinary, and territorial boundaries. A marine observing consortium may use adaptive classifiers to flag anomalous measurements, machine translation to circulate notices, robotic platforms to collect ecological evidence, and scheduling software to coordinate vessels and computational infrastructure. An international organization may use a language model to prepare comparative summaries of policy submissions; a public agency may employ automated triage to route complaints; and a transnational technical network may

allocate scarce computing or communication capacity through machine-generated recommendations. These activities differ materially in purpose, risk, and authority. Each inserts a technological process into a cooperative relation whose consequences depend upon data access, delegated competence, technical maintenance, and the capacity of affected parties to contest a result. The GR question concerns how this mediation changes the practical possibilities of the participants and the institutions through which they cooperate.

AI ethics and governance already supply substantial resources for answering parts of that question. Matthias's responsibility-gap problem asks how responsibility is assigned when adaptive machines behave in ways not readily predictable by individual operators (Matthias, 2004). Santoni de Sio and van den Hoven develop a philosophical conception of meaningful human control that attends to the relation between autonomous behavior and responsible human reasons (Santoni de Sio and Hoven, 2018). Work on accountable algorithms examines technical and institutional conditions for auditing decisions (Kroll et al., 2017). The NIST AI Risk Management Framework organizes risk management around governance, mapping, measurement, and management (National Institute of Standards and Technology, 2023); the OECD AI Principles address transparency, traceability, accountability, robustness, and opportunities to challenge outputs (OECD, 2024a). UNESCO's Recommendation on the Ethics of Artificial Intelligence emphasizes attribution of ethical and legal responsibility to natural persons or existing legal entities and the continuing place of human oversight (UNESCO, 2021b). These foundations make it inappropriate to claim that oversight, transparency, traceability, or human accountability are new GR discoveries. The present inquiry instead asks whether their coordination across heterogeneous and changing generative systems can be analyzed more precisely, including when apparently complete local accountability mechanisms leave consequential gaps at the level of the entire cooperation.

### Distinguishing technical action, evidential contribution, and authorized decision

An AI system can generate a prediction, record a sensor event, recommend a course of action, or initiate a physical operation under a preauthorized control policy. These functions occupy different positions in an institutional process. A model score describing the likelihood of an environmental anomaly is a technical output, with uncertainty and domain limits; a scientific finding depends on an authorized method of interpretation and validation; a legal or administrative determination requires a competent source of institutional authority. Even a highly accurate prediction does not by itself confer a power to suspend an activity, allocate rights, or decide a grievance. The difference should remain explicit when an autonomous system carries out physical control: its capacity to actuate equipment is a fact about technical configuration, while the lawfulness and legitimacy of the authorization for that act are separate questions.

Let  $q$  identify an AI-mediated task within the joint configuration  $X$  of Section 6. A minimal task profile is

$$D_q = (\text{Purpose}_q, \text{Inputs}_q, \text{Model}_q, \text{Output}_q, \text{Delegation}_q, \text{Effects}_q, \text{Review}_q, \text{Fallback}_q). \quad (80)$$

The profile distinguishes the task's authorized purpose, admissible inputs and model/version, output types, documented delegation boundaries, possible consequences, routes of challenge, and feasible fallback procedures. Its fields are analytically separate. Knowing that a predictor generated a score does not identify which authority decided to act on it; knowing who signed a delegation does not show that a challenged decision can be corrected. A technically successful operation may nevertheless exceed delegated scope, produce evidence inaccessible to an affected institution, or make its subsequent activities dependent on a provider with exclusive control over software, calibration, or compute.

The term "agent" also requires typed interpretation. In a human–human (H–H) interaction, human participants may communicate through automated tools. In a human–AI (H–AI) interaction, a human interacts with a deployed system whose operations are supported by developers, operators, owners, infrastructures, and policies. An AI–AI interaction may describe software systems that exchange sig-

nals, negotiate allocations under prescribed constraints, or coordinate physical robots. The occurrence of machine-to-machine negotiation establishes neither autonomous legal personality nor independent moral authority. Existing legal duties, contractual allocations, human rights protections, and public responsibilities apply according to competent governing arrangements. If future research motivates distinct normative statuses for particular artificial subjects, their proposed standing must be evaluated through explicit criteria and lawful institutional change. The GR metamodel can represent heterogeneous mechanisms without settling that normative question through notation.

### Following decisions through a distributed chain of accountable transformations

Consider a transnational early-warning service connecting a sensing platform, an anomaly model, a regional observatory, a public authority, and communities exposed to the resulting action. A machine-produced warning may travel through several transformations: collection, preprocessing, classification, translation, aggregation, administrative interpretation, communication, and response. Each stage may have a qualified operator and a service-level agreement. Nevertheless, an affected community may be unable to discover which calibration version produced a false alert, identify a public body empowered to amend the response, or obtain a remedy when the warning has caused a tangible loss. The cooperation can therefore exhibit competent subsystems and an incomplete end-to-end accountability route.

For a consequential output  $y_q$ , define a typed mediation trace

$$\text{Tr}_q : (x, \nu, \eta) \xrightarrow{f_q} y_q \xrightarrow{\iota_j} d_j \xrightarrow{a_j} z, \quad (y_q, d_j, z) \xrightarrow{\rho} (r, \delta). \quad (81)$$

Here  $x$  denotes authorized input records,  $\nu$  a model and calibration version,  $\eta$  relevant operating conditions,  $f_q$  a technical transformation,  $\iota_j$  an institutionally authorized interpretation,  $d_j$  a determination,  $a_j$  an authorized act, and  $z$  its effects. The review relation  $\rho$  can produce findings  $r$  and an enforceable or otherwise practically executable correction  $\delta$ . Arrows express heterogeneous causal, evidential, and legal relations; they are deliberately typed rather than treated as interchangeable function evaluations. Some processes will be stochastic or interactive, and therefore require kernels or sets of admissible transitions. A review may legitimately confirm an original decision or recognize that a remedy is unavailable under existing law. The model records that outcome instead of silently assuming a favorable resolution.

The practical adequacy of this trace depends on more than retaining an audit log. An audit record may be complete yet held by a provider that cannot lawfully disclose the underlying data; an official may have authority to acknowledge an error but lack power to correct the allocation affected by that error; an appeal may exist while being inaccessible to a person without specialist legal or technical assistance. Section 16 analyzed contestation as a sequence of protected evidential operations, while Section 18 examined whether a claim can reach an executable institutional response. AI mediation adds dependence upon model versioning, technical provenance, human-machine interfaces, operational permissions, and recovery infrastructure. A relational analysis must test the assembled pathway, including the points at which different organizations' mandates and technical standards meet.

### A conditional gap between automated performance and relational accountability

Suppose two jointly operated marine observation systems,  $X^A$  and  $X^B$ , deliver identical validated warning sequences over the observed test period. Both satisfy the same service performance threshold, and each appoints a nominal review officer. Under arrangement  $A$ , the participating coastal authority can obtain protected calibration records, reproduce disputed classifications through an accredited procedure, suspend local reliance on an unreliable output under stated conditions, and obtain a review by the competent public authority. Under  $B$ , model weights and calibration data are exclusively controlled by an external contractor, the designated review officer can examine only the final warning,

and the operator cannot transfer the system to an alternative service during the relevant risk window. The observed output and formal presence of a review officer are equivalent; the effective possibilities of independent verification, authorized correction, and cooperative continuation are different.

This is a constructed comparison, with its implications conditional on the chosen task and feasible alternatives. Its point is not that every proprietary model is unaccountable, or that open weights necessarily provide useful oversight. Independent validation can be furnished through appropriately secured external review, restricted evidence rooms, or certified testing without general public disclosure. In high-risk contexts, releasing detailed operational data may expose communities, security arrangements, or protected knowledge. The relevant variable is whether the required scrutiny and lawful response are *actually feasible for appropriately authorized parties* under the operating conditions. One can represent the divergence schematically as

$$Y_q(X^A) \equiv Y_q(X^B), \quad \mathcal{U}_i^{\text{review}}(X^A; \Theta) \not\equiv \mathcal{U}_i^{\text{review}}(X^B; \Theta), \quad (82)$$

where  $Y_q$  denotes a declared performance observation and  $\mathcal{U}_i^{\text{review}}$  the set of effectively accessible review-and-response operations for institution or affected participant  $i$ . The expression asserts a logically possible separation, rather than a measured difference in any deployed marine system. Identifying it requires a comparison with the safeguards already proposed by contemporary AI governance, software assurance, human-factors engineering, and administrative-law analysis. The GR contribution would be limited if those methods detect the same actionable gap with less conceptual overhead.

AI-assisted translation produces a second, distinct challenge. A model may faithfully render locally familiar words while altering the legal or procedural effect of a commitment when the translated document is reused by another institution. A multilingual notice stating that a dataset “may be accessed for review” could be interpreted as a right to inspect at one site and as permission to receive a redistributable copy at another. The discrepancy becomes consequential when a third party relies on the translated language to release sensitive records. Section 7 distinguishes semantic path dependence from jointly inconsistent obligations. Here the model’s linguistic output is one transformation in a longer chain of human interpretation, institutional approval, and material action. The responsibility to establish valid meanings and permissions remains with authorized interpreters and institutions. Independent expert review and provenance-preserving, jurisdiction-sensitive drafting are therefore relevant interventions; their effects on accuracy and accessibility require testing.

### Autonomous material action and the conditions of responsible delegation

When software controls physical infrastructure, the cooperative stakes extend beyond errors in reports. An autonomous marine vehicle may change course, collect samples, or allocate energy and communication capacity under an approved mission plan. Its control policy can satisfy physical constraints while creating unanticipated externalities for another participant, a protected habitat, or a public-service obligation. A complete engineering analysis requires feasible dynamics, uncertainty sets, sensing limits, collision and ecological safeguards, and fallback modes. These belong to the physical model and relevant safety standards. The GR representation adds an inquiry into how delegation and control affect participants’ authority to request changes, suspend operations, and recover from failures without incurring unacceptable dependency.

Define  $\mathcal{D}_q(X)$  as the authorized operations delegated to an autonomous component and  $\mathcal{S}_q(X)$  as the physically feasible operations satisfying independently specified safety and ecological requirements. Executable operations must lie in

$$\mathcal{A}_q(X) = \mathcal{D}_q(X) \cap \mathcal{S}_q(X) \cap \mathcal{F}_q(X; \Theta_q), \quad (83)$$

where  $\mathcal{F}_q$  is the task’s available material and institutional implementation space. This expression is a constrained design screen. It does not establish that an automated controller can correctly recognize

all unsafe conditions, that emergency intervention is always feasible, or that every affected party has a veto. Those claims depend on validated engineering requirements and competent legal authority. Especially where remote intervention is delayed or communications fail, oversight must be planned as a combination of bounded delegation, tested autonomous safe states, monitoring, record preservation, and authorized emergency procedures. Human oversight is meaningful only when responsible persons and institutions possess relevant knowledge, capacity, and opportunity to exercise it, a point already developed in the meaningful-control literature (Santoni de Sio and Hoven, 2018).

A cooperative safety failure can also produce cascading governance failure. An AI-mediated allocation service may prioritize emergency communication for one partner based on an approved rule, while an unrecorded dependency deprives another partner of the bandwidth needed to exercise its agreed review right. Both the allocation algorithm and the appeal procedure may individually meet their technical specifications. At the joint-system level, the conditions necessary to use the appeal procedure have been withdrawn by another authorized operation. The example connects the authority-composition problem of Section 21 with the capacity and infrastructural problems of Sections 12 and 15. Its possible novelty lies in deriving and testing a contradiction among the *operational prerequisites of authorized rights* across independently administered subsystems.

**Delegated operation and the limits of subject attribution.** An AI-enabled system can be represented as an operational actor in *A* when it changes the evidence or actions available to others. That role does not itself establish that the system has legal standing, moral personhood, a human-like trust disposition, or authority to authorize institutional remedies. For each delegated operation, the assessment should record the competent principal, the technical system's permitted action type, the provenance and limitations of its observations, and the person or body accountable for correction. The same interface test can then be used for human and machine nodes while preserving the distinct legal and normative statuses of those nodes. This prevents an apparently seamless technical workflow from obscuring a missing authorized institutional response.

### Practical implications for diplomacy, cooperation, and warranted public trust

The Global Digital Compact, adopted as part of the 2024 Pact for the Future, frames international digital cooperation and AI governance as matters of shared institutional responsibility and capacity building (United Nations, 2024). A GR-informed practical investigation can work within, and be compared against, such existing frameworks. For a cross-border scientific consortium, its first artifact would be a task-and-delegation register identifying what each AI component does, whose authorization it uses, what evidence it produces, who can reproduce that evidence, and what institution may lawfully act upon it. A second artifact would map end-to-end accountability: from an affected person's claim through technical provenance, competent review, actionable remedy, and follow-through. A third would record dependencies in training, calibration, local technical competence, compute access, and emergency fallback, so that apparently convenient automation can be evaluated for its effects on cooperative capacity.

For preventive diplomacy, AI-assisted translation or early warning could be introduced first in bounded informational roles, with expert comparison of meaning, retained original records, and formal procedures for clarifying divergent interpretations. For peacemaking, an automated conflict-event classifier should be assessed for sampling bias, risk to witnesses, disputed definitions, and the possibility of coercive use; access to underlying personal testimony must respect protection needs and informed consent. A model score should never be treated as sufficient grounds to override lawful protections or substitute for an authorized peace-process determination. For organizational trust, administrators could compare announced human review with the actual time, expertise, permissions, and institutional independence of reviewers. For public trust, an AI-assisted service should be evaluated through error correction, accessible explanations, protected complaint pathways, continuity of public service, and

demonstrated response to harms. Trust ratings may be collected as observations of public experience, with warranted trustworthiness assessed independently of reputational improvement.

Evaluation should proceed against competent established alternatives: a conventional AI risk assessment, a software safety case, a data-governance audit, an administrative appeal review, or a conflict-sensitive impact assessment. Predeclared outcomes could include the proportion of consequential decisions for which a lawful end-to-end review route is executable, time to reproduce a challenged output under approved access controls, false-positive and false-negative rates across affected populations, feasibility of fail-safe operations, rate of completed corrections, and changes in participants' capacity to maintain or replace an essential service. Costs, confidentiality breaches, ecological consequences, and exclusions from representation are adverse outcomes, even when aggregate accuracy improves. Where the GR analysis yields the same useful recommendations as the simpler baseline, the appropriate result is convergence with established practice rather than a claim of independent novelty.

The conditional thesis is thus specific. AI mediation can improve cooperative observation and coordination while simultaneously changing which subjects have the effective capacity to interpret evidence, enforce limits, revise rules, and continue acting under changed circumstances. Its institutional significance depends on the typed chain connecting technical transformations to legitimate authority and material capacity. The next section consolidates that chain with the wider GR account of heterogeneous subjects, histories, commitments, power, and remedies into a minimal formal representation suitable for explicit propositions and counterexamples.

## 24 A Minimal Formal Representation of Cooperative Relations

The earlier sections have introduced descriptions of heterogeneous subjects, relational histories, commitments, power, evidence, normative translation, and institutional action. A minimal model should now state how these objects fit together, which distinctions can be made rigorously, and what remains outside the model. The purpose is a disciplined language for comparing cooperative arrangements that may produce similar observed results while differing in their available continuations. The representation is intentionally modular: an investigator may instantiate one relation by a legal rule, another by a technical access-control policy, and another by a physical resource constraint, without pretending that legal authority and material energy obey identical dynamics. The relevant epistemic and normative assumptions must accompany each instantiation.

### A typed relational configuration as a projection of the GR metamodel

Let  $X$  be the more comprehensive GR joint configuration defined in Equation (5), and let  $\mathcal{Q}$  be a declared task-relative projection. For the institutional analysis, write

$$X = \mathcal{Q}(X) = (A, G, H, C, O, P, M, N). \quad (84)$$

Here  $A$  is the set of typed subjects and institutional actors;  $G$  collects directed and higher-order dependencies and authorized interactions;  $H$  contains distributed and possibly inconsistent representations of relational history;  $C$  represents commitments and conditions of their applicability;  $O$  denotes available observations and the procedures producing them;  $P$  records relevant distributions of material capacity and power;  $M$  contains authorized remedy, review, and revision mechanisms; and  $N$  contains situated normative languages, constraints, and translation interfaces. The label  $M$  in this projection abbreviates institutional *remedial mechanisms*; it is separate from the subject-level  $\mathcal{M}_i$  for *generative mechanisms* in Equation (4). The projection is many-to-one. It loses some detail about the full heterogeneous generative structures, and an analyst should specify the information retained and discarded before claiming that a result has general validity. In particular, comparisons between  $X$  and  $X'$  require declared correspondence maps for relevant actors, actions, rights, observation types, and

authority roles. Equality of reports or continuation sets across changing institutional boundaries is otherwise ill-typed. A projection-preservation claim requires evidence that omitted mechanisms cannot alter the particular protected action or response path under examination.

The types of  $A$  matter. A state may exercise sovereign legal competences, a university may govern a scientific service under its charter, an Indigenous representative institution may possess rights and authorities recognized under applicable legal and normative orders, and an autonomous robot may implement delegated operations. Their entries in  $A$  indicate that they affect the modeled interaction. That bookkeeping convention assigns neither equal legal status nor commensurable moral worth. A separate competence map  $\text{Auth}(a, d, X)$  identifies which actions subject  $a$  may authorize in domain  $d$ , together with constraints and grounds. Legal validity comes from law and appropriately constituted arrangements, while scientific descriptions require evidential support. A model can therefore represent an action that is technically available while ruling it out under applicable protection constraints.

For a domain  $d$ , consider a set  $\Pi_d(X)$  of proposed *joint* operations or policies. Jointness is important: independent actions by two participants can each be feasible in isolation while their combination violates a resource constraint, a safety requirement, or an institutional obligation. Define the feasibility screen

$$\mathfrak{F}_d(X; \Theta) = \left\{ \pi \in \Pi_d(X) : \begin{array}{l} \pi \models \text{Phys}_d(\Theta), \pi \models \text{Comp}_d(X), \\ \pi \models \text{Protect}_d(X), \pi \models \text{JointNorm}_d(X) \end{array} \right\}. \quad (85)$$

The parameter set  $\Theta$  specifies documented modeling assumptions, physical bounds, competence requirements, uncertainties, and evaluation horizons or historical cuts. The four constraints represent physical and technical feasibility, competent authorization, legally and ethically justified protections, and joint satisfiability of the applicable normative interface. They are typed placeholders, whose operational content must be supplied independently. If a legitimate legal procedure permits revision of certain rules, a policy may include that revision with its required authorization; the model should never treat a right or binding duty as disposable merely to restore mathematical feasibility.

A cooperative arrangement is *constructible relative to*  $(X, d, \Theta)$  when there exists  $\pi \in \mathfrak{F}_d(X; \Theta)$  that satisfies the explicitly specified participation and viability conditions of the inquiry. This is an existence question under stated assumptions, with the status of formal conditions distinguished from evidence that any real arrangement is achievable. Where the participants can legitimately renegotiate the rules or jointly invest in technical capacity, those authorized changes may be modeled as operations transforming  $X$  into a new configuration, and constructibility can be examined over such transformations rather than a fixed option set. Search procedures that fail to find an arrangement are evidence of infeasibility only within the specified search domain and completeness guarantees.

## Relational histories and the separation of observation from state

The history component  $H$  is distributed across actors and representations. One institution's record of an intervention, another's account of the resulting harm, and a machine-generated event log may correspond to overlapping aspects of an occurrence without being epistemically or normatively identical. Let  $\Gamma(X; \Theta)$  denote admissible relational trajectories under a chosen description, and  $\gamma \in \Gamma(X; \Theta)$  a candidate trajectory. Observation is modeled through a family of partial and potentially noisy mappings

$$o_{i,d} \in \text{Obs}_{i,d}(\gamma, \omega_i), \quad \text{Obs}_{i,d} : \Gamma \times \Omega_i \rightsquigarrow \mathcal{Y}_{i,d}, \quad (86)$$

where  $\omega_i$  includes relevant instruments, classifications, sampling practices, access permissions, and uncertainties. Here the right-hand side denotes a set of permissible observed records for a relational observation map; a probabilistic implementation would instead specify a normalized kernel and report likelihoods. Membership in this set establishes compatibility with an observation, rather than truth of a uniquely inferred history. The mapping may itself change when a partnership modifies the sensors or rules through which later evidence is produced. Consequently, a change in reported cooperation may reflect a change in conduct, a change in observability, or both. A reported increase in complaints,

for instance, could follow improved access to grievance channels even while underlying misconduct declines. The analyst must specify how such interpretations can be distinguished.

Define context-indexed trust  $T_{a \rightarrow b}^{(d)}$  as a latent assessment or disposition attributed to actor  $a$  concerning reliance on  $b$  in domain  $d$ , with the content and admissibility of that attribution fixed by a specific measurement theory. In some studies  $T$  may be ordinal, multidimensional, or represented by a set of permissible beliefs. An interval-valued survey instrument provides one possible operationalization; it is not a universal GR scale. Let  $K_d$  denote separately defined cooperative conduct, such as fulfilled joint tasks, maintained channels of coordination, or observed adherence to a bounded agreement. Distinguishing  $T$  from  $K$  prevents the circular inference that observed cooperation proves subjective trust, or that a measured declaration of trust establishes substantive institutional credibility. The distinction also preserves the possibility of prudent reliance on enforceable guarantees amid justified distrust.

The representation may be evolved through a set-valued transition relation

$$(X^{c'}, T^{c'}, K^{c'}) \in \mathfrak{F}_\Delta(X^c, T^c, K^c; e, r, u, \pi), \quad (87)$$

where  $c, c'$  are specified analytical cuts through relational history;  $e$  denotes interpreted evidence,  $r$  documented remedial outcomes,  $u$  contextual uncertainty or disturbance, and  $\pi$  a situated operation. This notation organizes candidate dependencies without claiming a universal causal transition law. A deterministic  $F$  may be recovered when a domain model and evidence justify unique evolution under the prescribed inputs. Historical cuts do not imply that a metaphysically privileged present separates settled past from open future. The choice of cut and the class of admissible transformations are analytic conventions made explicit for a particular investigation.

### Capacity-sensitive continuations and effective institutional alternatives

The central GR question requires a description of possible continuations rather than an exclusive focus on current outputs. Let  $\Gamma_d(X; \Theta)$  consist of jointly admissible trajectories, and for each participant  $i$  define a typed capacity query  $q_i$  over those trajectories. A query might ask whether the participant can independently reproduce a measurement, lawfully challenge a determination, maintain critical public service under a provider failure, or invoke a protected withdrawal procedure. Let  $\mathcal{V}_i$  denote the applicable viability and rights safeguards for that participant. Fix a declared action or capability type  $\text{Cap}_{i,d}$  and let  $q_i : \Gamma_d(X; \Theta) \rightarrow 2^{\text{Cap}_{i,d}}$  return the protected, materially executable capabilities realized along a trajectory. This set-valued convention avoids mistaking a label for an independently executable capacity. Then

$$\mathcal{R}_i^{(d)}(X; \Theta) = \bigcup_{\substack{\gamma \in \Gamma_d(X; \Theta) \\ \gamma \models \mathcal{V}_i}} q_i(\gamma). \quad (88)$$

The symbol  $\mathcal{R}_i^{(d)}$  denotes reachable capabilities, distinct from the relational component  $\mathcal{R}_i$  of the subject profile. Its elements are individually typed executable capabilities, not necessarily numerical quantities. An empty set may express a proved absence under a complete model; a partial empirical model instead warrants the designation *unknown* when the data or search coverage cannot establish reachability. The latter must never be recoded as proven impossibility. Research claims should distinguish these possibilities. A capacity measure is normatively significant only when the selected capabilities and protections have been justified, including the rights and interests of affected third parties.

For a prospective joint policy  $\pi$ , define each actor's projection  $p_i(\pi)$  and an admissibility predicate  $V_i(p_i(\pi), X; \Theta)$ . Joint viability requires a *single* policy satisfying the relevant criteria simultaneously:

$$\exists \pi \in \mathfrak{F}_d(X; \Theta) \bigwedge_{i \in I_d} V_i(p_i(\pi), X; \Theta). \quad (89)$$

The quantifier is important: the separate existence of a feasible policy for each subject can be satisfied by incompatible policies. This addresses the composition error introduced in Sections 7 and 20.

Conversely, joint feasibility under a narrowly selected  $\Theta$  does not imply that an agreement is morally legitimate, empirically sustainable, or supported by those it affects. Those judgments require evidence, protected participation, and applicable public justification.

### Distinguishing equivalent performance from divergent generative prospects

For a declared institutional observation  $Y_d$ , write  $X \sim_{Y_d} X'$  when the configurations yield the same selected records or distributions under a specified test protocol and an agreed correspondence of measurement types. This observational equivalence relation is relative to instruments, tasks, and sampling assumptions. We can then compare the corresponding capability sets  $\mathcal{R}_i^{(d)}$  and available correction paths  $\mathcal{U}_i^{\text{rev}}$ . The comparison has the form

$$X \sim_{Y_d} X', \quad \left( \mathcal{R}_i^{(d)}(X; \Theta), \mathcal{U}_i^{\text{rev}}(X; \Theta) \right) \not\approx \left( \mathcal{R}_i^{(d)}(X'; \Theta), \mathcal{U}_i^{\text{rev}}(X'; \Theta) \right). \quad (90)$$

The relation  $\simeq$  is a task-relative equivalence over typed capacities, and must be declared before any comparison. Both sides must refer to matched actors and the same capability universe, disturbance class, rights floor, resource budget, and observation horizon, or to explicitly justified translations between them. Here  $\mathcal{U}_i^{\text{rev}}(X; \Theta)$  denotes the set of complete, lawfully executable paths from an affected participant's admissible challenge to competent institutional response; its type is a set of paths, separate from the disturbance-conditioned joint policies considered in Proposition 5. A valid challenge route does not ensure that the challenger prevails or that any particular ruling is substantively justified. The expression is a discrimination criterion, rather than a proof that a particular pair of institutions satisfies it. It motivates an empirical design: construct well-matched arrangements with comparable performance records, document the constraints and accessibility of their alternatives, and examine whether differences in review and continuation capacity lead to different responses to a controlled disruption or contested decision.

The comparison additionally requires a common specified capability alphabet  $\text{Cap}_{i,d}$  and a consistent set-valued query  $q_i$  in Equation (88). Where a configuration creates a new institution or authority, the researcher must document the translation of actor roles across configurations or abstain from claims of direct equivalence. A minimal counterexample can be stated without statistical claims. Let two scientific partnerships publish the same approved measurement  $y$  after passing identical accuracy tests. In  $X$ , a participating laboratory holds an independently usable copy of a lawful calibration protocol and has authority to petition for a retrial of a disputed classification. In  $X'$ , the consortium provides the same  $y$  while the laboratory's only calibration access is a service controlled by an external party and its formal appeal depends on that party's discretionary approval. If the model's safeguards and technical assumptions permit lawful independent verification in  $X$  but exclude it in  $X'$ , Equation (90) holds for the review-capacity query even though the measured output is identical. The assumptions must explicitly include technical competence, confidentiality and security protections, funding for review, and the governing legal instruments. An independent accredited review service could eliminate the difference; the counterexample should then be revised or rejected. This openness to defeating cases is a requirement of the inquiry.

The analysis can also distinguish *restricted yet legitimate* options from domination. A participant may voluntarily accept exclusive use of a shared safety-critical controller because interoperable command authority would create unacceptable hazard. A public institution may lawfully restrict access to a vulnerable person's testimony. Lower cardinality of feasible actions is therefore not intrinsically injustice, and greater technical access is not intrinsically accountability. Normative evaluation must assess the justification for constraints, the rights of third parties, distributed material risks, meaningful authorization, and the paths through which decisions can be challenged. The GR concept of generative credibility is thereby tied to *protected and warranted capabilities*, rather than an indiscriminate maximization of possible actions.

## A finite countermodel and the limits of observability

The separation between recorded success and protected continuation can be made exact in a deliberately small model. Consider two admissible configurations  $X_A$  and  $X_B$  for a laboratory consortium during a specified reporting interval. Let the public reporting alphabet be  $\mathcal{Y} = \{\text{pass}, \text{fail}\}$  and let the stipulated evaluation protocol  $P_0$  inspect only whether one calibrated measurement passes its accuracy tolerance. In both configurations the observed trace is the singleton record pass. Suppose the available, lawful operations after that report are

$$\mathcal{R}_i^{(d)}(X_A; \Theta) = \{\text{maintain}, \text{verify}\}, \quad \mathcal{R}_i^{(d)}(X_B; \Theta) = \{\text{maintain}\}, \quad (91)$$

where verify denotes an independently executable, protected calibration check; maintain denotes an otherwise equivalent continuing service. The action verify is genuinely feasible in  $X_A$  only if the participant has adequate instruments, authority, technical competence, resources, and necessary privacy protections. In  $X_B$ , the same operation requires a credential controlled by another institution and is unavailable under the stipulated constraints. We obtain  $X_A \sim_{P_0} X_B$  and  $\mathcal{R}_i^{(d)}(X_A; \Theta) \neq \mathcal{R}_i^{(d)}(X_B; \Theta)$  by explicit enumeration.

This is a finite *countermodel to the implication from report equivalence to capacity equivalence*. It relies on the declared observation protocol. A richer protocol  $P_1$  that includes a supervised request for independent recalibration might distinguish the configurations immediately. Similarly, an accredited substitute provider could add verify to the second set. The finite construction proves the failure of the unrestricted implication under the stated model; it neither proves that the represented power asymmetry exists in any real consortium nor establishes that greater independent access is ethically preferable in every setting. A legitimate restriction may protect safety, confidentiality, or third-party rights. This countermodel is an original *instantiation* of a familiar information-loss phenomenon, while observational equivalence, dependency, and capability analysis have well-established antecedents.

The finite example treats  $q_i(\gamma)$  as the capabilities executable on a specified protected continuation. Thus the two displayed sets are unions of realized actions, not sets of lists or sets of incompatible outcome labels. The example stipulates all required feasibility constraints; the observation-only record does not establish their truth in any empirical setting. The construction suggests a practical identification test. Define one report-only protocol and one rights-respecting capability-probe protocol in advance. Compare whether participants can complete a lawful independent verification task after a controlled interruption, record costs and legal limitations, and preserve the possibility that an authorized confidential reviewer supplies an equivalent safeguard. Such an experiment can discriminate the specified models without requiring disclosure of protected data or an attempt to maximize the number of available actions.

## Partial translations, authority composition, and institutional response paths

Let  $\tau_{ij} : \mathcal{L}_{i,d} \rightarrow \mathcal{L}_{j,d}$  represent an authorized, partial interpretation between domain-specific normative or evidential languages, with the domain of definition and warranted equivalence made explicit. Two routes  $\tau_{ik}$  and  $\tau_{jk} \circ \tau_{ij}$  may give different interpretations of the same term, and a jointly implemented commitment can remain inconsistent even when every translation is semantically sound in its local domain. For each proposed operation  $\pi$ , the joint constraint test of Equation (85) must therefore check both translation validity and the conjunction of operative obligations. Semantic non-commutativity and practical normative contradiction are separate findings, each demanding different forms of correction.

Authority and remedy paths compose only when the output type of one process satisfies the legitimate input conditions of the next. Let  $C_i$  be a complaint initiated by subject  $i$ , and let  $D$  be a competent determination with an executable corrective act  $\delta$ . A candidate path is

$$C_i \xrightarrow{\text{submit}} E \xrightarrow{\text{admit}} R \xrightarrow{\text{decide}} D \xrightarrow{\text{implement}} \delta, \quad (92)$$

where E indicates duly admissible evidence and R a review process. This diagram is operationally meaningful only when each arrow is accessible, competent, sufficiently resourced, and lawful under the connected system's applicable constraints. An institution may possess a certified reviewer and an authorized operator while their interface rules make actual correction unreachable. AI-mediated cases in Section 23 add model provenance and delegated technical actuation to the path. Environmental cases in Section 22 add biophysical viability constraints and questions of representation. These extensions illustrate how the same minimal types organize different practical inquiries without reducing their disciplinary substance.

### A crosswalk from GR primitives to discriminating observations

The compact projection  $X = \mathcal{Q}(X)$  is useful only if a reported difference can be traced back to a typed mechanism and an admissible change. A minimal crosswalk has four elements. First, a *generative mechanism*  $\mathcal{M}_i$  corresponds to identifiable technical capabilities, authorized institutional procedures, or productive rules, with an evidential source and a known scope. Second, a *change operation*  $\alpha_i$  or  $\hat{\alpha}_i$  states which transitions are allowed, how resources and authorization constrain them, and whether the mechanism itself can change. Third, an *observation map*  $\text{Obs}_{i,d}$  states which aspects of a trajectory become inspectable under a specific reporting regime and which remain outside identification. Fourth, a *protected continuation query*  $q_i$  asks whether a legally and materially executable capacity remains reachable under specified disturbances. Without all four entries, a supposed GR difference may amount to renaming a dependency already discovered by standard institutional review.

The four elements should be tested by a *paired diagnostic*: hold the documentary record, resources, decision task, and legal constraints fixed; record the conclusion reached through an established rights-based or organizational assessment; then add an explicit model of mechanism change, observation limits, and protected continuation. A claimed GR increment must identify an independently corroborated additional distinction that changes a justified decision or prediction at an acceptable cost. Increases in conceptual detail without a discriminating inference count as representational elaboration, not explanatory progress. This is compatible with relational peace scholarship, collective-capability approaches, and formal institution theory; their competence is a substantive benchmark rather than a foil (Söderström et al., 2021; Ibrahim, 2006; Goguen and Burstall, 1992).

**Comparison contract for claims about protected continuations.** A report of  $X \sim_{Y_d} X'$  and  $\mathcal{R}_i^{(d)}(X; \Theta) \not\sim \mathcal{R}_i^{(d)}(X'; \Theta)$  is interpretable only when the author specifies the observation protocol that grounds  $Y_d$ , the mapping between the two actor and action types, a common rights-and-safety-constrained query, and whether the sets are estimated or known exactly. When evidence supports several feasible configurations, report the range of supported reachability results rather than selecting a convenient reconstruction. A difference in estimated reachability can be attributed to institutional mechanisms only with a separate causal design that addresses selection, measurement error, and the possibility of omitted alternatives. This comparison contract binds the counterexamples in Section 25 and the proposed practice evaluations.

### Three distinct claims of novelty and their evidentiary thresholds

The formal contribution needs a taxonomy that prevents a familiar logical fact from being advertised as a newly discovered social mechanism. *Representational integration* is achieved when existing concepts of admissible continuation, power-dependent observation, normative translation, and authorized remedy are expressed in one coherent typed configuration. This can be an original synthesis in presentation or workflow while having no independent theoretical novelty. *Analytical discrimination* is achieved when two specified institutional configurations that a declared baseline treats as equivalent are separated by an explicitly defined protected continuation or cross-interface response condition; the

finite examples in this section establish such discrimination only relative to their chosen observation maps. *Demonstrated explanatory or practical increment* would require an independently adjudicated finding in a real or faithfully reconstructed institutional episode where the GR augmentation, against a strong baseline and common evidence, changes an empirically supported diagnosis or improves a rights-consistent decision.

These levels should remain separate in all subsequent interpretation. A finite countermodel refutes a universal implication of the form “identical outputs entail identical opportunities” under its declared definitions; it does not establish that another research tradition assumes that implication. A typed workflow may improve communicability while being informationally equivalent to existing legal, engineering, or capability analyses. A comparison that adds data gathering, staff hours, or a different expert team to the GR arm without matching these resources is likewise unable to identify a GR-specific benefit. The working standard for a distinctive advance is a *bounded, reproducible, justified diagnostic difference*, together with a specified reason why existing competent methods would not have exposed the same fact at comparable cost and risk.

### Prospective tests, limitations, and methodological discipline

The formalism supports three candidate research results that will be developed as conditional propositions in the following section. The *constructibility* question concerns whether a legitimate joint transformation can render a previously infeasible cooperation viable. The *generative-credibility* question concerns when arrangements with equivalent observed performance produce distinguishable protected continuations. The *compositionality* question concerns when locally competent, interpretable, and compliant institutional operations fail to compose into an executable collective response. A nontrivial result would specify assumptions, prove a narrow logical implication or counterexample, and identify observations capable of discriminating its mechanisms from existing accounts of institutional design, procedural justice, and technological governance.

An empirical protocol should first establish the most suitable established comparator. Relevant baselines include transaction-cost and institutional rational-design models, process tracing of implementation and disputes, networked-governance studies, ordinary responsibility matrices, algorithmic impact assessment, administrative-law review, and conflict-sensitive evaluation. The investigator should then specify the case boundaries, actor and competence types, relevant material constraints, causal hypotheses, and evidence quality. Whenever possible, competing explanations should be assessed on the same observations and against predeclared outcome criteria. Additional formal objects impose a cost in expertise, data collection, privacy risk, and interpretive complexity; any GR improvement must justify that cost by identifying a material discrepancy or a better justified intervention.

The proposed method has important limits. Social relations do not come with objectively complete state spaces; historical evidence can be selective or contested; significant future transformations may lie outside any predefined feasible set; normative plurality cannot be eliminated by assigning arbitrary weights to rights, values, or legitimacy. Some action sets are computationally intractable or unidentifiable from the available data. Physical conservation principles may constrain an ecological or engineering subsystem, while trust, credibility, and justice remain dependent on independently defended normative and empirical theories. Where high-stakes decisions affect persons in violent conflict, vulnerable communities, or critical infrastructure, the abstract model cannot substitute for competent legal review, robust scientific evidence, safety analysis, participation, and professional accountability.

The appropriate interpretation of the eight-tuple is thus an *instrument for structured inquiry*. It forces distinctions among descriptions and operations that routine performance measures can conceal; it enables explicit joint-feasibility questions; and it records where a proposed diagnosis depends on an assumption that might fail. Its adequacy must be judged by transparent comparisons and the practical ability of affected institutions to contest and refine the analysis. The following section turns from representation to conditional propositions and counterexamples, asking precisely what can be derived

and where the present GR formulation remains only an exploratory hypothesis.

## 25 Conditional Propositions and Counterexamples about Cooperative Reliability

The preceding representation yields a disciplined language for questions of institutional reliability, but a language alone is not a result. Its scientific value depends on whether a set of assumptions permits a consequence to be derived, a counterexample to be constructed, or an empirical discrimination to be made that remains invisible to an appropriate, less elaborate comparator. This section develops eight conditional propositions in that spirit. Some are elementary consequences of feasibility or reachability definitions; their importance lies in identifying what an institutional investigation must actually measure. Others are mechanistic hypotheses whose truth cannot be established by formal notation. None is advanced as a newly discovered universal law of cooperation. The intellectual antecedents include institutional design and cooperation under uncertainty (Keohane, 1984; Koremenos et al., 2001), relational power (Barnett and Duvall, 2005), collective-action institutions (Ostrom, 1990), and the distinction between exit and voice (Hirschman, 1970).

### The scope of derivation and the meaning of reliability

Fix a task domain  $d$ , a relational configuration  $X$  as in Equation (84), and a declared set of factual, physical, legal, and epistemic assumptions  $\Theta$ . The analysis distinguishes an observed performance record  $Y_d$ , an admissible joint-policy set  $\mathfrak{F}_d(X; \Theta)$ , participant-specific protected continuation sets  $\mathcal{R}_i^{(d)}(X; \Theta)$ , and an institutional response path  $\mathcal{U}_i^{\text{rev}}$ . These are different objects. A high value of an operational performance metric does not establish that a participant's rights are satisfied, that a report is independently verifiable, or that a lawful revision mechanism can be exercised. Conversely, the presence of a protected right may restrict available operations for good reasons without signifying institutional failure.

For an arrangement  $\pi$ , define  $\text{Perf}_d(\pi)$  as its context-specific performance test,  $\text{Evid}_d(\pi)$  as the authorized and practically accessible evidence conditions, and  $\text{Cont}_i(\pi)$  as the protected continuation and response conditions applicable to participant  $i$ . A useful analysis retains the vector

$$\mathcal{C}_d(\pi; X, \Theta) = (\text{Perf}_d(\pi), \text{Evid}_d(\pi), \{\text{Cont}_i(\pi)\}_{i \in I_d}), \quad (93)$$

without treating its components as commensurable or assigning an unexplained scalar weight to legitimacy. The three entries are descriptive tests that require independent normative justification; they are not substitutes for legally established obligations. To call one arrangement *more credible* than another requires specifying the relevant task and the dimensions on which the comparison is justified. We distinguish in each proposition an analytic claim, its assumptions, a defeating condition, and a prospectively observable implication.

### Proposition 1: bounded commitments under incomplete trust

Consider a protected participation decision with an authorized acceptance threshold  $b_i$  for the maximum tolerable exposure of participant  $i$ . Let  $L_i(\gamma)$  be a documented, task-specific loss functional on possible joint continuations, with safety and rights constraints enforced separately. Suppose a proposed policy  $\pi$  lies in  $\mathfrak{F}_d(X; \Theta)$  and admits a *nonempty* protected continuation set  $\Gamma(\pi, X; \Theta)$  such that

$$\sup_{\gamma \in \Gamma(\pi, X; \Theta)} L_i(\gamma) \leq b_i, \quad i \in I_d. \quad (94)$$

If all required parties possess lawful authority, sufficient operational resources, and meaningful consent to this bounded policy, then the possibility of cooperative participation is consistent with an arbitrarily low subjective trust report. This is a *compatibility result*: the stated acceptance conditions do not logically require high  $T_{i \rightarrow j}^{(d)}$ . It is not an empirical assertion that a particular party will choose to cooperate, nor a proof that the bounds in Equation (94) can be enforced.

A staged, jointly monitored exchange of non-sensitive environmental measurements illustrates the result when each contribution has a pre-agreed scope, protected withdrawal, and an independent way to check an alleged breach. The result fails when exposure has been underestimated, meaningful refusal is unavailable, material retaliation is possible, or the outside options disappear upon enrollment. A nominally revocable arrangement may thus fail the very assumption of bounded loss. In prospective practice the independent measures are not generic “trust building” scores; they are actual ceilings on financial, safety, informational, and institutional exposure, completion of agreed milestones, and the accessibility of refusal. The role of trust is recorded separately. This proposition refines, without displacing, established approaches to credible commitments and incremental confidence-building.

### Proposition 2: evidential control and indistinguishable compliance records

Let  $Y_d = \text{Obs}_d(\gamma, \omega)$  be the announced compliance record and suppose  $\gamma_1, \gamma_2$  are two admissible histories with the same announced record,  $Y_d(\gamma_1) = Y_d(\gamma_2)$ , but different effects on an affected party’s protected interests. If the reporting map is non-injective over this pair and no further authorized evidence can be obtained, a reviewer using only  $Y_d$  cannot determine from that record which history occurred. Concentrated control of instrumentation, event selection, classifications, or review permissions can maintain this evidential limitation even where the formal reporting scheme is fully complied with. The inference follows from the specified observation map; a wider claim that concentrated evidential control always reduces trustworthiness would not.

A counterexample to a simple transparency remedy is a highly sensitive medical or humanitarian record for which unrestricted disclosure would itself violate rights. In that case an accredited, confidential reviewer may supply reliable contestation without public release. Nor does independent review guarantee error correction if its mandate is too narrow or a remedy is unenforceable. The observable distinction for a comparative study is therefore between *producing more records* and *creating protected, competent routes to corroboration and consequential correction*. A GR capacity query asks whether a participant can actually exercise the latter route with the time, knowledge, permission, and material means available to them. The underlying problems of information asymmetry and legitimacy are long-standing (Feldman and March, 1981; Tyler, 2006); the proposed extension is an explicit reachability test across technical and institutional boundaries.

### Proposition 3: independent remedy and contingent downside

Suppose a breach produces a nonnegative, task-specific loss  $L$ , fixed for this conditional comparison and assessed over a declared horizon. The model treats monetary or otherwise commensurable costs only within that justified, limited unit of account; it does not assign prices to inalienable rights or replace individualized safety assessment. Conditional on choosing to file an admissible remedy claim, let  $p$  be the probability that the authorized process produces an effective restoration  $r$ , with  $0 \leq r \leq L$ . Let  $c_f \geq 0$  be the expected filing and participation cost incurred regardless of outcome, and  $c_s \geq 0$  an additional cost incurred upon successful restoration. For this deliberately restricted model,

$$\begin{aligned}\mathbb{E}[L_{\text{net}} \mid \text{file}] &= L + c_f + p(c_s - r), \\ \mathbb{E}[L_{\text{net}} \mid \text{decline}] &= L.\end{aligned}\tag{95}$$

Filing lowers the stipulated expected loss precisely when  $p(r - c_s) > c_f$ , subject to the model’s risk and rights conditions. For fixed  $r, c_f, c_s$  with  $r > c_s$ , increasing the probability of effective remedy

lowers expected net loss *conditional on filing*. The result says nothing about the claimant's perceived danger, willingness to initiate proceedings, or the causal effect of introducing an appeal office. All probabilities and costs are conditional on the information and safeguards available to the participant; the process itself may affect them. The distinction between a formal remedy and a practically usable one is therefore central to empirical application.

The counterexample is an appeal mechanism whose use exposes a witness to reprisal or exhausts resources needed for survival. Here the filing cost  $c_f$ , contingent cost  $c_s$ , and separately assessed retaliation risk may outweigh the remedy; the linear approximation may fail entirely because its parameters depend on whether the claimant files. A further difficulty is the conversion of money into restored institutional capability: compensation for lost data does not necessarily recreate scientific competence or independent control. The practical implication is to record realized correction, enforcement, time burden, resource cost, and retaliation risks separately from the existence of a formal complaints office. The UN's remedy framework recognizes that forms of reparation serve different functions (United Nations General Assembly, 2005).

#### Proposition 4: remedial equivalence and non-restored capacity

Define  $X \sim_{Y_d} X'$  by the performance equivalence criterion of Section 24. Suppose both partnerships deliver identical compensation after a service interruption and restore the same visible service indicator. If a participant possesses a lawful, practically executable continuation  $q_i$  in  $X$ , such as reproducing the disputed measurement without the original provider, but the corresponding continuation is inaccessible in  $X'$ , then

$$X \sim_{Y_d} X' \quad \text{and} \quad \mathcal{R}_i^{(d)}(X; \Theta) \not\subseteq \mathcal{R}_i^{(d)}(X'; \Theta). \quad (96)$$

Consequently equivalence in a declared set of remedial outputs does not entail equivalence in restored generative capacity. This proposition is a direct countermodel to the logical implication, not a demonstration that an observed institution actually produces the capacity difference. The conditions require that the reported outcomes omit the relevant capacity measure and that the alleged alternative be lawful and materially executable.

A defeating case exists where an independent service or interoperable infrastructure supplies equivalent capability to the second participant. A second defeating case occurs when independent control would present an unacceptable safety or confidentiality risk and a different protected option is legitimate. The evaluation should therefore compare justified, typed capabilities rather than counts of unrestricted choices. This proposition advances the manuscript's central *generative credibility* problem: identical observed institutional reliability may coexist with substantively different opportunities to maintain, contest, or transform cooperation. It also specifies how such a claim could be falsified.

#### Proposition 5: institutional revision and conditional robustness

Let  $\Omega$  contain a documented set of relevant disturbances, including provider failure, ecological change, budget loss, or altered legal competence. Fix a common typed policy universe  $\bar{\Pi}_d$  (or an explicitly justified embedding of each institution's policies into it), and define  $\mathcal{U}(X; \omega) \subseteq \bar{\Pi}_d$  as the joint policies that remain authorized, viable, and materially executable under disturbance  $\omega$ . A restricted robustness claim is that adding a protected revision mechanism may enlarge the disturbances admitting at least one viable response *if* the revised arrangement preserves all previously lawful and executable responses, leaves essential resources intact, and permits any new response to satisfy the same safeguards:

$$\mathcal{U}(X; \omega) \subseteq \mathcal{U}(X^+; \omega) \quad (\omega \in \Omega), \quad (97)$$

where  $X^+$  denotes the revised institution under those explicit inclusion assumptions. This is a structural monotonicity statement under an explicit common policy type and inclusion premise. Defining

$W(X) = \{\omega \in \Omega : \mathcal{U}(X; \omega) \neq \emptyset\}$ , the set inclusion implies  $W(X) \subseteq W(X^+)$ ; the conclusion does not follow simply from announcing a new amendment procedure. It does not imply that more frequent amendments, or maximum legal flexibility, improve the stability of an institution.

A counterexample is an emergency network where multiple parties can unilaterally revise a common routing rule, resulting in conflicting safety commands. Revision without an authorization protocol may reduce feasible coordinated action. Another counterexample concerns revision rights that exist on paper but require technical access or funding that a participant lacks. The proposed GR practice is to test *effective and legitimate revision reachability*, including who can initiate an amendment, which evidence is admissible, whose consent is necessary, how adverse effects are checked, and whether the new rule can actually be implemented. Adaptive-governance arguments already anticipate many of these concerns (Sabel and Zeitlin, 2008; Ostrom, 2010); the additional value, if any, must be established through comparative measurement of the resulting continuation sets.

### Proposition 6: collective gains and asymmetric strategic vulnerability

Consider a simple production system in which two participants obtain a higher joint output  $Q$  by sharing a specialized service rather than maintaining duplicated services. Suppose the shared service is controlled through a single indispensable authorization point and one participant lacks a lawful alternative. Then output can increase while the second participant's set of independently executable continuations shrinks. The simultaneous occurrence is possible because a performance measure and a dependency measure encode different properties of the joint configuration. A graph representation can make the failure mode explicit: in an appropriately typed directed dependency network, a unique authorization node may dominate every permissible path from the dependent participant to the required service; more generally, a set of nodes can form a terminal-specific cut. Calling that node an *articulation point* without specifying an undirected graph and its connectivity assumptions would be incorrect. Directed, hypergraph, and institutionally conditional dependencies require their own reachability tests.

The point is not that centralization is necessarily harmful. A well-governed shared service may reduce hazardous duplication, broaden access, and be independently monitored under robust safeguards. High-output cooperation with strong, enforceable redundancy is also possible. An empirical claim of asymmetric vulnerability therefore requires testing failover, licensing, locally available competence, feasible exit, institutional review, and costs of interruption under realistic disturbances. Existing dependency and structural-power approaches supply important precedents (Barnett and Duvall, 2005; Hirschman, 1970). The proposed formal extension concerns the operational connections among technical dependency, authorized institutional paths, and protected generative continuations.

### Proposition 7: local compatibility does not entail joint normative satisfiability

Let three institutions agree to binary protocol choices  $a, b, c \in \{0, 1\}$ . Suppose their bilateral arrangements require, respectively,  $a \neq b$ ,  $b \neq c$ , and  $a \neq c$ . Every constraint is satisfiable in isolation, and every two-constraint subset is jointly satisfiable, but no assignment satisfies all three simultaneously. Indeed  $a \neq b$  and  $b \neq c$  over binary values imply  $a = c$ , contradicting  $a \neq c$ . Thus,

$$\bigwedge_{J \subseteq \{1,2,3\}, |J|=2} \text{SAT} \left( \bigwedge_{j \in J} C_j \right) \not\models \text{SAT}(C_1 \wedge C_2 \wedge C_3). \quad (98)$$

This elementary satisfiability counterexample is not a new theorem. It identifies a distinct institutional diagnostic: individually acceptable bilateral obligations can jointly exclude every feasible policy. A practical instance might involve a three-way data-access regime with mutually incompatible confidentiality, availability, and audit arrangements, although real legal obligations will not ordinarily reduce to binary variables.

There are two separate problems. In a *translation defect*, parties attach different meanings to an obligation; correcting the interpretive interface may resolve disagreement. In a *constraint defect*, the obligations remain jointly inconsistent even after accurate translation; resolution requires duly authorized institutional modification or redesign. The latter cannot be repaired simply by improving communication. The model must also admit a counterexample in which all obligations compose consistently despite divergent languages. Institutional translation theory and norm-localization research offer prior art (Goguen and Burstall, 1992; Acharya, 2004); a GR contribution would arise only where tracked generative conditions and authority transformations produce a new explanation or intervention beyond an ordinary consistency audit.

### Proposition 8: functioning local procedures need not compose into an executable remedy

Suppose institution  $A$  can register a claim and issue a valid referral, while institution  $B$  can review evidence upon presentation of a locally authorized token. Each procedure may operate according to its own rules. If the token issued by  $A$  is not accepted by  $B$ , or if a third subsystem holds indispensable data under an incompatible authorization, there may be no executable path from an affected claimant to a decision-maker able to implement a remedy. The failure is a typed interface mismatch, which can be represented using the composed-path condition of Equation (92). Formally, the existence of functioning individual arrows does not entail the existence of a valid, composable chain from initial claim to correction.

This defect could be remedied by an authorized translation of credentials, an agreed cross-institutional review mandate, protected access to evidence, or an independent escalation mechanism. Its formal witness should specify each procedure's input and output types, the precise failed composition, the claimant's effective access to each transition, and the authority required for repair. It may remain irreparable within the present legal order, in which case the model should report infeasibility rather than invent an institutional authority. A defeating case is a federated review system with a verified end-to-end chain: local plurality there creates no accountability gap. This diagnostic may be especially useful for AI-mediated public services, scientific consortia, and complex peace or environmental monitoring arrangements, but the concept must be compared with existing enterprise-systems engineering and administrative-law analyses before a claim of originality is sustained.

### A small formal audit of what the propositions establish

The eight numbered results have different logical standing. The bounded-exposure result is a compatibility claim requiring a nonempty protected feasible set; the evidential result follows from an explicitly non-injective observation map; the remedy result is an expected-loss calculation with specified filing and success costs; the revision result is monotonic only where the enlargement of *lawful and executable* options is assumed. The production-dependency result and the remedial-equivalence result are existence countermodels. The binary normative example is a three-constraint unsatisfiability witness: assigning  $a = 0, b = 1, c = 0$  satisfies the first two constraints, while every complete assignment violates at least one of the three. The path-composition result requires checking credential, mandate, evidence, and execution interfaces. None of these steps, individually, implies improved observed peacemaking or greater public trust.

A practical proof obligation is therefore two-tiered. The *formal tier* supplies a stated universe, explicit lawful constraints, and either a constructive witness or a checkable countermodel. The *empirical tier* supplies evidence that a real case instantiates the formal premises, including the absence or presence of a valid alternative route. The second tier requires independent confirmation of rights, actual resources, and authorization; a model's inability to find an option provides little evidence of real-world impossibility unless its search procedure is complete within an adequately justified domain. This separation also prevents a simple inconsistency in a toy constraint network from being claimed as a novel

theorem of international cooperation.

**The inferential ledger behind each numbered proposition.** Every application should register four independent judgments: (i) whether the mathematical consequence follows from explicitly documented premises, (ii) whether the premises themselves have support in the chosen case, (iii) whether a competent baseline reaches the same diagnostic conclusion, and (iv) whether acting on the diagnosis is authorized and likely to improve a protected outcome at acceptable risk. Proposition 2, for example, can be logically valid under a non-injective observation map even if additional authorized records resolve the uncertainty in practice. Proposition 7 can establish joint unsatisfiability for a given finite constraint encoding even where parties are lawfully permitted to revise an operative requirement. An analytically sound formalism thus need not yield an actionable defect. This four-part ledger prevents a countermodel, a documentary episode, and an intervention recommendation from being described as a single result.

### From propositions to falsifiable institutional queries

For traceability, the eight propositions yield eight distinct *queries*, each evaluated under a documented lawful and resource-constrained observation scheme. Proposition 1 asks whether exposure bounds and consent remain enforceable during a bounded cooperative trial; relevant failures include unanticipated dependence or retaliatory withdrawal costs. Proposition 2 asks whether different admissible histories with the same public report can be distinguished by an approved verification route; the defeating case is an already adequate protected review. Proposition 3 asks whether filing costs, success-contingent costs, effective restoration, and credible protection against reprisals justify the stipulated remedy model; observational verification includes actual case completion, rather than merely the creation of an appeal office. Proposition 4 asks whether restoration returns the named executable capabilities, as distinct from an equivalent payment or service metric. Proposition 5 asks whether a documented change in authorized revision rules preserves existing protected actions and genuinely expands disturbance-conditioned responses. Proposition 6 asks whether removing a specified service or authorization dependency disables otherwise lawful activities under a controlled disturbance. Proposition 7 asks whether combined operative obligations have a feasible common witness after authorized translation, rather than merely obtaining bilateral signatures. Proposition 8 asks whether a claimant can follow every competent, accessible transition from filing through executed response across institutions.

These queries differ in logical and evidentiary status. Propositions 2, 4, 7, and 8 can be illustrated by finite countermodels, but real institutional diagnosis still requires reliable evidence for each premise. Proposition 3 follows from a deliberately restricted expected-loss model; its numerical parameters remain empirical. Proposition 5 is conditional on preservation and common typing of feasible policies. Propositions 1 and 6 establish compatible possibilities under stipulated protections and dependencies. An audit should report *established*, *refuted*, or *undetermined under available evidence* for each case-specific premise; the third status must not be interpreted as a failure of the affected participant to demonstrate harm.

### Distinguishing three possible contributions from three familiar observations

The paper does not offer a new result merely by establishing that actors differ, trust can evolve, or institutions adapt. These are properties already represented in relational peace, collective capabilities, institutional analysis, and constructivist norm research (Söderström et al., 2021; Ibrahim, 2006; Acharya, 2004). The formal contribution is narrower. A *constructive witness* exhibits a jointly lawful and executable coupling under stated constraints. A *projection countermodel* establishes that an outcome-reporting map can identify two arrangements while a specified protected continuation query distinguishes them. An *interface composition test* determines whether legal authority, technical to-

kens, normative meanings, and remedial action form a valid executable path across participating bodies. These three results are checkable within the described model; each has antecedents in satisfiability, systems engineering, and institutional theory.

Whether their synthesis deserves a distinct GR explanation turns on an additional test. A competing analysis should receive the same case records, sufficient time, and access to suitably trained reviewers. When the conventional analysis reconstructs the same mechanism and recommends an equally defensible intervention with less burden, the GR increment is null or negative. When the GR extension detects a corroborated change in the admissible continuation set or response path that the baseline misses, the difference should be reported alongside uncertainty and cost. This is an operational criterion for originality at the level of use, rather than a claim that the formal objects themselves were unprecedented.

### Adjudicating what has actually been established

The eight propositions fall into analytically different groups. Propositions 1 and 3 are compatibility or elementary expected-loss results under stipulated behavioral and cost assumptions. Propositions 2, 4, 7, and 8 construct non-identification or feasibility counterexamples; they demonstrate the invalidity of particular inferences from reported output, local procedural success, or bilateral satisfiability to protected global outcomes. Propositions 5 and 6 concern conditional institutional robustness and distributed vulnerability, for which substantive empirical mechanisms remain to be tested. Across these groups, formal correctness establishes conditional validity, never substantive priority over previous formal, legal, capability, or institutional research.

A practical novelty claim accordingly specifies five objects: the baseline procedure  $B$ ; the GR-augmented procedure  $G$ ; an identical, permissible information set  $D$ ; a predeclared set of independently assessable conclusions or authorized interventions  $Q$ ; and an evaluation protocol  $E$  covering accuracy, consequentiality, cost, and harm. The research question concerns a justified difference  $E(G, D, Q) - E(B, D, Q)$ , with the sign interpreted only after the evaluation dimensions and normative safeguards are fixed. No unexplained scalar “peace score” or trust index is required. Where the baseline already recovers the relevant capacity loss, translation conflict, or authority defect, the finding is methodological convergence, not a failure of responsible scholarship. Where a GR assessment adds credible information but also reveals confidentiality or retaliation risks, the net evaluation must acknowledge the burdens rather than counting every detected link as beneficial.

### A comparative test of the framework’s explanatory increment

The eight propositions mix elementary formal consequences, conditional design observations, and empirical hypotheses. Their epistemic status should be recorded individually. To compare explanatory approaches fairly, consider three analysis conditions for the same documented scenario: a conventional stakeholder, incentive, and risk assessment; a competent rights-based and procedural-accountability review; and those analyses augmented by the GR variables of typed generative mechanisms, protected continuation sets, and cross-institutional reachability. The comparison should be performed by analysts who have access to the same evidence and comparable resources. Suitable prespecified tasks include detecting a hidden failure to restore capacity, identifying jointly inconsistent commitments, and finding a formally available but operationally unreachable remedy. Independent adjudicators should review the proposed diagnoses against accessible source records and professional standards.

Claims of added value would require an incremental improvement in accuracy, anticipation of a relevant failure, decision quality, or detection of a previously unrepresented risk, after accounting for additional costs, analyst time, privacy intrusion, and false alarms. A method that asks more questions will often identify more apparent issues; a fair test also measures whether these are real and decision-relevant. Prediction is particularly difficult because interventions can themselves alter the

configuration and what becomes observable. A preregistered case-comparison design or a prospective simulation with documented generative assumptions could establish limited results. Neither could justify universal causal generalization without further evidence. Cases where established methods reach the same decision more efficiently must count against the assertion that the GR formalism is indispensable.

These propositions specify, more clearly than a general claim about “relational trust,” the possible scientific contribution of the manuscript. A particular form of reliability may be observationally equivalent while differentiated by protected generative possibilities; normative and remedial structures may fail to compose; and feasible cooperation under incomplete trust may depend on material safeguards whose execution can be tested. Whether these distinctions constitute a distinctive explanatory advance is still an open question. The following section translates the formal tasks into an ethically bounded process for investigating and, where appropriate, changing actual cooperative arrangements.

## 26 From Generative-Relational Analysis to a Situated Praxis Cycle

The formal account is valuable for practice only if it helps responsible participants recognize an otherwise neglected condition, choose a lawful and feasible response, and assess the resulting change without concealing harm. Praxis here denotes situated, accountable action through which a relational configuration is interpreted, tested, and potentially transformed by the subjects and institutions involved. Its orientation is neither a claim that every disagreement has a cooperative solution nor an injunction that all participants must trust one another. A refusal to collaborate, protected exit, independent legal challenge, or deliberate maintenance of institutional distance may be appropriate outcomes. The purpose of a GR-informed method is to make such possibilities visible alongside the material dependencies and normative constraints of proposed cooperation.

This procedure builds on UN mediation principles, conflict-prevention practice, commons scholarship, and public-participation guidance (United Nations, 2012; United Nations and World Bank, 2018; Ostrom, 1990; OECD, 2022; OECD, 2024b). Its incremental claim is narrowly diagnostic: by connecting a subject’s generative conditions to executable rights, evidence, cooperation, and repair, can it identify a consequential gap that competent conventional analysis misses? Claims of benefit require a protected comparison and independent corroboration.

### Specify the problem, affected relations, and limits of authority

An intervention begins with a precisely bounded decision problem. The initiating question may concern the safety of a local peace dialogue, the exchange of disputed environmental measurements between states, the governance of a shared scientific instrument, or an appeal following a failed public service. The investigator identifies which operations are genuinely within the mandate of the participants and which require competent public authorities, judicial processes, professional mediators, or independent specialists. A formal GR map is not an authorization to intervene. Where violence, forced displacement, unequal control of basic needs, or threat of retaliation is present, the safety of affected persons and the legitimacy of the process take precedence over analytic completeness.

A first record is a *scope and protection statement*: the purpose and possible uses of the inquiry; convening or sponsoring authority; affected groups and third parties; relevant legal jurisdictions; rights that cannot be traded away within the process; confidentiality and data-retention limits; financial and technical resources; and criteria for suspension. The statement must be understandable to participants in the relevant languages and must not falsely promise control over outcomes that the conveners do not possess. It also identifies what will count as non-cooperation, withdrawal, or meaningful refusal. The existence of a formal participation channel is insufficient where access to livelihood, services, or personal safety depends on submitting to it.

## Construct a plural relational map with provenance and uncertainty

The eight-component institutional projection  $X = (A, G, H, C, O, P, M, N)$  provides a useful checklist, while the more general subject-level GR model prevents all actors from being reduced to uniform utility maximizers. A relational map specifies who acts or is affected, which capacities enable their activity, what obligations already apply, which resources or representations connect their operations, whose account of interaction history is being used, and where important material or institutional bottlenecks occur. For every claim about an event, a responsibility, or a proposed injury, the record distinguishes participant testimony, independently checked evidence, official determination, and analytic inference. A story of conflict supplied by one party remains an attributed account until adequately corroborated; differences in narrative should be represented without requiring premature agreement on their truth.

For a selected subject  $i$ , the practical generative-condition profile may be written

$$\text{Cap}_i^{(d)} = (\text{Res}_i, \text{Know}_i, \text{Auth}_i, \text{Alt}_i, \text{Voice}_i, \text{Rem}_i; \Theta_d), \quad (99)$$

where the entries are documented and task-relative resources, knowledge and competence, lawful authorization, effective alternatives, decision influence, and accessible remedies. These entries are typed descriptions, not an unvalidated common score. A community's language and subsistence practices, a laboratory's calibrated instruments, and a public agency's legal competence may each be essential to continuing activity but cannot be treated as interchangeable quantities. Mapping must attend to heterogeneity within groups: representatives may not speak for every constituent, and a government's formal position does not exhaust the experiences of its population. Scientific uncertainty and ecological interdependence may require additional independent specialists and appropriate representation of affected third parties.

## Establish normative interfaces and non-negotiable protections

Participants should be invited, where safe and voluntary, to explain what they regard as an obligation, legitimate evidence, an injury, an adequate response, and an acceptable boundary of compromise. This is a form of partial normative translation as developed in Section 7. Agreement on vocabulary does not imply agreement on history, legal meaning, or ultimate values. The process records terms that support operational coordination, terms with unresolved interpretation, and commitments that are inconsistent when composed across institutions. Binding international or domestic law, applicable human rights, humanitarian protections, informed participation, and safeguards against discrimination are independently applicable constraints; they cannot be set aside because a compromise would be mathematically convenient.

A practitioner should maintain a *normative-interface register*. Each entry contains the originating claim and language; a proposed working interpretation; the authorized decision-maker; relevant source or agreement; the conditions under which a translation is valid; objections raised; and a procedure for re-examining it. This guards against the common mistake of treating translated words as stable shared obligations when the parties' operational practices diverge. A translation may be sufficient for an interim warning protocol while remaining insufficient to settle sovereignty, cultural rights, or contested liability. A sound process records that limit explicitly.

## Identify feasible options, hazards, and capacities for refusal

The co-design stage uses the joint feasibility relation in Equation (85), rather than selecting policies independently for each participant. A small set of prospective options is examined against physical capacity, resources, legal authority, human rights and safety protections, joint obligations, and meaningful participation. The analysis asks whether each participant can perform its assigned task and

whether the entire set can coexist without contradiction. It also asks which capabilities, including access to verification, maintenance, independent counsel, cultural practice, or lawful withdrawal, remain executable *after* an arrangement begins. Feasibility must reflect actual budget, staffing, energy, bandwidth, transport, safety, and institutional permission, not nominal availability in a contract.

A protected cooperative trial may be preferable to a sweeping agreement where the relevant risks can be limited and participants give genuine consent. A possible sequence is an exchange of narrow, non-sensitive observations; agreement on a shared classification dictionary; independent checking of one disputed classification; review of the burdens incurred; and a decision on whether to expand or discontinue. That sequence is illustrative. It is inappropriate where a trial would expose witnesses, confer a contested legal status, normalize coercion, or create irreversible dependencies. The decision to abstain can be the justified result of a feasibility screen, especially where minimum security or remedial conditions cannot be guaranteed.

### Design commitments that can be demonstrated and challenged

A *credible-commitment-and-evidence register* records the responsible actor, bounded action, resources allocated, authorized beneficiaries, observable completion condition, permitted evidence, confidentiality class, verifier, dispute channel, remedial authority, revision rule, and lawful exit conditions. This extends an ordinary task tracker by joining operational commitments to the rights and capacities necessary to check and contest their implementation. It also records whether a weaker participant must depend on the alleged breaching party to produce the evidence needed for an appeal. The final entry is a *dependency exposure*: what necessary service, right, or productive condition the participant could lose because of the new arrangement.

Where monitoring itself risks coercion or information misuse, use proportionate verification through approved intermediaries, aggregate reports, or confidential accredited review rather than maximal disclosure. Evidence should be traceable without requiring the public release of protected personal or security-sensitive information. A procedural right is assessed by actual reachability: can a claimant reach a competent, independent decision-maker with acceptable evidence and obtain an implementable remedy? If not, the plan must report the gap, identify who has authority to correct it, or state that the arrangement cannot responsibly proceed.

### Implement through accountable roles and reversible learning where feasible

Implementation should name operational owners, authorizing bodies, participant representatives, independent reviewers, safety contacts, and the persons responsible for recording adverse events. Information channels, language access, accessible formats, staffing, and contingency resources must be arranged before claiming that participation is meaningful. In cross-border projects, technical interfaces and legal jurisdictions must be checked together; an agreement to share an alert may be unusable if the receiving party lacks calibrated equipment or permission to interpret and act upon it. In local peace-making, intermediaries should not compel disclosures or promise protection beyond their competence. In public-facing organizations, a consultation exercise must be linked to an actual decision point rather than a purely reputational campaign.

A cooperative intervention can be represented as an authorized operation  $\pi$  with a documented, uncertain transition correspondence

$$X' \in \mathcal{T}_\Theta(X, \pi, e, u), \quad (100)$$

where  $e$  denotes admissible observed evidence and  $u$  relevant uncertainty. The transition is not presumed benevolent. Shared access may increase productive capability while reducing a participant's ability to operate independently; new complaint channels may increase recorded grievances even when underlying harm is falling; better verification may temporarily expose disputes that earlier reporting

obscured. The evaluation must distinguish these possibilities from failures or successes created merely by changes in visibility.

### Establish independent contestation, repair, and legitimate exit

A third practitioner artifact is a *repair-and-revision log*. It records an alleged harm, available evidence, which institution can investigate, procedural safeguards, applicable standards, the responsible decision-maker, remedy sought, response issued, implementation result, remaining grievance, and any changes to underlying dependencies. Allegations and verified findings remain distinguishable. Affected participants should have routes to obtain advice, challenge decisions without retaliation, and request correction. Where the relevant remedy is unavailable, an unresolved breach should not be portrayed as repaired merely because a payment or apology has been delivered.

The log also distinguishes restoration of services, compensation, acknowledgment, legal reparation, restoration of effective capabilities, and voluntary reconciliation. These can coincide, but none entails all the others. A participant may legitimately decline renewed interaction following a procedurally fair decision. Relational repair should respect that autonomy. Institutions must identify who possesses revision authority; the capacity to make suggestions is not equivalent to the ability to initiate or obtain a decision on an institutional change. In situations where the existing actors cannot lawfully amend a disputed rule, the protocol may identify an appropriate higher-level process without treating a proposed revision as already authorized.

### Reassess relations without a privileged endpoint

The cycle is iterative because interventions change what actors know and what they are able to do. A revised relational map records new resources, dependencies, histories, translation problems, and claims about legitimacy. Reassessment need not be synchronized across actors: some communities may require longer deliberation or choose nonparticipation, and an ecological process can have dynamics very different from institutional reporting periods. Analytic cuts through evolving relational histories allow comparison without an ontological assumption that one present moment or one final equilibrium has special status. An arrangement can remain provisional by design, subject to protected rights and lawful ongoing obligations.

The reporting framework preserves several separate dimensions: documented completion of commitments; warranted accuracy and contestability of evidence; accessible services and protective outcomes; participant capacities for independent maintenance, voice, revision, and exit; distribution of costs, risks, and benefits; relevant ecological indicators; reported trust or distrust where ethically measurable; and harms or unintended consequences. These dimensions should not be combined into a single “peace” or “trust” score without a defended measurement and normative theory. Particularly in conflict environments, measurement can expose participants to danger; data collection must be minimized and reviewed accordingly. A failure to obtain safe evidence may require abstention from causal claims rather than stronger surveillance.

### Three operational records and a minimal evaluation protocol

A field or institutional pilot can therefore maintain three linked records. The *relational configuration map* contains the typed actors, contested histories, material dependencies, generative conditions, safeguards, and missing voices. The *commitment-and-evidence register* contains responsibilities, scope, means of verification, costs, and review pathways. The *repair-and-revision log* records grievances, competent actions, implemented outcomes, unresolved harms, and actual amendments. Each record needs versioned provenance, responsible custody, appropriately restricted access, explicit retention

and deletion rules, and channels for correcting the record. A protected participant should not need to surrender personal testimony merely to preserve a project performance score.

A minimal prospective evaluation begins with a defined decision unit and task; baseline conditions and plausible harms; an established competent comparator; the additional GR diagnostic; a limited intervention; independent monitoring appropriate to the risk; and explicit conditions for stopping, correcting, or withdrawing. Predeclared observational tasks may include detection of an otherwise hidden dependency, resolution of a previously uncomposable obligation, actual completion of an appeal chain, or restoration of lawful independent capability. Relevant negative outcomes include privacy invasion, exclusion from voice, ecological damage, reprisals, unjustified delay, additional administrative burden, capture of infrastructure, and a decline in protected alternatives. An institution must not choose a burdensome experimental intervention merely to validate a theoretical framework.

The incremental value of the GR approach can be investigated in controlled case exercises or carefully documented comparative studies. One team applies an established mediation or governance assessment, another applies the same assessment supplemented by GR capacity and compositionality queries, and qualified independent reviewers examine whether the second procedure makes more defensible decisions with acceptable additional cost. Blind adjudication of diagnostic cases may help where practicable; true field randomization may be impossible or ethically inappropriate. Useful analyses distinguish changes attributable to ordinary resource provision, procedural fairness, reciprocal commitments, legal enforcement, or training from changes specifically attributable to the proposed GR mapping. A null result matters: if a standard rights-based review already finds and corrects every relevant problem more economically, there is no justification for promoting a complex GR procedure as independently superior.

### **An incremental diagnostic record connecting formalism to intervention**

For each candidate intervention, the practitioner can add a short paired record to the three existing instruments. Its first entry is the *baseline finding*: what a competent conventional mediation, legal, organizational, or technical assessment already explains. Its second entry is the *GR-specific mechanism*: which subject boundary,  $\mathcal{M}_i$ , admissible transformation  $\alpha_i$ , observation map, or protected continuation differs, and how the difference is substantiated. Its third entry is the *proposed action*: an authorized, proportionate change to a concrete dependency or response path. Its fourth entry is the *observable discriminant*: the outcome that would differ if the additional GR mechanism mattered, together with a feasible measurement interval and relevant adverse indicators. Its fifth entry is the *defeating result*: evidence that the baseline explains the case as well, that the assumed path does not exist, or that the intervention imposes excessive risk. This record prevents an invocation of GR from substituting for a diagnosis.

The relevant discriminants differ by domain. In peacemaking, the additional question may be whether a proposed settlement restores a safe and lawful livelihood continuation under a foreseeable interruption. In diplomacy, it may be whether a clarification can travel between scientific and diplomatic authorities without being reclassified as an unauthorized commitment. In international research cooperation, it may be whether a partner can reproduce a critical result during provider failure. In interpersonal or community relations, it may be whether a person can revise a bounded commitment without retaliation. In organizations, it may be whether an accepted complaint can reach the staff and resources needed for correction. In public administration, it may be whether a procedurally valid appeal reaches a body competent to implement the remedy. In every case the test should be evaluated against the strongest relevant existing practice, including structural-power, collective-capability, professional mediation, or administrative-law analysis.

## A typed trace from the GR model to practitioner decisions

The practical record should preserve a reproducible chain of inference, with explicit responsibility for each step:

$$(H, O, \Theta) \xrightarrow{\text{specify}} X \xrightarrow{\text{test}} (\mathfrak{F}_d, \mathcal{R}_i^{(d)}, \mathcal{U}_i^{\text{rev}}) \xrightarrow{\text{authorize}} \pi \xrightarrow{\text{audit}} (Y_d, \Delta \mathcal{R}_i^{(d)}). \quad (101)$$

The arrows denote documented activities subject to competent approval, rather than an automatic prediction or a transfer of decision authority to the model. The final capacity comparison requires matched participants, a declared capability alphabet and horizon, common protection constraints, and an observed or independently corroborated transition; if these requirements fail, the appropriate outcome is an unresolved inference. In particular, a reported change in access does not establish a change in a legally executable continuation without evidence about permission, competence, time, safety, and resources.

The relational configuration map records the boundary and mechanism assumptions for  $X$ , especially plausible omitted actors and dependencies. The commitment-and-evidence register supplies the authorized policy types, reporting map, legal and technical evidence constraints, and the strongest relevant comparator. The repair-and-revision log tests the complete response-path type  $\mathcal{U}_i^{\text{rev}}$ , including actual implementation rather than a mere referral. The additional diagnostic record ties the relevant numbered proposition to a prespecified positive control, a negative control, an adverse-event trigger, and a result classified as established, refuted, or indeterminate. These records are deliberately minimal and task-dependent; their use requires appropriate data minimization and retention safeguards.

**Bidirectional traceability and uncertainty.** The formal-to-practice trace in Equation (101) is an audit workflow, rather than a deterministic inference that recovers a unique configuration from records. Competing, rights-consistent reconstructions of  $X$  should be retained when the historical evidence or normative interpretation is incomplete. Conversely, any proposed intervention  $\pi$  must map back to a competent authorization, an identified protected continuation query, and a source-supported reason for expecting its consequences. If the favorable assessment depends on one contested reconstruction, the protocol should record that dependency and use a safer existing procedure where appropriate. The three operational records thereby support two-way accountability: observations constrain the model, and the model's recommendations remain contestable by the people and institutions affected.

## A bounded example linking the six praxis domains

Consider a hypothetical transnational marine-observation partnership in which two scientific institutions and affected coastal communities disagree about an automated environmental alert. The immediate task is to clarify what was observed without disclosing sensitive ecological locations or attributing hostile intent from an unverified classification. Diplomatic contacts maintain a protected notification channel; scientific teams maintain the provenance and uncertainty of sensor data; community representatives identify how fisheries, livelihoods, and local trust may be affected; and the relevant public authorities retain their legal responsibilities. A narrow, jointly authorized reanalysis might be possible before any broader political settlement. The GR map asks not only whether the new shared report is accurate, but who can reproduce it, whose testimony enters the decision, and whether the resulting data infrastructure creates a unilateral dependency.

In this example, peacemaking contributes conflict-sensitive recognition of possible harms and safe participation; diplomacy contributes channels for clarification and de-escalation; international cooperation contributes the shared technical infrastructure and allocation of maintenance duties; interpersonal trust matters for voluntary scientific collaboration; organizational trust concerns competent disclosure and correction; and public trust concerns whether relevant institutions actually protect rights and respond to justified complaints. These are distinct tasks, and their coordination is not guaranteed merely

by naming a common principle. Sections 27–32 will examine each domain in greater depth. The present example is a design illustration with no claim of observed efficacy.

### The smallest useful addition and the decision to stop

The praxis layer should be evaluated as an *augmentation* to an already competent practice, never as a wholesale replacement of mediation, legal analysis, humanitarian protection, engineering risk review, or public administration. A minimum viable GR addition begins with one bounded question that the baseline leaves uncertain, such as who can reproduce a disputed measurement, which authorization step blocks a lawful remedy, or whether independently acceptable obligations jointly admit an executable plan. Only the data and participants needed to answer that question should be engaged. An independent reviewer records whether the augmented inquiry identified a real additional constraint, whether its discovery altered an authorized and proportionate action, and whether affected participants gained a materially usable option. The review also records added time, expense, informational exposure, confusion, and unintended constraints on participation.

Stopping may be the appropriate outcome. If the baseline resolves the problem, the extra modeling layer is omitted. If the mapping demands speculative attribution of ecological interests, discloses sensitive testimony, or proposes action outside the relevant authority, the analysis is suspended or redesigned by competent professionals. If a positive finding depends upon unverified assumptions about another subject's generative system, the result remains a bounded hypothesis. This procedure operationalizes a deliberately modest research ambition: GR is useful when it improves the quality of a lawful decision under specified constraints, and redundant when it merely translates an already adequate analysis into a new vocabulary.

### Failure conditions and the limited claim of generative-relational praxis

Four failure modes deserve continuing attention. First, analytic capture occurs when powerful conveners define the subject boundaries, normative vocabulary, or acceptable evidence in ways that silence affected persons. Second, pseudo-precision occurs when an uncertain relational account is converted into unsupported numeric scores. Third, institutional laundering occurs when a workshop produces the appearance of inclusion or independent review without altering decision authority or actual remedial capacity. Fourth, procedural overreach occurs when a voluntary cooperative process trespasses on legal protections, emergency safety needs, professional mediation responsibility, or another competent institution's jurisdiction. The appropriate response may be to narrow the intervention, seek specialist oversight, preserve dissent, or refrain from proceeding.

The proposed contribution of a GR praxis cycle is thus intentionally limited and testable. It brings together analysis of heterogeneous subjects, the transformation of their generative conditions, the composability of institutional norms, and the effective reachability of evidence, remedy, and revision. It asks whether cooperative arrangements alter the protected possibilities through which each subject can continue acting and whether those alterations are visible to affected participants and accountable institutions. It does not establish that every subject ought to cooperate, that all generative possibilities should be expanded, or that reported trust should increase. The next chapters use this disciplined praxis architecture to investigate peacemaking, preventive diplomacy, international cooperation, interpersonal relationships, organizational conduct, and warranted public trust on their respective terms.

## 27 Peacemaking through Generative Recognition and Conflict-Sensitive Mediation

Peacemaking gives the preceding formal analysis an especially demanding practical test. In disputes marked by displacement, traumatic events, security fears, contested authority, and unequal access to material resources, a model that merely inventories interests or assigns a common trust score can obscure the conditions under which dialogue becomes possible. The generative-relational (GR) question is whether a proposed process changes the protected capacities of parties and affected persons to live, exercise rights, make claims, and participate in the institutions governing coexistence. The question includes the limits of cooperation: some parties require protection, lawful accountability, or institutional distance rather than a shared reconciliation programme. An agreement deserves assessment through its actual consequences, including its treatment of people whose interests receive limited representation at the negotiating table.

The established framework remains indispensable. The United Nations *Guidance for Effective Mediation* identifies preparedness, consent, impartiality, inclusivity, national ownership, international law, coherence, coordination, and quality agreements as fundamentals (United Nations, 2012). Inclusive mediation guidance addresses unequal participation and gendered consequences across process design and implementation (United Nations Department of Political Affairs, 2017). The United Nations Sustainable Development Group emphasizes conflict sensitivity throughout programme design, organizational operations, and evaluation (United Nations Sustainable Development Group, 2022). GR claims an incremental analytic role, conditional on demonstration: it can make explicit the links between apparently successful negotiation steps and the material, epistemic, and institutional conditions that permit affected subjects to exercise their resulting commitments. Its proposed contribution lies in that joint dependency-and-capability test, rather than in the invention of inclusion, dialogue, reparations, or civilian protection.

### Interpret conflict as a plurality of situated relational accounts

A conflict diagnosis begins with accounts whose scopes, evidence, and normative commitments differ. A government may describe a dispute in terms of territorial authority, a displaced household in terms of shelter and return, a local organization in terms of access to water and representation, and a mediator in terms of obstacles to negotiation. Each account emerges from a situated epistemic and institutional position. Recognition requires preserving that plurality while evaluating particular factual assertions through appropriate evidence and lawful determination. Recording two contradictory testimonies as two attributed claims does not establish that both accurately describe an event. Conversely, the absence of a complete evidentiary record does not license the exclusion of a vulnerable claimant.

The practical mapping unit can be written as

$$K_{i,d} = (H_{i,d}, G_{i,d}, N_{i,d}, E_{i,d}, P_{i,d}, V_{i,d}), \quad (102)$$

where H contains attributed and corroborated relational histories, G the generative dependencies sustaining livelihood and agency, N normative claims and binding constraints, E evidence and its provenance, P the effective distribution of power, and V practical vulnerability and protected continuations. These fields refer to distinct evidence types. A rights claim requires an appropriate legal analysis, a local ecological condition requires relevant scientific assessment, and a fear of retaliation calls for confidential risk evaluation. A single workshop should never be presumed capable of adjudicating them all.

The analyst should map a minimal set of relations: the capacities needed for subsistence and safety; access to services, mobility, culture, education, and lawful political participation; dependencies upon institutions or intermediaries controlled by other parties; and the procedural routes through which harms can be challenged. Some relations operate beyond the conflict parties' immediate mandates,

including cross-border financing, displaced family networks, ecological conditions, and humanitarian provision. The account should specify whose participation might expose them to retaliation, the protections available to translators and local facilitators, and how documentation itself may create risk. Information minimization and protected storage are design constraints throughout the process.

This exercise prevents a recurring category error: a community's willingness to attend meetings is evidence of participation in a specific procedure, whereas its substantive ability to influence decisions and maintain essential capacities requires independent examination. Apparent acceptance may reflect constraints on livelihood, movement, legal status, or personal safety. A mediator may therefore document broad attendance and still conclude that the process lacks conditions for free, informed consent.

### Distinguish the objects and permissible ends of peacemaking

De-escalation, cessation of hostilities, humanitarian access, political settlement, accountability, reconciliation, and transformative peace concern different operative objectives. Their institutional requirements and temporal profiles can diverge. A limited agreement enabling safe civilian passage may be urgent even when political narratives remain irreconcilable; a negotiated political arrangement may require extensive legal and constitutional processes extending beyond local mediation. The term *peace* consequently requires an explicitly identified evaluative domain rather than a composite score presented as universally sufficient.

For a candidate process  $\pi$ , let  $\mathcal{S}(\pi)$  describe compliance with independently specified safety, rights, and professional constraints; let  $\mathcal{C}_i(\pi)$  denote participant  $i$ 's protected practical continuations; and let  $\mathcal{A}(\pi)$  denote competent and executable accountability paths. A cautious suitability test is

$$\begin{aligned} \pi \in \mathcal{F}_{\text{authorized}}, \quad \mathcal{S}(\pi) = 1, \\ \mathcal{A}(\pi) \text{ accessible where required, } \mathcal{C}_i(\pi) \cap \mathcal{V}_i \neq \emptyset \quad \text{for affected } i. \end{aligned} \quad (103)$$

Here  $\mathcal{V}_i$  denotes contextually justified viable continuations and the notation is a screening schema rather than an algorithm that certifies a real peace agreement. The test does not assign equal veto powers to all parties regardless of legal competence. It also does not permit reciprocal bargaining over non-derogable protections or excuse unlawful violence as a cultural preference. Assessing the operative constraints requires qualified legal, humanitarian, and security expertise.

A useful GR extension is to distinguish a *settlement of claims* from a *transformation of conflict-producing dependencies*. An agreement can delimit use of an irrigation system yet leave a community unable to access any independent means of measuring water allocation. Compliance reports can improve while the underlying dependence on one party's instruments and records deepens. In such cases a mediator might propose independent sampling, protected access to water information, maintenance training, or a recognized review channel, subject to feasibility and consent. These are familiar institutional options; the additional GR diagnostic is a reasoned test of whether their combined deployment restores relevant generative capacities. It can fail where the new institutions impose costs, concentrate authority, or expose residents to fresh retaliation.

### Design consent-based, protected, and appropriately inclusive contact

A practical process can begin with separate, confidential scoping conversations conducted by suitably qualified conveners. The immediate purpose is to learn the limits of each party's mandate, clarify actual safety risks, assess readiness to engage, and identify independent avenues of protection. Risks of surveillance, intimidation, coercion, reprisals, or forced disclosure may justify deferral or cancellation. The convening team should separately consider women, displaced people, youth, disabled persons, marginalized minorities, and other constituencies whose needs and safety may be obscured by the

representatives of dominant parties; representation must be adapted to context rather than inferred from a category label alone (United Nations Department of Political Affairs, 2017).

Consent has several dimensions. A representative must possess a credible mandate to speak for a defined constituency; people asked to disclose experiences require informed agreement about the use of that information; and parties must understand which decisions the process can lawfully make. Participants may choose silence, private representation, indirect participation, or withdrawal. Public exposure of an individual's testimony must not become the price of recognition. Mediation impartiality concerns the management of a fair process; it does not entail moral indifference to the protection of civilians or the permissibility of unlawful acts. Distinct humanitarian actors may operate under their own neutrality and independence obligations, which should be respected rather than absorbed into a political settlement apparatus (International Committee of the Red Cross, 2025).

Protected contact can be organized through a limited sequence: (i) establish independent channels for legal or humanitarian protection; (ii) seek consent for a narrowly described information exchange; (iii) record the standing of assertions and unresolved disagreements; (iv) identify a small set of feasible actions reducing immediate risk; (v) define verification, correction, and suspension provisions; and (vi) revisit capacity, fairness, and harm before expanding scope. This is a menu of candidate measures rather than a mandatory trajectory. An urgent humanitarian intervention may need to occur without a general political agreement; an unsafe dialogue may be suspended while protection continues. Reliable documentation should distinguish facts independently checked, jointly stipulated facts, allegations, and unresolved interpretations.

For each prospective commitment, a practical register identifies its issuer, responsible bearer, scope of legal competence, performance obligation, protected interests, verification channel, review trigger, remedy, and exit or suspension conditions. Agreements should designate competent parties for verification and avoid making the most vulnerable participant solely responsible for proving a breach. Where joint investigation is genuinely feasible, responsibility for secure record custody and dissemination should be allocated in advance. Where such arrangements would endanger people, restricted independent verification may be preferable to general transparency.

### **Relational positionality and the risks of formal extraction**

Contemporary relational peace inquiry already proposes a pluriversal, more-than-human approach to situated peace practice (Lakitsch, 2026). The GR mapping process must therefore acknowledge a risk of its own: a model that claims to include heterogeneous ways of living may erase them by forcing communities, ecological relations, and spiritual or customary understandings into administrative categories chosen by an external analyst. A formally well-typed representation is neither a substitute for locally legitimate knowledge nor evidence that the subjects represented accept its partitions. The mapping protocol should identify who supplied each category, how dissenting descriptions are preserved, which information remains confidential, and who can refuse or revise the representation. Ecological dependencies require qualified observation and accountable representation rather than an automatic claim that every physical process has the same legal or moral standing.

The distinct test for the GR layer is whether, after these safeguards, it identifies a concrete discrepancy between a promised settlement and an executable, protected continuation that qualified relational-peace and conflict-sensitive practitioners did not already discover. If independent baseline practitioners flag the same irrigation-data dependency or restricted livelihood option, the example illustrates compatibility among approaches and provides no evidence of distinctive explanatory power. This explicit comparator makes the practical proposal more testable while preventing formalization from exercising an unacknowledged power over the people whose relationships it describes.

## An illustrative community-resource conflict

Consider a constructed dispute in a coastal delta where two communities, a municipal authority, and a regional water operator disagree over control of floodgates and fishing access. One community reports historic exclusion from flood protection; another fears that altering releases will damage its crops. Municipal records describe satisfactory compliance with existing operational rules, yet the operator alone controls the monitoring equipment and raw logs. Displacement has affected both communities, while residents lacking identification documents struggle to attend official consultations. These stipulations are an analytic illustration and do not report an actual field case.

A conventional, well-conducted mediation would already assess conflict drivers, stakeholder inclusion, power, legal mandates, implementation feasibility, and potential harm. The supplementary GR inquiry asks whether the proposed settlement's dependence on the operator leaves some groups unable to verify releases, initiate lawful review, or sustain their livelihoods. It identifies a possible divergence between declared agreement and protected practical capacity. The parties might explore a jointly recognized inspection arrangement, independently retained readings, a language-accessible notice procedure, protected representation for displaced persons, and an authorized mechanism to amend emergency release rules. Ecological and engineering specialists must assess whether the technical measures are safe; a mediator has neither scientific nor regulatory authority to pronounce them so.

The intervention should proceed through separable decisions. A protected notice procedure may be feasible even where ownership disputes remain unresolved. A shared technical review may reveal unreliable sensors without establishing the merits of all historical allegations. Assistance to displaced families may require independent public or humanitarian channels outside the negotiation. The arrangement should identify its own failure modes: the joint inspection might expose sensitive locations; community representatives might be threatened; monitoring might become financially unsustainable; or a nominal appeal might never lead to an authorized operational correction. Where any of these risks become credible, the scope must be reconsidered under appropriate safeguards.

**What an added GR diagnosis must identify.** A mediator may already map fear, grievance, livelihoods, relational histories, and unequal negotiating power. A proposed GR supplement should consequently isolate a documented change in an authorized generative mechanism: for example, a settlement's formal right to appeal depends on evidence held exclusively by a party that can unilaterally terminate access. The researcher must compare that diagnosis with a competent conflict-sensitive and rights-based mediation assessment using equivalent information and protective safeguards. A possible additional finding concerns the *executability* of the appeal under plausible disturbances; a mere restatement that the less powerful party is vulnerable adds no independent explanatory value. The participants' protected choices, including nonparticipation and withdrawal, remain primary.

## Evaluate consequential change, rival explanations, and adverse effects

Evaluation should distinguish immediate protective effects, fulfilled obligations, participation with meaningful influence, accurate evidence handling, operational remedies, and changes in participants' ability to continue lawful social and economic activity. Indicators may include the accessibility and timeliness of protected complaint channels, independently checked delivery of essential services, incident reports where reliable and safe to collect, the percentage of actionable grievances receiving competent responses, and the durability of alternatives to unilateral infrastructure control. Reported perceptions of safety or trust can be collected only with suitable ethics and confidentiality protections, and must remain analytically separate from actual protection and observed compliance.

Comparative assessment should begin with an established conflict-sensitive process as the baseline. An additional GR mapping may be judged helpful only where it identifies a concrete dependency, constraint, or missing institutional interface; motivates a lawful and feasible adjustment; and yields an

independently reviewable improvement sufficient to justify its demands. Rival explanations include extra mediator attention, resource transfers, legally mandated inclusion, improved procedural fairness, or technical repairs that any competent baseline team would have made. A negative finding is informative: when the GR layer adds paperwork or exposure without improving decisions, its application should be reduced or abandoned. The relevant ethical outcome may also be a justified refusal to mediate, maintained distrust, or a protected exit.

The proposed theoretical bridge is therefore narrow and substantive. A peacemaking intervention changes an evolving relational configuration, including who can verify and challenge claims, who bears risk, and which lawful activities remain possible. The GR metamodel helps articulate possible mismatches between settlement performance and the reproduction of protected generative capacity. Its practical legitimacy depends upon experienced mediation, human rights and humanitarian obligations, independent professional competence, and evidence of incremental utility, all of which remain prior to any aspiration to validate a new formal theory.

*Formal-to-practical audit.* The bounded trial is assessed against Proposition 1 (enforceable exposure limits), Proposition 4 (restored livelihood capability after a claimed remedy), and Proposition 8 (a complete lawful path from complaint to executed protection). The field record specifies a realistic disturbance, the affected party's available lawful livelihood continuation, a competent protection authority, and the outcome that a conventional conflict-sensitive assessment already predicts. Unsafe probing of participants, coercive disclosure, or pressure to reconcile defeats the protocol irrespective of an apparent improvement in settlement rates.

A discriminating GR assessment would therefore identify a documented change in the material or institutional mechanisms sustaining an affected participant's safe continuation, beyond the conflict and protection mechanisms already identified by a competent mediator. For example, if an independently available livelihood route remains blocked under a proposed settlement, the analyst should specify which lawful change operation would open it and who has authority to authorize that change. A baseline mediation design that already identifies and addresses this route is a counterexample to any claim of additional GR benefit. Relational peace theory is an important comparator, particularly its attention to how relationships themselves shape peace (Söderström et al., 2021; Brigg, 2025).

## 28 Preventive Diplomacy and the Stewardship of International Relationships

Preventive diplomacy concerns the maintenance and responsible transformation of relationships among political actors in situations where disagreements, uncertainty, or perceived threats could develop into more dangerous conflict. It includes authorized channels of communication, timely clarification of disputed events, carefully designed assurances, and the protection of opportunities for peaceful settlement. These practices have long-established diplomatic foundations. The United Nations distinguishes conflict prevention and the Secretary-General's good offices as means of addressing disputes before their escalation, while the OSCE's confidence- and security-building measures provide concrete arrangements for information exchange, notification, verification, and consultation (United Nations, 2012; Organization for Security and Co-operation in Europe, n.d.; Organization for Security and Co-operation in Europe, 2011). GR can serve as an additional diagnostic language only insofar as it clarifies the evolving dependencies, interpretive translations, and authority interfaces through which such measures actually operate.

Diplomatic relationships differ from interpersonal trust. States and international organizations exercise legally and politically constituted authorities, represent plural domestic constituencies, and act under changing institutional mandates. The beliefs attributed to a state cannot be inferred from a single spokesperson, and the aims of a diplomatic relationship need not include affection, normative convergence, or unrestricted data exchange. A relevant form of trustworthiness is the warranted expectation

that specified contacts, protections, communications, and agreed procedures will be honored within their stated scopes. The immediate practical objective may be predictable conduct and accurate clarification even among actors who remain deeply distrustful.

### Diplomacy as stewardship of evolving relational capacities

A relational inventory can distinguish four channels. The first is *political communication*, including duly authorized contacts and the routes through which messages acquire official standing. The second is *epistemic coordination*, including technical vocabularies, evidence sources, classifications, and arrangements for handling incompatible interpretations. The third is *material interdependence*, including essential communications links, trade, shared ecological systems, critical services, and the physical means of verification. The fourth is *institutional accountability*, including the competence to acknowledge incidents, commission fact-finding, authorize corrective measures, and contest results through lawful procedures. In a particular disagreement, these channels can have different owners, access rules, and failure modes.

Represent a standing diplomatic relation from  $i$  to  $j$  in domain  $d$  as a typed interface

$$D_{ij}^{(d)} = (\text{Ch}_{ij}, \tau_{ij}, \text{Evid}_{ij}, \text{Auth}_{ij}, \text{Saf}_{ij}, \text{Rev}_{ij}), \quad (104)$$

where Ch denotes available channels,  $\tau$  the authorized partial translations of claims and classifications, Evid admissible evidence and provenance, Auth the competence to undertake or accept operations, Saf safety and confidentiality constraints, and Rev review and revision paths. This is a structured checklist rather than a measurement of diplomatic friendship. The utility of the representation lies in exposing *interface failures*: a notification may reach the correct office while lacking the competence to trigger an operational response; an agreed technical term may be translated differently by two agencies; a shared alert may be verifiable scientifically while its disclosure violates a valid confidentiality restriction.

The GR framing also directs attention to the continuations that a diplomatic arrangement makes available. If one party's cooperation requires surrendering all independent access to the evidence on which a joint assessment rests, the relation may function during ordinary periods yet become brittle under dispute. Conversely, protected restrictions on data or access may be essential to national security, privacy, ecological protection, and the safety of individuals. The relevant criterion is the defensibility, proportionality, and contestability of specific restrictions, together with the presence of competent alternatives for clarification, rather than an assumption that maximum openness constitutes peace.

### Design bounded predictability amid persistent disagreement

Standing channels can be designed to permit several grades of contact: receipt acknowledgment, interpretation query, restricted technical clarification, escalation to authorized political representatives, third-party facilitation where accepted, and jointly documented procedural revision. Each channel should have a known purpose and a defined confidentiality classification. A hotline performs poorly if participants disagree about who may use it, what kind of event warrants a call, or whether its receipt constitutes political recognition of a disputed claim. Even a frequently tested technical channel can fail institutionally when the official authorized to respond lacks the ability to obtain the evidence or initiate a corrective action.

A narrow protocol for a selected class of events can record (1) the event definition and limits of automatic detection; (2) minimum notification fields, source uncertainty, and authentication; (3) the authorized receiving and responding institutions; (4) permissible handling of sensitive evidence; (5) a mutually recognized route for correction of erroneous classification; (6) consultation, suspension, and review triggers; and (7) responsibilities for maintaining the channel itself. Parties may agree on the structure of a process while preserving sharply different substantive positions. This can reduce ambiguity without implying settlement of jurisdictional or legal disputes.

The operational form of an incident might be

$$e = (\text{id}, \text{type}, \text{scope}, \text{source}, \text{uncertainty}, \text{access}, \text{recipient}, \text{review}). \quad (105)$$

5110 Every field is defined by authorized, context-specific agreement; the model supplies neither universal notification thresholds nor a right to acquire otherwise protected data. A responsible design clarifies how a missing field is handled and what inference remains unwarranted. Silence might reflect network failure, organizational incapacity, deliberate withholding under lawful confidentiality, or a refusal to cooperate; it is analytically unsound to interpret it automatically as hostile intent. Such uncertainty  
5115 should remain explicit in the diplomatic record.

For any escalation rule  $\rho$  that maps observed information into proposed institutional action, the analyst should specify who holds authority to apply it and what protective conditions limit that authority:

$$\rho : \mathcal{O}_d \rightarrow \mathcal{A}_d, \quad \rho(o) \in \mathcal{A}_{\text{authorized}} \cap \mathcal{A}_{\text{safeguarded}} \quad \text{whenever } \rho(o) \text{ is defined.} \quad (106)$$

This remains an admissibility schema rather than a prescription to automate diplomatic or military escalation. Decisions involving force, coercion, or sensitive security operations remain subject to  
5120 applicable law and accountable human institutions. A GR analysis should make the chain of competent responsibility easier to inspect, never obscure it behind a model output.

### Normative translation and the interpretation of disputed conduct

The same event may be rendered through technical, diplomatic, legal, ecological, and public communication vocabularies. Terms such as *unauthorized entry*, *unusual activity*, *pollution event*, or *data*  
5125 *incident* can carry different evidential and jurisdictional conditions across institutions. A partial translation  $\tau_{ij}$  should record its domain of legitimate application, its unresolved terms, and any relevant reservations. Once multiple agencies or states participate, bilateral translation paths may produce distinct interpretations of one observation. The compositional analysis from Sections 6 and 24 therefore applies directly, subject to the types and competences established by the respective institutions.

5130 Consider a report that an autonomous marine platform has entered a disputed operational zone. One authority might classify the event under navigational safety, a second under environmental monitoring, and a third under a security notification arrangement. Each classification may be coherent within its own rules while imposing incompatible reporting requirements or deadlines when combined. An incident response should first distinguish the observed platform position from interpretations of authorization and intent; identify which body has competence over each claim; and preserve authenticated  
5135 records that are lawfully shareable. The parties might agree on a joint chronology of observable facts while retaining legal disagreement over the zone's status. Such an agreement supplies a limited epistemic interface, with no implied concession of sovereignty or rights.

This example illustrates a candidate GR advantage: the incompatibility may lie in the composition  
5140 of reporting and response interfaces rather than in a failure of any single institution to act. A competent diplomatic or legal review could already find that problem. The research task is to determine whether typed GR mapping exposes it more reliably, earlier, or with less institutional ambiguity than an ordinary responsibility matrix and technical cross-check. A formal demonstration of possible interface failure does not establish frequency, causal importance, or the effectiveness of any particular  
5145 confidence-building measure.

### A constructed maritime-observation alert and a safe clarification protocol

Suppose two neighboring states support a shared ocean-observation project operated by a scientific consortium. An autonomous sensor classifies an unusual acoustic or navigational event near a sensitive maritime boundary. One national agency receives only an alert label and believes the event warrants

immediate diplomatic protest. The neighboring agency holds an alternative classification based on a different sensor calibration. The consortium possesses raw records, yet portions of the observations contain protected environmental-location information and technically sensitive metadata. No claim in this constructed example concerns an actual state or incident.

An authorized clarification process could use five linked instruments. A *notification record* establishes that an alert was received, while explicitly marking its automated and provisional character. An *evidence-provenance memorandum* distinguishes raw measurement, preprocessing, classifier output, expert assessment, and official determination. A *translation register* records how relevant technical and diplomatic categories correspond or diverge. A *protected-review mandate* specifies the experts, data access, permissible disclosure, independent challenge, and correction procedure. Finally, an *institutional response register* identifies who may acknowledge findings, alter a public alert, and implement any lawful operational remedy. Each instrument requires competent authorization, privacy and security review, and proportionate information management.

At the initial stage the parties may agree only to avoid treating the automated label as a verified attribution of intent and to exchange an authenticated minimal factual notice through existing channels. A scientific clarification may establish calibration uncertainty; a separate legal or diplomatic process may address questions of jurisdiction. If a protected expert review is infeasible, the parties can record that limitation and confine any joint statement to its warranted evidential scope. Where the process itself creates unacceptable exposure of sensitive systems or affected persons, it must narrow or suspend the evidential exchange. The purpose is to increase the reliability of bounded communication while preserving the parties' legitimate positions and lawful independent decision-making.

An effective protocol must also survive turnover, technical outages, and changing interagency mandates. Parties could periodically test whether the notification contact remains reachable, whether authenticated corrections propagate to every authorized receiver, whether the technical and diplomatic records can be reconciled, and whether a disputed determination has an end-to-end path toward competent review. These exercises should be controlled and agreed; collecting real security-sensitive evidence for a research study would require permissions that an academic manuscript cannot confer. In a broader ecological consortium, the same record-control problem may arise between states, research institutes, local communities, and technical operators even when the initial dispute lacks military significance.

**A diplomatic inference boundary.** A successful technical clarification establishes, at most, that specified records were reconciled through a competent communication path. It need not establish benign intentions, enduring political confidence, treaty compliance in other domains, or an institutional ability to correct a different incident. The proposed GR diagnostic therefore tests whether a change in evidence classification or delegated focal points interrupts a previously executable authorized response path. It should be evaluated against qualified diplomatic protocol and incident-management practice, with attention to confidentiality, security, and the risks of additional disclosure. An actor's decision to retain skepticism after successful clarification may be prudent and should remain a legitimate outcome.

### Evaluate relationship maintenance without treating trust as an output target

Evaluation requires outcomes matched to the protocol's purpose. Candidate measures include authenticated delivery of agreed notifications, time and completeness of technical clarification, correction propagation across authorized agencies, incidence of unresolved classification conflicts, lawful access to independent review, operational continuity under expected faults, and burdens created by additional procedures. Reporting should keep measurement uncertainty, representational disagreement, and official legal determinations separate. Apparent speed can be misleading when a fast but inaccurate response amplifies a false alert; increased information exchange can create new hazards when confidentiality or context is lost.

Credible preventive diplomacy also needs adverse-event review. An incident registry should record unauthorized disclosure, mistaken attribution, false assurance, retaliatory use of shared evidence, administrative overload, discrimination against affected populations, and failures to transmit corrections. The review must be proportionate and avoid creating surveillance infrastructure under the pretext of peace. A satisfactory outcome may involve calibrated restraint, sustained channels amid disagreement, reduced ambiguity about responsibilities, or a procedurally fair record of unresolved claims. Public approval ratings and declarations of friendship are weak substitutes for these operational observations.

For comparative evaluation, the counterfactual baseline should be a competent conventional procedure drawing on established diplomatic contacts, OSCE-style confidence-building where relevant, technical incident review, and applicable international law. The supplementary GR map deserves consideration only if it reveals a meaningful missing interface, dependency, or constraint on protected agency and supports a lawful correction with acceptable cost. Possible rival explanations include improved training, more timely information exchange, credible political assurances, or the availability of neutral technical experts. Comparative tabletop exercises can assign equivalent incident files to appropriately qualified teams, varying whether the GR supplementary questions are available and reviewing the resulting diagnoses under blinded criteria where feasible. Such research should avoid real-world deception, intrusion into sensitive systems, or live crisis experimentation.

The discipline of diplomatic restraint extends to claims of causal success. An institution's completion of a notification process, continued communication, or lower incidence of reported incidents establishes limited outcomes in defined conditions. Broad assertions that a framework has prevented war would require a substantially stronger causal and historical research design. The proposed GR contribution is more circumscribed: it offers a way to inspect whether heterogeneous normative translations, distributed evidence, and overlapping authorities compose into a protected, effective diplomatic relationship, even where trust remains low. The following sections extend these questions to productive international partnerships and then to interpersonal, organizational, and public relationships.

*Formal-to-practical audit.* A documented notification exercise probes Proposition 2 by comparing the authenticated technical record with the authorized clarification available to the parties; Proposition 7 tests whether the scientific and diplomatic interpretations support a jointly lawful response; Proposition 8 follows correction across the competent offices. The discriminating observation is completion of the agreed correction or clarification chain under realistic communications disruption, assessed against a competent established diplomatic protocol. Evidential uncertainty must remain visible rather than being converted into claims about hostile intent.

The additional GR diagnostic in this domain is a typed handover test, rather than a generic injunction to communicate. For a contested technical notification, the analyst records whether data provenance, classification, diplomatic authorization, and any correction remain composable after an institutional change such as delegation to a new focal point. A secure established diplomatic channel that already passes this test supplies a negative control. Where the channel fails, repair may require an authorized institutional interface rather than another confidence-building declaration.

## 29 Designing International Cooperation to Reproduce Shared and Distributed Capacities

International cooperation is a particularly consequential domain for testing the proposed distinction between productive achievement and the reproduction of generative capacity. Joint scientific infrastructures, development partnerships, transnational health programmes, shared environmental observation, and technical assistance can create benefits that participants could scarcely produce in isolation. They can also reorganize the distribution of instruments, skilled labour, data access, institutional authority, and the practical means of continuing work. A consortium may fulfill its stated deliverables while concentrating the capability to interpret its results or decide its next direction. The problem is therefore

to determine which relational transformations a successful project makes possible, which it forecloses, and for whom. These questions concern the arrangement's material and normative consequences rather than the good faith of its members alone.

An extensive body of practice already addresses parts of this problem. The Busan Partnership identifies ownership, results, inclusive partnerships, transparency, and shared responsibility as development-cooperation principles (OECD, 2011). The 2026 OECD–UNDP assessment of the Global Partnership's monitoring round evaluates ownership, use of country systems, whole-of-society participation, transparency, and the condition of mutual accountability (OECD and United Nations Development Programme, 2026). Its findings highlight continuing limitations in the availability and quality of mutual-accountability arrangements; the sampled countries, indicators, and reporting periods must be respected before translating those results to another setting. In scientific collaboration, UNESCO's Recommendation on Open Science addresses access, infrastructure, participation, and capacity-building (UNESCO, 2021a). These traditions provide substantive standards to which the generative-relational (GR) approach must be compared. The prospective GR increment is a joint, time-indexed account of whether particular dependencies and governance interfaces alter participants' *effective sets of admissible continuations*. The model adds value only if this account identifies actionable constraints that competent capacity-building and participatory assessments otherwise overlook.

### Distinguish project output from cooperative capacity reproduction

Suppose an international project has achieved a target level of environmental measurement accuracy. Its observable output is represented by  $Y(\pi)$  for cooperative arrangement  $\pi$ . For participant  $i$ , however, an output measure describes only a projection of its relational situation. Let  $\mathcal{C}_i(\pi \mid X)$  denote the protected, practically accessible continuations for that participant under the configuration  $X$  and arrangement  $\pi$ . These continuations may include independently repeating a measurement, maintaining an essential instrument, submitting a competing interpretation, negotiating an operational change, or leaving the consortium while retaining legally permitted access to records. Feasible continuations should incorporate material requirements and institutional permission, together with ecological, safety, and rights constraints.

We can compare two cooperation designs whose outputs coincide:

$$Y(\pi_A) = Y(\pi_B), \quad \mathcal{C}_i(\pi_A \mid X) \not\subseteq \mathcal{C}_i(\pi_B \mid X). \quad (107)$$

The relation  $\simeq$  denotes a contextually specified comparison of accessible continuations, *not* equality of their cardinalities. One continuation could be more significant for safety or lawful self-determination than several routine alternatives. The formal example exposes a measurement problem: project-deliverable equivalence is compatible with materially consequential differences in practical agency. It does not establish that  $\pi_A$  is preferable for all participants. Licensing costs, quality assurance, safety, confidentiality, indigenous and community rights, cybersecurity, scientific comparability, and ecological impacts may justify meaningful restrictions on some pathways. The inquiry should record the reasons and contested consequences of each restriction.

A second distinction concerns *distributed* and *collective* capacities. Collective capability refers to what the collaboration can accomplish through coordinated activity. Distributed capability concerns what particular participants can initiate, maintain, evaluate, or legitimately influence within and beyond that collaboration. These can move differently. An efficient, highly centralized infrastructure may increase collective capacity while restricting local maintenance; a fully decentralized arrangement may preserve many locally controlled pathways while imposing costs that make reliable joint monitoring infeasible. The appropriate institutional design follows from actual demands, protected values, and technical limits. GR supplies a representation of their interaction rather than a categorical preference for centralization or decentralization.

## Construct a dependency ledger before allocating obligations

A serious cooperative agreement should be accompanied by a dependency ledger that differentiates at least six categories. First are material and ecological requirements, such as sensors, laboratories, vessels, energy, network access, environmental permits, and safe maintenance. Second are epistemic requirements: calibration procedures, software, metadata, methodological explanation, provenance, and scientific training. Third are operational capacities, including qualified personnel, replacement parts, maintenance schedules, and continuity arrangements. Fourth are governance capacities: access permissions, appointment of representatives, agenda-setting authority, rights of review, and the power to initiate amendments. Fifth are financial and legal conditions, including recurring costs, licences, procurement rules, intellectual-property claims, and enforceable remedies. Sixth are protective conditions, covering personal and community data, sensitive ecological locations, safety, non-retaliation, and legitimate confidentiality.

For dependency class  $d$ , write  $D_{i \leftarrow j}^{(d)}$  for participant  $i$ 's situated reliance on another participant or infrastructure controller  $j$ . The notation is descriptive and remains compatible with legitimate and beneficial dependencies. A dependency becomes a matter of concern when loss, refusal, or unilateral alteration of the relevant service places protected continuations beyond the participant's practical reach. This can be evaluated through a bounded disruption inquiry:

$$\mathcal{C}_i^{[-d]}(\pi \mid X) = \{\gamma \in \mathcal{C}_i(\pi \mid X) : \gamma \text{ remains viable following the specified disruption of } d\}. \quad (108)$$

The notation requires a declared disruption scenario, duration, substitutes, and relevant legal restrictions. It is a sensitivity analysis, not a claim that every institution should be capable of independent production in every circumstance. Particular public-interest, safety, and scientific requirements may appropriately demand shared control or specialist dependence.

Preparation of the ledger itself is a power-sensitive act. Funding agencies, programme managers, national ministries, local researchers, affected communities, and technical providers often hold different knowledge and authority. Participants should agree upon who records dependencies, whose claims can modify the ledger, and which entries require protected handling. The presence of a community delegate in a meeting cannot substitute for an assessment of the delegate's mandate or of potential reprisals for disagreeing with an institutional sponsor. Documents should distinguish observed capabilities from promises of future provision, self-reported concerns from verified technical constraints, and currently lawful options from proposed changes requiring new authorization.

## Design agreements that maintain capacities through their use

Cooperation design can then address the mechanisms by which joint activity sustains or changes each participant's available continuations. A technology transfer may provide an instrument and training while leaving its calibration software or replacement parts unavailable. An open-data commitment may publish observations without sufficient metadata for independent interpretation. A jointly financed server may be accessible while one organization retains sole authorization to change the analytical pipeline. An apparently participatory steering committee may lack competence to revise procurement or intellectual-property arrangements. These are concrete interface failures that should be made visible before outputs are accepted as evidence of completed capacity-building.

Possible provisions include verifiable maintenance and documentation commitments; interoperable formats, where legally and technically appropriate; protected access to methods and provenance; mutually agreed training with opportunities for independently demonstrated competence; allocated operating and replacement costs; shared or appropriately licensed tools; clear intellectual-property and data-governance provisions; and procedures through which participants may request revision. Capacity commitments should specify a recipient, a responsible provider, a feasible milestone, the resources needed for operation, a method of assessment, and an avenue for remedy. Contractual transfer alone

does not demonstrate effective use. Independent competence demonstrations and routine operations may provide better evidence, although their cost and risks should be stated openly.

This should include an explicit *continuation and withdrawal protocol*. After a project ends, a participant may need lawful access to its own records, preservation of attribution, enough documentation to reproduce authorized analyses, or assistance transferring a service without losing essential continuity. Withdrawal cannot guarantee perpetual entitlement to another party's proprietary assets, personnel, or resources. The parties must determine the permitted scope through negotiation and applicable law. A cooperation design that promises graceful exit while withholding essential operating information may possess formal reversibility and lack effective restorability, as distinguished earlier in the manuscript. A design that offers unrestricted extraction of sensitive ecological or personal data may instead create unacceptable risks. Both failures are visible through a typed evaluation of who can do what, using which resources, under whose authority.

Three institutional mechanisms may make these commitments more credible. A capability verification process tests whether required operations can be undertaken under specified conditions. A shared evidence process preserves provenance and enables authorized, proportionate challenges to the validity of assessments. A revision and remedy process identifies an institution empowered to respond when a promised capability cannot be maintained. These mechanisms must compose: a technically valid complaint that cannot reach any institution with the competence and resources to make a correction is a procedural dead end. A useful dossier identifies each link from detected failure to evidence, authorized review, decision, resources, and executable response.

### An illustrative marine-observation partnership

Consider a hypothetical transnational consortium establishing a marine environmental observation system. Institution *A* operates a sophisticated data centre and specializes in instrument calibration; institution *B* contributes regional scientific expertise and field operations; several coastal communities participate in deliberations over the dissemination of environmentally sensitive information. Under architecture  $\pi_A$ , a central operator provides standardized collection, quality control, and publication. Other participants receive reports and limited access to a proprietary processing interface. Under architecture  $\pi_B$ , the partners negotiate interoperable data schemas, shared validation records, a delegated regional-processing function, differentiated access controls, maintenance training, and a jointly reviewable governance charter. These architectures are analytic constructions; they are neither descriptions of real BBNJ projects nor empirical assertions about which architecture would perform better.

Assume for illustration that both architectures meet a stated sensor-accuracy threshold during an initial project cycle. The consortium then tests three disruptions: prolonged loss of access to the central processing system; a disagreement about a calibration update; and a challenge from an affected coastal group regarding public disclosure of a sensitive location. Under  $\pi_A$ , the central institution might rapidly resolve calibration disputes but leave others unable to reproduce the analysis or independently maintain the service. Under  $\pi_B$ , local competence might be greater, while distributed quality control and access governance introduce coordination burden and possible inconsistency. Both require an independently justified confidentiality regime. A study should record each scenario's technical and legal requirements, actual capabilities, affected participants, opportunity costs, and contested normative judgments rather than compressing the comparison into a universal score.

This illustration has a concrete treaty context without presuming the implementation outcomes of that context. The Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction, in force from 17 January 2026, includes capacity-building and marine-technology transfer alongside other substantive areas; it establishes cooperative institutional mechanisms, including a clearing-house framework (United Nations, 2026a). Its first Conference of the Parties was scheduled for January 2027 at the time of this draft. International marine cooperation therefore offers relevant legal and institutional questions about demand-driven support and the

capacities needed to participate, while the durability of particular mechanisms remains to be evaluated through implementation evidence. Existing international norms governing open science, marine technology transfer, and data stewardship must likewise be analysed on their own terms rather than treated as derived from GR (UNESCO, 2021a; United Nations, 1982).

**Matched performance and capacity horizons.** A partnership's output record and its participants' capacity records should be reported separately, each over an explicit horizon. A baseline might show timely delivery of shared marine observations, while a disruption test asks whether the participating laboratories could lawfully reproduce, audit, or continue an essential measurement after a provider failure. A short interruption simulation supplies evidence about selected contingencies, rather than exhaustive proof of resilience. Any proposed change in ownership, data access, training, or infrastructure governance must also satisfy applicable ecological, contractual, and legal constraints. The corresponding GR increment is an independently corroborated diagnosis or improvement that competent development-effectiveness and infrastructure-risk approaches do not already provide on the same facts.

### A practitioner protocol for cooperative capacity

The following protocol is offered as an adaptable analytical instrument, requiring professional and institutional authorization where relevant. The process begins with jointly specifying a concrete outcome and the legal, ecological, and safety conditions under which it may be pursued. Participants then identify affected subjects and document relevant dependencies, material costs, and alternative arrangements. A baseline records what each participant can already perform, maintain, interpret, contest, and influence, while distinguishing authorized powers from desirable but presently unavailable ones. Negotiation links every proposed shared output to its critical capabilities, responsible parties, funding and maintenance conditions, evidential requirements, and revisable governance interfaces. Independent review checks whether the claimed capacities can be exercised. Subsequent evaluations examine changes in the system and provide accessible routes for correction or justified termination.

At a minimum, reporting should separate six dimensions: (i) outputs and scientific or service quality; (ii) retained and newly acquired capabilities by participant; (iii) dependencies and substitutes under specified interruptions; (iv) inclusion and practical governance authority; (v) accessibility and effectiveness of review and remedy; and (vi) ecological, privacy, safety, and other adverse consequences. A report should identify who bears the costs of each capability, who is permitted to rely upon it, and whose accounts remain missing. Agreement about a metric is itself a governance outcome requiring scrutiny. Disaggregated narrative evidence may be indispensable where numerical indicators would conceal distinct legal or ethical stakes.

To evaluate the incremental usefulness of GR, compare this mapping-and-continuation protocol against an established partner-led results, ownership, and accountability assessment. A prospective study could randomize comparable project-design exercises to receive conventional best-practice support or that support plus a structured GR dependency-and-continuation analysis, provided the setting is appropriate for experimentation and has ethical oversight. Outcomes would include accurately identified institutional bottlenecks, resolved contradictions among agreements, detected vulnerable dependencies, time and administrative burden, participant autonomy, and unintended risks. Qualitative process tracing can test whether any improved outcome actually followed from the distinctive GR elements rather than more facilitation time, stronger technical expertise, better resourcing, or the mere existence of an explicit checklist. In contexts where randomization is ethically or practically inappropriate, matched process studies with transparent selection criteria offer a more limited alternative.

The strongest conclusion permitted by this section is a research proposition. Successful international cooperation requires evaluation of more than collectively produced outputs whenever those outputs depend upon relations that transform participants' practical capacities. GR may improve such

evaluation by connecting typed dependencies to effective, authorized continuations and complete institutional response pathways. Its added explanatory and practical value remains to be demonstrated against established cooperation and capacity-building methodologies.

*Formal-to-practical audit.* This partnership comparison instantiates Proposition 6 through a controlled failure of a documented indispensable service, Proposition 5 through the availability of an authorized revision response, and Proposition 4 through participants' continuing capacity after repair. A comparable established capacity-development and procurement audit is the baseline. Evaluators record actual technical capability, substitute services, rights constraints, costs, and time to restoration; an asserted lack of alternatives is recorded as unknown when substitute providers or legal permissions have not been investigated adequately.

The proposed GR increment can be subjected to a controlled interruption scenario: remove a specified indispensable provider or authorization, preserve legal protections, and determine which partners can still reproduce an agreed essential function. Compare the result with an ordinary dependency audit and collective-capability assessment (Ibrahim, 2006). Only a corroborated difference in the practical continuation, or a defensibly improved institutional choice attributable to its representation, supports the additional framework. Aggregate productivity alone cannot settle that comparison.

### 30 Cultivating Warranted Trust in Interpersonal and Community Relationships

Interpersonal and community relationships provide a smaller-scale yet equally demanding arena for generative-relational (GR) praxis. Two people can complete a shared task successfully while understanding their obligations differently, possessing unequal freedom to refuse, or relying upon different institutional supports. Conversely, a relationship in which trust has diminished may remain civil, cooperative for particular purposes, and structured by legitimate limits. A GR investigation therefore attends to the conditions under which persons and groups interpret conduct, maintain boundaries, exchange value, and sustain practical agency. Its purpose is to support warranted judgments and accountable interaction, while preserving the right to decline engagement or withhold trust.

The foundational issues are already familiar to trust scholarship. Mayer, Davis, and Schoorman distinguish trust, trustworthiness, and willingness to become vulnerable, with ability, benevolence, and integrity among the relevant antecedents of trustworthiness (Mayer et al., 1995). Hardin's account of encapsulated interest investigates how a particular trustee's incentives and relationships make trust intelligible (Hardin, 2002). Research on trust violation and repair differentiates competence and integrity problems and examines how responses to accusations influence judgments (Kim et al., 2004). O'Neill's account of intelligent accountability and informed consent highlights the importance of judging whom and what to trust, including the legitimacy of refusal, rather than pursuing trust as a universal aggregate good (O'Neill, 2004). GR must meet these traditions as a comparator. Its proposed contribution concerns the relation between warranted reliance in a specific domain and the changing generative conditions that make that reliance practicable and revocable. Recasting conventional good practice in GR terms, by itself, would add little.

#### Situate trust in a domain, relation, and practical decision

Suppose individual  $a$  considers relying on  $b$  to maintain a shared research instrument, protect a confidential account, or represent a community concern. The pertinent question concerns a specified domain  $d$  and undertaking  $q$ , including which evidence can reasonably support reliance and what forms of vulnerability follow from it. The directed expression  $T_{a \rightarrow b}^{(d)}$  developed in Section 10 is a conceptual representation of situated trust; it is neither an independently observable psychological quantity nor a universal social score. In practice,  $a$  may trust  $b$ 's technical ability while remaining uncertain of

*b*'s discretion, and may accept a bounded collaboration while reserving disagreement about values or institutional politics.

GR recognition begins with partial knowledge. Each person encounters another through limited accounts of lived history, communicative practices, current resources, opportunities, and constraints. These are neither transparent windows into another's inner experience nor grounds for speculative diagnosis. A responsible discussion invites persons to describe the commitments and limitations they consider relevant. It preserves the possibility of different interpretations, protects confidential material, and asks permission before translating personal accounts into shared records. A declaration of identity or vulnerability should not be treated as authorizing an outsider's construction of the person's entire generative system.

At community scale the problem becomes more complex. Relations among neighbours, volunteers, local organizations, public-service intermediaries, and community leaders may be mediated by property rights, social status, employment, language, administrative rules, and access to public assistance. A shared tradition or membership label does not establish that members possess uniform norms, experiences, or preferences. Nor does a person's attendance at a meeting demonstrate unconstrained endorsement. An actor can be simultaneously trustworthy in one interaction and institutionally empowered to impose costs in another. Mapping these relations is a means of identifying possible constraints and remedial paths, with interpretive authority shared appropriately among the people affected.

### Separate legitimate trust from dependence and managed reassurance

A person's reported confidence can change because the trustee performed well, because the evidence became clearer, because available alternatives disappeared, or because expressing skepticism became socially costly. These pathways have different normative and practical significance. Let  $R_{a,b}^{(d)}$  denote observable reliance and  $\mathcal{C}_a$  denote the protected practical options available to *a*. Then a change in reliance does not determine the direction of warranted trust or agency:

$$R_{a,b}^{(d)}(X_1) > R_{a,b}^{(d)}(X_0) \not\Rightarrow [T_{a \rightarrow b}^{(d)} \text{ is better warranted}] \text{ or } [\mathcal{C}_a(X_1) \text{ is expanded}]. \quad (109)$$

The ordering of  $X_0$  and  $X_1$  designates comparison points in an observational series rather than privileged ontological past and future. The expression is a non-entailment statement and a request for additional evidence, not an empirical law. For example, a resident may use a neighbourhood service more often because a competing service has closed, even while unresolved complaints make the service's reliability uncertain. Another resident may report reduced trust after learning accurate information about previously concealed errors, thereby demonstrating better-informed judgment rather than deteriorating civic character.

This distinction imposes limits on interpersonal interventions. Techniques intended to increase liking, emotional openness, or confidence can be inappropriate when one party controls employment, housing, benefits, immigration status, or access to justice. A group exercise can produce apparent consensus while its participants perceive substantial costs for dissent. Under those conditions, the immediate tasks concern rights, material protections, accessible alternatives, and freedom from retaliation. Structured contact may be deferred or omitted. Where personal relationships involve abuse, intimidation, or coercive control, a general trust-building protocol is unsuitable as a substitute for qualified safeguarding, legal advice, or survivor-centred support.

The aim of a warranted-trust practice can thus include improved capacity to make a cautious judgment, a more accurate understanding of another's scope of competence, acceptance of a limited service, or confident refusal. It should avoid imposing reconciliation as a measure of success. Trust, forgiveness, restitution, and continued collaboration are different phenomena, and persons may reasonably choose distinct combinations. An unresolved normative disagreement need not prevent respectful action in a narrower domain; similarly, politeness does not demonstrate reliable commitment or just institutional conduct.

## Translate relational recognition into reciprocal, bounded practice

A practical sequence starts by establishing the voluntariness and scope of contact. Participants identify what specific collaboration they are considering, why it matters, which institutional constraints apply, what can be shared safely, and who has authority to commit resources. They then exchange interpretations of the task, distinguishing observations from inference and personal preferences from binding rules. A short written or oral commitment can specify an action, an agreed quality threshold, a feasible time or event condition, a way to recognize completion, and a procedure for revising the commitment when circumstances change. Small commitments can reduce exposure, although they should not be treated as tests of personal worthiness or instruments for covert behavioural assessment.

The distinct GR question concerns the effect of the commitment on available continuations. Does carrying out a task help each participant act with greater clarity or competence? Does it create a dependence on the other person's time, equipment, endorsement, or confidentiality? Can either person correct a mistaken account, decline a subsequent task, or appeal to a suitable organizational channel if the relation crosses an institutional boundary? These questions invite practical discussion while avoiding the demand that participants disclose sensitive histories or accept a shared normative vocabulary. A common task may sustain cooperation despite interpretive differences, provided those differences remain visible where consequential.

A voluntary community-science activity offers a modest illustration. Several residents agree to record observations of a local waterway for a public-interest project. An ordinary exercise might establish a shared objective, distribute recording forms, and encourage friendly discussion. A GR-informed variant would additionally identify each participant's experience and practical constraints, specify who interprets the observations, offer accessible correction of metadata, clarify rules for privacy and site protection, and permit withdrawal without stigmatization. Community members could also obtain explanations of how their observations affect the project's decisions. The added components are familiar elements of good participatory practice. Their hypothesized GR-specific utility arises from connecting the observations and commitments to changing effective agency and end-to-end institutional response, a claim requiring comparative evidence.

Consider two variants of this project whose participation counts and submitted observations are identical. In the first, participants cannot see how records are interpreted, and corrections depend upon an inaccessible administrator. In the second, participants may review attributed records, challenge errors through a protected process, and choose whether their observations remain in a particular dataset, subject to consent, law, and scientific integrity requirements. The variants may differ in remedial reachability and practical control even while their quantitative outputs coincide. Yet an overly burdensome review process may reduce scientific quality or exclude participants who lack time. A responsible intervention must test those possibility costs, not simply add procedural complexity in the name of empowerment.

## Respond to mistakes while respecting separate decisions about trust

Mistakes create multiple and distinct obligations. The factual event requires a reliable account; affected interests may require an explanation or protection; recoverable losses may call for proportionate restitution or compensation; and recurring failures may require changes in practice or governance. The trustee's acknowledgement should accurately identify what is known, what remains uncertain, and what can be changed within the trustee's authority. The affected party may prefer independent review, limited future contact, a narrower shared task, or withdrawal. Visible remorse, extensive disclosure, and repeated requests for forgiveness cannot replace effective correction. Organizational structures can impede even sincere individual attempts to repair harm when a worker lacks the authority, time, or resources to implement an agreed remedy.

For a candidate remedial action  $m$ , define  $\text{Resp}(m)$  as its justified and executable response path,

and  $C_a(m)$  as the protected continuations accessible to an affected participant. A minimal review asks whether  $m$  can be carried out, whether it addresses an identified harm, whether the person retains lawful alternatives, and whether it exposes anyone to further risk. This review supports a plural set of legitimate outcomes rather than a target trust level. Continued distrust after a formally adequate remedy may express additional unresolved concerns, limited observation, or a reasoned preference for distance. These possibilities can be documented without pathologizing the person or treating trust as an owed response.

In communities, correction can also be distorted by unequal reputational power. A prominent organization may control the newsletter, meeting agenda, and public record, while an affected participant has only a private complaint. The inability to obtain acknowledgment does not always indicate an absence of facts; the allegation itself must still be assessed fairly. Safeguards can include confidential reporting, independent facilitation where appropriate, notice of conflicts of interest, proportionate reasons for decisions, and protection against retaliation. Privacy concerns may appropriately limit publicity. The critical test is whether a competent route exists from a supported claim to a usable response, consistent with the evidential and institutional analyses in Sections 16 and 18.

**Separate the observer's variables from a person's private judgments.** A research variable  $T_{a \rightarrow b}^{(d)}$  is a task-specific representation of a reported expectation or carefully justified behavioral inference, rather than transparent access to another person's inner experience. An appraisal of the warrant for reliance requires independent evidence about conduct, available alternatives, consent, and safety. The practical protocol should therefore favor voluntary descriptions, minimal sensitive data collection, and the freedom to decline further interaction. A supported improvement may consist in more accurate recognition of risk and a well-founded decision to distrust. A reported increase in interpersonal trust is neither a necessary nor sufficient success criterion for GR praxis.

### **Evaluate warranted judgment, autonomy, and adverse effects**

The methodology should test whether structured GR analysis offers any improvement beyond an ethical, well-facilitated conventional trust-building or community-cooperation exercise. A feasible preliminary study might involve voluntary, low-stakes community collaboration groups with independent consent and safeguards. Both comparison conditions receive a shared-goal exercise, appropriate facilitation, clear behavioural standards, and accessible complaint channels. The GR condition additionally uses a short relational-dependency map, an explicit account of participant-controlled continuations, and a recorded route for correcting consequential interpretations. Outcome assessment should be conducted, where feasible, by evaluators independent of intervention delivery and with consideration for cluster effects and differences in participant circumstances.

The study's primary endpoints should be selected before implementation: accuracy of mutual task understanding; completion of agreed actions; participants' perceived freedom to decline or modify commitments; independently documented correction of mistakes; and observed reachability of an effective complaint or review path. Secondary measures may include domain-specific trust judgments, voluntary continued engagement, perceived fairness, inclusion, actual participation costs, and recognized reasons for disengagement. A reduction in expressed trust following more accurate disclosure should not automatically be classified as programme failure. Interviews can investigate whether increased confidence was warranted by subsequent performance or whether participants felt constrained to report harmony. Indicators of coercion, privacy loss, stigmatization, emotional burden, and unwanted contact should be separately monitored.

Alternative explanations require equal attention. The intervention may appear effective simply because it supplies more time, stronger facilitators, better resourcing, or clearer written commitments. Relational maps may increase cognitive load, reinforce the authority of articulate members, or promote speculative categorization of others. A valid evaluation therefore compares the *distinctive* mapping of

generative dependencies and response pathways, holding conventional best practice constant as far as feasible. The programme should be revised or abandoned if those distinctive elements fail to improve decisions or introduce avoidable harm.

The central GR proposition in this domain is accordingly narrow and demanding. Reliable interpersonal and community cooperation may be better understood when evaluators distinguish observable reliance, warranted domain-specific trust, unequal practical alternatives, and the transformation of participants' capacities to act and contest. This distinction may support a practice of reciprocal recognition without requiring homogeneity, intimacy, or reconciliation. Whether GR supplies additional diagnostic precision or beneficial practical consequences beyond established trust and community-participation methods is a matter for ethical, context-sensitive study rather than declaration.

*Formal-to-practical audit.* Proposition 1 applies only to genuinely voluntary, bounded commitments, while Proposition 3 separates actual costs and effective restoration from the existence of a complaint route. Proposition 4 asks whether a participant can still lawfully correct their own contribution or leave the arrangement after apparent reconciliation. Conventional consent and community-facilitation safeguards are the benchmark. Verification should ordinarily use nonintrusive records and voluntary feedback; a person's reluctance to recount a grievance cannot be converted into an inference of trust or successful repair.

A GR-based interpersonal inquiry has particularly strict boundaries. It must avoid inferring another person's hidden normative system, assigning a numerical trust score without consent, or converting relational understanding into a demand for disclosure. Its narrow distinctive question is whether a specific, freely chosen commitment preserves the capacity to revise, refuse, or exit within safe and ethically appropriate limits. Where ordinary interpersonal trust and consent practices already secure these conditions, the GR vocabulary offers clarification rather than a new intervention.

## 31 Building Organizational Trust through Demonstrated Reliability and Relational Repair

An organization makes commitments through people, rules, assets, data systems, and relationships with other institutions. Its assurances can therefore be sincere and practically impossible to fulfil, technically accurate and inaccessible to affected people, or procedurally valid and unable to produce a remedy. These distinctions matter whenever employees, volunteers, collaborating organizations, service users, and communities rely on an organization for consequential activities. The present section applies the generative-relational (GR) framework to the formation of organizational trustworthiness. It asks how an organization can make reliability demonstrable and institutional failures correctable while maintaining the capacities of people who depend upon it. Trust is treated as a possible warranted response to conduct and evidence, with lawful refusal, criticism, and distance remaining legitimate outcomes.

Foundational organizational-trust research already distinguishes willingness to accept vulnerability from the perceived ability, benevolence, and integrity of a trustee (Mayer et al., 1995). Subsequent work addresses time, levels of analysis, reciprocity, control systems, and the measurement of trust (Schoorman et al., 2007). Organizational justice research distinguishes distributive, procedural, interpersonal, and informational dimensions, with empirically investigated relationships to organizational outcomes (Colquitt, 2001; Colquitt et al., 2001). Accordingly, GR cannot claim novelty for the general importance of fairness, competent administration, consultation, or restitution. The prospective contribution is more circumscribed: a typed representation of how reliable performance, the capacities required to produce it, evidential pathways, and executable organizational remedies are connected across roles and interfaces. The resulting diagnoses should be compared with competent organizational-justice, quality-management, and grievance-handling practice.

## Locate organizational trust within its differentiated relationships

Trust in an organization is rarely a single relation. A volunteer may trust a coordinator to communicate a schedule while doubting that the organization can protect personal information. An employee may regard a supervisor as technically competent while questioning the independence of the institution's complaint mechanism. A partner organization may reliably receive research results while lacking authority to challenge a shared methodology. A service user may accept emergency assistance while seeking independent review of an adverse administrative determination. Each relationship specifies a trustor, an organizational function, a relevant domain, a standard of warranted conduct, and a vulnerability arising from reliance. These relations may be mediated through different legal duties, professional obligations, physical infrastructures, and resource constraints.

For a domain  $d$  and organizational role  $r$ , let  $q_{r,d}$  denote an undertaking,  $K_{r,d}$  the relevant performance capability, and  $E_{r,d}$  the evidence that an authorized observer can inspect. A preliminary diagnostic is the typed tuple

$$A_{r,d} = (q_{r,d}, K_{r,d}, E_{r,d}, J_{r,d}, M_{r,d}, C_{r,d}), \quad (110)$$

where  $J_{r,d}$  describes an accountable determination mechanism,  $M_{r,d}$  an executable response or remedy, and  $C_{r,d}$  the domain-relevant protected continuations of affected participants. The tuple is an organizational mapping instrument, rather than a psychological scale or a sufficient legal test. It asks a practical sequence: who can carry out a commitment, what would count as reliable evidence of execution, who may review an alleged failure, who can authorize correction, what resources are needed, and which meaningful alternatives remain available to the affected person. A high-quality performance report could establish the first component while leaving the others unresolved.

Organizational boundaries should be treated as analytical choices with consequences. Some capabilities lie with contractors, affiliated hospitals, externally hosted cloud services, professional regulators, or international partners. A declaration that a decision falls outside an organization's direct responsibility may be legally justified, but it does not by itself complete the inquiry into who can respond to an affected person's claim. Conversely, the organization cannot promise to exercise another institution's lawful authority. A GR map should identify actual mandates and uncertainties, recording where referral, contractual coordination, independent adjudication, or negotiated remedies could form a legitimate response path. The mapping is especially valuable where an apparently self-contained public-facing service depends upon several organizations whose responsibilities do not align neatly.

## Assess whether commitments are supported by reproducible capacities

A written organizational promise depends on personnel, training, time, permissions, material supplies, records, technical systems, and financial continuity. Management may reasonably report that a service was delivered on time, while workers lack the staffing and authority needed to correct a recurrent cause of failure. An institution can satisfy an output target by shifting uncompensated burdens onto volunteers or downstream partners. In such cases, present performance and the reproduction of future organizational capacity may develop differently. The GR concern is the relation between observed outputs and the changing configurations that make those outputs possible.

For a hypothetical policy  $\pi$ , let  $Y_d(\pi)$  denote observed service performance and let  $\mathcal{C}_i^d(X; \pi)$  denote the legitimate feasible continuations of affected participant  $i$ , under specified resources and protections. Consider two organizations reporting the same rate of on-time service completion:

$$Y_d(\pi_1) = Y_d(\pi_2), \quad \mathcal{C}_i^d(X; \pi_1) \neq \mathcal{C}_i^d(X; \pi_2). \quad (111)$$

In a constructed example,  $\pi_1$  relies upon one indispensable coordinator, while  $\pi_2$  funds documented handover, role separation, a protected feedback channel, and a lawful continuity procedure. Their equal reported outputs during the observation period do not settle whether they are equally dependable

under staff departure, an access dispute, or a contested decision. The difference must be demonstrated with specific disruption tests, not inferred from the mere presence of redundancy. Additional procedural complexity can itself create delays or new exclusion, so an expansive continuation set cannot automatically be taken as a superior or fairer organizational design.

This perspective motivates a *commitment-to-capacity register*. For each important promise, the register records its legal or organizational basis, the responsible role, required resources, critical third-party dependencies, evidential standard, escalation route, and continuity condition. Workers and affected participants should have safe ways to correct the register's representations. An assurance remains provisional where staffing or authority is uncertain. This instrument can be integrated into existing risk, audit, and quality systems, avoiding duplicative documentation. Its possible contribution lies in making coupled bottlenecks explicit, especially where a commitment is fulfilled locally while its institutional conditions become more fragile.

### Distinguish reputational response from accountable repair

Organizations have legitimate reasons to communicate during a service failure. Accurate notices, apologies where appropriate, and timely practical instructions can reduce further harm. Yet the effect of communication on perceived trust can diverge from the actual correction of a failed service or an unjust decision. A reassuring public statement may reach many people while an affected person receives neither the records required to challenge the decision nor an authorized remedy. Conversely, competent remedial action may initially produce lower survey ratings because previously concealed failures become visible. Trustworthiness must therefore be investigated through accountable performance and accessible evidence, with perceptions interpreted in context.

A credible response path can be represented as a composition of typed actions:

$$\begin{array}{l} \text{claim} \xrightarrow{e} \text{admissible evidence} \xrightarrow{j} \text{authorized determination} \\ \xrightarrow{m} \text{executable remedy} \xrightarrow{v} \text{review of consequences.} \end{array} \quad (112)$$

The path exists effectively only when each transition is accessible under applicable protections and at least one competent authority is able to perform its assigned step. For example, a customer-service unit may accept a complaint while lacking access to the record; a compliance office may investigate while being unable to direct operational correction; an independent reviewer may issue a recommendation without implementation resources. Individual units can appear responsive even though the combined arrangement leaves the claim unanswered. The proposed *organizational response-path test* asks evaluators to trace a supported claim through these interfaces and observe the actual correction, its timeliness, and its burdens. As earlier Sections 18 and 19 established, the availability of a formal appeal is distinct from an executable route to remedy.

A response mechanism should protect independent review and fairness to every party. Appropriate process can include a confidential intake, careful differentiation of allegation and finding, conflict-of-interest controls, proportionate opportunities to respond, non-retaliation measures, and the preservation of legally required records. Remedies should fit the harm and authority: correction of an erroneous record, restored access, service redesign, compensation where justified, institutional reform, or a lawful external referral. Safeguards for employees and whistleblowers must address asymmetric exposure and possible coercion. Some confidential matters cannot be publicly explained in detail; accountability then relies upon authorized oversight and appropriate disclosure rather than universal visibility.

### A constructed organizational scenario

Consider a hypothetical non-profit coordinating volunteers and professional services for a regional public-interest programme. A staff shortage causes several appointments to be incorrectly recorded.

Programme leadership promptly apologizes and publishes a reassuring notice, while the scheduling service and its audit records are maintained by an external contractor. Volunteers are able to resubmit availability, but affected service users cannot establish whether their appointments were reassigned or cancelled. The organization records a rapid public response and a high percentage of newly issued confirmations; neither measure alone establishes that disputed cases were corrected or that future errors are less likely.

Three arrangements are analytically possible. Under the first, complaints are received by an internal communications unit, forwarded informally, and closed when a confirmation message is sent. Under the second, a designated case owner may retrieve protected transaction history through a lawful contractor interface, request correction from an authorized scheduling operator, record the actual outcome, and provide review or referral when the matter remains contested. Under the third, the organization also improves staffing and data-quality controls, but the resulting administrative burden reduces service availability. A sound assessment must compare the costs, error rates, privacy exposure, outcomes for affected people, and practical feasibility of these alternatives. Neither a more complex protocol nor the publication of additional records guarantees justice. The specific GR diagnostic asks whether a complete response path can be constructed and whether its operation reproduces the capabilities needed to answer future claims.

The scenario also exposes a difference between internal organizational trust and external public trust. Employees may be hesitant to disclose scheduling failures because management measures their performance through complaint counts. Volunteers may feel obliged to express satisfaction to maintain access to assignments. Service users may report confidence because no alternative provider exists. These observations require interpretation against actual evidence and available options. Incentives tied to suppressing complaints can generate apparently favourable indicators while degrading epistemic access. Evaluation must protect the participants against retaliation, obtain informed consent for research where required, and distinguish operational administration from research involving human subjects.

**Institutional rather than reputational evidence.** A trustworthiness assessment should identify a verifiable commitment, the competent persons or systems on which it depends, and an authorized response if its conditions fail. Satisfaction surveys and reputation metrics may be relevant observations, but they do not substitute for completion logs, safety outcomes, or tested remedy routes. The additional GR test uses a specified disturbance to compare continuation and correction options within the same institutional boundary. Any alleged advantage must be checked against ordinary governance, service-recovery, safety, and administrative assessments, with implementation burden and retaliation risks included in the evaluation.

### A bounded practitioner protocol for organizational trustworthiness

The procedure begins by identifying a concrete organizational function and the people entitled to rely upon it, contribute to it, or question it. The institution then maps the commitments, the capabilities necessary to fulfil them, the evidence for actual performance, and the routes by which affected persons can obtain an authorized response. An independent, proportionate disruption exercise can probe selected dependencies: staff turnover, conflicting records, unavailable contractors, an interpreter requirement, a data-access restriction, or disagreement between professional and managerial authority. Each exercise should have pre-agreed safeguards and should avoid live disruption of essential services. The organization then records observed response paths, decision rights, and realistic correction costs. Findings are considered through procedures that allow relevant stakeholders to contest the record and propose feasible improvements.

Evaluation should separate observed service reliability; correctness and accessibility of evidence; actual complaint disposition; safety and fairness of participation; workforce and volunteer capacity; ability to continue authorized operations during disruptions; and the accessibility of independent reme-

dies. Time-to-correction, repeated failures, unresolved cases, unwanted disclosure, administrative burden, and worker exhaustion should be recorded explicitly. Measures of confidence and reputation may be collected for interpretive purposes, but a rise in such measures must not override evidence of coercion or unresolved harm. Where trust declines because valid information becomes more accessible, the evaluative question is whether people's judgments become better warranted.

A comparative pilot could give matched organizational units competent established grievance and quality-improvement assistance, with the intervention group additionally receiving a GR dependency-and-response-path analysis. Predefined tasks would test whether the additional mapping reveals consequential bottlenecks that routine procedures missed. Evaluators should identify false positives, cases where the mapping diverted resources from direct service improvement, and any harms to confidentiality or staff relationships. The explanatory claim is supported only if observed differences can reasonably be attributed to the distinctive analysis instead of facilitation intensity, resourcing, baseline competence, or selective case choice. The appropriate research outcome may be a limited scope of usefulness or a decision to discontinue the additional procedure.

The section's conclusion is deliberately conditional. Organizational trustworthiness becomes more intelligible when promises, performances, generative dependencies, evidence, and executable remedies are represented as connected but distinct elements. GR offers a possible language for identifying failures at their interfaces. Its practical worth depends on showing that this representation improves warranted decisions or remedies beyond the contributions of established organizational justice, risk management, and quality assurance, while respecting the people whose work and lives the organization affects.

*Formal-to-practical audit.* The commitment-to-capacity register operationalizes Proposition 6 by testing actual service continuity under staff or provider loss; the response-path review tests Proposition 8 from admissible complaint to implemented correction; Proposition 5 requires a lawful, resourced amendment rather than an unenforceable suggestion. These tests are compared with a competent quality-management and grievance review. A case closed by communications staff counts as an executed remedy only when the authorized corrective step has actually occurred, subject to confidentiality and fairness constraints.

For independent evaluation, a case exercise can compare a conventional service-quality and grievance audit with a version that also models the organization's changeable resource and authority conditions. The distinguishing task is whether a documented complaint could be remedied following a plausible staff, licensing, or provider disruption. Correctly identifying a formally valid but operationally unreachable repair, while avoiding false allegations and excess procedural cost, would support a bounded diagnostic advantage. The existence of a complaint office alone supplies no such evidence.

## 32 Strengthening Public Trust through Accountable Institutional Relationships

Public institutions exercise functions through which people obtain services, make claims, contest decisions, and participate in collectively consequential choices. In these relations, trust carries an important normative asymmetry: an institution may have a responsibility to act competently and fairly even when the public has sound reasons to distrust it. Citizens and affected residents can exercise rights, seek evidence, decline optional engagement, criticize institutions, or contest the exercise of power without owing institutional confidence. The purpose of generative-relational (GR) praxis in this domain is therefore to improve *institutional trustworthiness and the conditions for warranted public judgment*. Reported trust is a potentially informative outcome, interpreted alongside institutional performance, evidence, rights, agency, and effective remedies. It is neither a compulsory civic duty nor a sufficient measure of legitimacy.

Research on political trust, procedural justice, and public governance already establishes much of this starting point (Levi and Stoker, 2000; Tyler, 2006; OECD, 2024b). The OECD's third survey of drivers of trust, published in June 2026 and based on its 2025 fieldwork, reports cross-national information on reliability, responsiveness, integrity, openness, fairness, and political voice across 33 OECD and five accession-candidate countries (OECD, 2026). Its results are descriptive and associational, and differences among countries and institution types are consequential. For example, the report records that about 42% of respondents across the OECD considered it likely that public services would improve after a complaint; this is a perception measure, not a count of successfully resolved complaints (OECD, 2026). The existing literature thus supplies substantial comparators for any GR claim. The prospective extension concerns how public trustworthiness depends on the *composition* of institutional response paths and on the continuing capacities of people to obtain evidence, participate, contest, and pursue justified alternatives.

### Distinguish institutional performance, warranted trust, and public agency

The object of public trust must be specified before evaluating it. Trust in a local administrative office's ability to process a benefit application is distinguishable from trust in the integrity of central government policy formation, the competence of a public hospital, or the independence of a regulatory tribunal. Public actors occupy different legal positions; a government ministry, public research institute, municipal body, contracted service provider, court, and civil-society intermediary cannot be treated as interchangeable sources of authority. Equally, a favourable view of one service does not license an inference about confidence in all state institutions. The relevant domain, jurisdiction, population, time period, and possible harms should be made explicit.

A GR analysis treats public action as an institutional configuration rather than as a singular decision-maker. Budget allocations, professional knowledge, records, technical systems, statutory mandates, and relationships with affected communities jointly constrain feasible institutional conduct. Its epistemic representations are partial: official datasets may omit unreported harms, language barriers, marginalized experiences, and cases withdrawn because the procedure became inaccessible. Its normative interfaces may also diverge: an administrative office may seek procedural regularity, a health professional may prioritize clinical safety, a resident may seek an accessible explanation, and a supervisory institution may require protection of confidential evidence. Identifying these differences helps specify responsibilities without presuming that every standpoint is equally authoritative for every legal or empirical question.

For a population or affected group  $g$ , decision domain  $d$ , and institutional arrangement  $\pi$ , define a provisional *public accountability reachability* condition:

$$AR_{g,d}(X, \pi) = 1 \iff \exists \rho \in \text{Paths}_{g,d}(X, \pi) : \text{Lawful}(\rho) \wedge \text{Accessible}_g(\rho) \wedge \text{Executable}(\rho). \quad (113)$$

Here  $\rho$  denotes a typed pathway connecting an admissible claim to appropriate evidence, competent review, an authorized decision, and a feasible institutional response. The formula does not require that every claim prevail, that every decision be publicly disclosed, or that every disagreement produce policy change. It asks whether a justified claim has an accessible procedural route to a reviewable disposition, including reasoned rejection and lawful appeal where relevant. Claims can be constrained by time limits, jurisdiction, standing, privacy, due process, safety, and resource availability. A finding of  $AR = 1$  for one class of claims does not establish reachability for every person or dispute. Empirical evaluation needs specified test cases and defensible standards of accessibility, timeliness, and remedy.

### Public service relationships and the conditions of responsive administration

An administrative institution can deliver high average service satisfaction while particular groups cannot correct consequential mistakes. For example, digital submission may shorten most applications

while making access harder for people with limited connectivity, disability accommodations, or complex documentation. A complaint portal may accept requests but lack access to the data needed for correction. An automated eligibility process may produce consistent classifications while withholding understandable reasons or leaving the human reviewer without authority to reverse an error. Average output quality, distribution of error, evidential access, and the feasibility of redress therefore demand separate examination. GR can offer a connected representation of these differences, while ordinary administrative justice and inclusive-service-design frameworks already address many of them.

A practical public-service assessment should trace a complete application or disputed case: the initial interaction, information requirements, data provenance, decision rule, notice, ability to request explanation, authority to review, and availability of correction. Under lawful confidentiality constraints, the exercise may employ anonymized records or synthetic test cases rather than exposing private information. Public service users and front-line workers can identify gaps missed by organizational charts, particularly when a formally available channel cannot be reached because of translation, cost, disability, fear of retaliation, or inaccessible technology. Participation must be appropriately consented to and structured so that service entitlement never depends on joining a trust-building exercise.

Institutional responsiveness should be evaluated through observed corrections and independently interpretable case outcomes, including reasoned rejections, rather than complaint counts alone. Fewer complaints may reflect fewer mistakes, limited knowledge of available procedures, reduced public access, or deterrence. More complaints may indicate newly accessible reporting channels or worsening service. The direction of the count is ambiguous without case-level context. Careful reporting can include complaint accessibility by relevant population, time from filing to admissibility decision, proportion receiving reasoned disposition, actual implementation of justified remedies, repeat-error rates, adverse disclosure, staff workload, and observed participation costs. Aggregate indicators should be disaggregated only when it is lawful, ethical, statistically meaningful, and protective of privacy.

### Political voice, contested evidence, and the legitimacy of disagreement

Public trust extends beyond service transactions to disputed collective decisions. A municipality considering a coastal adaptation project may gather technical evidence from engineers, fiscal assessments from administrators, experience from residents, and observations from environmental scientists. Different participants may disagree about which risks are tolerable, which ecosystems deserve protection, and whose livelihoods should bear an intervention's costs. Such disagreement can be reasonable even after extensive disclosure. GR analysis asks how the process structures access to relevant information, the ability to submit counterevidence, representation of affected interests, and the institutional capacity to revise a policy when justified. It also asks whether one group bears disproportionate costs of participation or is formally consulted after consequential alternatives have already been foreclosed.

Consultation should have a declared purpose and honest boundaries. A public body may be legally empowered to seek evidence, solicit preferences, negotiate certain design features, or make a binding decision. Distinguishing these powers protects participants from false expectations. The institution should identify which decisions remain open, who is authorized to decide, what evidence carries what epistemic status, and how the public will learn what happened to submitted claims. Diverse normative positions can be recorded without assuming that all are mutually translatable or that majority preference overrides protected rights. Where expertise or confidentiality constrains participation, proportionate reasons and independent scrutiny may be especially important.

The GR-specific analytical challenge concerns *jointly inaccessible institutional pathways*. A resident's complaint may be admissible before an ombuds office, while the scientific evidence is controlled by an independent agency and the remedy requires an appropriation from a third body. Each institution may comply with its mandate, yet the composed pathway from the resident's supported claim to an executable response may fail. Conversely, a decision-making network can operate effectively without a single centralized authority if its roles and interfaces are legitimately coordinated. The central ques-

tion is whether institutional competencies compose for a specified problem under applicable law. This proposition should be investigated using actual administrative processes, competing explanations, and careful evidence of outcomes; it is not established simply by drawing a relational diagram.

### A hypothetical public environmental-health information service

Consider a hypothetical regional service publishing information about environmental conditions potentially relevant to community health. Environmental monitors produce observations, a public scientific institution validates measurements, a local authority issues protective notices, and a separately contracted platform hosts the public interface. Suppose the service provides timely notices and receives favourable user surveys. A resident then identifies a possible location error that could affect whether their neighbourhood receives an alert. The platform can acknowledge the report but cannot revise the scientific classification. The scientific unit can correct the source record but cannot compel prompt alteration of a published notice. The local authority can issue a new notice but lacks direct access to the technical change log. Each unit may satisfy its individual service standard while the combined error remains consequential.

A GR-guided assessment would construct a typed map of the observation, validation, notification, review, and correction channels. It would identify the legitimate authority to change each element, available technical evidence, affected populations, and the resources necessary for coordinated correction. The assessment might reveal a missing legal agreement between the scientific institution and the notice-issuing authority, inadequate metadata, or an inaccessible procedure for submitting location-specific evidence. Alternative designs could include a shared incident identifier, a protected joint-review channel, specified correction deadlines appropriate to risk, and an auditable record that distinguishes original observation, revised interpretation, and public notification. Any additional mechanism must preserve scientific independence, data protections, proportional disclosure, and emergency communication speed. Excessive multi-stage review could worsen risk and reduce capacity for timely public action.

The example is hypothetical and establishes neither an actual failure of any agency nor that a GR intervention would outperform competent incident-management practice. Its value is analytical: it exposes a case in which favourable satisfaction scores and successful local procedures can coexist with an incomplete route for correcting a shared institutional output. A comparative inquiry would determine whether the GR mapping discovers consequential deficiencies earlier, supports an effective authorized remedy, or merely restates what a well-conducted cross-agency safety review would already find.

**Public trust as a separate evaluative target.** The model should distinguish at least three public-facing observations: service performance, the practical availability of accountability or appeal, and people's expressed trust or distrust. These observations may move in different directions as access to information improves. Consequently, the proposed GR public-institutional comparison should assess independently documented response-path completion and relevant rights protection, then examine changes in expressed trust only as an additional, population-specific outcome. Improved disclosure can justifiably lower confidence; that possibility prevents a publicity or attitude-management intervention from counting automatically as successful institutional repair.

### A public-institutional trustworthiness protocol

A practicable GR-informed assessment could proceed through six linked inquiries. First, specify the public purpose, institutional mandate, applicable rights, and affected populations, including people unable or unwilling to participate in consultation. Second, map the relevant generative dependencies:

records, finances, personnel, legal powers, technical infrastructure, expertise, intermediaries, and foreseeable disruptions. Third, distinguish objective performance evidence from institutional reports and public perceptions, recording whose accounts may be missing. Fourth, test selected claim-to-decision-to-remedy pathways using ethically approved and legally authorized cases. Fifth, consider alternative arrangements that could preserve service quality while improving accessibility, contestability, correction, or legitimate institutional revision. Sixth, report observed improvements, unresolved limitations, distributional effects, and the cost of sustaining these mechanisms. These inquiries may be incorporated into existing public-sector assurance and complaints processes rather than established as a parallel bureaucracy.

Public-facing communication should state what is known, its uncertainty and provenance where appropriate, what institutions can actually do, and how affected people can seek clarification or correction. It should refrain from implying that institutional approval is the criterion of success. For research evaluation, outcome domains should include service accuracy and timeliness, error correction, fairness of access, protected civic agency, independence of oversight, unresolved claims, privacy and security harms, administrative burden, and the strength of alternative explanations. Reported trust can be analysed as a secondary, domain-specific measure. A fall in reported trust following the disclosure of substantiated errors may accompany a genuine increase in institutional honesty and public capacity to make warranted judgments. Public criticism or lawful non-participation can accordingly be compatible with the practical goals of the intervention.

The strongest available evaluation would compare an established, properly resourced accountability programme against the same programme augmented by explicit GR dependency and response-path mapping. Comparative designs should avoid withholding essential access, legal remedies, emergency information, or legally mandated safeguards from any group. Where random allocation would be inappropriate, process tracing across comparable agencies or periods can investigate the mechanisms with clear attention to selection, policy changes, staffing, resources, and information-system upgrades. A pilot should assess whether the GR method uncovers cross-institutional bottlenecks, predicts which cases become procedurally stranded, or leads to more effective authorized corrections. Negative findings and new harms require publication alongside claimed gains. The method should be abandoned or narrowed if its marginal benefits are small relative to costs, risks, and existing professional practice.

The argument therefore specifies a prospective research contribution rather than claiming a universal formula for increasing trust. A public institution can become more trustworthy by improving the competence, accessibility, accountability, and continuity of its relationships with affected people; whether people consequently trust it remains a distinct empirical and normative matter. GR may contribute by explaining how these relationships jointly produce or constrain public agency and how fragmented institutional powers can frustrate credible correction. The appropriate standard is the demonstrated improvement of public-serving institutional conduct and warranted judgment, under rights and safeguards, rather than the manufacture of confidence.

*Formal-to-practical audit.* Proposition 2 asks whether an affected person can obtain or confidentially challenge relevant evidence through a legally competent channel. Proposition 8 asks whether the authorized referral chain results in a decision that the executing body can implement; Proposition 4 examines whether a corrected public service also restores the person's relevant lawful capability. The benchmark is competent administrative-law and public-service review, including accessibility and rights protections. Public confidence ratings are secondary descriptive information and cannot substitute for measured accountability or for a person's right to remain critical.

Public-institutional testing should be especially cautious about the outcome measure. A GR-informed review can ask whether a citizen's justified request remains executable after a cross-agency referral, including under disability accommodation, language access, confidentiality, and lawful review requirements. Its result should be judged by independently audited response completion and rights protection, alongside burdens and harms, rather than by an increase in survey approval. The 2026 OECD trust survey supplies valuable perception data but does not independently validate the

effectiveness of this proposed reachability analysis (OECD, 2026).

### 33 A Comparative Research Strategy for Transnational Institutions

The preceding sections have presented generative-relational (GR) concepts, conditional propositions, counterexamples, and situated praxis protocols. An empirical investigation faces a different demand: establish what actually occurred in particular institutions, assess which mechanisms helped produce those outcomes, and determine whether the additional GR representation yields information beyond competent established approaches. The four cases considered here—the Montreal Protocol, the Paris Agreement, the Agreement on Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ), and the Aarhus Convention—create a deliberately heterogeneous comparison across material assistance, reciprocal reporting, developing cooperative machinery, and enforceable procedural participation. Their diversity supports disciplined contrast among institutional mechanisms; it does not supply a controlled experiment or a representative sample of international organizations. The historical case chapters offer documentary assessments and specific lines of inquiry, while causal identification and evaluation of the GR instruments remain subsequent research tasks.

The methodological starting point is structured, focused comparison and within-case process tracing (George and Bennett, 2005; Beach and Pedersen, 2019). Rather than assigning numerical scores to whole treaties, the analysis asks comparable questions about identifiable episodes: a financial-assistance decision and supported conversion, a reporting-and-review cycle, an institutional capacity-building measure, or an affected person’s attempt to obtain information and review. In each instance the unit of observation is a *commitment–implementation–response episode* within a stated jurisdiction, time interval, and class of affected subjects. An episode can span institutions: treaty parties, implementing agencies, ministries, domestic regulators, technical experts, firms, and affected communities may jointly shape a reported outcome. The boundaries of the episode and excluded participants must be stated because a single state’s reported compliance and a firm’s capacity to maintain substitutes describe different phenomena. Where a proposed subject is an ecosystem or a future population, the analysis distinguishes scientifically modeled effects from the legally authorized procedures through which its interests are represented.

#### Case choice, analytical leverage, and limits of comparison

The Montreal Protocol and its Multilateral Fund provide an opportunity to examine whether and how financial assistance, technological substitution, national regulatory capacities, and internationally agreed controls interact. The Paris Agreement’s enhanced transparency and stocktake architecture offers a contrasting setting in which reporting, expert review, and collective reassessment are prominent, while nationally determined contributions and differentiated implementation contexts delimit what is being promised. The BBNJ Agreement affords a prospective inquiry into newly established arrangements for scientific cooperation, capacity-building, and benefit sharing, with sharply limited evidence of mature implementation because it entered into force in January 2026 (United Nations Treaty Collection, 2026). The Aarhus Convention brings a different dependent variable into view: an affected person’s legally structured access to environmental information, public participation, and review mechanisms. Taken together, these regimes vary in the relation between material capabilities, evidential access, and review authority. Their mandates and affected populations differ substantially, and those differences must remain visible in the analysis.

For the Montreal Protocol, the outcome may be a country’s reduction of controlled-substance consumption relative to a treaty baseline, alongside the institutional means used to implement substitution. For the Paris framework, an episode may concern the submission of a biennial transparency report and the operation of its technical review, rather than the adequacy of aggregate global mitigation.

In the BBNJ case, the appropriate present-day outcome may be the creation of an authorized operational mechanism or a preparatory decision, with implementation outcomes explicitly pending. Under Aarhus, an episode may follow a request for information or review and document whether the applicant obtained an executable response. Labeling every one of these outcomes “trust” would destroy the very distinction the paper seeks to preserve. Trust reports, where reliable observations exist, are supplementary measures indexed by subject, domain, and time; they cannot substitute for evidence of treaty performance, institution-building, or effective remedy.

### Six axes of structured comparison

Each episode is investigated along six axes. *First*, material interdependence: what physical production, technologies, money, labor, ecological functions, and data services must remain available for participants to perform? *Second*, relational histories: what documented promises, disputes, prior interventions, and demonstrated conduct structure the relevant expectations? *Third*, commitment type and observability: what action is owed, under what legal or political instrument, and by which procedure can its performance be measured or challenged? *Fourth*, asymmetrical power and capacity: who controls scarce expertise, intellectual property, procurement, infrastructure, reporting standards, or practical alternatives? *Fifth*, access to participation, accountability, and remedies: what lawful routes connect an objection to evidence, competent determination, and executable correction? *Sixth*, revision and adaptation: which bodies can change commitments, allocate additional assistance, or authorize an alternative implementation pathway, and can affected participants practically invoke those processes?

These axes extend conventional institutional analysis only where a more explicit representation of generative mechanisms changes an observable inference. For example, a transfer of replacement equipment can register as a completed project while the receiving country’s maintenance, training, regulatory, or procurement capacities remain dependent on an external provider. If established project-evaluation methods already identify and adequately analyze those issues, the GR reconstruction may offer organizational convenience while adding little explanatory power. Conversely, if two projects match on recorded phase-out outcomes yet differ substantially in their protected ability to maintain compliance following supplier withdrawal, the explicit comparison of *reachable continuations* is potentially informative. Neither result should be assumed prior to examining actual project and country records.

A minimal episode record is

$$e = (d, I, t, c, s, y, z, r, q), \quad (114)$$

where  $d$  denotes the operative regime and domain,  $I$  the documented participating and affected subjects,  $t$  a dated period,  $c$  the relevant commitment,  $s$  the material and institutional support,  $y$  the measured outcome with its reporting standard,  $z$  the available sources and their provenance,  $r$  the route for review and response, and  $q$  the set of relevant continuation or revision options. The record is a structured field guide rather than a claim that a cross-treaty scalar index can be justified. Every field may carry an uncertainty interval, contested interpretation, missing-value code, or confidentiality restriction. A comparison of two  $y$  values without their reporting definitions and baseline periods is invalid. The full GR analysis is then a typed enlargement of this descriptive record when the subjects’ internal generative and epistemic conditions matter for the question under study.

### An evidence ledger and a claim-level inferential ladder

For every cross-case assertion, the research register distinguishes five inferential statuses. A *legal-design observation* ( $L$ ) reports a provision or formally allocated competence; an *administrative observation* ( $A$ ) records an actual filing, review, approval, decision, or payment; a *capacity observation*

(*K*) documents a participant's reproducible ability to carry out a specified protected task; a *mechanistic inference* (*M*) connects a cause to an outcome through discriminating process evidence; and an *incremental-method finding* (*I*) establishes that GR adds a warranted diagnosis or decision benefit beyond a qualified non-GR comparator. The classifications identify kinds of claim rather than an automatic ascending evidentiary scale: a verified treaty provision cannot be converted into a verified causal effect by relabeling it *M* or *I*. A single sentence may require distinct supporting records for different statuses.

The case ledger records the exact document and date, the unit of observation, the numerator and denominator of any indicator, its reporting window, an alternative explanation, the additional observation needed to discriminate interpretations, and an explicit *not-established* field. Two safeguards follow. First, a notification received or a project approved is an *A* observation, whereas sustained technical autonomy is a separate *K* question. Second, an analyst's successful diagnosis under GR is insufficient for *I* if similarly qualified legal, capability, or workflow analysts would have reached the same conclusion. These requirements impose additional burdens of measurement on GR itself and make null findings publishable.

### A competitive baseline envelope for claims of conceptual originality

A comparison with one deliberately simplistic baseline could exaggerate the framework's increment. The relevant baseline envelope contains, as appropriate, relational-peace analysis (including pluriversal and non-anthropocentric practice), structural-power and collective-capability assessment, legal competence and conflict-of-norms analysis, and technical dependency or workflow tracing (Söderström et al., 2021; Brigg, 2025; Lakitsch, 2026; Barnett and Duvall, 2005; Ibrahim, 2006; Goguen and Burstall, 1992). A strong comparison should select one or several competent methods suitable to the same case, rather than requiring a single field to solve every task. Combined baseline methods are especially relevant where lawyers, local facilitators, and technical specialists already collaborate in ordinary institutional practice.

For each contested claim, reviewers first record a baseline explanation, the evidence supporting it, and the lawful action it already recommends. GR analysts receive equivalent factual access and comparable time, personnel, and legal support. Their additional analysis is separately logged and independently adjudicated. In a prospective study, assignment can vary the analytical protocol within ethically permissible episodes while retaining protections available to all participants; in a retrospective study, the manuscript should describe nonrandom selection and refrain from treating analyst comparison as a causal experiment. Incremental value may be diagnostic (detecting a verified hidden constraint), practical (changing a lawful course of action), procedural (making the reasoning usable and contestable), or absent. These outcomes are recorded individually because a shared scalar would obscure ethically relevant trade-offs.

### Causal-process expectations and rival accounts

The first proposed mechanism links capability support to performance: an international commitment creates a transition requirement, domestic actors identify concrete constraints, authorized finance or technical transfer relaxes some constraints, implementation agencies and recipients modify production or administrative routines, and the resulting practices support observable compliance. A process-tracing investigation would search for sequenced decisions, specified costs, procurement records, technical milestones, training and regulatory documents, monitoring results, and independent evidence of changed production. Treating a grant approval as proof of capacity formation would conflate a decision with a result. Equally, a later decline in controlled consumption cannot be attributed automatically to the grant: shifts in market demand, technological prices, domestic regulation, industrial restructuring, trade rules, and measurement practices are plausible alternative causes.

The second proposed mechanism concerns evidential and accountability reachability. Formal data requirements or an independent review body may improve the visibility of deviation, yet the institutional chain can break between observation and a competent, implementable response. Relevant evidence includes who had standing to raise an issue, which data were accessible, how uncertainty or confidentiality was handled, whether the reviewing body could request additional evidence, what decision authority it possessed, and which follow-up measures were implemented. The rival is an ordinary legal-institutional explanation in which specified mandates and sufficient administrative resources fully account for the outcome. A GR claim gains traction only if reconstructing dependencies, translations, and practical continuation sets reveals a material gap missed by that established account.

The third mechanism concerns revision and learning. Institutions may adjust control schedules, funding conditions, reporting arrangements, or participation procedures as scientific information and implementation capacities change. The causal claim must distinguish genuine adaptation from relabeling an existing policy or accommodating a dominant actor's preferences. Possible evidence comprises the record of a recognized problem, alternative proposals, who had authority to present them, objections and supporting evidence, the resulting decision, and subsequent changes in participant capacities. Existing experimentalist-governance, regime-complex, bargaining, and power theories are direct competitors (Sabel and Zeitlin, 2008; Raustiala and Victor, 2004; Barnett and Duvall, 2005). The added GR conjecture is that the *transformability of the actors' generative conditions* can predict consequential differences among arrangements that appear similarly effective under an agreed public metric.

### Operationalizing constructibility, credibility, and compositionality

To investigate the paper's three primary research problems, the unit record in Equation (114) is mapped to three distinct objects. For *constructibility*, record an identifiable joint arrangement  $\pi$  and evidence that it was within the participants' lawful, feasible and protected options, as defined in Section 24. The existence of a signed agreement is evidence of formal coordination; it cannot establish that every participant had a meaningful option to refuse or that the agreement was environmentally viable. For *generative credibility*, compare documented performance with independently described protected continuation sets. Here examples include trained personnel retained, locally exercisable procurement authority, access to technical manuals where lawful, functioning national regulatory offices, alternatives in case of equipment failure, and feasible remedies for loss of essential capacity. Such features must be interpreted in context; transfer of every technology or unrestricted public disclosure is neither necessary nor always legitimate.

For *normative compositionality*, represent the duties, permissions, and authorizations applicable at each institutional interface and investigate whether a proposed combined action has a valid path through all relevant jurisdictions. An observed dispute could concern inconsistent substantive rules, incompatible reporting definitions, uncertain responsibility, or simple failure of administrative communication. These possibilities require separate coding. A demonstration of genuine joint infeasibility must show that each relevant local arrangement is individually feasible under its own rules while their authorized conjunction is unavailable under explicitly stated assumptions; a difference in terminology alone is insufficient. The analysis should attend to domestic and international law, including the distinction between binding treaty obligations, subsequent institutional decisions, nonbinding guidance, and researcher-proposed normative criteria.

A *negative case* for the incremental value of GR would be an episode fully explained by a conventional institutional design, cost, and enforcement analysis, with no additional well-grounded distinction in observed capacities or feasible continuations. A stronger counterinstance would show that the GR worksheet systematically invents speculative dependencies, overstates power asymmetry, burdens participants, or recommends changes that reduce safety, rights, or implementation effectiveness. Such findings should be reported as substantive limits. A positive instance would require documentary support for an otherwise overlooked dependency or accountability gap, a plausible causal sequence, and

a practically consequential revision that competent existing methods did not independently supply. Novel notation cannot substitute for this comparison.

### Evidence architecture and transparent coding

6210 The source hierarchy begins with operative treaty provisions and their authoritative versions, followed by decisions and reports of parties and competent committees, independent evaluations, national implementation records, and peer-reviewed studies that assess particular episodes. Public-facing institutional websites are useful to locate official datasets and understand current structure; their aggregate impact claims should be traced to an underlying definition, date, denominator, and method. Scientific assessments of the ozone layer or marine ecology address physical outcomes; compliance claims require treaty-specific controlled-substance or administrative indicators. Statements made by governments, program administrators, nongovernmental critics, and affected groups should be attributed to their sources and compared where possible. A disputed claim may legitimately remain disputed after documentary review.

6220 An auditable extraction sheet would contain the source URL or archival identifier, publication and event dates, jurisdiction and episode boundary, quoted operative clause or numerical datum, analyst paraphrase, actor making the claim, observation type, confidence or contestation flag, source dependencies, and links to contrary material. Primary and secondary coders should separately assign whether the episode shows a *formal entitlement*, *available procedure*, *successful use*, or *effective material outcome*; disagreement is reconciled with a recorded explanation rather than concealed in an aggregate score. Rights-sensitive information and proprietary records require ethical clearance, protection of sources, and appropriately limited access. Absence from the public record is recorded as unobserved, never automatically as absent in reality.

6230 Process tracing distinguishes the probative value of evidence. A contemporaneous decision linking named technical constraints to a funded intervention is stronger evidence of the authorization step than a later celebratory summary. Invoices and training records can establish that an intervention occurred, yet alone demonstrate little about independent maintenance capabilities several years later. A national inventory or consumption report may support a compliance observation, subject to its measurement and verification limitations. To infer that a GR-identified dependency caused a failed continuation, additional evidence must exclude plausible interruptions in funding, political changes, market exits, or regulatory actions. The proposed research may combine carefully selected within-regime contrasts with cross-regime analytical comparison; small documentary samples will rarely justify global treatment-effect estimates.

### An adversarial comparison protocol with positive and negative controls

6240 A preliminary empirical test should compare *competent established analysis* with the *same analysis augmented by GR-specific dependency, continuation, and composition maps*. Both teams receive the same admissibly disclosed facts and access to equally qualified legal and domain expertise. The task set should include a positive control with a verified cross-institutional handoff failure, a positive control with a documented interruption of protected productive capacity, and negative controls where restricted disclosure or centralized authorization is lawful and safety-preserving. The positive controls establish whether a method can find a known, consequential problem; the negative controls reveal whether it overdiagnoses vulnerability or recommends inappropriate removal of safeguards.

6250 Before examining adjudication results, investigators should register the unit and time window, the available factual record, the comparator procedures, the criteria for a consequential diagnosis, and a feasible standard for independent adjudication. Each analyst submits a typed claim identifying an alleged mechanism, supporting evidence, proposed remedy, and explicit reasons that the remedy remains lawful and feasible. A blinded expert panel, with relevant disciplines and protected representation of

affected participants, evaluates whether the diagnosed issue was real, actionable, and omitted by the baseline. Disagreements and missing records are retained as observations. Analysts should report documented false positives, missed problems, time and training burdens, confidentiality risks, and proposed interventions that fail an independent safety or legal test.

The comparative endpoint is a vector rather than a single scalar: verified additional findings, verified false alarms, usable remedies, required resources, protection of rights, and participant burden. A finding attributable to GR requires a traceable explanatory chain from a distinctive GR operation to the result; accidental use of terminology, a longer interview, or unequal analyst effort cannot establish such an increment. Randomizing the order of methods across scenarios, rotating analyst teams, retaining baseline-only replication, and performing sensitivity checks under defensible actor boundaries would further limit investigator effects. The appropriate comparison may find that ordinary contractual, administrative, or technical workflow analysis provides the same useful answer more efficiently.

Causal assessment requires evidence capable of distinguishing an observed sequence from a supported mechanism. In process-tracing terminology, an observation may supply a weak clue, satisfy a necessary diagnostic condition, or provide stronger discriminating evidence against a rival account; a compelling chronology alone is insufficient. The tests should be defined for particular rival hypotheses and assessed with an explicit record of their evidential strength (Mahoney, 2012; Beach and Pedersen, 2019). For instance, a service interruption followed by institutional criticism is insufficient to establish a GR-specific power mechanism. Evidence concerning authority over the indispensable resource, a blocked lawful alternative, the actual consequence for the affected participant, and a comparison with other competent explanations would be required.

**A prespecified reproducibility bundle.** Each candidate increment requires a bounded case identifier, a documentary cut-off date, an actor-and-competence map, the selected task and protected continuation query, a versioned baseline protocol, and a GR-augmented protocol. Coders should register excluded information, disagreements, missing records, potential rights or security restrictions, and the grounds for any counterfactual assumption. Independent adjudicators should classify added diagnoses as corroborated, already captured by the baseline, unsupported, indeterminate, or adverse. Aggregate comparisons should include analyst time and intervention cost; detecting more candidate problems alone does not establish improved knowledge or governance.

### A comparative decision rule for GR added value

For a question  $Q$  about one episode, let  $B_Q$  be the set of distinctions and predictions yielded by the best justified established comparator, and let  $G_Q$  denote those produced by a GR-augmented analysis using the same admissible data. Proposed GR added value requires a grounded consequence in  $G_Q$  that changes the explanation or a protected practical decision while remaining absent from  $B_Q$ . Schematically,

$$\text{AddedValue}(Q) = 1 \implies \exists \delta \in G_Q : \text{Supported}(\delta) \wedge \text{Consequential}(\delta) \wedge \delta \notin B_Q. \quad (115)$$

This is a necessary criterion within the stipulated evaluation, not an identification theorem or a recommendation to privilege the more complex model. The research must also record the collection cost, analyst discretion, false positives, informational harms, and institutional burden required to obtain  $\delta$ . If competent institutional evaluation already captures the same distinction, or if the GR addition yields unverifiable claims, the appropriate conclusion is limited incremental value.

The comparative chapters that follow apply this design with different degrees of evidential maturity. For Montreal, the treaty, financing, and implementation infrastructure afford historical documentation, but country-level causal testing requires additional data. For Paris, reporting cycles can be inspected as they become available without inferring emissions effects from transparency rules. For BBNJ, institutional foundations can be assessed while mature outcomes remain prospective. For Aarhus, legal

entitlements can be followed through practical participation and review episodes where sufficiently detailed records exist. These cases therefore supply tests of representational adequacy and plausible causal mechanisms. Their function is to discipline the preceding formal claims and make future GR praxis assessable, with findings that can sustain, narrow, or overturn the theoretical proposals.

### 34 The Montreal Protocol and the Material Support of Compliance

The Montreal Protocol supplies a historically developed instance of cooperation in which differentiated legal obligations were connected to organized financial and technical assistance. Its relevance to the generative-relational (GR) inquiry derives from the interaction of international rules, industrial replacement technologies, national administrative capacities, scientific monitoring, and access to implementation resources. In a simplified institutional account, states accept controls on ozone-depleting substances and organize compliance through domestic regulation. The actual arrangement contains further relational conditions: some states and producers faced transition costs they could not readily finance, replacement technologies could be held by firms or foreign suppliers, and reliable accounting of production and consumption depended upon functioning data and regulatory systems. These historical features make the Protocol a useful case for examining the conditions under which a jointly specified obligation becomes materially executable. They also provide longstanding institutional and political-economic explanations against which any distinct GR claim must be assessed.

Adopted in 1987 and entering into force in 1989, the Montreal Protocol regulates the production and consumption of specified ozone-depleting substances through evolving schedules, reporting duties, and related trade measures (UNEP Ozone Secretariat, 1987; UNEP Ozone Secretariat, 2026e). Its original obligations have been amended and adjusted, while the Kigali Amendment adopted in 2016 introduced a phased reduction in hydrofluorocarbons (HFCs), powerful greenhouse gases that are not themselves ozone-depleting substances (UNEP Ozone Secretariat, 2026e). These distinctions matter: the scientific benefit of ozone recovery, compliance with a particular controlled substance's timetable, and later climate-related transition objectives are different outcomes. The Ozone Secretariat reports a global phase-out of approximately 99% of controlled ozone-depleting substances in the terms of its summarized aggregate measure (UNEP Ozone Secretariat, 2026a). That important aggregate finding neither identifies the contribution of each financing instrument nor demonstrates that every beneficiary acquired durable autonomous implementation capacity. It must be treated as a global outcome indicator and positioned alongside more specific evidence.

#### Differentiation and the making of feasible obligations

Article 5 creates differentiated arrangements for qualifying developing-country parties; Articles 10 and 10A explicitly link the implementation of control measures to financial cooperation and technology transfer. Article 10 establishes a financial mechanism that provides financial and technical cooperation, including technology transfer, and requires it to meet *agreed incremental costs* subject to the specified criteria. The mechanism includes the Multilateral Fund, whose functions extend to country-specific technical studies, information exchange, workshops, project assistance, and coordination of cooperation. Its disbursements require the concurrence of the beneficiary party. Article 10A calls for practicable steps to transfer suitable technologies under fair and favorable conditions (UNEP Ozone Secretariat, 2026c; UNEP Ozone Secretariat, 2026d). These rules recognize that a state's formal commitment and its feasible implementation pathway depend upon different actors and resources. They also establish a negotiated allocation of financial responsibilities rather than an unlimited entitlement to every cost or technology sought by a beneficiary.

The 1990 London changes placed the financial mechanism within the Protocol's institutional development, and subsequent decisions continued to address the adequacy and conditions of support. Decision VII/4 explicitly links additional control measures for Article 5 parties with the need for additional

funding and technology transfer (Meeting of the Parties to the Montreal Protocol, 1995b). Decision VII/26 records difficulties concerning conditions attached to approvals, technology-transfer fees, and parties' experiences of impediments, showing that the existence of formal finance and transfer duties did not settle every distributional dispute (Meeting of the Parties to the Montreal Protocol, 1995a). For GR purposes, these decisions provide evidence that the material conditions of implementing a norm became themselves objects of intergovernmental negotiation. A more modest traditional reading is equally possible: effective treaty bargaining internalized incremental costs and induced participation. The GR framework must explain something further than this familiar linkage between compensation, incentives, and compliance.

An analytically useful distinction is among *financial eligibility*, *approved implementation support*, and *realized domestic generative capacity*. A country may be eligible for an agreed incremental-cost grant; an Executive Committee may approve a project; implementing agencies and local actors may then purchase equipment, retire controlled technology, retrain personnel, update licensing arrangements, and administer new reporting routines. Each transition introduces additional conditions and opportunities for interruption. Funds or technical assistance can enable specific changes without implying that the recipient gains indefinite independent control over all future technology choices. The institutional arrangement also includes costs of continuity: maintenance, training turnover, licensing, spare parts, standards compliance, access to viable suppliers, and monitoring infrastructure can remain relevant after a supported conversion has been recorded as complete.

### Institutional interfaces and historical evidence

The Multilateral Fund operates under the authority of the parties and is overseen by an Executive Committee with balanced representation of Article 5 and other parties. UNEP, UNDP, UNIDO, and the World Bank have served as implementing agencies with distinct technical roles (UNEP Ozone Secretariat, 2026c; UNEP Ozone Secretariat, 2026b). The Fund's website reports, as of June 2026, 10,584 approved projects across 144 Article 5 countries, with approximately 86% completed, and roughly US\$4.5 billion in funding allocated under its reported accounting (Multilateral Fund for the Implementation of the Montreal Protocol, 2026b). Those figures are useful for identifying the breadth and administrative scale of the programme. The number of project approvals, funding allocation totals, and completion shares are distinct measures; their denominators and cumulative time windows must be preserved when interpreting results. None alone establishes a causal impact on atmospheric recovery, the marginal effect of assistance, or the distribution of capacities among beneficiaries.

One important institutional interface connects project support to compliance review. The Protocol's non-compliance procedure, adopted and refined by the parties, allows reporting of implementation concerns, responses from the party concerned, consideration by an Implementation Committee, and recommendations to the Meeting of the Parties (Meeting of the Parties to the Montreal Protocol, 1992). The procedure expressly provides for exchanging information with the Fund's Executive Committee on financial and technical cooperation. At the same time, the parties' Decision XIV/37 emphasizes the separation of roles: Fund approvals do not waive the recipient's compliance duties, the Implementation Committee's recommendations are distinct from the Fund's disbursement decisions, and neither committee exercises the other's decision authority (Meeting of the Parties to the Montreal Protocol, 2002). This division illustrates a central problem for the manuscript: institutional responsibilities can be properly differentiated while action on a shared problem still depends on effective inter-institutional communication. In this case, the text supplies a defined interface, making a claim of general institutional incoherence unwarranted. Whether the interface works in a particular contested episode remains a matter of documentation.

The funding mechanism also operates on a multi-year replenishment basis. In Decision XXXV/1, parties established a US\$965 million budget for 2024–2026, explicitly drawing part of that amount from anticipated balances and other sources associated with the preceding triennium and expected in-

terest (Meeting of the Parties to the Montreal Protocol, 2023). The headline figure should not be confused with US\$965 million in entirely new cash commitments or disbursements in that period. Such accounting distinctions are relevant because announcements of institutional support do not directly measure resources delivered to specific recipients at the point of implementation. A capacity analysis would require the timing of individual approvals, actual transfers, project activities, and verified continuity of domestic capabilities.

### What the documented programme totals identify

The Multilateral Fund's published June 2026 headline is a cumulative programme description: 10,584 projects approved across 144 Article 5 countries and an 86% completion share (Multilateral Fund for the Implementation of the Montreal Protocol, 2026b). It is an administrative observation of reported scope and status, subject to the Fund's definitions. The project count is neither a sample of independent national policy experiments nor the denominator for an estimate of continuing autonomy after project closure. Project size, dates, country eligibility, technological sector, implementation agency, and forms of continuing support may differ substantially. A defensible comparison therefore selects a specified substance, country-sector unit and reporting interval, extracts project-level approval and completion records, and separately establishes subsequent maintenance, procurement, regulation, and measurement capacity. Unobserved capacities are recorded as missing rather than assigned an adverse value.

Selection into assistance is a central causal obstacle: programmes may fund the most difficult transitions, the most administratively prepared recipients, or projects with particular co-financing options. Comparing completed and incomplete projects without accounting for those differences risks reversing the meaning of an observed association. The source record verifies that financial and technological support is institutionally organized; it cannot alone estimate its marginal effect on a recipient's protected continuation options. This remains a proposed within-regime research design, not a finding of a GR-specific causal mechanism.

### Tracing a candidate mechanism from commitment to capacity

The provisional GR mechanism can be represented as a temporally ordered sequence, whose components are individually open to investigation:

$$\begin{aligned} \text{ControlDuty} \rightsquigarrow \text{ConstraintDiagnosis} \rightsquigarrow \text{ApprovedSupport} \\ \rightsquigarrow \text{DomesticTransition} \rightsquigarrow \text{VerifiedPractice} \\ \rightsquigarrow \text{ContinuationCapacity.} \end{aligned} \quad (116)$$

The symbol  $\rightsquigarrow$  denotes a proposed mechanism for empirical tracing rather than a logical entailment. A successful transition need not progress through each listed organizational step, and economic substitution may occur without Fund assistance in particular sectors. The last term carries the GR-specific interest: after a measured reduction in a controlled substance, what lawful and material alternatives remain available to the country, its institutions, and affected producers to maintain or adapt the practice? Documenting that outcome would require following relevant technical, administrative, and financial dependencies beyond a single project's recorded completion.

A comparative documentary investigation could identify a pair of supported conversion episodes with similar observed phase-out milestones but different arrangements for technician training, access to spare parts, local regulatory competence, supplier alternatives, or independently verifiable data. The investigation would first establish whether such a pair actually exists in the Fund's project and evaluation records. It would then examine implementation reports, national ozone-unit documentation, customs and licensing processes, independent assessments, and subsequent regulatory or market disruptions. The hypothesis is that the same compliance observation  $Y$  can be consistent with different

protected continuation sets  $\mathcal{R}_i^{(d)}$ , as defined in Section 24. A confirmed instance would illustrate the manuscript's *performance-equivalence problem*; it would not, by itself, establish that the GR framework offers a superior causal explanation to existing capacity-building scholarship.

A historically grounded point of comparison is Zhao's study of China's negotiation and compliance under the Protocol. The study argues that access to the Fund mattered for participation and that a sector-based funding approach remedied limitations of narrower project-by-project assistance, in conjunction with domestic implementation measures (Zhao, 2002). This is directly relevant prior scholarship: it already theorizes how the design of financial support shapes the ability to comply, so claiming to discover that financial assistance generates capacity would be misleading. A distinct GR extension would ask whether different funding architectures produced different *accessible sets of future industrial, regulatory, or scientific transformations*, even where their reported compliance milestones were comparable. That proposition demands evidence beyond Zhao's reported findings and must be presented as a further hypothesis.

### Observability, data quality, and independent evaluation

The Multilateral Fund maintains country-programme and project information, and its independent evaluation function assesses relevance, efficiency, and effects across Article 5 implementation contexts. The Executive Committee approved a formal evaluation policy at its ninety-sixth meeting in May 2025 (Multilateral Fund for the Implementation of the Montreal Protocol, 2025; Multilateral Fund for the Implementation of the Montreal Protocol, 2026a). The existence of this apparatus means that independent scrutiny and capacity assessment are established elements of the regime; a GR analysis should seek to learn from them. In the proposed study, project completion is recorded separately from equipment functionality, verified substance reductions, retention of technical knowledge, functioning domestic monitoring, and adaptation to replacement chemicals or technologies. An evaluation may have observed some of these phenomena already. If so, they belong to established explanatory achievements and need no artificial reassignment to the GR framework.

Several documentary problems arise. Reported chemical consumption and production can be affected by baselines, stockpiles, trade flows, and national data capability. The treaty's legal definitions and reporting periods must be applied before interpreting a numerical change. Project files may describe a firm's conversion without documenting downstream service-sector maintenance or country-wide capacity; independent evaluation summaries may differ in what they disclose. A government may demonstrate genuine compliance while available public evidence cannot identify which intervention mattered most. For questions of trust, financial records and chemical inventories offer limited direct evidence about what particular officials, enterprises, or communities believed. The manuscript therefore treats trust as a possible contextual mechanism requiring dedicated evidence, rather than inferring it from the amount of cooperation or the aggregate ozone outcome.

The present public-source review allows a bounded finding: the Montreal regime establishes explicit institutional links among differentiated obligations, negotiated financial assistance, technology transfer, information exchange, reporting, and non-compliance procedures. It also demonstrates the historical evolution and scale of these instruments through legal decisions and programme reporting (UNEP Ozone Secretariat, 2026c; Meeting of the Parties to the Montreal Protocol, 1992; Multilateral Fund for the Implementation of the Montreal Protocol, 2026b). These are documentary facts about the structure and operation of the regime. A stronger claim—that Fund-supported capacities caused specific compliance achievements, or that GR variables outperform conventional assistance-and-regulation models—requires episode-level evidence and a credible account of the counterfactual. The available public summaries, standing alone, cannot settle those claims.

## The central GR comparison and a countervailing case

Let  $\pi_a$  and  $\pi_b$  denote two hypothetical, lawfully implemented assistance configurations, and  $Y_d(\pi)$  their specified measured phase-out outcomes. Suppose that  $Y_d(\pi_a) = Y_d(\pi_b)$  within a defined reporting period, whereas  $\pi_a$  includes durable local maintenance and administrative capabilities while  $\pi_b$  relies on a single external supplier whose withdrawal would prevent continued performance. Under these stipulated assumptions, the two arrangements are observationally equivalent on  $Y_d$  while their reachable protected continuations differ. The distinction follows analytically; whether Montreal-funded projects instantiate it is an empirical question. The researcher must avoid treating local technological independence as an absolute good, since specialized supply chains and pooled expertise can be efficient, mutually agreed, and safe. A legitimate alternative to full localization may be reliable reciprocal procurement, contractual continuity, or jointly governed access to technical services.

The converse case is equally important. Suppose a country has a diversified supplier base and strong domestic technical institutions prior to receiving international assistance. Its compliance may owe more to national regulation, changing market incentives, and technology costs than to the Fund intervention. A GR worksheet that enumerates many relations without discriminating among these causes adds little and may obscure a simpler explanation. Further, if extensive capacity-transfer demands divert resources from urgent phase-out activities without creating practical benefit, they may reduce rather than improve implementation effectiveness. Thus a GR-informed intervention would need to demonstrate a specific, evidence-supported bottleneck, a feasible protected response, and an advantage relative to established technical assessment or project-evaluation practice. The burden of proof is on the proposed augmentation.

## Practical lessons for credible transnational cooperation

The Montreal case suggests several questions for designing and assessing international cooperative arrangements, stated as research-guided prompts rather than universal prescriptions. When negotiators create binding implementation duties, can parties jointly specify which material conditions are required for performance and how they will be assessed? Do finance and technology-transfer mechanisms distinguish formally approved support from usable capabilities? Can local participants identify and contest a mistaken assessment of their needs? Does the compliance body receive pertinent information from technical and financial institutions while respecting their distinct legal mandates? Are replacements, maintenance arrangements, and reporting systems robust to foreseeable supplier, ecological, and regulatory changes? Can authorized revisions occur without eroding legitimate rights or shifting uncompensated burdens onto less powerful participants?

A small applied pilot would select a completed project with publicly available grant, technical, and evaluation records and reconstruct the chain in Equation (116). The baseline would be a competent existing evaluation using the Fund's own criteria and relevant national records. A second assessment would add explicit relational-dependency mapping, protected continuation options, and the composition of review authorities. Independent reviewers could then compare whether the augmentation identifies previously missed, verifiable failure modes or actionable corrections, and at what time and resource cost. The design should protect commercially sensitive information, participant confidentiality, and the legitimate authority of the national institutions involved. It would be inappropriate to treat a project's historical recipients as experimental subjects without their consent or necessary ethical approvals.

The case thereby offers a carefully qualified illustration of *materially enabled credible cooperation*. The Protocol's legal and funding architecture acknowledged that formal obligations operate through unequal technological and institutional capacities; historical practice developed instruments intended to address those constraints. Established institutionalism, bargaining theory, regulatory analysis, and assistance evaluation already explain substantial portions of this history. The proposed GR contribu-

tion remains narrower: assessing whether two apparently comparable cooperative achievements leave affected participants with different *feasible, lawful, and revisable generative possibilities*, and whether tracing those differences improves explanation or real institutional design. This is a testable research question, rather than a verdict about the success or moral status of an entire international regime.

## 35 The Paris Agreement and the Architecture of Reciprocal Transparency

The Paris Agreement provides an instructive contrast to the Montreal Protocol case. Its implementation regime links nationally determined action, periodic information disclosure, expert review, collective assessment, and differentiated support in a setting where legal obligations, national ambitions, scientific measurements, and material implementation capacities must remain analytically distinct. The central problem for a generative-relational (GR) investigation is how such an arrangement can make cooperative conduct increasingly legible while leaving open the distribution of capacities to produce the records, contest their interpretation, implement responses, and revise the cooperative undertaking. Unlike the Montreal case, in which a long-established financial mechanism can be examined over decades of projects, the enhanced transparency framework (ETF) became operational through its first biennial transparency reports (BTRs) during 2024–2025. Its evidence is emerging through a documented review cycle. The corresponding analysis must distinguish the legal design, observable implementation processes, and any claimed consequences for emissions or political trust.

### Nationally determined commitments and the purposes of transparency

Adopted in December 2015 and in force since November 2016, the Paris Agreement combines common temperature-related objectives with nationally determined contributions (NDCs). Each party prepares, communicates, and maintains successive NDCs and pursues domestic mitigation measures with the aim of achieving their objectives, while the legal structure differentiates duties associated with communication and conduct from a simple international guarantee that every announced emissions outcome will be attained (United Nations Framework Convention on Climate Change, 2015; United Nations Framework Convention on Climate Change, 2026c). This distinction is essential for interpreting the word *compliance*: the existence of a transparency report does not certify fulfillment of an NDC, and an NDC does not describe the entire legal position of its author. Adaptation, climate finance, technology development and transfer, and capacity-building also enter the institutional architecture. The specific political and scientific consequences of a party's actions require independent evidence.

Article 13 establishes an enhanced transparency framework for action and support, explicitly oriented toward mutual trust, confidence, and effective implementation, with built-in flexibility responsive to different national capacities. The provision differentiates transparency of action—including inventories and tracking progress toward NDCs—from transparency of support provided, mobilized, needed, and received, where applicable. Article 13 also requires attention to facilitation, national sovereignty, and avoidance of undue reporting burden (United Nations Framework Convention on Climate Change, 2015; United Nations Framework Convention on Climate Change, 2026f). The framework is thus simultaneously an informational arrangement and an institutional compromise about what kinds of information may reasonably be demanded from heterogeneous participants. Its flexibility provisions should be described by their legal terms rather than treated as either discretionary secrecy or an unconditional equivalence of reporting ability.

Article 14 provides for a global stocktake of collective progress, first undertaken in 2023 and then at five-year intervals. Article 15 establishes a separate facilitative mechanism for implementation and compliance, which is expert-based and operates in a transparent, non-adversarial, and non-punitive manner (United Nations Framework Convention on Climate Change, 2026c; United Nations Frame-

work Convention on Climate Change, n.d.). These distinct institutions should not be collapsed into a single enforcement chain. In particular, a technical expert review is neither a judicial determination nor a sanction, a global stocktake evaluates collective progress rather than imposing a uniform national allocation, and the compliance mechanism has its own mandate. The question is how these differentiated procedures generate usable interfaces for collective learning and accountable adjustment.

### The first reporting cycle and the evidence it makes accessible

The modalities, procedures, and guidelines adopted in decision 18/CMA.1 structure the BTRs and associated technical expert reviews. The first general BTR deadline was 31 December 2024; reports are due biennially, with a second general deadline of 31 December 2026. Least developed countries and small island developing states have the special discretion recognized under the relevant reporting rules. Reported information may include national greenhouse-gas inventories, progress toward NDCs, adaptation, financial and technological support, capacity-building, and identified gaps. The framework also uses common reporting tables, common tabular formats, and submissions through prescribed reporting tools (United Nations Framework Convention on Climate Change, 2026a; United Nations Framework Convention on Climate Change, 2026d). Consequently, comparing submissions demands attention to which categories were required of a party, which flexibilities applied, which methods were used, and which records were actually provided.

The ETF's operating history is already more substantial than a mere prospective promise. The UNFCCC secretariat reported in January 2026 that fifty technical expert reviews of BTRs had been completed during the 2024–2025 biennium, involving more than three hundred experts (United Nations Framework Convention on Climate Change, 2026b). The reported count is a dated measure of review activity, not the number of states that fulfilled their climate commitments, and it cannot establish the effect of the reviews on national emissions. The reporting framework also provides for a facilitative, multilateral consideration of progress following technical expert review. Expert teams examine consistency with the applicable guidelines and identify areas for improvement and capacity-building needs. They undertake this work within a facilitative, non-intrusive and non-punitive design, rather than as a tribunal replacing the parties' nationally constituted authorities (United Nations Framework Convention on Climate Change, 2026e; United Nations Framework Convention on Climate Change, 2026a).

The resulting institutional sequence may be represented by typed relationships:

$$\begin{aligned} \text{NationalMeasurement} &\xrightarrow{r} \text{BTR} \xrightarrow{v} \text{ExpertReview} \\ &\xrightarrow{q} \text{MultilateralConsideration} \xrightarrow{u} \text{DomesticResponse}. \end{aligned} \quad (117)$$

Here  $r$  denotes reporting according to applicable standards,  $v$  a competent review interface,  $q$  the informational and procedural relationship to multilateral consideration, and  $u$  a possible national or cooperative response. Each arrow abbreviates a contingent process; the treaty does not guarantee that every observation reaches every forum or produces the same policy change. The sequence contains no assumption that a reviewer can compel the last transition. Nor does disclosure automatically turn heterogeneous measurements into perfectly comparable scientific facts: inventory boundaries, uncertainty, baselines, methodological revisions, support classifications, and data-access rules can remain significant.

This separation allows three distinct empirical questions. First, are a party's action and support records sufficiently specified for an authorized reviewer to follow the claimed accounting procedure? Second, can the review process communicate methodological concerns and support needs in terms that the relevant national authority can use? Third, does documented review lead to a traceable correction, improved capacity, or reasonably explained decision to retain a particular practice? Progress in the first task does not establish completion of the third. An accountable assessment should preserve the

possibility that review identifies a valid shortcoming while the means to remedy it remain outside the reporting body's power.

### Reciprocity in evidence does not require symmetry in resources

The phrase *reciprocal transparency* denotes an institutional expectation of mutual legibility and review, subject to the treaty's differentiation. It should not imply that all parties possess equivalent monitoring instruments, statistical systems, expert staff, negotiating leverage, or influence over the international methodologies by which their reports are judged. A relatively well-resourced institution can generate inventory estimates, maintain databases, and respond quickly to a technical finding. Another may be required to coordinate remote data, fragmented domestic records, international consultants, and constrained funding. Both may fulfill applicable duties, while their costs of remaining intelligible to a cooperative institution are very different. In a GR reading, production of *credible evidence* itself has material and organizational prerequisites.

For party  $i$ , let  $E_i(X)$  denote the set of legally and technically accessible evidentiary operations (such as repeating an estimate, obtaining input data, submitting a methodological explanation, or requesting a review), and let  $\mathcal{R}_i^{(d)}(X; \Theta)$  denote protected continuation capacities as defined in Equation (88). Consider two regimes  $X$  and  $X'$  with identical public report status  $Y$  and identical review completion indicators:

$$Y(X) = Y(X'), \quad \text{TER}(X) = \text{TER}(X'), \quad (E_i(X), \mathcal{R}_i^{(d)}(X; \Theta)) \neq (E_i(X'), \mathcal{R}_i^{(d)}(X'; \Theta)). \quad (118)$$

The expression states a *possible* observational equivalence; it is not an empirical assertion concerning any particular pair of parties. One configuration might grant domestic institutions continued access to the assumptions, source data, trained personnel, and software necessary to reproduce estimates. A second might meet reporting and review requirements with externally prepared products while retaining narrower capacity for independent revision. Both arrangements may be lawful and useful. Their effects on institutional autonomy and continuity remain distinguishable only if the relevant variables are measured. The potential GR contribution concerns precisely this distinction between completed transparency procedures and the distribution of the means to reproduce transparency.

The difference should be evaluated carefully. Technical assistance can make high-quality reporting possible; dependence on external expertise may be accepted voluntarily, efficient in the short term, or justified by scarcity. The framework cannot infer institutional injury merely from a foreign supplier or consultant. It must establish a relevant causal and normative consequence, such as an avoidable inability to examine errors, discharge a duty, exercise an existing procedural right, or maintain a critical monitoring function following foreseeable disruption. Conversely, a highly autonomous reporting institution may produce poor scientific estimates or disregard external review. Generative capacity and methodological reliability therefore remain separate dimensions.

### The limits of the first-cycle review count

The UNFCCC's January 2026 account reports *50 completed technical expert reviews during the 2024–2025 biennium* (United Nations Framework Convention on Climate Change, 2026b). This is an administrative count of completed review processes, whose unit is a review and whose reporting period is explicitly bounded. It is not a measure of 50 independently improved national systems, the number of parties that attained their nationally determined contributions, or a direct effect of review on trust. The BTR submissions and accompanying technical reviews support separate documentary analysis of data-production issues, reviewer observations, national responses, and follow-up measures.

A causal test would need matched, dated observations of a specific reporting problem, its diagnosis, action by the competent national authorities, and subsequent reproducibility of the relevant inventory or

estimate. International assistance, domestic statistical reform, political incentives, changes in methodology, and expert outsourcing are plausible competitors. Flexibilities available to least developed countries and small island developing states must be incorporated into the lawful reporting baseline, so a lower frequency of submitted reports cannot mechanically be coded as institutional failure (United Nations Framework Convention on Climate Change, 2026a).

### The relationship between reporting, review, trust, and implementation

The treaty expressly connects transparency with confidence, but this objective does not establish that more disclosure increases interpersonal or intergovernmental trust in every context. Reported confidence may depend on expectations, political contestation, exposure to adverse facts, changes in measurement quality, and broader diplomatic relations. Greater verification may reveal discrepancies that prudent observers previously could not see. In that case, a decline in confidence could represent improved epistemic calibration rather than failure of the institution. The appropriate GR research object is the relationship among evidence access, justified assessment, and viable cooperative action, rather than the maximization of a survey response.

A candidate causal pathway is that improved measurement and review support more accurate diagnoses, which facilitate competent domestic correction and make future reports more reproducible. Alternative explanations include regulatory policy, financing, technology costs, economic conditions, electoral change, and broader climate diplomacy. The evidence required to discriminate among these explanations includes successive submissions, revision histories, technical review findings, response documents, financing records, and changes in domestic measurement capabilities. A descriptive BTR review alone cannot identify which factor changed emissions. Nor does convergence of national reporting vocabularies establish convergence of normative obligations: the NDC approach preserves important asymmetries and political choices. This case therefore tests the limits as well as the value of a common epistemic interface.

### A bounded praxis protocol for transparency-based cooperation

A GR-informed practitioner could use the ETF case to formulate a *transparency-to-capacity trace*. The starting record would identify a concrete reporting or verification problem, the relevant Article 13 obligation or flexibility, its source documentation, and the responsible national and international institutions. A second record would connect this problem to feasible evidentiary operations, including the lawful availability of inventory data, trained reviewers, and methodological expertise. A third would document the actual path from review finding to an authorized response, including support commitments, corrective measures, or a justified explanation of non-adoption. The final inquiry would ask whether the receiving institution has gained, lost, or maintained the ability to reproduce the function under a foreseeable change of personnel, provider, or technical standards.

This protocol should be compared with competent UNFCCC reporting-capacity assessments and existing climate-transparency evaluations. A claimed GR increment would require a concrete finding that such a baseline misses: for example, a verified inability to reproduce a reported estimate after the end of project-funded external assistance, despite formally satisfactory reporting and review. The proposed remedy might be sustained training, legally appropriate access to methods, interoperable documentation, or an agreed domestic capability plan. Any intervention must respect national competence, privacy, protected data, scientific integrity, differentiated obligations, and the intended facilitative character of technical review. Wider access to raw data could be inappropriate when confidentiality, security, or legitimate Indigenous or community knowledge protections apply.

The Paris case supports a conditional conclusion. Institutionalized transparency can create structured opportunities for reciprocal examination, identification of capacity gaps, and collective reassessment. Whether those opportunities yield warranted trust and durable action depends on relations among

evidence producers, reviewers, national authorities, support providers, and affected publics. The GR apparatus is useful only if specifying these relationships changes a consequential and adequately supported diagnosis beyond what the established transparency framework already explains. The next case concerns a younger treaty arrangement where many such institutional paths are still being constituted.

### 36 The BBNJ Agreement and the Formation of Marine Cooperative Institutions

The Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ Agreement) provides a case of cooperation during institutional formation. It brings together ecological interdependence, marine scientific observation, genetic-resource information, technological capacity, differentiated participation, and intersecting regulatory authorities. As a comparison with Paris, it shifts the question from the review of an operating transparency framework toward the making of the institutional and technical interfaces through which new obligations can become executable. A central GR inquiry is whether evolving marine cooperation creates accessible, accountable capacities among participating subjects, including those with comparatively limited scientific and technological infrastructures. A further inquiry concerns how ecological conditions and the interests of affected communities enter decisions that may be authorized far from the locations in which their effects are experienced.

The Agreement was adopted on 19 June 2023 and entered into force on 17 January 2026. Its first Conference of the Parties (COP) is scheduled for 11–22 January 2027 at United Nations Headquarters. The legally binding treaty provisions therefore coexist, as of the present analysis in October 2026, with ongoing work on the modalities and operational structures of newly constituted bodies (United Nations Treaty Collection, 2026; United Nations, 2026b; United Nations, 2023). The United Nations General Assembly created a Preparatory Commission in 2024 to develop recommendations for the first COP; its third session took place in March–April 2026 and considered institutional arrangements, the clearing-house mechanism, financial rules, and other operational questions (United Nations Division for Ocean Affairs and the Law of the Sea, 2026c). Entry into force is an important legal event, yet it should not be represented as proof that a fully staffed secretariat, mature review procedures, functioning financial distribution channels, or conservation outcomes already exist. Those require separate records and dates.

#### Four substantive domains linked by marine knowledge and authority

The BBNJ Agreement addresses four principal domains: marine genetic resources of areas beyond national jurisdiction and benefit sharing; area-based management tools, including marine protected areas; environmental impact assessments; and capacity-building together with the transfer of marine technology. These domains are related but differ in their actors, evidence, operative legal procedures, and material conditions (United Nations, 2023; Intergovernmental Oceanographic Commission of UNESCO, 2026). Marine genetic-resource activities raise questions of collection, records, access to samples or related digital sequence information, use, and applicable benefit-sharing arrangements. Area-based tools require ecological justification and interaction with other competent instruments and bodies. Environmental assessment requires reliable descriptions of potential impacts under the relevant thresholds and procedures. Capacity-building involves the resources and opportunities required for participants to undertake or evaluate these activities. A common treaty does not make their scientific or legal interfaces automatically interoperable.

Part V of the Agreement explicitly seeks to develop scientific and technological capacity, facilitate inclusive and effective participation, increase and share knowledge, and support developing states par-

ties in implementing the Agreement. Articles 40–46 concern the objectives, cooperation, modalities, monitoring, and review of capacity-building and transfer of marine technology. Article 51 establishes a clearing-house mechanism whose envisaged open-access platform will connect information on activities under the Agreement, requests for capacity-building, technology-transfer opportunities, and relevant external mechanisms. Article 52 addresses financial resources and mechanisms (United Nations, 2023; United Nations Division for Ocean Affairs and the Law of the Sea, 2026c). The wording of these provisions should guide any institutional diagnosis: a general objective of promoting technology transfer cannot be simplified into a duty to transfer any desired proprietary technology without regard to the Agreement’s conditions and applicable law. Similarly, a proposed cooperative data interface must respect legitimate scientific, commercial, privacy, community, and conservation safeguards.

The Agreement’s institutional design includes a COP, a Scientific and Technical Body, a secretariat, subsidiary and financial arrangements, and the clearing-house mechanism. It also contains provisions concerning interaction with relevant legal instruments, frameworks, and global, regional, subregional, and sectoral bodies. For activities beyond national jurisdiction, actors must take account of the different competences of institutions engaged in shipping, fisheries, scientific research, seabed activities, and environmental protection. The resulting structure is polycentric. Whether it becomes operationally coherent depends on procedures for recognizing submissions and evidence across these domains, allocating decisions to lawful authorities, and providing procedural avenues for addressing conflicts or omissions. The existence of several competent bodies does not by itself establish a governance defect; fragmentation becomes consequential when a demonstrable joint task lacks a valid interface.

### **An early institutional episode: provisional genetic-resource notification**

A small but revealing documentary episode was recorded in October 2026. The United Nations Division for Ocean Affairs and the Law of the Sea (DOALOS), temporarily performing secretariat-related functions, reported receipt of a pre-collection notification under Article 12(2) concerning marine genetic resources. Its notification dated 13 October 2026 explains that, until the Agreement’s clearing-house mechanism is operational, the relevant information should be submitted to the Division for dissemination through the Agreement website. It identifies an interim reference in place of the standardized identifier to be generated once the mechanism operates (United Nations Division for Ocean Affairs and the Law of the Sea, 2026b). The notice demonstrates a documented provisional route for one type of notification; it does not establish that all categories of information exchange or downstream traceability are operational. Nor does the notification, by itself, adjudicate the ecological consequences of the proposed collection.

This episode is analytically important because the treaty’s informational duties and its anticipated digital infrastructure occupy different institutional states. The current arrangement translates a treaty-defined notice into a provisional administrative record that can later require consistent integration with a standardized system. Whether interim records remain reliably retrievable, correctly linked to later identifiers, and accessible to those with legitimate oversight interests is a concrete, falsifiable question. An institutional handover can be successful if provenance and permissions remain intact. It can also introduce a gap if relevant parties lose the ability to connect an authorized notification with associated research activities or obligations. These possibilities should be investigated through actual records rather than inferred from the mere existence of a temporary mechanism.

The episode further illustrates a problem of temporally distributed authority without positing that an institution possesses a privileged present. Different documents, authorizations, identifiers, and scientific representations are produced along a relational trajectory. Their legal and evidential significance depends on whether later operations can recognize valid earlier commitments and records, while preserving applicable protections. The GR language can make this relationship explicit, but record migration and identifier persistence are familiar information-governance problems. Originality would require a supported demonstration that the GR analysis detects a consequence beyond ordinary data

stewardship and administrative-law review.

### A bounded early administrative series

The UN's notification register identifies two pre-collection notices during the initial period: one received from Ireland on 16 July 2026, assigned the temporary reference BBNJ-MGR-TEMP-2026-001, and another received from the United Kingdom on 13 October 2026, assigned BBNJ-MGR-TEMP-2026-002 (United Nations Division for Ocean Affairs and the Law of the Sea, 2026a; United Nations Division for Ocean Affairs and the Law of the Sea, 2026b). Both were publicized while the Division for Ocean Affairs and the Law of the Sea provided the interim communications channel pending an operational clearing-house mechanism. These dated records document receipt, routing, and provisional indexing of notices. They do not establish that collection activities proceeded, that benefits were equitably distributed, that all eligible participants could navigate the procedure, or that ecological results were achieved.

A later institutional evaluation should follow each temporary identifier through any eventual standardized batch identifier, document-preservation rules, public-access and confidentiality decisions, and the competent authority for correction of inaccurate information. The missing transition records are a clearly identified research need, rather than evidence that a handover failure has already occurred. As of 28 October 2026, the scheduled first COP in January 2027 remains prospective (United Nations, 2026b).

### A coupled model of ecological viability, capacity, and authorization

Consider a prospective marine scientific consortium involving research organizations, states parties, vessel operators, laboratories, repository services, and institutions responsible for ecological assessment. Let  $\pi$  be a proposed joint operation, possibly involving sampling, sensing, storage, and publication of scientific results. The institutional task is to identify operations that are feasible under the relevant physical conditions and within the applicable legal, safety, and normative constraints. Write

$$\mathfrak{F}_{\text{marine}}(X; \Theta) = \{\pi \in \Pi(X) : \pi \models \text{LawfulAuthority}, \pi \models \text{EcologicalSafeguards}, \pi \models \text{TraceableEvidence}, \pi \models \text{ProtectedParticipation}\}. \quad (119)$$

The predicates are domain-specific specifications, and their contents cannot be produced by a mathematical definition alone. They may refer to environmental assessment criteria, valid permits or notifications, scientific protocols, community or Indigenous knowledge protections where applicable, safety requirements, confidentiality, and relevant inter-institutional authorizations. The model does not imply that every participant is a treaty party or that a research robot possesses state-like legal capacity. Technical agents execute delegated operations under accountable human and institutional arrangements. Similarly, representation of ecological interests must identify its scientific and normative grounds rather than treat ecological measurements as self-executing political decisions.

Two hypothetical designs illustrate the difference between output and generative conditions. Under design  $X_A$ , the consortium supplies partner institutions with validated observations and regular technical reports, but retains critical processing methods, calibration information, replacement parts, or review permissions within one central provider. Under design  $X_B$ , comparable outputs are produced through documented interoperable standards, authorized access to methodological explanations, and shared maintenance training. Suppose the observed scientific products are equivalent under a specified accuracy criterion:

$$\text{Output}(X_A; \Theta) = \text{Output}(X_B; \Theta), \quad \mathcal{R}_i^{(\text{marine})}(X_A; \Theta) \neq \mathcal{R}_i^{(\text{marine})}(X_B; \Theta). \quad (120)$$

The second relation is a hypothesis requiring measurement of legally and physically realizable capacities. A comparison might examine whether a partner can independently validate the data, reproduce

a model after provider interruption, obtain a correction for an erroneous assessment, or participate in revising research and benefit-sharing procedures. As in the Paris case, centrally maintained services can be appropriate and even preferable where they are better funded, safer, ecologically less damaging, or scientifically more reliable. The assessment therefore concerns protected effective alternatives and jointly justified institutional purposes, rather than a universal preference for decentralized engineering.

### Normative interfaces and the limits of bilateral coordination

The treaty connects participants who may have partially compatible but heterogeneous normative understandings of scientific openness, technological autonomy, benefit sharing, conservation, and legitimate control over sensitive knowledge. A marine data record can be open to some research uses while subject to restrictions for legitimate reasons; those uses need not be governed by a single universal conception of value. A repository may permit reproducibility, a provider may require confidentiality, and a conservation body may impose restrictions on sensitive ecological locations. Each arrangement can be individually justified yet collectively prevent a planned research, review, or benefit-sharing operation. In the notation of Sections 24 and 25, the problem is joint satisfiability of competent obligations, as distinct from disagreement produced by incomplete translation.

For example, assume that a participating laboratory can distribute summarized genetic-resource metadata under one agreement; a second partner requests provenance sufficient for verification; and a third holds information that is lawfully restricted. A proposed unified platform must determine which claims can be verified through authorized transformations of the data, which details can remain protected, and whether an independent review pathway is required. This is a hypothetical institutional-design problem, not a finding that the BBNJ regime currently contains the specified conflict. Design options include tiered access, protected auditing, separation of public and restricted metadata, locally retained evidence, and formally recognized escalation procedures. Each option carries costs and scientific trade-offs. Agreements must also remain consistent with the BBNJ text, applicable legal instruments, and the rights of affected participants.

The formal problem can be expressed as an interface question:

$$\begin{aligned} \exists \pi, \tau : \quad & \pi \in \mathfrak{F}_{\text{marine}}(X; \Theta), \\ & \tau \in \text{AuthorizedTranslations}(X), \quad \text{ReviewPath}(\pi, \tau) = \text{Executable}. \end{aligned} \quad (121)$$

Here  $\tau$  is an authorized means of relating records and obligations across institutional languages, rather than an unrestricted renaming of legal commitments. The test concerns an end-to-end path from a contested scientific or regulatory claim to a competent response. Its failure may signify missing cooperation, legitimate legal barriers, deficient technical standards, or inadequate information in the research record. Those explanations must be discriminated rather than merged into a generic allegation of governance failure.

### Practical implications for marine cooperation and ecological protection

A GR-informed marine cooperation protocol would begin with a situated map of competent authorities and relevant protective obligations. It would next trace the physical and informational dependencies of the proposed observation or sampling operation: vessels and sensors, data-processing environments, calibration records, local scientific expertise, laboratories, ecological assessment channels, and authorized registries. The participants would then document provisional information-exchange arrangements, identify which evidence must be reproducible or independently audited, and test whether reasonable disruptions leave a legitimate route to maintain essential functions and remedy errors. The protocol would also specify how scientific findings inform institutional decisions while preserving opportunities for disagreement and lawful challenge.

Special care is necessary when framing benefit sharing and scientific inclusion. The fact that a repository is accessible does not prove that a less-resourced party can use its contents, interpret sequence data, access equipment, or participate meaningfully in the design of conservation measures. Conversely, capacity-building programmes cannot be evaluated solely by the number of workshops, accounts created, or transferred devices. Outcomes of interest include continuity of trained personnel, technical support, locally relevant research capacity, safe access to methods, durable participation in expert bodies, and independently verifiable ecological measures. The relevant normative question is how those capacities are distributed and justified under treaty obligations, rather than whether one engineering architecture maximizes all capabilities simultaneously.

The BBNJ case also connects marine observation to ecological limits. Better sensors can expand the ability to detect biological change while increasing data processing, vessel traffic, energy use, or operational disturbances. The design problem therefore includes the ecology of knowledge production: the means of measuring an ecosystem may themselves impose relevant impacts. The earlier papers on oceanic robotics and ecological autonomous production supply candidate technical questions, but they do not establish treaty compliance or ecological safety for any proposed deployment. Those require independent field evidence and appropriate environmental review. An adequate GR praxis must permit a proposed research operation to be modified, paused, or rejected where legal, ecological, or safety conditions warrant such action.

### What the early treaty record can establish

For the comparative protocol of Section 33, the BBNJ evidence presently supports several institutional findings: a treaty has entered into force; provisions establish differentiated substantive tasks and cooperative objectives; the preparatory process has discussed operational modalities; and at least one interim channel for genetic-resource notifications was used in October 2026 (United Nations Treaty Collection, 2026; United Nations Division for Ocean Affairs and the Law of the Sea, 2026c; United Nations Division for Ocean Affairs and the Law of the Sea, 2026b). This record establishes neither aggregate conservation effectiveness nor the impact of capacity-building interventions. Stronger claims require dated decisions of the COP and associated bodies, functioning clearing-house records, measured project outcomes, ecological monitoring, and documented distributions of access and authority. They may also require observation over a suitable period in order to distinguish institutional establishment from operational continuity.

Established international-law scholarship, marine-science governance, capacity-development methods, and ordinary information-systems analysis already offer substantial explanatory resources. A distinct GR result would require a documented failure of cooperative constructibility, generative capacity, normative composition, or accountability reachability that those methods do not adequately identify under the same evidence and reasonable analytic effort. The analytical promise of this case is therefore carefully bounded. It allows the manuscript to articulate institution-building questions at the intersection of ecology, science, and power while preserving scientific uncertainty and legal specificity. Taken together with Montreal and Paris, it also demonstrates why agreements, resources, reporting, and actual capacities must be studied as different but coupled elements of international cooperation.

## 37 The Aarhus Convention and the Procedural Infrastructure of Contestation

The Aarhus Convention furnishes a particularly demanding case for a generative-relational (GR) account of institutional trustworthiness. Its principal subject is the distribution of procedural opportunities through which members of the public can obtain environmental information, participate in consequential decisions, and seek review of acts or omissions affecting the environment. The convention

thereby supplies an unusually explicit institutional vocabulary for relationships among knowledge, participation, and contestation. Yet this specificity creates a test for the proposed GR contribution: rights to information and review, the distinction between nominal and effective access, and the need for meaningful remedies already form part of Aarhus law and implementation research. A new theory must explain something more discriminating than the familiar proposition that a legal right can be ineffective in practice. The candidate extension here concerns *compositional accountability*: whether the several institutions responsible for a claim, its evidence, review, and practical correction collectively provide an authorized and executable pathway, and how that pathway affects the claimant's continuing capacity to act.

### The legal architecture and the circumstances of its application

The Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters was adopted at Aarhus in June 1998. Its three connected pillars concern access to environmental information, participation in environmental decision-making, and access to justice (United Nations Economic Commission for Europe, n.d.; United Nations Economic Commission for Europe, 2026f; United Nations Economic Commission for Europe, 2026c). Article 1 relates their implementation to the protection of the right of present and future generations to live in an environment adequate to health and well-being. The convention is a treaty with defined parties, authorities, subject matters, and national implementation arrangements. It should therefore not be represented as establishing a globally uniform judicial entitlement, nor does the mere fact that a project carries ecological significance determine the competence of every tribunal or committee.

Access to information under Article 4 generally concerns requests addressed to competent public authorities, subject to treaty-defined grounds for refusal and procedural conditions. Access to information also entails active collection and dissemination duties under Article 5. Public participation under Article 6 addresses decisions on specified activities, including arrangements for timely notification, reasonable participation periods, and access to relevant information while options remain open. Articles 7 and 8 address participation in relevant plans, programmes, policies, and executive regulations through differently specified modalities (United Nations Economic Commission for Europe, 2026e). Affected persons' ability to submit observations is analytically distinct from a guarantee that their preferred substantive decision will prevail. The procedural obligation to take due account of participation is compatible with reasoned disagreement, provided the governing legal requirements are satisfied.

Article 9 differentiates review of information-request decisions, review concerning decisions subject to public-participation obligations, and procedures to challenge certain acts or omissions contrary to environmental law. Its scope depends in part on the particular paragraph, national standing rules, and the applicable legal setting. The provisions also address the adequacy and effectiveness of remedies, fairness, timeliness, expense, and access-related assistance (United Nations Economic Commission for Europe, 2026c; United Nations Economic Commission for Europe, 2026d). These features already amount to a practical conception of procedural reachability: the legal claim is that designated review possibilities should be available under specified conditions, and that access should be meaningful. A GR analysis adds value only when it identifies a further dependency, interface mismatch, or capacity consequence that established Aarhus interpretation and access-to-justice assessments would otherwise leave insufficiently described.

The convention further includes a separate compliance-review system. Under Article 15 and decision I/7, the Aarhus Convention Compliance Committee operates a non-confrontational, non-judicial, consultative mechanism. It can receive communications from members of the public concerning a party's compliance, among other triggering routes. Its findings and recommendations inform subsequent consideration by the Meeting of the Parties (United Nations Economic Commission for Europe, 2026a; United Nations Economic Commission for Europe, 2026b). This institutional path must be distinguished from domestic judicial or administrative review. A communication to the Committee is

not itself a domestic appeal, a mechanism that automatically grants compensation, or a general replacement for the competent national authority. Claims concerning the actual consequences of a Committee finding require examination of follow-up decisions and corresponding implementation evidence.

The institutional record is substantial enough to make the case more than a discussion of legal design. At its eighth session in 2025, the Meeting of the Parties adopted decisions addressing compliance by individual parties and approved a work programme for 2026–2029 (United Nations Economic Commission for Europe, 2025b). UNECE documentation has also reported practical access-to-justice barriers involving jurisdiction, standing, cost, delay, evidence, expertise, and remedies in environmental disputes (United Nations Economic Commission for Europe, 2025a). These sources document real implementation concerns, but do not by themselves determine the outcome of a particular complaint or establish that a GR representation offers better causal explanation than the specialized legal scholarship already devoted to those problems.

### What formal rights and public communications establish

The UNECE account of Article 9 identifies three different categories of access-to-justice procedure and stipulates the legally relevant roles of standing, independent review, costs, and applicable domestic rules (United Nations Economic Commission for Europe, 2026c). The Committee’s publicly listed communications document opportunities for international compliance scrutiny (United Nations Economic Commission for Europe, 2026b). They should not be coded as equivalent to successful domestic judicial remedies, and an admissible communication does not demonstrate that the complainant obtained the particular substantive outcome sought. Likewise, the mere availability of a domestic procedure cannot establish that it was practically accessible to a particular person within the relevant time and resource constraints.

An empirical episode must therefore name its legal claim, the relevant domestic jurisdiction, the admissibility route and deadlines, the actual disposition, and where legally necessary the implementation of ordered relief. Evidence of time or resource burdens may be drawn from appropriately protected case records, including adverse or unsuccessful claims, while lawful dismissals should not automatically count as accountability failures. The claim-specific institutional sequence provides an observable baseline against which any additional GR continuation or composition diagnosis must be evaluated.

### From formal entitlement to an executable response path

Consider a member of the public who questions a permit for a facility affecting a river system. A legally appropriate procedure may require the applicant to obtain environmental information from agency *I*, present objections to permitting authority *P*, seek review before an authorized body *J*, and rely on implementation authority *E* for any corrective order to take practical effect. The example is constructed for analytical comparison and is not an allegation concerning a particular party or permit. Each institution may discharge its own defined task and remain subject to its own procedural requirements. Yet the claimant’s objective—an authoritative resolution of a specific alleged defect—also depends on valid transitions among those institutions.

Let  $\text{Claim}_i$  denote a claim that participant *i* is legally entitled to advance, and let  $\text{CorrectiveAction}$  denote a legally authorized and practically executable response. A simplified institutional chain is

$$\begin{aligned} \text{Claim}_i &\xrightarrow{a} \text{AdmissibleRequest} \xrightarrow{b} \text{AccessibleEvidence} \\ &\xrightarrow{c} \text{CompetentReview} \xrightarrow{d} \text{Determination} \xrightarrow{e} \text{CorrectiveAction}. \end{aligned} \quad (122)$$

The arrows are typed, conditional interfaces. Their presence in a diagram asserts neither that each transition is legally required for every Aarhus claim nor that a remedy must be granted on the merits. An information request might legitimately be refused under a relevant exception, an applicant might lack

standing under applicable provisions, and a reviewing body may lawfully reject an unfounded claim. An adequate institutional assessment distinguishes these determinations from failures of accessibility, broken referrals, withheld reasons, unworkable review periods, or an inability to implement relief that has been validly ordered.

For a valid claim  $q$  in a specified institutional configuration  $X$ , define a domain-specific response-path predicate

$$\begin{aligned} \text{Reach}_i(q; X, \Theta) = 1 \iff \exists p \in \mathcal{P}_i(q; X, \Theta) : \\ \text{Authorized}(p) \wedge \text{Accessible}_i(p) \\ \wedge \text{Reviewable}(p) \wedge \text{Executable}(p). \end{aligned} \quad (123)$$

Here  $\Theta$  contains the relevant legal standard, subject matter, and practical constraints;  $\mathcal{P}_i$  denotes candidate paths from the claim to a competent institutional disposition, with implementation where legally called for. The predicate is *procedural* rather than a guarantee that the claimant receives the demanded substantive result. In particular, a reasoned, accessible, legally proper rejection can satisfy procedural reachability. The definition must be adapted to stages where the right concerns information or consultation rather than judicial relief. Its analytical value arises from specifying the dependencies and asking which transition actually prevents a competent disposition, instead of treating every unsuccessful claim as proof of injustice.

A second distinction concerns the continuation capacity represented by Equation (88). A complainant who obtains information may still lack affordable specialist assistance to understand it; an organization can participate in a hearing while having no durable means to preserve records or pursue authorized review; and a community may receive a favorable decision while lacking the resources to monitor its execution. These difficulties are well recognized in access-to-justice practice. The GR extension is to evaluate them as relations among a particular subject's legally protected continuations, institutional interfaces, and material or epistemic dependencies, rather than as isolated indicators of formal entitlement or administrative performance.

### A constructed test of observationally equivalent participation

Suppose two local environmental programmes report the same number of information requests answered, hearings held, and appeal decisions issued. Their public-facing procedural indicators are equivalent under a pre-specified metric  $Y$ . In configuration  $X_A$ , participants can retain and inspect relevant technical records under appropriate safeguards, obtain comprehensible reasons, and use a competent review channel where applicable. In configuration  $X_B$ , each nominal stage is present, but records are supplied in a form that cannot be independently examined within the legally relevant period, or an indispensable review authorization is unavailable across the responsible agencies. We may write

$$\begin{aligned} Y(X_A) = Y(X_B), \\ (\text{Reach}_i(q; X_A, \Theta), \mathcal{R}_i^{(d)}(X_A; \Theta)) \neq (\text{Reach}_i(q; X_B, \Theta), \mathcal{R}_i^{(d)}(X_B; \Theta)). \end{aligned} \quad (124)$$

This is a formal counterexample to the inference from identical procedural counts to identical effective contestability. It is *not* a finding that any party to the Aarhus Convention exhibits such a configuration. It also does not establish novelty relative to existing legal doctrine: competent procedural-justice evaluation could identify the same problem. A GR investigation must earn its increment through a specific, otherwise missed explanation—for example, by tracing how a technically functioning cross-agency data interface and a formally valid review mechanism fail to compose into one authorized evidence-to-remedy chain.

Practical measurement would examine the full episode rather than count participation events alone. The documentary record should identify the legal basis of the request, applicable exceptions, the precise information sought, dates and quality of responses, permissible review routes, financial and linguistic barriers, the review authority's actual competence, reasons supplied, and follow-through on

any binding determination. Where confidentiality, personal data, culturally sensitive knowledge, or environmental protection require limited disclosure, an independent protected-audit route may sometimes meet legitimate verification needs more appropriately than unrestricted public release. Equating transparency with maximum disclosure would conceal these trade-offs and could expose vulnerable individuals or locations to harm.

### **Domestic adjudication and international compliance review as different institutional layers**

An Aarhus complaint can move through domestic legal procedures, while a separate concern may be raised through the Convention's international compliance mechanism. Their objects, admissibility criteria, authority, and possible consequences differ. A domestic body may have the legal power to order a specified correction in a particular case. The Compliance Committee examines a party's compliance with convention requirements and may issue findings and recommendations within the treaty framework. The Meeting of the Parties may adopt corresponding decisions. Evidence that a problem reaches the international mechanism does not itself demonstrate that domestic relief is accessible, nor should the international mechanism be portrayed as a substitute court (United Nations Economic Commission for Europe, 2026a; United Nations Economic Commission for Europe, 2026b).

A GR account can model these relationships as partly connected institutional layers. In a hypothetical situation, an international finding clarifies a treaty-compliance issue while the domestic authority's enabling legislation, funding, or administrative arrangements require separate change. The empirical question is whether the recommendation can travel through legally appropriate authorities to a practical response, and how affected people can examine that response without exceeding the international committee's mandate. This may reveal bottlenecks in delegated responsibility or administrative implementation, but the first explanatory baseline must remain the convention's own compliance practice and constitutional or administrative law. A broken path is sometimes a question of unfulfilled obligations; in other instances the path is intentionally limited by the separation of institutions and powers. The analytical model cannot decide between those possibilities independently of law.

### **GR praxis for contestation, institutional learning, and justified public trust**

A situated protocol for this case can be stated without inventing new rights. It begins by identifying the claim, affected subjects, the applicable convention provisions and domestic legal norms, and the authorities whose competence actually reaches the subject matter. It then reconstructs an evidence-to-decision path, including the provenance of information, lawful access to documents, standing and review requirements, deadlines, costs, risks, and the legal consequences of a determination. A third stage maps dependencies: which persons or organizations can reproduce essential evidence, obtain advice, preserve records, or pursue relief if an intermediary or a source of finance disappears? A fourth stage specifies lawful correction or reasons for non-correction, with an appropriately independent way of assessing implementation. Finally, any proposed institutional reform is assessed for accessibility, protective effects, financial burden, and unintended restrictions on other rights and interests.

For peacemaking and diplomacy, the Aarhus experience illustrates that participation can be an institutional resource even where consensus on environmental values is absent. Parties may continue to dispute the merits of a project while recognizing legitimate processes to obtain evidence, offer objections, and obtain reasoned determinations. Such processes may reduce avoidable uncertainty and help avert escalation, but their presence does not guarantee reconciliation, higher measured trust, or substantive ecological success. For public organizations, the lesson is similarly bounded: legitimacy is strengthened, when it is strengthened, through reliable and accountable procedures responsive to justified claims rather than through reputation management. Where a person's reasonable confidence declines after newly accessible evidence discloses serious deficiencies, that decline may indicate im-

proved public knowledge rather than a failure of the access regime.

The Aarhus case consequently places a demanding burden on the GR approach. The treaty and its compliance machinery already embody sophisticated provisions connecting evidence, participation, and remedies. A defensible added contribution would be a documented *cross-boundary dependency or compositional mismatch*, together with an intervention that is shown to address it more effectively than ordinary access-to-justice analysis, while respecting legal safeguards and the right to maintain disagreement. Without that comparative result, GR functions as an alternative descriptive representation, rather than a demonstrated new theory of procedural environmental governance.

### 38 Comparative Findings, Countervailing Cases, and Institutional Design Implications

The four documentary case studies create an opportunity to compare distinct institutional means of making cooperation viable: material assistance under the Montreal Protocol, structured reporting and review under the Paris Agreement, emerging implementation arrangements under the BBNJ Agreement, and rights-based information, participation, and contestation under the Aarhus Convention. They do not support a single league table of international institutions or a causal ranking of treaty effectiveness. Each arrangement responds to different problems and involves heterogeneous legal competences, ecological time scales, resources, and political contexts. The appropriate synthesis therefore distinguishes *documented institutional properties*, *GR-compatible interpretations*, and *unverified propositions* that would require additional evidence. The central question is whether a common analysis of generative capacities, typed institutional dependencies, and jointly executable accountability helps explain something that competent treaty-specific approaches miss.

#### Four cases, four principal institutional mechanisms

The Montreal Protocol's financial mechanism establishes a connection between internationally agreed substance controls and practical support for eligible parties. Article 10 provides for financial and technical cooperation, including technology transfer, to enable compliance with the Protocol's control measures (UNEP Ozone Secretariat, 2026c; UNEP Ozone Secretariat, 2026d). The accumulated operations of the Multilateral Fund offer documented project and programme records through which implementation assistance can be examined. A supported conversion is evidence of an implementation activity; a completed project or a favorable aggregate phase-out indicator should still be distinguished from the capacities maintained by firms, regulators, and technical personnel after particular assistance arrangements end. The central GR question is how apparently similar compliance trajectories can be associated with differently reproducible productive and regulatory capabilities. Yet the Montreal literature already studies assistance, incentives, and implementation capacity, and it offers a strong competing account of many observed outcomes.

The Paris Agreement places reciprocal reporting and facilitated review within a differentiated framework of nationally determined commitments. The enhanced transparency framework supplies common structures for national reporting, technical expert review, and multilateral consideration without converting the expert review into a general sanctioning court. First biennial transparency reports were generally due at the end of 2024 and second reports at the end of 2026, with special discretion for least developed countries and small island developing states (United Nations Framework Convention on Climate Change, 2026a; United Nations Framework Convention on Climate Change, 2026e). These are observable procedures. The specific claims that reporting increased trust, changed emissions, or permanently improved national analytical capacity require separate inquiry. The candidate GR mechanism is the possible divergence between internationally accepted evidence products and the domestic capacities through which such products can be independently reconstructed or corrected.

The BBNJ Agreement was in force from 17 January 2026, with its first Conference of the Parties scheduled for January 2027 (United Nations Treaty Collection, 2026; United Nations Division for Ocean Affairs and the Law of the Sea, 2026c). Provisions governing marine genetic resources, area-based conservation, environmental impact assessment, and capacity-building supply legally relevant institutional tasks. However, the implementation architecture is still being constituted at the time of this manuscript. An interim genetic-resource notification channel supplies evidence of an initial administrative process, rather than evidence of mature benefit sharing, broad scientific capacity, or ecological effectiveness (United Nations Division for Ocean Affairs and the Law of the Sea, 2026b). The GR questions are prospective: whether authorized information flows, technical capacities, ecological constraints, and review authority can be assembled into viable cooperative paths, and whether emerging international institutions distribute their enabling conditions in defensible ways.

The Aarhus Convention provides an explicit rights-oriented procedural architecture. Its information, participation, and justice provisions, together with its non-judicial international compliance-review arrangement, make evidential access and contestation part of the treaty's own core analytical language (United Nations Economic Commission for Europe, 2026f; United Nations Economic Commission for Europe, 2026a). Its documentary record includes decisions and reviews of implementation concerns. The candidate GR extension is to specify the cross-institutional conditions that turn separate procedural competences into an accessible and executable path for an affected participant, including the material means to pursue that path. This is also the case in which a low threshold of purported GR novelty is most readily rejected: established access-to-justice analysis already evaluates procedural barriers and effective remedies.

These cases can be represented, for comparative purposes, by four nonexclusive institutional emphases:

$$\begin{aligned}
 \text{Montreal} &: \text{Control} \leftrightarrow \text{MaterialSupport}, \\
 \text{Paris} &: \text{Report} \leftrightarrow \text{Review}, \\
 \text{BBNJ} &: \text{Cooperation} \leftrightarrow \text{InstitutionBuilding}, \\
 \text{Aarhus} &: \text{Claim} \leftrightarrow \text{ContestableResponse}.
 \end{aligned}
 \tag{125}$$

The arrows indicate prominent research relationships, rather than complete descriptions of each regime. Montreal also has reporting and compliance review; Paris involves support and capacity-building; BBNJ includes legal obligations and procedural review; Aarhus entails substantive consequences for environmental governance. Assigning one analytical emphasis to each case is a heuristic that makes comparison legible. It must never become an empirical claim that each treaty contains only one type of mechanism.

### Cross-case evidentiary status and non-equivalence of observations

The case evidence supports four different *administrative or legal* observations at different units and dates: Montreal's cumulative project-approval and completion statistics as of June 2026; Paris's completed review count during 2024–2025; two BBNJ pre-collection notifications routed through an interim communications mechanism by October 2026; and Aarhus's standing legal architecture and documented routes for public communications (Multilateral Fund for the Implementation of the Montreal Protocol, 2026b; United Nations Framework Convention on Climate Change, 2026b; United Nations Division for Ocean Affairs and the Law of the Sea, 2026a; United Nations Division for Ocean Affairs and the Law of the Sea, 2026b; United Nations Economic Commission for Europe, 2026b). These are neither comparable measurements of trust nor comparable treatment outcomes. In particular, counting projects, reviews, notices, or communications supplies a different denominator and selection process in each regime.

The evidence ledger included with this draft records the bounded support for each claim, the inference that remains unavailable, and the most direct next observation. The documented record war-

rants an analysis of *institutional architecture and reported actions*; it does not currently contain a matched sample of participant continuation capacities or a prospective comparison of GR and baseline diagnoses. This scope restriction applies even when the formal model yields a valid distinction: observational equivalence is a logically constructed possibility until a real episode is measured under a common domain, window, and normative standard.

### The recurrent gap between visible institutional output and generative conditions

Across the four cases, legal commitments and observed procedures can be distinguished from the capacities required to reproduce their outcomes. A Fund project may be completed while continuing maintenance capacity remains uncertain. A climate report may be submitted and reviewed while an institution depends on externally supplied methods. A marine notification may be registered before a planned permanent institutional platform is fully operational. An information request may be answered without establishing the feasibility of a legally authorized challenge to the disputed decision. Each example points toward the same analytical hazard: inferring the complete state of a cooperative relation from one accessible output measure.

Let  $X$  and  $X'$  be two hypothetical configurations within a given comparison domain  $d$ , and let  $Y_d$  be a legitimately selected set of observable institutional performance indicators. Then the statement

$$Y_d(X) = Y_d(X') \not\Rightarrow \mathcal{R}_i^{(d)}(X; \Theta) = \mathcal{R}_i^{(d)}(X'; \Theta) \quad (126)$$

formalizes a non-identification problem. The same output does not logically determine all relevant continuation capacities. This is a mathematical possibility rather than an empirical generalization about the four conventions. To demonstrate it in a real case would require evidence of the allegedly different capacities, a defensible account of the subject and normative domain, and an explanation of how those capacities matter to legally appropriate cooperative action. The GR model earns an increment only if its typed dependencies or continuation test reveal a supported difference that other serious analytical frameworks fail to identify under comparable conditions.

A second recurring issue concerns the composition of otherwise competent institutions. An implementing agency can approve funds, a ministry can regulate, an expert body can review data, and a court or compliance mechanism can issue its own authorized determination. Their separate competence does not guarantee the existence of a valid chain connecting an affected subject's claim to an implementable outcome. The conditional composition test of Equation (92) asks whether each transition is legally admissible, technically executable, appropriately evidenced, and practically accessible. Such questions are often pursued through existing administrative law, institutional design, and process tracing; the formal GR vocabulary does not supersede those established methods. It offers, at most, a potentially reusable way to trace interfaces across heterogeneous institutions and distinguish a genuine cross-boundary gap from a lawful limitation of institutional authority.

### Countervailing configurations and disciplined negative findings

An inquiry oriented only toward identifying hidden dependency will over-diagnose institutional failure. Several countervailing configurations are essential. First, centralized provision of technology or expert review can be more accurate, economically sustainable, safe, and accessible than duplicating specialized infrastructure across all participating institutions. A recipient may reasonably choose shared service provision, provided the arrangement protects relevant rights, capacities, and corrective pathways. The mere existence of reliance does not establish exploitation or an impaired generative condition. Second, broad transparency can expose sensitive knowledge, personal data, commercial information, ecological locations, or individuals whose safety depends upon confidentiality. A restricted evidence interface coupled with authorized independent review may be more accountable than

unrestricted publication. Third, easy institutional revision can undermine predictability, encourage opportunism, or destabilize a carefully negotiated settlement. Appropriate amendment procedures must balance voice, continuity, legal certainty, and protection against unilateral coercion.

Fourth, norm translation sometimes should remain partial. A diplomatic or scientific agreement can preserve unresolved differences without preventing limited, lawful cooperation. A demand for fully unified normative language could erase meaningful pluralism and create power asymmetries of its own. Fifth, a procedurally accessible contestation pathway may correctly reject a claim: an unfavorable substantive decision need not be defective. Finally, cooperation may be inappropriate where consent is invalid, the foreseeable risks are unacceptable, rights are infringed, or vulnerable participants cannot be protected. An ethical praxis must allow refusal, suspension, independent review, and withdrawal where justified. These counterexamples prevent the GR vocabulary of capacity and transformability from becoming an unqualified instruction to maximize options, disclosure, institutional flexibility, or cooperation.

These points also expose limits of the four-case comparison. The selection includes prominent environmental treaty arrangements with unusually rich records. It does not establish how a model performs for conflict mediation, fragile local organizations, interpersonal relationships, or autonomous agents. The documentation differs sharply in age and completeness. Montreal offers a long-run project and compliance record, Paris an operating but still developing enhanced reporting cycle, BBNJ an early implementation trajectory, and Aarhus a rights and review regime operating through varied domestic systems. Apparent differences among them may reflect treaty age, legal design, financing, domestic capacity, or measurement availability rather than an underlying GR mechanism.

### A discriminating test of incremental explanatory value

To test the GR framework, a future study should register a unit of analysis, define the subject's relevant capacities, specify the legally grounded baseline, and state the outcome to be explained before examining the record. The baseline must include the strongest available domain-specific approaches—treaty implementation research for Montreal, climate-transparency assessment for Paris, marine institutional and scientific-capacity analysis for BBNJ, and legal access-to-justice analysis for Aarhus. A GR-informed team would then add a typed dependency map, authorized translation and composition checks, and measurements of protected continuation capacity. Teams should have access to the same documents and a comparable opportunity to examine them.

Let  $D$  denote a prespecified documentary and observational record,  $\mathcal{M}_0$  a competent baseline, and  $\mathcal{M}_{GR}$  the baseline supplemented by the GR-specific representation. An incremental research claim requires more than a change of vocabulary:

$$\Delta_{GR}(D) = \text{ValidatedConsequences}(\mathcal{M}_{GR}, D) - \text{ValidatedConsequences}(\mathcal{M}_0, D). \quad (127)$$

This schematic difference denotes a preregistered comparison of appropriately defined achievements, not subtraction of two universal scores. Suitable outcomes might include correctly identified institutional handoff failures, reproducible diagnostic explanations, lawful and adopted corrective designs, or independently verified retention of an essential capacity after disruption. False diagnoses, burdens placed on affected people, confidentiality breaches, additional costs, and failure to improve decisions must be recorded as adverse or null results. Where  $\mathcal{M}_0$  already captures every consequential dependency, the defensible conclusion is that the GR representation contributed no demonstrated explanatory increment.

The study would need a temporal design. A case may reveal a policy decision at one date, its technical implementation at another, and the persistence or deterioration of capacity later. Prespecified windows and event boundaries help avoid attributing every subsequent benefit or injury to the initial agreement. Claims about causal mechanisms should be assessed through process tracing, alternative

explanations, and evidence of actual decision or capacity change rather than solely through participants' self-reports. Where feasible and ethical, independent analysts could code episodes under baseline and augmented protocols, with blinded evaluation of findings. Such an approach can demonstrate utility without pretending that a small set of legally heterogeneous treaties forms a controlled natural experiment.

### **Institutional-design implications for peacemaking and public cooperation**

The comparative synthesis yields practical design questions rather than universal institutional prescriptions. In peacemaking, the counterpart to Montreal's material support is the material feasibility of an agreement: security, livelihoods, infrastructure access, and the resources needed to honor reciprocal commitments. The counterpart to Paris's transparency arrangements is a mutually intelligible, independently assessable process for clarifying specific claims without assuming that transparency alone produces reconciliation. The counterpart to BBNJ's institutional establishment is the staged constitution of new technical and governing interfaces, with honest acknowledgement of functions not yet operational. The counterpart to Aarhus is an accessible, appropriately protected route for affected people to obtain reasons and pursue competent review. The mappings are analogies, not claims that environmental treaties can be transferred unchanged to violent conflict, a diplomatic crisis, or local service provision.

A defensible design process can therefore be organized as a series of traceable questions. What concrete cooperative operation is sought, and which actors have the capacity and legitimate authority to carry it out? Which heterogeneous values and institutional rules are relevant, and where might translations or obligations conflict? What evidence could justify a claim, who can lawfully inspect it, and how can independent assessment proceed when direct disclosure would be harmful? Which actors control critical material and informational dependencies, and how would the relationship respond to foreseeable interruption? What forums can consider justified objections, which decisions are binding, and who can implement remedies? How can affected participants retain meaningful freedom to contest, renegotiate, or decline an arrangement within lawful and protective conditions?

These questions inform international cooperation, organizational design, and public trust-building as well. A government may publish performance indicators yet lack mechanisms to correct interagency errors; an international consortium may publish open data yet leave contributors unable to maintain field instruments; a nonprofit may report successful service delivery while clients remain unable to challenge significant decisions. Such patterns become research hypotheses to investigate, not presumed misconduct. Building warranted trust requires accurate public communication about both reliable performance and institutional limitations, evidence of competent responses, meaningful protection against retaliation, and opportunities for lawful contestation. It should remain possible for informed citizens to distrust or criticize an institution even after it has implemented a procedurally adequate remedy.

### **The comparative increment and its existing competitors**

The four cases supply different forms of evidence: Montreal records of financial and technical assistance, Paris transparency and expert review, BBNJ's emerging institutional duties, and Aarhus's procedures for information access, participation, and review. Their institutional maturity and observability differ substantially, precluding a common estimate of causal effectiveness. A distinctive GR diagnosis would have to identify a documentary-supported divergence between formal performance and a specified protected continuation, or a failure to compose otherwise competent response paths. Its marginal explanatory contribution must be measured against the strongest domain-specific baseline under comparable time, evidence, and resources.

That baseline includes relational peace, collective-capability, legal, power-sensitive, and organizational approaches that already examine relationships, agency, and institutional transformation (Söder-

ström et al., 2021; Brigg, 2025; Ibrahim, 2006). A documented GR finding counts as novel only when those comparators do not supply the same consequential diagnosis; proposed interventions would additionally require independent evaluation of outcomes and adverse effects. The current cases provide candidate discriminants and negative controls, rather than an established increment in empirical explanatory power.

### A bounded originality verdict across the four cases

The comparative episodes expose four different interfaces: technology-and-finance assistance, climate-reporting review, nascent marine-information administration, and environmental-rights procedures. Their documentation substantiates institutional arrangements and selected administrative actions; it does not demonstrate that a GR analyst has uncovered a dependency that relevant treaty experts, capability researchers, legal practitioners, or relational peace scholars would have missed. Montreal's implementation capacity question overlaps with development and capability analysis; Paris's evidential asymmetries overlap with transparency and measurement scholarship; BBNJ's evolving institutional responsibilities overlap with treaty implementation studies; and Aarhus's access-to-remedy pathway overlaps with established procedural justice and administrative law. These overlaps are strengths of a cross-domain synthesis when explicitly acknowledged.

The defensible manuscript-level claim is therefore an *integrated and contestable research protocol*: it relates task-specific cooperation, admissible continuations, observation, normative translation, and institutional response paths in a consistent workflow. The next independent study must discover whether that workflow reveals a consequential cross-interface defect with accuracy or utility beyond an appropriately combined baseline. A negative result would leave the formal countermodels intact while narrowing the framework's practical claim. An adverse result, such as overdiagnosing conflict or increasing disclosure risk, would require changing the protocol. The present evidence warrants neither a theory-wide novelty verdict nor a claim of empirically demonstrated GR superiority.

**Bounded comparison across unequal case maturity.** The four treaty regimes supply a deliberately heterogeneous documentary sample. Montreal's long-running funding and compliance records, Paris's developing reporting cycles, BBNJ's initial implementation stage, and Aarhus's entrenched participatory procedures cannot be pooled into an undifferentiated measure of institutional trustworthiness or generative capacity. Any cross-case GR claim should instead state its shared analytical question and then retain separate legal authorities, observation windows, and evidentiary statuses. In this manuscript the comparison supports the usefulness of a common classification vocabulary. A claim of predictive, causal, or practical superiority would require independent episode-level tests of specified mechanisms against equally competent established approaches.

### What the comparative record permits us to conclude

The documentary record supports a restricted but useful conclusion: material support, evidential reporting, emerging governance infrastructure, and legally specified public contestation are different institutional methods for enabling cooperation. The four regimes demonstrate that a treaty's legal obligations, observed administrative outputs, and underlying capacities are empirically and normatively distinct. They also show why confidence in cooperative arrangements should be assessed through actual procedures and outcomes rather than inferred from the existence of formal agreements. These findings are substantially consistent with established international-law, political-economy, governance, and procedural-justice scholarship.

The GR framework consequently supplies a common, falsifiable set of cross-case questions concerning typed dependencies, protected continuations, and end-to-end accountability. This is an achieved conceptual and documentary organization of the comparison. Reproducible incremental diagnosis,

causal effects of GR-informed reform, and benefits for affected people remain open empirical questions, appropriately subject to independent scrutiny.

### 39 Limits of the Framework and Directions for Empirical Investigation

The preceding chapters establish a vocabulary for examining cooperative possibility, historical and institutional relations, distribution of generative capacity, and the pathways through which claims can produce accountable responses. They also offer a set of conditional constructions, hypothetical counterexamples, praxis protocols, and four documentary institutional comparisons. This material supports a preliminary research programme; it does not, on its own, validate a distinct causal theory of trust, identify the effectiveness of an intervention, or establish that generative-relational (GR) analysis improves the decisions of practitioners. A rigorous limitation analysis must therefore reach beyond an inventory of missing data. It must specify which propositions remain logically conditional, what might make their premises false, when a simpler explanation would be preferable, and which observations could lead us to abandon an asserted GR advantage.

The framework's underlying philosophical commitment is also deliberately restrained. Relational configurations, heterogeneous subjects, change operations, and normative interfaces are analytical constructs through which a situated inquiry represents a domain. The assumed ontological relational space-time functions as a formal convenience, while observed records and institutional categories remain epistemic and practical representations. The resulting representations may illuminate dependencies without settling the ultimate ontology of persons, institutions, biological entities, or artificial systems. Distinctions of this kind become especially important where the paper moves among scientific observation, social explanation, legal obligation, and moral evaluation. A correct measurement of an ecological process does not independently confer representative authority; a technically executable action does not independently establish its legitimacy; a strongly predicted behavior does not automatically become trustworthy.

#### Conceptual underdetermination and the boundaries of subjects

The term *generative capacity* covers several analytically different objects: a biological or material possibility, an economically supported ability to produce, a legally permitted action, an institutionally reachable remedy, or a normative opportunity for participation. Their interpretation depends on the domain, affected subjects, and applicable constraints. A single metric would suppress important differences among these capacities. In the GR representation, a participant-specific continuation set  $\mathcal{R}_i^{(d)}(X; \Theta)$  is always defined relative to a declared task  $d$ , factual and normative assumptions  $\Theta$ , and a decision about the boundary of subject  $i$ . Investigators can reach different results by selecting different boundaries or admissible actions while using identical underlying records. Accordingly, agreement on observational facts may coexist with justified disagreement about what should count as a protected continuation.

Institutional boundaries offer a concrete example. A ministry, a regional office, its staff, and a contracted platform may be treated as a single organization for a reporting task, yet they are distinguishable for labor rights, procurement authority, access to a review process, and the ability to challenge a managerial decision. The choice of a single representative entity may hide responsibilities or vulnerabilities borne by component groups. Conversely, disaggregating every role can make an investigation needlessly costly and obscure genuinely collective capacities. The analyst should record which subjects are represented, which affected groups are excluded, which tasks justify the selected boundaries, and how the conclusions change under defensible alternative boundaries. Where those changes reverse a proposed diagnosis, the conclusion must be reported as boundary-sensitive.

There is also a danger of treating agency, viability, and normative worth as naturally aligned. An

institution can increase its available courses of action by acquiring more extensive surveillance capabilities, or a powerful actor can gain greater productive flexibility by shifting environmental costs onto others. The enlargement of such a continuation set is not automatically a desirable outcome. Legal protections, third-party rights, ecological viability, and ethically justified constraints must be stated before an expansion of options is evaluated. A GR analysis that celebrates every additional capability would risk reproducing precisely the power asymmetries it seeks to examine. Normative admissibility is therefore part of the research design, subject to scrutiny, rather than a consequence supplied by the mathematics.

### Latent trust, partial observation, and observational equivalence

Trust is a directed and domain-sensitive judgment or disposition, whose components can include expectations of competent conduct, reliance on integrity, acceptance of vulnerability, and the recognition of another's situated obligations. The conceptual distinctions in Section 4 constrain any empirical instrument: reported confidence, observable reliance, compliance, cooperation, and warranted trustworthiness cannot be treated as interchangeable observations. A survey may elicit a participant's expressed expectation without recovering the relational history through which that expectation developed. A successful transaction may be driven by a monopoly or a lack of alternatives rather than confidence in a provider. Conversely, cautious or critical respondents may accurately perceive institutional defects while choosing to cooperate under safeguards. Established trust research and public-institution surveys provide useful constructs, but their interpretation requires attention to population, domain, and measurement context (O'Neill, 2002; Tyler, 2006; OECD, 2026).

The observational-equivalence criterion of Equation (90) makes a useful logical point: the same declared performance indicator can arise under different practical capacities. It also exposes an identification problem. With limited records, investigators may be unable to tell whether such capacities actually differ. Let  $D$  be the admissibly collected record and let  $\mathcal{X}(D; \Theta)$  denote the configurations consistent with it. A statement that every plausible configuration lacks an effective remedy is stronger than a statement that some consistent configuration lacks such a remedy. A defensible sensitivity analysis reports the range

$$\mathcal{I}_i(D; \Theta) = \left\{ \left( \mathcal{R}_i^{(d)}(X; \Theta), \mathcal{U}_i^{\text{rev}}(X; \Theta) \right) : X \in \mathcal{X}(D; \Theta) \right\}. \quad (128)$$

When  $\mathcal{I}_i$  contains substantively different feasible outcomes, the available record underdetermines the claimed diagnosis. Obtaining a longer record, independent verification, a protected interview, or an authorized technical test may narrow the set. In some settings confidentiality, danger, or legal restrictions justify leaving it wide. Research integrity requires an explicit *unidentified* result rather than asserting the most concerning possibility as fact.

Cross-cultural and cross-institutional measurement further complicates equivalence. "Trust," "participation," "consent," "repair," and "credible evidence" may carry different practical and legal implications across linguistic communities. An instrument translated word for word can alter the relevant construct. The partial normative translation maps of Section 7 are useful here if they reveal their own limits: translation requires locally competent interpretation, documented uncertainty, and the possibility of unresolved meaning. The investigator should compare behavioral and documentary evidence with interviews conducted in appropriate languages, while refraining from forcing divergent normative frameworks into a single synthetic scale. The same caution applies to temporal comparison. A dated administrative sequence records ordered events within a selected institutional clock; it does not justify assuming that all subjects share an identical temporal account of obligation, remembrance, or expected continuity.

## Formal reachability and the empirical difficulty of demonstrating possibility

The constructibility test in Equation (85) is relative to a declared feasible-policy space  $\Pi_d(X)$  and assumptions  $\Theta$ . It can establish that a candidate arrangement satisfies the specified constraints, when those constraints have been correctly represented. A failed computational search may simply have exhausted an incomplete set of proposals. A successful simulation may omit political obstruction, hidden costs, lawful authorization requirements, ecological disturbances, or the actual willingness of a participant to consent. Consequently formal constructibility, political attainability, legitimate authorization, and realized cooperation must each be evaluated separately. Claims of impossibility require particularly careful treatment because an authorized institutional transformation may change the feasible-policy space itself.

The same qualifications govern compositional accountability. A mathematical chain of arrows represents an institutional response only when each link has a legally competent authority, a valid evidence or authorization type, an executable material operation, and an accessible procedure for the affected claimant. Showing that two service interfaces accept incompatible tokens does not by itself show that an international or domestic legal obligation was breached. The interface may embody an intentional protection of confidentiality or jurisdiction. Where a proposal requires changing the scope of a competent organ's authority, the analysis must identify the lawful instrument through which such change could occur. An attractive diagram cannot confer public power on a mediator, a scientific consortium, an AI service, or an international secretariat.

There is a further limit to the interpretation of the conditional propositions. Some, such as the binary inconsistency example in Proposition 7 of Section 25, are elementary consequences of constraint satisfaction. Others express plausible mechanisms, including how protected access to evidence or continued capacity may affect cooperation. The former are mathematical countermodels to over-generalized implications, while the latter require causal evidence. Mathematical clarity supports the formulation of research questions, yet novelty and explanatory success must be judged against formal logic, existing institutional analysis, rights-based review, organizational engineering, and empirical scholarship rather than inferred from the appearance of a new notation.

## Historical selection, causal identification, and alternative explanations

The four treaty cases were chosen because they illuminate different institutional mechanisms. They provide conceptual variation across financial assistance, reporting and review, emerging marine institutional design, and procedural contestation. They were neither randomly sampled nor selected to represent the distribution of all transnational institutions. Their distinct legal mandates and ecological or administrative outcomes prevent straightforward causal comparisons. In particular, the BBNJ implementation record remains young as of October 2026; legal entry into force and preparatory institutional steps cannot serve as observations of mature ecological or distributive effects. Montreal's extensive historical documentation and Aarhus's rights-based compliance record are more developed in some respects, though their outcomes also depend on domestic implementation and political context.

Even within a regime, institutional mechanisms are endogenous to the conditions they are supposed to affect. The allocation of technical support may respond to already visible implementation difficulties. A state may improve reporting capacity because of changes in domestic administration or external consultancy rather than a treaty review mechanism. An organization that adopts a GR-inspired repair procedure may differ from its peers in staff resources, leadership, prior trust, or willingness to disclose errors. Observed associations between safeguards and cooperation can consequently reflect selection, reverse causation, or common institutional causes. Process tracing and structured comparison (George and Bennett, 2005; Beach and Pedersen, 2019) can examine sequences and rival explanations, but strong causal claims require evidence beyond retrospective descriptions of apparently successful episodes.

For each proposed mechanism, the research record should state a plausible competitor. For constructible cooperation under low trust, staged assurance, incentives, and risk management supply conventional explanations. For asymmetric capacity after successful joint production, dependency theory, capability analysis, contract governance, and infrastructure studies may identify the same vulnerabilities. For normative composition defects, formal satisfiability checks and legal conflict-of-norms analysis can establish incompatibility without GR. For accountability gaps, administrative-law doctrine and workflow engineering may already provide the needed path analysis. If such methods yield the same warranted diagnosis and remedy with fewer assumptions, the GR contribution should be reported as a representational synthesis or a practical interface rather than a novel explanatory law.

### Conditions that would weaken the proposed contributions

A meaningful research programme specifies outcomes that can defeat its claims. The present investigation proposes three central theoretical directions and a praxis extension, each with a distinct vulnerability to counterevidence. The following are *adverse tests*, with relevance and decision thresholds to be prespecified within particular domains:

1. *Constructibility*. If seemingly workable GR-derived arrangements repeatedly fail under adequately measured legal, material, and protective constraints, the proposed representation or its search assumptions are inadequate. If established negotiation methods consistently generate the same admissible arrangements at lower cost, GR has limited incremental design value. Evidence of non-consensual participation, concealed danger, or displacement of responsibility would defeat claims of protected constructibility.
2. *Generative credibility*. If continuation-set differences cannot be reliably distinguished under reproducible measurement, the concept remains operationally underdetermined. If conventional capability and infrastructure assessments identify all material differences, the claim of a distinctive GR diagnostic weakens. Conversely, a stable capacity difference that has no demonstrated bearing on any protected task may be theoretically interesting while remaining practically peripheral.
3. *Normative compositionality and accountable reachability*. If alleged translation failures disappear under ordinary competent interpretation, the GR analysis has overdiagnosed conflict. If formally identified cross-institutional gaps are legally authorized barriers protecting rights, recommendations to remove them could be harmful. If qualified institutional analysts already detect and rectify all such gaps, the incremental claim again fails.
4. *Praxis*. If GR-augmented procedures increase coercion, exposure to retaliation, information burden, misclassification, or delay without corresponding gains in verifiable safety, accountability, or agency, their use should be reconsidered. A rise in reported trust accompanied by reduced rights or practical remedies would count against the claimed aim of warranted trust-building.

These tests acknowledge that an institutional framework can be applicable yet fail to be preferable. Formal coherence alone cannot justify implementation. Comparative success requires credible evidence of a consequential difference after accounting for analyst competence, implementation cost, and potential harms.

### Partial identification, model dependence, and a stopping rule

The identification set in Equation (128) suggests a direct sensitivity protocol. Specify at least two defensible subject boundaries, alternative authorized interpretations of a disputed rule, and plausible ranges for otherwise unobserved material capacities. Recompute whether a protected alternative or complete response path exists under each configuration. A diagnosis is *robust within the declared*

*sensitivity family* only where it survives all justified alternatives in that family. If both a functioning remedy path and its absence remain consistent with the record, the case should be coded as unidentified; the alarming configuration can be recorded as a scenario for ethically acceptable verification rather than reported as an established institutional defect.

Sensitivity analysis also applies to the cost of introducing the GR procedure. If the enhanced method depends on unconsented mapping of private relationships, demands sensitive testimony without adequate protection, or makes decisions less contestable, its proposed incremental benefit fails a basic admissibility screen. A pilot therefore requires a stop rule with thresholds fixed by qualified local experts: immediately suspend an intervention on credible signals of retaliation, unauthorized disclosure, invalid consent, severe participant burden, or an impending unlawful institutional action. The stopping decision must remain available independently of whether the formal model continues to report an apparent improvement in cooperative capacity.

Three kinds of conclusion should be kept separate in the research record: *formal* (a result valid under mathematical premises), *documentary* (a claim adequately supported about an institution at a specified date), and *causal/practical* (an intervention or mechanism whose distinctive effect is established against plausible rivals). The present manuscript demonstrates formal countermodels and documentary institutional features; it leaves the broad causal and incremental-practical claims open. This classification should accompany the paper's claims in any condensed publication.

### Pre-specifying comparable causal questions

A prospective test of GR should prespecify both the *institutional estimand* and the *methodological estimand*. The first asks whether a specified mechanism, such as a funded technical intervention or an evidence-review handoff, changed a protected task outcome for a defined set of participants over a stated observation window. The second asks whether adding the GR representation to a competent baseline improved analysts' warranted decisions *given the same admissible evidence and comparable effort*. These are distinct quantities: a mechanism may be effective even where GR adds nothing to its analysis, and GR may improve a diagnosis without demonstrating that a subsequent reform caused better outcomes.

For the methodological comparison, pre-register the eligible cases, endpoint definitions, acceptable false-positive rates, observer qualifications, permissible evidence, analysis time, participant burden, and conditions requiring the exercise to stop. Blind or independently adjudicate each alleged added diagnosis where practicable; publish null and adverse results. For treaty-history reconstructions without a viable comparator or measured outcome, limit the conclusion to source-supported process description and identified uncertainty. These restrictions are especially important for the newly established BBNJ processes, where future administrative development cannot be treated as an observed effect of arrangements already in force.

### Research decisions when the originality hypothesis fails

An internally coherent integration may still be redundant in a specific professional setting. The pre-specified disposition of an originality test should allow at least four outcomes. First, *incremental corroboration*: an independently supported finding or safer authorized action is obtained only with the GR augmentation under reasonably matched conditions. Second, *convergence*: both the GR and baseline procedures identify the same material or normative issue with comparable quality, in which case the manuscript claims an optional representational interface. Third, *inconclusive comparison*: absent records, disputed jurisdiction, or unacceptable differences in access prevent identification of the incremental effect. Fourth, *adverse increment*: GR mapping increases false positives, procedural cost, disclosure risk, or misplaced confidence. The fourth outcome warrants suspension or redesign in the affected domain.

Further work should distinguish *discovery advantage* from *explanation advantage*. A process diagram that helps a team notice an omitted authorization step may have practical value even if administrative law fully explains that step. Conversely, an elegant formal mechanism with no reliably measurable observation adds theoretical vocabulary without an independently testable prediction. Recording this distinction preserves modest forms of practical usefulness while preventing the claim that every improved workshop or clarified diagram constitutes a new causal theory of international cooperation.

**Disconfirmation and scope revision across praxis domains.** A disappointing result requires interpretation at the appropriate level. Failure to find a viable cooperation policy can indicate genuine joint infeasibility, incomplete search, an overly narrow option universe, or disputed assumptions about authority. Failure of a proposed repair can reflect a defective diagnosis, inadequate implementation, institutional resistance, or adverse side effects. Likewise, agreement between GR and established analysts is a meaningful null increment when the baseline reaches the same protected conclusion with equal or lower burden. The evaluation should preserve these distinctions and specify whether the next research decision is to revise a definition, collect missing evidence, narrow the domain, suspend intervention, or abandon an asserted advantage.

### A staged empirical programme and criteria for learning

A feasible research sequence begins with *retrospective documentary reconstruction*. For each case, construct an episode dossier linking an operative commitment to the institutions, physical or informational dependencies, observations, legal mandates, and actual decisions involved. Code separately formal rights, available mechanisms, successful invocation, and effective outcomes. Include contrary sources, unresolved claims, and the reasons for excluding data. These dossiers can support a reproducible audit of whether an alleged dependency or accountability gap is supported by evidence. They can also reveal where the representation is too elaborate to add value.

A second stage could employ *prospective institutional walkthroughs* and tabletop simulations. Participants with relevant legal, technical, diplomatic, public-administration, and community expertise would examine matched scenarios under prespecified constraints. One group could use competent conventional stakeholder, risk, and rights-based assessments; another could apply the same tools supplemented by GR dependency and continuation mapping. Scenarios would include both true interface gaps and deliberately misleading cases in which confidentiality, specialization, or limited authority is legitimate. Independent reviewers, ideally blinded to analysts' methodological allocation, would adjudicate correct identification of task-relevant risks, false positives, viable proposed responses, and adequacy of protective safeguards. Simulations can clarify conceptual performance and implementation costs, while remaining limited evidence of real-world social effects.

A third stage might follow *voluntary, low-risk pilot practice* in settings where institutions have independent legal authority to experiment with complaint routing, transparent commitments, community-science protocols, or collaborative technical maintenance. Such pilots require applicable ethics approval, meaningful consent, privacy protection, accessibility, security review, documented stop conditions, and protection against retaliation. A diplomatic or violent-conflict setting demands a much higher threshold of conflict sensitivity and competent authorization. The manuscript's hypothetical mediation cases are unsuitable as direct operational instructions without local expertise and safeguarding arrangements. A researcher should never solicit sensitive disclosures merely to complete a GR relational map.

Evaluation should retain a multidimensional outcome record. Potential endpoints include detection of a verified accountability gap, the time and cost needed to obtain a competent answer, realization of an authorized correction, retained maintenance or verification capability, affected persons' access to participation, fairness across groups, protection from retaliation, institutional learning, ecological or material performance, and the occurrence of adverse effects. Warranted trust must be interpreted

alongside this evidence rather than optimized as a single survey score. A possible comparative decision rule is

$$\text{PreferGR}_d \implies \text{ValidGain}_d > \text{AddedBurden}_d \quad \text{subject to RightsSafeguards}_d, \quad (129)$$

where the relation expresses a contextually justified assessment rather than an assumed commensurable numerical subtraction. The “gain” may be a supported diagnosis or protective improvement absent from an established comparator; the burdens include cost, false alarms, privacy exposure, and procedural delay. Explicit rights safeguards are constraints on acceptable adoption rather than quantities to be traded away for improved scores.

A final stage would examine *heterogeneity and external validity*. Relations among individuals, nongovernmental organizations, states, technical consortia, and autonomous infrastructures differ in the legal and moral status of their participants, the source of their authority, and their capacity to refuse. Success with a university complaint pathway would supply limited evidence about peacemaking; a treaty reporting process would offer limited evidence about interpersonal trust. Replications should vary institutional density, resource constraints, linguistic plurality, and the concentration of technical power. Where consent or confidentiality prevents reliable measurement, the valid conclusion is an acknowledged limit, accompanied where appropriate by an appropriately bounded qualitative analysis.

### The ethical status of a theory intended for intervention

GR praxis can become invasive if an analyst attempts to map another community’s values, vulnerabilities, and options without authorization. It can become paternalistic if a powerful institution uses a purported capacity assessment to decide what a less powerful participant should value. It can distort diplomacy if uncertain classifications are presented as objective measures of another society’s intentions. For this reason, the situated protocol in Section 26 requires affected-party voice, explicit normative justification, lawful authority, restraint in sensitive data collection, independent contestation where needed, and a right to challenge the analyst’s categories. These conditions apply to the model’s use as well as to the institutions it studies.

The paper’s practical aim is consequently a form of *accountable inquiry*. A GR model should disclose the purposes for which it is fitted, the subjects and interests it includes, the uncertainties it carries, and the institutional decisions it could affect. It should be revisable in response to evidence, criticism, and changed circumstances. Its success would consist in demonstrating that particular relational and generative distinctions improve warranted understanding or responsible practice within specified domains. Its failure would be informative when the chosen representation is misleading, redundant, ethically costly, or unable to resolve the operational problems for which it was proposed. The value of the research programme lies as much in permitting such conclusions as in offering a new conceptual language.

## 40 Conclusion

Transnational cooperation connects heterogeneous subjects through agreements, shared production, knowledge systems, legal authorities, and material dependencies. Its success is therefore partly a question of which relational possibilities an institutional arrangement makes accessible to its participants. Existing work on credible commitments, institutional power, relational peace, norm formation, and collective capabilities already addresses much of this terrain (Keohane, 1984; Barnett and Duvall, 2005; Söderström et al., 2021; Ibrahim, 2006). This study asks whether the generative-relational (GR) representation can yield an additional, operationally useful distinction under the constraints of established scholarship and institutional practice.

Three problems structure that inquiry. *Constructibility of coexistence* concerns the joint feasibility of authorized and protected cooperative trajectories across heterogeneous generative systems. *Gen-*

*erative credibility* distinguishes observed performance from the participants' subsequent capacities to verify, maintain, contest, and revise cooperative arrangements. *Normative compositionality* asks whether locally acceptable commitments and procedures remain jointly workable when multiple institutions and languages of obligation are connected. The formal sections define their objects, derive conditional consequences, and exhibit counterexamples to selected inferences from local feasibility or observed compliance to collective feasibility or protected continuation. These constructions establish logical possibilities under explicit assumptions; empirical frequency, causes, and remedies require separate investigation.

Trust occupies a related, analytically distinct place. It evolves through situated relations and partial observations and may coexist with justified caution, bounded reliance, institutional disagreement, or asymmetric dependency. Trustworthiness is better assessed through demonstrable conduct, lawful authority, evidence access, and effective correction than through expressed confidence alone. Reparation may be meaningful even when the affected party continues to distrust an institution or chooses to withdraw. The normative evaluation of those outcomes must respect rights, competent legal processes, and the unequal material conditions in which decisions are made (O'Neill, 2002; OECD, 2026).

The praxis chapters translate the proposed distinctions into a safeguarded diagnostic cycle. They connect authorized problem definition, plural relational mapping, partial normative translation, feasibility screening, bounded commitments, verification, contestation, and institutional revision. Peacemaking tests whether a settlement changes dependencies that sustain insecurity; preventive diplomacy traces technical notifications through competent communication and correction; international cooperation examines the distribution of capacities to maintain shared services. Interpersonal, organizational, and public trust inquiries assess bounded reliance and executable response paths without converting analysis into pressure for trust or disclosure. Each domain has independent professional standards. Consent, confidentiality, conflict sensitivity, safety, lawful review, and the freedom to refuse or withdraw govern the application of any GR-inspired proposal.

The comparison of four international arrangements supplies a differentiated documentary foundation. Montreal illustrates financial and technical assistance for implementing obligations; Paris provides an operating transparency and expert-review architecture; BBNJ presents newly binding obligations and institutions still under formation as of October 2026; and Aarhus specifies procedural rights involving environmental information, participation, and access to justice. These arrangements support the distinction between legal rules, administrative performance, and practical capacity. They do not form a matched causal study and cannot by themselves establish that GR is explanatorily superior to international-law, political-economy, capability, or institutional-analysis approaches.

A defensible test of the paper's contribution therefore compares GR-augmented assessment with competent baseline methods using the same case record, prior expectations, permissible authority, and resource constraints. Evaluators should prespecify the relevant protected continuations, adjudicate any newly alleged dependency or accountability gap, track implementation and adverse effects, and record negative findings. A formal countermodel, a documentary claim, and a causal estimate are different kinds of result. A GR diagnosis that merely restates what ordinary conflict analysis, institutional tracing, or collective-capability evaluation already reveals would be an additional vocabulary rather than a demonstrated advance.

The completed exploratory inquiry provides a typed representation, conditional propositions, counterexamples, a field-oriented protocol, and a comparative research plan with explicit failure criteria. Its presently defensible novelty is the explicitly integrated and auditable research procedure; relational ontology, recognition of plural worlds, collective capabilities, and logical composition have substantial scholarly precedents. A subsequent comparative study must decide whether the integrated procedure produces any supported incremental diagnosis or rights-consistent practical benefit beyond suitably combined existing methods. Its originality and utility remain bounded by future independent tests. Where GR identifies a supported and consequential constraint otherwise overlooked, the framework may help institutions safeguard both collective cooperation and differentiated agency. Where estab-

lished methods prove equally effective and more economical, their sufficiency should be acknowledged. The guiding question remains: *under what conditions can transnational institutions sustain credible cooperation while preserving the practical ability of heterogeneous subjects to know, contest, and participate in transforming the relationships that shape their coexistence?*

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