

Near-Critical Trust Relations

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Abstract

Trust relations develop through histories that shape what participants can undertake, recognize, contest, and revise. Those histories can also transform the actors, commitments, and interpretive practices sustaining cooperation. This manuscript investigates trust formation, maintenance, interpretation, and continuity when cooperative restoring processes approach a qualitative reorganization. Its central conditional argument concerns relations whose performance capacities and interpretive recourse depend on supports implicated in the same possible transition. The conceptual analysis distinguishes trust, reliance, assurance, effective capacity, interpretive change, and practical alternatives. It develops formation, mediation, shared history, maintenance, protective distrust, rupture, and renewal. Four formal investigations then specify the relevant dependencies. A history-bearing two-complex construction preserves the programme's element, coupling, event, and boundary assignments; composition and summary-sufficiency results state what a reduced description must retain. A finite revision operator algebra separates accessible observations from feasible operations, derives an observation-based correction condition, and identifies purpose-specific recourse through backward reachability. A discrete support-field model derives restoring modes from interface and anchoring assumptions. A coupled dynamical model yields an explicit stability threshold, a nonlinear regime reorganization, and finite-horizon limits on delayed correction. A stable-spectrum counterexample separates amplification from the proposed critical mechanism. Proofs and reproducible illustrative calculations establish model consequences without assigning trust a universal scalar or treating social relations as quantum systems. Comparative cases and an empirical inquiry protocol connect these results to changing authority, delayed uptake, surviving alternatives, constructive reconfiguration, and strategic manipulation. Later recognition remains fallible, and preserving an alternative does not establish that continued cooperation is desirable. Prepared for sustained public discussion, the manuscript credits inherited formalisms and develops their assumptions, consequences, and limits. Whether an actual trust relation instantiates the proposed critical regime remains an empirical and interpretive question.

Keywords: trust relations; critical transitions; interpretive change; cooperation; Generative Relational theory

Research Scope

This paper develops conceptual and formal investigations within the open Generative Relational research programme. It examines a specified class of possible trust relations through historical geometry, revision operators, support fields, dynamical models, and hypothetical comparisons. The formal propositions establish consequences within explicitly stated model classes; the computations check illustrative examples. Neither supplies an empirical classification of political systems or a calibrated quantitative theory of trust. Relational spacetime, two-complexes, fields, and operator algebras are representational constructions, not proofs of ultimate ontology.

The working title identifies the problem being investigated. Whether a given relation is near a critical transition requires independent evidence about the processes sustaining it, the disturbances to which it responds, and the alternatives to a criticality explanation. The paper's practical implications are conditional on those dependencies and on separately justified judgments about protection, accountability, and acceptable exposure.

The cited prior GR manuscripts are identified as working papers. Their presence in a repository establishes neither peer-reviewed acceptance nor the truth of their proposals. Their role here is to make inherited commitments and the limits of the present contribution visible.

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Status. This working draft is prepared for the author’s review. It records an evolving research argument; definitions, section structure, and conclusions remain subject to revision. Completion of the draft does not imply publication, acceptance, or final author approval.

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Statement on the use of language models. The author selected the research problem, working title, and paper queue and provided the exploratory discussion and corrections. OpenAI Codex assisted with source retrieval, conceptual analysis, formal reconstruction, drafting, computational examples, and technical checks. This completed working draft awaits the author’s review; its new formulations and arguments have not yet received final author approval. Authorship credit remains with the human author. This disclosure should be reviewed before external circulation.

1 Cooperative Trust Problems

A cooperative partner can remain sincere while losing the authority to fulfil a commitment. A reassuring message can preserve its wording while losing the practical significance it acquired through earlier interactions. A procedure for clarifying an incident can continue to exist while its decisions cease to bind the participants whose conduct matters. These possibilities create a problem for trust relations: the history supporting an expectation may remain accessible even as the processes that made the expectation dependable are being reorganized. This paper examines that problem through a conditional analysis of near-critical trust relations.

The analytical object is the trust relation, including its formation, maintenance, interpretation, and cooperative consequences. Trust is studied as a historically constituted orientation toward another's conduct that can influence which interactions occur and how they are understood. Its development is connected to organizational capacities, interpretive practices, and arrangements for handling disagreement. The relevant unit can therefore include actors, intermediaries, records, and commitments, provided their inclusion explains the trust relation under examination. The inquiry does not assume that every such element belongs in every case.

The difficulty has both a practical and an interpretive dimension. Participants act through relations whose significance they cannot always settle in advance. Their action can help generate or dissolve the capacities they are trying to understand. An undertaking can give a representative practical authority; withdrawal can weaken it. A review can create a route for evidence that did not previously exist. A successful history can deepen cooperation while concentrating dependence on supports whose fragility becomes visible only later. Trust development therefore concerns changing possibilities as well as changing attitudes toward a partner.

This makes continuity a substantive problem. What counts as the continuation of a relation when its actors, conventions, or means of performance change? Which earlier commitments remain consequential, and for whom? How can incomplete later understanding affect conduct after the categories used to describe that conduct have changed? These questions belong together because the object being understood also helps constitute the conditions of understanding and action.

Trust scholarship already supplies substantial resources for this problem. Mayer, Davis, and Schoorman distinguish willingness to accept vulnerability from risk-taking behavior and distinguish perceived ability, benevolence, and integrity [25]. Möllering places interpretation and the bracketing of unresolved uncertainty within the constitution of trust [26]. Prior GR work examines recursive trust development, interpretive buffering, and closure, while reserving stronger attractor claims for stronger evidence [16]. The present inquiry inherits these distinctions. It does not introduce relational trust or self-reinforcement as newly discovered phenomena.

Its organizing concern is the possible transformation of the processes that sustain a trust relation and make it intelligible. The criticality hypothesis adds a specific condition: a cooperative regime may approach a qualitative change in its sustaining dynamics, so that disturbances previously contained can acquire different consequences. That condition must be distinguished from rapid change, crisis, ambiguity, and limited knowledge. A further dependency is required for the paper's central case: the supports implicated in the possible transition also help participants interpret conduct and revise their commitments. Criticality alone does not establish that dependency.

The argument is that, where this dependency exists, a trust assessment restricted to the partner's intentions and past conduct can omit changes in the effective relation that connects commitment, performance, and interpretation. Updating the assessment may then be insufficient for restoring cooperation. Formation requires examining which lessons from interaction remain portable; maintenance requires examining how supportive interpretation can retain access to contrary evidence; and cooperative continuity requires identifying what can remain practically available through reorganization. Continuity can involve a revised commitment or a protected termination rather than preservation of the previous relationship.

The method combines conceptual reconstruction, formal investigation, comparative hypothetical cases, and reproducible illustrative calculations. Intermediate distinctions establish the objects before

the formal sections derive consequences. The history representation preserves heterogeneous local processes and the two-complex assignments of earlier GR work [7]. A finite operator algebra distinguishes what is observable from what remains actionable. A discrete field model derives the modes restored by specified supports, and a coupled dynamical model exhibits a stability boundary and a nonlinear reorganization. The criticality programme supplies a defeasible background [9]; the formal models specify particular mechanisms within that background rather than confirm it empirically.

The formal results sharpen the practical argument in several ways. They state the conditions under which a compressed configuration retains the consequential history of a relation; distinguish insufficient information from an absent correction operation; and show how an internally consistent support field can lack an independent restoring anchor. The coupled model identifies a feedback threshold even when its isolated channels remain restoring. A further calculation shows how limited time and intervention capacity constrain correction despite accurate later recognition. These are mathematical consequences of declared constructions, not universal laws of trust. Their assumptions also make counterexamples precise, including strong transient amplification with a fixed stable spectrum.

Cases involving coordinated passage, collaborative archives, ordinary interpretive conflict, constructive reorganization, and adversarial reassurance test different parts of the account. The cases identify what would have to correspond to a formal object in an application; they do not supply measurements merely by assigning familiar names to variables. Relational spacetime and operator-algebraic language remain representational, with no physical ontology or quantum dynamics inferred for social relations.

The manuscript is developed for sustained discussion. Its purpose is to make the foundations, inferences, alternatives, and unresolved questions sufficiently explicit that different parts can be criticized and revised. Changing interaction rules, future possibilities, repair, and temporal organization are also already developed in prior GR work [16]. Reconstructing them here supports a focused inquiry into their interaction near possible transitions; it does not turn their reuse into a claim of discovery.

Section 2 establishes the relational vocabulary. Sections 3 and 4 distinguish transition susceptibility from interpretive reorganization. Sections 5 and 6 examine trust development and cooperative continuity. Sections 7 through 10 develop the historical, algebraic, field, and dynamical investigations. The comparative sequences in Section 11 expose the assumptions behind those arguments. Sections 12 and 13 address empirical identification, rival explanations, and scope. Section 14 develops the remaining research problems, before Section 15 draws out the implications for trust relations and their continuing investigation.

2 Relational Trust Foundations

The purpose of this section is to identify the relation whose development the paper investigates. It separates participants' orientations from their observable cooperation, then specifies the historical and interpretive dependencies relevant to the later argument. These distinctions provide an analytical vocabulary; they do not settle the contested philosophy of trust.

2.1 Trust Commitments

The inquiry follows relations in which participants place something of consequence in another's hands and orient themselves toward that other as a possible bearer of trust. Favorable expectations can help make such exposure acceptable, but trust need not be reduced to a confident prediction. Its content can concern care, restraint, competence, fidelity to a commitment, or another specified performance. The content and basis must be identified locally. This working delimitation identifies the practical relations being studied; it is not a proposed necessary-and-sufficient definition of every instance of trust.

Reliance identifies a practical dependency: a plan depends on another's conduct. Such reliance can be compelled, strategically calculated, or supported by trust. Cooperation identifies coordinated activity, which can continue through coercion or narrow incentives as well as favorable expectations. Assurance identifies arrangements that make exposure more manageable, such as inspection, staged performance,

or recourse. Assurance may support trust, reduce the amount of trust required, or redirect the relevant expectation toward an intermediary. These possibilities are analytically distinct. Continued cooperation alone cannot show which one is operating.

Trustworthiness concerns the grounds for the favorable expectation in a specified domain. Perceived trustworthiness can diverge from the capacities and commitments actually relevant to performance. The ability, benevolence, and integrity distinctions in the organizational trust model are useful here because a failure of effective capacity need not be a change of intention [25]. Even effective capacity is relationally conditioned: a representative's promise may depend on staff, recognized authority, and access to resources. A sincere representative who loses those supports cannot necessarily perform the same commitment.

The analysis also permits trust and distrust to coexist across domains. The multidimensional approach of Lewicki, McAllister, and Bies already provides a basis for that possibility [24]. Participants may trust the accurate preservation of a record while distrusting its official interpretation. Accordingly, neither actor pairs nor institutions receive a single trust score in this paper. Increasing confidence in one function does not establish that confidence in every other function is warranted.

2.2 Philosophical Orientations

The differences among philosophical accounts matter because they locate the vulnerability of trust in different places. If trust is approached primarily through an assessment of reliability, changing evidence is an obvious concern. If it is approached through an affective orientation, the interpretation of an event includes how another person is encountered, not only which proposition is accepted. If trust involves a practical or normative stance, changing the relation can affect what one takes oneself to be entitled to expect and how a failure becomes answerable. These approaches cannot be made equivalent by calling each of them relational.

Jones's account of interpersonal trust emphasizes an affectively organized optimism about another's goodwill and competence, together with an expectation that being counted on can move the trusted person [23]. Holton distinguishes trust from reliance through a participant stance and argues that trusting need not require believing that the other is trustworthy [6]. Hawley's commitment account links trust and distrust to reliance on commitments; the relevant commitment can arise implicitly or through a role and need not coincide with a present intention to perform [5]. These brief characterizations identify different analytical starting points. The present paper does not adjudicate their complete accounts of justification.

For the current problem, their differences resist an overly narrow description of revision. A participant can acquire accurate information about an organizational change while continuing to encounter the familiar representative with a confidence formed in the earlier relation. Another can judge performance increasingly unlikely while continuing to address a demand to someone regarded as responsible for an undertaking. A third can cease relying without withdrawing the judgment that an obligation remains. These possibilities separate a prediction, an orientation toward the person, and a claim about what the relation requires.

This separation matters when an event is described as betrayal. A participant's disappointment can be causally explained by a lost capacity, yet the explanation does not automatically settle whether a responsibility was violated. The representative may have failed to disclose the loss of capacity, accepted an undertaking without adequate grounds, or inherited a duty to arrange a transition. Alternatively, the failure may have been beyond what could reasonably have been anticipated. The structural explanation and the judgment of answerability concern connected but different questions. A fuller causal account should improve that judgment, not preempt it.

The relational approach adopted here consequently preserves two levels of inquiry. At the first level, it asks what participants are doing when they trust, distrust, rely, withhold, or hold someone answerable. At the second, it asks which histories and practical supports make those orientations possible and consequential. The second level can illuminate why an orientation becomes difficult to sustain without claiming that trust is exhausted by its supporting infrastructure. A record system can enable the assessment of an undertaking without itself possessing the interpersonal significance of the undertaking.

Trustworthiness, justification for trusting, and reasons to cooperate also remain separate. A person may have good evidence for trust that turns out to be misplaced. A trustworthy counterpart may be poorly understood. A particular exposure may be too costly even when the counterpart is trustworthy in the relevant respect. Conversely, a protected exchange may be defensible despite substantial distrust. The near-critical analysis must trace which of these judgments changes; it cannot infer them all from a single favorable or unfavorable attitude.

2.3 Historical Configurations

The GR approach treats participants as history-bearing configurations. For an organization, relevant history can include earlier commitments, internal divisions, changes of personnel, sanctions, and the distribution of authority to speak and act. A relation's history also includes the interaction through which those features acquired significance for others. An organizational name can persist while the configuration supporting a promise changes. Conversely, personnel can change while sufficiently effective procedures preserve a commitment's practical force.

Calling a trust relation historically constituted has two implications. First, evidence is interpreted against an inherited relation rather than in isolation. Second, the trust orientation can help generate the subsequent history: participants may disclose information, accept limited exposure, or give an ambiguous incident time to be clarified. Prior GR work explicitly develops these recursive possibilities and their dangers [16]. They provide the starting point here, not the paper's novelty claim.

Relational efficacy remains distinct from ultimate ontology. The paper asks whether a relation makes a difference to the available conduct and interpretation of participants. It does not infer a metaphysical substance from that efficacy. This restraint follows the distinction between ontological uncertainty and relational reality developed elsewhere in GR [19]. The organizational and diplomatic examples below also require their own arguments; the source's application to artificial intelligence supplies no empirical evidence about those examples.

2.4 Relational Individuation

A history-bearing account must explain how its objects are identified. Otherwise the phrase "the same relation" can conceal the transformation the inquiry is supposed to examine. Organizational continuity, personal continuity, continuity of responsibility, and continuity of practical capacity need not coincide. A department can keep its name and records while losing the staff who carried its obligations. A new organization can take over a function without accepting the earlier organization's debts. A successor can accept responsibility while lacking the means to perform it. Each combination has a different significance for trust.

The proposed method is to individuate the relation through the task and the consequential dependencies under examination. For a collaborative archive, the relevant relation may connect contributors, custodians, access rules, and the practical preservation of contributions. For a negotiated passage, it may connect representatives, local authorities, recognized permissions, and the ability to secure movement. The analyst should then identify which continuities the participants themselves recognize, which the evidence supports, and which remain contested. These perspectives may diverge without making inquiry impossible.

This approach avoids treating a name as a sufficient identity criterion. It also avoids the opposite conclusion that any change creates a wholly new object. Ordinary relations persist through alterations of personnel, expectations, and procedures. The question is which changes matter for the inference being made. A record of accurate accounting may remain relevant after a minor staff change but become weaker evidence after the dissolution of the audit unit. The practical object must be specified before the relevance of the change can be assessed.

The unit of analysis can also move during the inquiry. An apparently dyadic failure may turn out to depend on a third party's control of a channel or on the recognition practices of a wider group. Enlarging the unit is justified when it makes an otherwise missing dependency visible. It requires explaining the

enlargement and revisiting earlier claims about what was internal or external to the relation. Merely adding every associated actor would replace explanation with a catalogue.

Relational individuation therefore has an epistemic and a practical aspect. It determines which evidence bears on the question and which actor can reasonably be asked to respond. If a former partner has fragmented into several organizations, the assumption that one successor inherits every earlier capacity can misdirect both trust and demands for correction. A careful account may identify several continuing relations, each bearing a different part of the history.

2.5 Collective Dependence

The step from persons to collectives requires an additional argument. A group's cooperation cannot generally be reconstructed by averaging its members' expressed confidence. It can depend on who can authorize action, whose reservations block a commitment, which records survive turnover, and how a local report reaches those able to respond. Prior GR work already treats collective trust through networks, distributed memory, and cross-scale translation [16]. The present analysis carries those distinctions into the transition problem.

Consider a collective whose members trust one coordinator to interpret external messages. Confidence in that person may sustain a coherent response even when members have little direct knowledge of the partner. The resulting cooperation depends on a translation role. If the coordinator loses standing, the difficulty can be larger than the loss of one favorable opinion: there may no longer be an accepted route through which an external undertaking becomes a collective commitment. Conversely, a reliable procedure can preserve that route through a change of coordinator, making personal distrust compatible with continued institutional reliance.

These cases distinguish concentration from collective strength. Centralization can make a response intelligible and timely while creating a dependency on one role. Distributed arrangements can preserve independent routes for challenge while making agreement slower or more demanding. Neither structure is uniformly superior. The relevant question is which disturbances it contains, which it transmits, and how it changes the participants' ability to interpret and revise an exposure. The criticality question will concern changes in those response properties rather than the mere presence of a network.

Cross-scale dependence can also make apparently contradictory reports accurate at different levels. Members may retain trust in a counterpart's local staff while losing confidence in an agreement between governing bodies. A central institution can preserve its recognized standing while the local arrangements needed for performance disintegrate. The analyst should specify the translation between these judgments instead of selecting one level as the real trust relation by default. What is stable at one level may depend on reorganization at another.

Collective dependence does not require a collective mind with one interpretation. A relation can be sustained by overlapping commitments among participants who understand its significance differently. The extent of overlap is an empirical and interpretive question. When the overlap narrows, an aggregate measure of institutional confidence may remain unchanged even as the particular coalition capable of performing a task is being lost.

2.6 Interpretive Supports

An interpretive support is a practice, capacity, or arrangement through which conduct becomes available for assessment. Examples include a shared record, a recognized representative, a convention for distinguishing explanation from concession, or a forum in which conflicting descriptions can be heard. Such supports need not deliver agreement or accurate understanding. They identify how assessments are made possible and whose assessments can have practical consequences.

Manifestation and relational reality must consequently be distinguished. A message, observable act, or official designation is a manifestation whose significance depends partly on its production and reception. The same phrase can have a different practical role after authority or conventions change. This does not authorize an analyst to dismiss inconvenient evidence by invoking an inaccessible reality.

A claim of changed significance requires evidence about the relevant production, interpretation, and action. The distinction therefore creates an explanatory obligation rather than a privileged observational position.

These supports belong within the analytical object when they help constitute or sustain the trust relation being studied. Their inclusion does not absorb all social life into the explanation. If a record system has no demonstrated bearing on participants' expectations, performance, or recourse, its presence in the surrounding environment is insufficient reason to treat it as part of this mechanism.

2.7 Endogenous Evidence

The history used to assess a trust relation is partly produced by that relation. A willingness to disclose creates opportunities for restraint or exploitation; a refusal to disclose prevents some of those opportunities from arising. Monitoring can reveal failures that an unmonitored relation would leave invisible. Conversely, excluding a participant from meaningful responsibility can prevent that participant from producing the evidence that would answer distrust. The point is already explicit in the prior GR account of action, observation, and updating [16].

This creates a selection problem for retrospective evaluation. A history containing few visible failures may record successful cooperation, restricted opportunities, weak detection, or suppressed reporting. The history alone does not distinguish them. An inquiry must examine how relevant opportunities and observations were generated. It should also distinguish absence of a recorded incident from evidence that the incident did not occur. Neither distinction warrants assuming hidden wrongdoing; both identify questions that favorable records cannot answer on their own.

Near a possible transition, the evidence-generating process can change with the relation. A report channel may lose participants, a trusted intermediary may cease receiving contrary accounts, or a new actor may enter the cooperative task without being represented in the old records. Comparing earlier and later performance then requires attention to whether the observations were produced under comparable conditions. An apparent deterioration may reflect better detection, while an apparent improvement may reflect lost access.

There is also a constructive possibility. Revising a relation can create evidence that was previously unavailable. Giving an affected group standing can reveal the practical meaning of an undertaking from a different position. A limited new arrangement can test whether a successor has the capacity it claims. The resulting evidence is not independent of intervention, but that does not make it worthless. Its interpretation must include what the intervention changed and which inference the new interaction supports.

The foundation for the later analysis is thus a relation with a history, not a container into which independent observations are deposited. Participants act, encounter consequences, interpret them, and thereby alter some conditions of subsequent action. The near-critical inquiry adds a specific question about when changes in those conditions alter the regime through which disturbances are contained or propagated. That additional question requires the distinctions developed next.

3 Critical Transition Susceptibility

This section specifies the criticality hypothesis used in the paper and the additional premises required for its application to trust. The task is to identify explanatory content beyond the observation that relations change. The account in this section is qualitative: it proposes a dependency to investigate rather than a measured distance from a critical point. Sections 9 and 10 subsequently derive particular restoring operators and transition conditions. Those model-specific constructions supply exact conditional results without turning the present vocabulary into a universal metric.

3.1 Cooperative Response Regimes

A cooperative response regime consists of the processes through which a specified relation handles disturbances over a specified period. These processes can include delegated authority, routines of explanation,

restraint by local participants, verification, and the practical revision of commitments. A restoring process contains a disturbance sufficiently to allow the relevant cooperative activity to continue or resume. It need not return every participant to an identical psychological state or reproduce every feature of a previous arrangement.

For the present inquiry, a critical transition is a qualitative change in such sustaining dynamics: a previously operative way of reproducing the cooperative relation loses stability or practical viability, and a different pattern of interaction becomes possible or established. The restricted near-critical hypothesis is that the relation approaches such a change through weakening of a specified restoring process, with consequential changes in its responses to a specified class of disturbance. This usage does not establish a thermodynamic critical point, a universality class, or self-organized criticality. Those are stronger claims with additional formal and empirical requirements. The restriction follows the broader programme's insistence on specifying response, scale, and rival mechanisms [9].

The distinction concerns the operation of a process, not the emotional intensity of an episode. A tense dispute can be contained by effective consultation and reliable local restraint. Conversely, a modest dispute can expose a change in whether representatives can secure compliance. Calling the second relation near criticality requires evidence that the change involves susceptibility to a qualitative reorganization of its sustaining dynamics. A delayed reply or an unusually large reaction, by itself, is insufficient.

Critical-transition research reinforces the need for specificity. Ashwin and colleagues distinguish bifurcation-, noise-, and rate-induced tipping; rapid parameter change can produce tipping without a bifurcation [2]. The present paper concentrates on weakening restoring processes and does not treat every form of tipping as an instance of that mechanism. Nor does it equate criticality with universal acceleration: critical slowing down concerns recovery in applicable models [29]. Transferring either concept to political relations requires identifying what changes, what recovers, and how the observations bear on those claims.

3.2 Relational Change Profiles

Several kinds of change can coexist in one episode. An incident can change a participant's confidence while the practices for interpreting incidents remain stable. It can change those practices, so that later incidents are classified differently. It can reorganize the actors able to participate or the actions that remain practically available. These are different objects of explanation, although one sequence can transform all of them.

Prior GR work already distinguishes movement within a relational configuration, evolution of interaction rules, and changes in reachable possibilities [16, 9]. The current paper uses that distinction without importing the earlier schematic equations as an empirical model. Describing a changing rule does not require supposing that participants have represented it explicitly. A convention can change through practice, and an organization can cease performing a function before its formal description is revised.

Table 1 separates the questions posed by these changes. The distinctions are analytical rather than an invariant hierarchy. A change that looks like a new state in a broad model can require changing the model's objects at a finer level. The distinction discloses what the description holds fixed; it does not assign each event a unique metaphysical category.

An explanatory error occurs when a change in one row is treated as an answer to a question in another. Greater confidence does not establish restored capacity. A revised convention does not establish that affected participants can use it. A successor's existence does not establish that it has inherited the relevant resources. Conversely, declining confidence does not establish that the practical relation has become less reliable; the decline may follow newly visible evidence of a long-standing problem.

The criticality hypothesis concerns the consequences of some of these changes for the response regime. It asks whether processes that contained a disturbance are losing efficacy or being reorganized in a way that changes the ensuing trajectories. It depends on a description of change but cannot be inferred from change alone. The GR commitment to evolving relations therefore supplies no automatic argument that every relation is near criticality.

Table 1: Relational change profiles. Each row identifies a possible object of inquiry; none is sufficient evidence of near criticality.

Change profile	Trust-relevant example	Explanatory question
Present orientation	Confidence declines after a missed undertaking.	Which evidence or experience changed the assessment?
Interpretive practice	An assurance no longer counts as an authorized commitment.	Which convention, standing, or production process changed?
Actor configuration	Several successors inherit parts of an earlier organization's role.	Who can undertake, perform, and answer for the commitment?
Practical possibilities	A participant retains a claim but loses access to suspension or remedy.	Which consequential actions remain accessible, to whom, and for how long?

3.3 Transition-Specific Proximity

Proximity requires identifying the transition to which it is alleged. A consultation arrangement might be susceptible to a loss of coordinated restraint. A collaborative institution might face fragmentation of authority. An interpretive practice might be losing its capacity to organize common action. The same relation can be close to one such change and robust against another. A generic label of fragility leaves this distinction unspecified.

Qualitative use still incurs an evidential burden. The analyst should identify a changing support, explain why it matters to a particular transition, and show how responses depend on it. Repeatedly needing exceptional interventions to contain a previously ordinary dispute could be relevant evidence. It could also reflect a different distribution of disturbances or an altered reporting process. These alternatives must be examined before the observation indicates proximity.

The near-critical relation can retain substantial organization. Commitments may still be fulfilled and familiar language remain effective. The hypothesis concerns susceptibility, not a requirement that every interaction already displays breakdown. At the same time, routine success cannot prove hidden susceptibility. The account needs evidence about supports and responses that routine success may leave untested. Neither visible turbulence nor outward calm supplies the diagnosis by itself.

Structural susceptibility also differs from an observer's surprise. An unexpected event can occur in a robust relation because the observer lacked ordinary information. A well-understood transition can occur without surprising anyone. Surprise characterizes an epistemic situation; susceptibility characterizes response properties. They can be causally connected, but neither defines the other.

The account does not require a single boundary crossed by all participants at the same instant. Local restraint may weaken before joint records lose authority; a record may remain authoritative after the capacity to act on it disappears. A finer account can identify several transition-relevant processes and the intervals during which they interact. The near-critical hypothesis should organize that investigation rather than replace it with one dramatic tipping moment.

3.4 Coupled Relational Dependencies

The paper's central case requires three premises. First, trust-supported cooperation depends on an identifiable process that previously contained a relevant disturbance. Second, changes in that process make the relation susceptible to a qualitative reorganization of cooperative responses. Third, some of the capacities for recognizing, interpreting, or revising the relation depend on the supports implicated in that reorganization. The third premise is independent: a cooperative process can become unstable while observation and adjudication remain effective.

Consider representatives whose authority both secures local compliance and makes a joint explanation count as an authorized account. If their authority is being withdrawn, a clarifying statement can lose two different capacities. It may cease to alter local conduct, and it may cease to settle what the parties

have undertaken. An observer who knows the statement's content accurately has not thereby restored either capacity. Additional data can establish what happened without reconstituting authority to act on that finding.

The inference proceeds in stages. A favorable expectation licenses an exposure partly because a commitment is believed to be performable. Performability depends on supports beyond the representative's intention. When those supports weaken, the same intention and message need not sustain the same expectation of performance. If interpretive recourse depends on the same supports, an attempt to clarify the discrepancy can also fail to change the relation. Thus a model that updates only the representative's trustworthiness while holding performance and recourse capacities fixed can miss a common source of both failures. This is a conditional explanatory limitation, not a claim that existing trust theories are incapable of representing such capacities.

The dependency can also produce an endogenous sequence. Failure to secure compliance weakens recognition of the representative; diminished recognition further weakens the representative's ability to secure compliance and convene review. Whether this sequence is self-amplifying enough to transform the response regime is an empirical question. Recursion alone does not prove criticality. The hypothesis becomes substantive when changes in the named restoring process explain why comparable disturbances cease to be contained and why renewed assurances lose efficacy.

3.5 Restoration Mechanisms

A disturbance can be contained by practical restraint, clarification of its significance, compensation that permits continued participation, or revision of the task. These processes can support one another. A credible explanation may justify restraint long enough for material correction; correction may make the explanation credible. The relation can fail when one link no longer works even if others continue.

Loss of restoration is not identical to absence of a favorable response. An investigation can produce a justified adverse judgment while preserving the capacity to handle disagreement. A favorable public statement can coexist with the disappearance of that capacity. The relevant property is whether a process contains the disturbance or supports viable reorganization, not whether it returns a participant to a positive mood.

Coupling varies in direction. Performance can depend on interpretation when an undertaking becomes operative only after an authorized classification. Interpretation can depend on performance when repeated fulfilment gives a representative standing to explain later incidents. Both can depend on a third support, such as the participation of local coordinators. These are different causal structures. Correlated failure does not identify which structure is present.

Two counterfactuals help locate the dependency. If recognition of an official account were restored while local performance capacity remained absent, would the undertaking become performable? If capacity were restored while affected participants still lacked a route to contest the undertaking, would the interpretation problem disappear? Negative answers suggest that different supports are needed. They expose the danger of treating one visible improvement as repair of the whole relation.

A restoring process can itself become destabilizing after other conditions change. Repeated central confirmation may once have contained local uncertainty; after authority fragments, it may obstruct timely local coordination. Giving the partner time to explain may once have prevented needless retaliation; after exposures become irreversible sooner, that practice may leave participants unable to protect themselves. These are mechanisms to investigate, not universal effects of centralization or patience. Their significance lies in the changed relation between a procedure and the activity it previously sustained.

3.6 Scale-Sensitive Propagation

A disturbance can be local in origin and wider in consequence. The explanatory work lies in the intermediate dependencies. A local refusal changes what a coordinator can promise; that change affects others' willingness to recognize the coordinator; their withdrawal changes which further undertakings can be

performed. The initial refusal does not contain these effects as intrinsic properties. They arise through the contemporaneous relation.

Conversely, a large disturbance can be absorbed when independent capacities continue to operate. A local breakdown need not propagate if another recognized representative can perform the commitment and the transfer preserves affected parties' claims. Multiple actors can interrupt propagation or multiply dependencies. The mechanism must specify which possibility applies.

The political criticality account treats scale and evolving couplings as part of the hypothesis [9]. The relation need not be equally susceptible at every level. Interpersonal confidence can persist while an interorganizational arrangement becomes unstable. A regional framework can remain in place while local implementation fragments. Describing one level as stable does not settle the behavior of the others.

Scale also affects timely recognition. Local participants may understand a changed practice before central records acknowledge it. Central officials may recognize a wider shift that local participants have not encountered. Neither level is epistemically privileged in advance. The inquiry should reconstruct what each could encounter, which transitions mattered to its commitments, and how relevant information could travel between them.

Such differences become especially consequential when translation between levels is changing. A report previously accepted as evidence can lose that status; a formerly marginal account can become authoritative. Criticality is relevant only if these changes participate in the specified response-regime transition. Scale dependence and translation are inherited relational problems, not sufficient demonstrations of a critical regime.

3.7 Explanatory Discrimination

Ordinary nonstationarity means that relevant relationships or distributions change over time; it does not identify the mechanism of change. A sufficiently rich nonstationary model could represent every dependency just described. Criticality is therefore not logically necessary to represent the problem. Its proposed added value is a more specific explanation of changed responses: weakening restoration, increased propagation through identified dependencies, and possible reorganization of the cooperative regime. That explanation must earn its place against simpler alternatives.

A partner can become less reliable because its resources decline steadily, while consultation and revision continue to function. An observer can misread a signal because a convention changes gradually, while the cooperative arrangement remains robust. A government can deliberately break a commitment despite retaining the capacity to honor it. Each possibility concerns trust; none requires the present criticality hypothesis. A finding of interpretive lag likewise provides no independent evidence of a critical transition.

The hypothesis would earn additional explanatory weight if evidence linked changing restoration to a change in the consequences of comparable disturbances, and linked those consequences to the altered efficacy of interpretive recourse. Evidence that restoring supports remained intact, that an exceptional external shock explains the outcome, or that deliberate defection suffices would weaken this account. The following sections investigate its implications while retaining these conditions. They do not infer that every deteriorating trust relation is near criticality.

3.8 Constructive Reorganization

Weakening of an established regime need not eliminate every cooperative possibility. The old arrangement may be unable to accommodate new participants or recognize exposures its categories excluded. Reorganization can make different commitments and more adequate interpretations possible. The near-critical hypothesis is compatible with constructive transformation, provided that transformation is shown rather than presumed.

A new review arrangement might give excluded participants a route to register concerns. Their participation can generate evidence; handling that evidence can help establish the arrangement's practical standing. Recognition and performance may reinforce each other, creating capacities absent from the

earlier regime. Recursion alone still does not establish a critical transition. One must show how the previous response regime changed and how a different organization became sustainable.

The practical question then concerns possible continuities rather than restoration of a single prior order. Some commitments may deserve preservation, some procedures replacement, and some exclusions termination. Preserving the old relation's name would not necessarily preserve what was valuable about it. Celebrating a new arrangement would not establish its trustworthiness either.

The criticality hypothesis supplies no direction of improvement. Greater accessibility of alternatives can permit repair, domination, fragmentation, or a mixture across participants. Trust can facilitate constructive change by supporting limited participation before its outcome is settled. It can also anchor participants to inadequate supports. Formation and maintenance therefore remain active problems of the changing relation; the analysis extends beyond responding to crisis after trust has failed.

4 Interpretive Reorganization

The preceding mechanism depends on more than inaccurate information. This section separates three objects of revision: assessments of conduct, understanding of practical capacities, and the categories or standing through which conduct is assessed. It then explains how temporal mismatch can matter without assuming that a final interpretation is waiting to be discovered.

4.1 Interpretive Revision Targets

An evidential revision changes an assessment within a sufficiently stable interpretive practice. Participants initially believe that an inspection was refused; a dated record shows that access was granted. They agree about what granting access means and who can establish that it occurred. The dispute can then be resolved by evidence. Trust may recover, decline, or remain unchanged, depending on the record and the participants' other reasons.

A capacity revision changes the understanding of what a commitment can accomplish. A signatory continues to promise access but no longer controls the facility. Establishing sincerity does not establish performability. The interpretation must connect the promise to its organizational support, including the possibility that a different actor now controls the relevant conduct. Accurate information can reveal that problem; repairing it may require a new commitment or an altered allocation of authority.

A revision of interpretive structure changes a category, convention, or recognized standing used to assess the relation. Participants may disagree about whether temporary access constitutes compliance, whether a technical explanation concedes political responsibility, or which representative can bind a reorganized institution. Sometimes such disagreement exposes a difference that was previously concealed; sometimes the relevant practices have changed. The analyst must distinguish those possibilities. Neither disagreement nor the analyst's dissatisfaction with an account is sufficient evidence of interpretive transformation.

Prior GR work already treats changes in concepts, units, and temporal boundaries as part of later relational reconstruction, without promising that the later reconstruction is final or superior [13]. The consequence here is specific to trust: earlier success can remain historically real while its classification as evidence for a present commitment becomes disputable. This need not erase the history. It requires identifying which inference the history can still support and which changed dependency limits that inference.

4.2 Interpretive Heterogeneity

Participants need not begin with a single language of trust. They can recognize different obligations in the same undertaking, attach different significance to restraint, or disagree about the conduct that warrants an explanation. A practice experienced by one as respectful discretion may be experienced by another as avoidance. A request for verification may count as routine responsibility for one participant and an

accusation for another. These differences do not automatically imply that either participant has failed to understand the other's words.

The first task is to distinguish disagreement within a shared category from disagreement about the category's application or authority. Two participants may agree on what confidentiality requires and dispute whether information was disclosed. They may instead disagree about whether a particular person was entitled to receive it. In the latter case, additional evidence about the act of disclosure may leave the dispute intact. The inquiry must address the membership, role, or undertaking through which the entitlement was supposed to arise.

Heterogeneity can be compatible with continuing cooperation. Participants may coordinate a limited activity while attaching different broader meanings to it. This possibility does not require concealing the difference or asserting an underlying equivalence between their worldviews. It requires enough practical agreement, or an adequate accommodation of disagreement, to specify what each is undertaking. Prior work on normative heterogeneity and diplomacy already develops the problem of such interpretation and mediation [13, 11].

Near a possible transition, the terms of that accommodation may change. A category that once allowed several interpretations to coexist may begin to organize incompatible demands. A provisional designation may become a condition of access to resources or a test of political loyalty. A difference formerly absorbed by local discretion can then require an explicit choice that one participant cannot accept. The criticality claim concerns whether these changes help reorganize the response regime. Heterogeneity itself is not evidence of proximity to a transition.

The analysis should also preserve the possibility of incommensurable remainders. A shared procedure may settle what will happen without settling how all parties should understand it. Recording that remainder can matter for later trust because apparent consensus otherwise becomes misleading evidence of a shared commitment. The practical achievement may be a limited accommodation with known boundaries. Treating it as complete interpretive convergence would overstate what the relation has generated and weaken the basis for subsequent expectations.

4.3 Semantic Transformation

Interpretive transformation concerns more than attaching a new opinion to an unchanged event. A designation can acquire a different institutional role, an earlier distinction can cease to organize conduct, or a newly recognized category can make an exposure visible. These changes can alter what an utterance does in the relation. A statement called a permission might become a recommendation requiring further assent. A routine correction might become an admission that transfers responsibility. The words can remain familiar while their practical implications change.

Such transformation must be distinguished from deception. An actor can knowingly exploit an unchanged convention by using its language insincerely. That is different from participants acting under different understandings of a convention whose authority is being reconstructed. Both can occur together: a strategic actor may take advantage of a real transition. The analyst should therefore ask separately what the practice permitted, what each participant understood, and what each had reason to disclose.

Nor is changing meaning necessarily a collective choice made at an identifiable moment. Practices can diverge across locations before an official vocabulary changes. A newly introduced category can be used by one institution and rejected by another. A participant may continue applying a familiar designation in good faith even after its consequences have changed elsewhere. The relation then contains uneven transformations rather than a single new code awaiting universal adoption.

The trust problem is especially sharp when the earlier interpretation authorized exposure. A person who accepted a commitment under one recognized meaning may find that the relevant institution now classifies it differently. A later account must preserve the historical grounds of that acceptance while examining the present meaning. Otherwise reinterpretation can erase responsibility by pretending the current category was always operative. The reverse error would freeze the earlier category despite evidence that it no longer organizes present conduct.

This tension supports a distinction between historical fidelity and present adequacy. An account should explain what the earlier undertaking could reasonably mean in its context. It should also identify which current capacities and conventions affect what can now be done. These tasks can produce different descriptions without contradiction. The work of relational revision includes connecting them sufficiently to make present responsibility and future commitments intelligible.

4.4 Temporal Mismatch

Epistemic lag denotes a qualitative mismatch between changes relevant to a relation and participants' understanding of those changes. Recognition also has a practical dimension when a concern must become usable in collective deliberation or action. These dimensions must be distinguished: delayed institutional uptake of an understood concern is not simply an individual's epistemic lag. The terminology specifies no universal numerical rate and does not classify every persistent disagreement as delay. Participants can recognize a change promptly while disagreeing about its meaning. They can also possess relevant records while lacking access to an authoritative forum in which the change can be acknowledged.

The substance of this mismatch is inherited. The analysis of symbolic diagnosticity already distinguishes changing conditions of symbol production from slower interpretive recalibration [18]. The analysis of intermediary paths also examines delay, drift, and the conditional value of ongoing correction through an illustrative model [10]. Those arguments do not supply a calibrated law for trust relations, and no such law is imported here. The present task is to trace the consequences when the supports of cooperation and interpretation are jointly affected.

Suppose local authority has changed, but the inherited designation of an official continues to prompt confidence that a commitment can be enforced. Repeated circulation of the official's statement can add information about what was promised without revealing the changed capacity to perform it. A later finding can correct that understanding. By then, however, an exposure already undertaken may be irreparable or the participants able to revise it may no longer have standing. The temporal difficulty concerns the changing practical consequence of recognition, not merely its date.

4.5 Recognition Trajectories

A more precise temporal account separates several possible difficulties. A participant may fail to encounter a relevant event. The event may be encountered but classified through an inadequate category. A plausible interpretation may be formed without gaining collective attention. An acknowledged finding may fail to reach a capable addressee. A capable addressee may understand the finding but choose not to act. These distinctions do not specify a mandatory sequence; inquiry can move back and forth among them.

They do identify different explanatory burdens. Lost access to reports requires an account of observation. Persistent use of an inadequate category requires an account of interpretation. Exclusion from a decision forum requires an account of recognition and power. Deliberate inaction requires an account of reasons, incentives, or responsibility. Describing all four as an information deficit would misidentify the object of correction. Describing all four as unavoidable lag would obscure choices that could have been made otherwise.

The distinctions also qualify a temporal comparison. An institution can appear slow because its official acknowledgment occurs late, even when local participants recognized the problem much earlier. A person can appear prescient because a vague concern is later reinterpreted as a precise warning. To assess either claim, the inquiry needs the content and practical context of the earlier understanding, not just the dates of statements. The question is what was recognized, by whom, with what grounds, and with what available consequence.

Recognition can be distributed. One participant knows that a role has lost authority, another that an alternative route remains open, and a third how to make a temporary arrangement effective. No single participant need hold a complete interpretation for their combined action to preserve cooperation. Distributed cognition provides a neighboring approach to such units of analysis [21]. It supplies no

guarantee that distribution will be timely: coordination among these partial understandings can itself be the missing capacity.

This possibility alters the image of cognition catching up with a moving reality. The practical objective may be to assemble enough relevant understanding to alter a particular exposure, while other questions remain unsettled. Later recognition need not be one comprehensive account held by a single observer. It can be a limited coordination of perspectives whose adequacy is relative to a stated task and open to subsequent criticism.

4.6 Later Recognition

Later recognition has several possible achievements. It can improve an account of an earlier episode, alter a present commitment, support compensation, or redirect future interaction. These achievements are separable. A persuasive historical reconstruction may arrive too late to prevent the harm in question while still mattering for responsibility or future conduct. Calling a correction late must therefore identify the purpose for which it has lost efficacy; it cannot declare all later understanding useless.

Preserving an alternative can allow a later, still incomplete interpretation to influence conduct. It cannot guarantee that the interpretation will improve, that participants will share it, or that the alternative will remain desirable. This is why reversibility enters the paper as a practical condition of some trust relations rather than a solution to epistemology. The argument asks how changing understanding can retain a consequential place in the relation without assuming a final common account of that relation.

4.7 Interpretive Warrant

Fallibility does not make every later interpretation equally defensible. An interpretation can fit the available record more adequately, explain previously unresolved discrepancies, distinguish capacities earlier conflated, or make its assumptions available for criticism. It can also fail by suppressing relevant testimony, treating a contested category as neutral, or using the outcome to rewrite what participants could have known. These are possible grounds for comparative assessment, not a context-free scoring rule.

The relationship between truth and practical consequence also needs care. An interpretation can become institutionally effective through authority while remaining mistaken. A well-supported interpretation can remain practically ineffective because its bearer lacks standing. The power to make an account consequential is therefore neither a necessary nor a sufficient indication of its truth. The GR distinction between relational efficacy and manifestation does not resolve this epistemic problem; it keeps the questions from being collapsed.

For public discussion, a defensible account should make disagreements inspectable. It should identify the evidence supporting a description, the inferences connecting that evidence to a commitment, and the points at which a normative judgment enters. Another participant can then accept one part while contesting another. This is more informative than presenting one total description of the relation as a condition of cooperation.

Such openness can have practical limits. Some information cannot be disclosed without creating a new exposure, and some disagreements must be decided for an activity to proceed. A limited decision need not be presented as the closure of every interpretive question. The distinction allows practical determination to coexist with recorded uncertainty, later review, or a narrower commitment. Whether such an arrangement is available must be established in the particular relation rather than inferred from its desirability.

The point of preserving alternatives is consequently not to ensure that the future is epistemically superior. It is to avoid making an unnecessary practical finality out of a present interpretation whose limits are known. When finality is justified by protection, resource constraints, or the commitments of others, those reasons should be stated directly. Their force need not depend on claiming that the present account has become complete.

5 Trust Development

This section follows trust development through formative interaction, shared history, maintenance, distrust, rupture, and renewed participation. Its objective is to explain how a changing response regime can alter the significance of each process. The method compares the functions that interactions can perform with the dependencies that make those functions possible. Trust formation remains connected to maintenance because an emerging relation may have to revise its supports before its initial expectations have become well established.

5.1 Trust Formation

An initial cooperative act can provide evidence about a participant and help establish capacities for subsequent cooperation. Making a limited commitment can reveal whether a representative communicates accurately, whether local participants comply, and whether a discrepancy can be discussed. The interaction can also establish a record, a contact, or a practice of clarification. Trust formation in this situation therefore involves both learning about a relation and participating in its development. This recursive structure is already part of the prior trust analysis [16].

The near-critical case adds a question about the portability of that learning. If the restoring processes sustaining the first interaction are changing, success provides qualified evidence for the next interaction. A successful limited delivery establishes that delivery under its actual conditions. Extending the inference to a larger commitment requires considering whether the relevant authority, coordination, and recourse remain available. The problem is not that history ceases to matter. It is that the inference from history must follow the dependencies that made performance possible.

The qualification can differ by domain. A successful exchange may remain evidence of willingness to cooperate even after the means of fulfilling a larger promise have deteriorated. It may establish a reliable channel for reporting difficulty without establishing the capacity to remedy that difficulty. Conversely, a failed delivery caused by an identified loss of authority need not erase evidence of honest reporting. Preserving these distinctions can prevent a single episode from being converted into an unrestricted judgment about a partner's identity.

Limited exposure is a candidate way to make such distinctions practically usable. It can allow participants to learn which commitments remain performable without staking an entire relationship on one trial. But there is no inference from "limited" to "safe." The exposure may be small for one participant and consequential for another; even a nominally reversible trial can disclose information that cannot be withdrawn. Its value depends on the nature and distribution of the exposure and on what the trial can actually reveal. Prior work on protected cooperation already supplies bounded commitments as a possible arrangement [17]; the present argument concerns the changed interpretation of their results.

5.2 Formative Interaction

An initial interaction does several possible kinds of work. It can reveal how a participant responds to exposure, establish a convention for later dealings, create a practical capacity for coordination, and give the participants a shared event to interpret. These achievements need not occur together. An exchange can reveal honesty without establishing an effective procedure; a procedure can work without generating interpersonal confidence. Assessing formation requires identifying which achievement is being claimed.

The distinction matters when the interaction changes the relation through which its result will be interpreted. A successful trial may give a representative authority to undertake a larger task. That authority changes the practical situation: the next exposure is not simply another observation of the same capacity. It may require new coordination, affect different parties, or create dependence on the representative's continued standing. The first success is relevant evidence, but the inference to the enlarged commitment must be defended rather than treated as automatic.

A failed trial can also be formative. If failure is reported accurately, the participants may learn that the reporting relation is more dependable than the performance capacity. They can then revise the task while

retaining the communication channel. If the failure is concealed, both performance and interpretation may become harder to assess. The distinction shows why counting successes and failures alone can miss what a formative encounter has generated.

Near a possible transition, a trial can also affect the trajectory it is intended to reveal. An undertaking may strengthen recognition of a new coordinating role, while withdrawal can weaken the role's practical authority. The participants are therefore not always testing a capacity independently of their own participation. This does not invalidate the trial. It changes the claim it supports: the observed capacity may be a capacity of the relation under that pattern of participation, rather than a property the partner would possess under all conditions.

The practical implication is to connect the interpretation of a trial to its constitutive conditions. Which participants enabled it? Which burdens made it possible? Which authorities recognized it? Which conditions are likely to survive the next undertaking? These questions can support a reasoned extension of trust while retaining the possibility that some initial success will not scale. They also identify where further experience would be informative, instead of treating all additional exposure as useful learning.

5.3 Mediated Entry

A relation can begin through an intermediary whose history is more established than the history between the eventual partners. The intermediary can introduce participants, certify a limited fact, translate an undertaking, or make recourse available. These roles create different grounds for participation. Confidence in accurate introduction does not establish confidence in the intermediary's ability to enforce performance. A certification of competence does not establish an acceptable distribution of exposure.

Mediation can make a limited start possible while leaving the emerging partners substantial reasons for caution. The resulting cooperation does not demonstrate that they already trust one another deeply. Some confidence may remain attached to the intermediary, some to a procedure, and some to the partners' own emerging history. Describing these orientations separately helps identify what a subsequent disruption changes.

If the intermediary's recognized role is itself changing, the entry conditions can shift before the new relation has acquired independent supports. A person who was accepted as a translator may become identified with one side. A guarantee may remain documented after the guarantor loses the ability to fulfil it. An apparently direct failure between the partners can then originate in a changing mediated relation.

This dependence does not entail that intermediaries should be avoided. Direct interaction also has histories and constraints, and a mediator may preserve access that would otherwise disappear. The near-critical question concerns the portability of the mediator's standing and capacities through the contemplated transition. It asks which parts of the emerging relation can continue if that role changes and which would require a new ground for participation.

5.4 Shared Historical Experience

Having participated in the same event does not guarantee a shared interpretation of it. One partner may remember successful coordination; another may remember having absorbed an unacknowledged burden to prevent failure. Both can accurately report the visible success. Their different histories become relevant when the event is later used as evidence that a larger commitment is safe or fair.

Shared history is therefore more than a common chronology. It can include an ability to compare accounts, recognize asymmetries, and understand how a joint achievement was sustained. Where that ability is absent, a favorable official history may conceal different expectations about the future. Near a transition, those differences can become consequential because the earlier distribution of support no longer holds.

Consider a partnership maintained by one participant's informal effort to repair small discrepancies. Its success may generate confidence on both sides, but only one side may know how much repair was required. If that participant's capacity declines, the record of success can overstate the resilience of the

formal arrangement. A fuller history would identify the work that made the successes possible and the conditions for its continuation.

The same analysis also shows how shared experience can improve adaptation. Participants who understand one another's constraints may detect changes sooner and distinguish a need for assistance from an intention to defect. The benefit depends on how the history was interpreted and retained. Familiarity can support such understanding, but familiarity by itself can equally preserve an outdated image of the partner.

5.5 Trust Maintenance

Maintenance requires more than repeated favorable judgments. Participants must reproduce enough of the practices supporting the relation for those judgments to remain consequential. This can involve retaining a channel for reporting failure, preserving the ability to fulfil a commitment, or distinguishing a local disturbance from a general withdrawal of cooperation. Trust can contribute to that reproduction by making time for clarification and reducing immediate defensive reactions.

The same favorable orientation can also screen out evidence of changed capacities. An established history may encourage participants to reinterpret every failure as an exception, even when the process that once repaired exceptions is disappearing. This hazard does not originate with the present paper. Möllering and Sydow examine self-reinforcing interorganizational trust that becomes difficult to abandon after it has been jeopardized [27]; prior GR work distinguishes interpretive buffering from closure [16].

For the present problem, the distinction turns on access to revision. Buffering can hold a judgment open while a relevant explanation is sought. Closure can deprive contrary findings of any route to change the relationship. A promise to investigate is therefore informative only in conjunction with the ability to register disagreement, identify who can respond, and alter an affected commitment. These capacities do not ensure a correct judgment. They distinguish a continuing opportunity for assessment from the mere postponement of an unchangeable conclusion.

Near-critical susceptibility can make this distinction consequential without deciding it in advance. Patient interpretation may prevent an avoidable cascade of withdrawals. The same patience may permit further commitments while the means of containing their failure are being lost. Which process is occurring depends on evidence about the restoring supports, the specific exposures, and the availability of practical revision. Neither stronger trust nor faster withdrawal follows as a general prescription.

5.6 Maintenance Practices

Maintenance can involve modest recurrent activities whose importance becomes apparent only when they cease. Participants clarify small anomalies, communicate changes of responsibility, renew permissions, and preserve access to relevant records. These activities do more than express an already existing attitude. They can reproduce the practical relation within which an attitude of trust remains reasonable and effective.

The effort is often unevenly distributed. One participant may perform the translation, remember exceptions, or initiate repair after every ambiguous incident. The relation's apparent ease can depend on that work being unrecognized. When the capacity or willingness to perform it changes, an observer may misclassify the resulting difficulty as a sudden loss of goodwill. The more precise question is which maintenance practice had been containing the disturbance and why it ceased to do so.

Maintenance also requires decisions about attention. Not every ambiguity can be investigated at equal depth without making cooperation prohibitively demanding. Trust can permit participants to devote attention elsewhere. Yet the categories used to decide which anomalies matter need to remain responsive to changing capacities. A routine exception under the old arrangement can become an early indication that the arrangement no longer performs the same function.

A workable practice may therefore combine ordinary reliance with opportunities for focused reassessment. What warrants reassessment can include a changed role, repeated failure of a previously effective

repair, or a credible report from a participant whose experience was not represented. These are proposed reasons for investigation rather than universal alarm thresholds. Their adequacy depends on the cooperative task and the costs of both investigation and continued exposure.

Reassessment should itself be intelligible within the relation. If asking for reasons is automatically interpreted as disloyalty, the practical cost of correction rises. If every concern automatically suspends all undertakings, coordinated action can become impossible. The relation needs some way to distinguish an inquiry, a protective restriction, a withdrawal of confidence, and a termination. Establishing those distinctions is part of maintaining cooperation through change, not evidence that trust has become unnecessary.

5.7 Protective Distrust

Distrust can organize conduct rather than merely indicate an absence of positive confidence. Participants may seek independent records, restrict disclosure, decline delegation, or retain alternatives because they anticipate a particular failure. Prior GR work examines these productive and potentially self-reinforcing effects [16]. The distinction from low trust matters here because a protective practice can remain active within a relation that also contains substantial cooperation.

The object of distrust should be identified. Distrust of a reporting channel can justify independent verification without establishing the unreliability of every person whose statements pass through it. Distrust of one actor's capacity can coexist with confidence in that actor's willingness to disclose limitations. Such distinctions prevent a local protection from becoming an unrestricted identity judgment without further reasons.

The protective practice can nevertheless change the relation. Monitoring may reveal a failure, but it may also alter the conduct being monitored or be understood as a withdrawal of recognition. Retaining an alternative can protect one participant while weakening the assurance on which another's investment depended. The possibility of these consequences does not invalidate the protection. It requires examining both the reason for it and its effects on subsequent interaction.

Near a possible transition, protection can either contain propagation or participate in it. A carefully delimited suspension can prevent one disputed commitment from bringing down other cooperation. An unexplained withdrawal can be interpreted as general defection and prompt reciprocal withdrawals. The difference cannot be read from the word "distrust." It depends on the relation's history, the scope of the action, and whether a usable channel remains for interpreting what the action means.

Nor should concern about propagation be used to require the exposed participant to continue indefinitely. A powerful partner can invoke the fragility of cooperation to make every refusal appear irresponsible. A defensible analysis must retain the possibility that protective distrust is warranted even when it has destabilizing consequences. Responsibility for those consequences cannot be assigned solely to the participant whose refusal makes an existing dependency visible.

5.8 Differentiated Reassessment

The resulting assessment can remain favorable in some respects and become restrictive in others. Participants might retain confidence in honest notification while reducing reliance on unenforceable promises. They might preserve a shared record while declining its interpretation by a forum whose authority is now contested. This differentiated reassessment avoids assuming that the relation must be classified as either wholly trustworthy or wholly untrustworthy.

The possibility also limits the inference from ongoing cooperation to successful trust maintenance. Activity may persist because exit is costly, alternatives have closed, or one participant controls the terms of interpretation. A record of continued transactions can then coexist with depleted trust and reduced agency. The analyst must examine the basis on which participants continue, including the commitments they can refuse or revise. Otherwise persistence becomes a misleading proxy for the quality and practical constitution of the trust relation.

5.9 Relational Rupture

Some events change more than a current assessment. They alter how subsequent conduct is encountered and what participants are willing to place at stake. A previously routine delay can acquire a new significance after a concealed failure is discovered. A renewed undertaking can require safeguards that were once unnecessary. Prior GR work treats this historical asymmetry of rupture and repair explicitly [16].

The consequence is that removing the immediate cause of failure need not restore the prior relation. A representative can regain formal authority after participants have learned that it was more fragile than they understood. They now possess a history that changes what renewed assurance means. That history is not an irrational residue to be erased merely because the earlier procedure has resumed.

This asymmetry differs from claiming that repair is impossible. Participants can develop a new relation that incorporates the failure through different undertakings, more explicit boundaries, or changed recourse. The relation may become more dependable in some respects while retaining less affective ease. It may become more open to challenge while supporting narrower exposure. Those combinations cannot be evaluated by asking only whether the previous level of reported trust has returned.

Near-critical susceptibility can intensify the asymmetry when the rupture helps reorganize the supports of later interaction. A failed commitment may cause a coalition to disperse, a forum to lose standing, or an alternative practice to acquire authority. Reestablishing the earlier promise then requires more than correcting a belief about it. The practical field in which the promise could operate has changed. Whether reconstructing that field is possible or desirable is a further question, not an implication of the wish to repair.

5.10 Renewed Participation

Renewal can begin with a commitment whose limits are understood more clearly than those of the earlier relation. A participant might agree to exchange records while declining material exposure, or accept a bounded task while retaining an independent route of review. Such participation can generate new evidence without requiring an immediate return to the former arrangement.

The significance of renewal depends on what has changed. A public reassurance can matter by acknowledging an experience previously denied, but it cannot alone demonstrate repaired capacity. A new procedure can improve recourse, but its existence does not establish that affected people can use it. A completed trial can show that a limited commitment was performed, but it cannot settle every future question. Each achievement should be evaluated on its own grounds before being extended to the relation as a whole.

Renewal also has a temporal dimension. An arrangement introduced during transition may need to be reassessed as roles and expectations stabilize. Conditions that made temporary participation acceptable may be unsuitable as permanent terms. Conversely, a safeguard created after failure may remain valuable even when confidence improves. The disappearance of visible conflict is therefore an insufficient reason to remove the capacities that made renewed participation possible.

The development of trust through transition is consequently a history of differentiated undertakings and changing supports. It can produce deeper trust, limited reliability, stable disagreement, or a defensible ending. The next section examines what must connect these stages if an earlier exposure is to retain a meaningful relation to later recognition and action.

6 Cooperative Continuity

The central practical question is what can remain sufficiently continuous for trust and cooperation to retain a meaningful future when their supports change. This section distinguishes continuity of a name or procedure from continuity of consequential commitments and access to revision. It develops conditional possibilities rather than a universal requirement to preserve relationships.

6.1 Continuity Carriers

A continuity carrier is an identifiable practice, commitment, record, or capacity through which an earlier interaction remains consequential after a change. A retained record can carry evidence of an undertaking; a successor's acknowledgment can carry responsibility for it; an accessible review process can carry standing to contest its interpretation. These roles are different. Preservation of the first does not imply preservation of the second or third.

This distinction allows continuity to be investigated without assuming unchanged actors or fixed procedures. A reorganized institution may acknowledge earlier obligations through a new representative. A disputed forum may transfer records and pending claims to another forum. A joint project may replace a contested convention while retaining a procedure for identifying whose exposure requires reconsideration. The relevant question is whether the change preserves or reconstructs the specified practical connection, not whether the institutional label remains the same.

For the particular route of continuing cooperation through revisable commitments, three connections matter. Participants must have some way to identify the conduct or exposure at issue; there must be an effective route for an affected participant to register a concern; and some actor or arrangement must be able to change the relevant conduct, commitment, or remedy. These are functional requirements of that route, not a universal definition of every possible cooperation. A one-off exchange can occur without an ongoing review relation. Equally, spontaneous restraint can preserve safety without preserving a shared institutional record.

The connections need not rest on an agreed account of the whole relationship. Participants can disagree about responsibility while recognizing the same pending delivery and accepting that it may be suspended for review. Such partial coordination requires enough mutual intelligibility to identify the action and its consequences. If even that limited connection is absent, invoking relational continuity does not supply it. Mediation or institutional reconstruction would then be an additional accomplishment requiring explanation.

6.2 Continuity Criteria

Continuity can be assessed through several different connections. There can be continuity of documentary identity, continuity of the capacity to perform a task, continuity of responsibility for an undertaking, or continuity of affected parties' access to challenge. No one of these establishes the others. The substantive question is which connection matters to the claim being made about trust.

Documentary continuity can make a past undertaking traceable without making it enforceable. Practical continuity can preserve a service while leaving earlier responsibilities unacknowledged. A successor can accept responsibility without possessing the capacity to remedy every loss. These combinations explain why a judgment that the institution has survived can be too coarse to settle the future of a particular trust relation.

The same differentiation applies to participants. A person may remain the bearer of an earlier experience while changing what they regard as acceptable exposure. Continuing identity does not require unchanged preferences or a duty to resume the earlier relation. An organization can inherit responsibilities through recognized succession without inheriting the personal confidence associated with its former representatives. Trust across a transition therefore needs an account of relevant continuity, not an assumption that everything either persists or disappears.

A proposed criterion should also disclose its normative content. Saying that a service continued describes a practical connection. Saying that its continuation adequately respected earlier claims requires further reasons. A transfer can be efficient and still erase the voice of those whose contributions made it possible. A more inclusive transfer can be slower or costly while preserving responsibilities that a purely functional description would omit.

The argument does not supply a universal ranking of these continuities. It requires that the selected criterion fit the research question and that omitted connections remain visible. For trust in an undertaking, the connection between expectation, performance, and answerability is particularly important.

A claim that trust has been preserved should identify how that connection continues, which parts were reconstructed, and where the relation has instead ended.

6.3 Transitional Recognition

Continuity across changing procedures presents a further difficulty: the authority of a successor arrangement may itself be disputed. A formal transfer of records does not guarantee that affected participants can use them, that the new forum recognizes their standing, or that its decisions have force. The analysis must therefore examine the transition between arrangements, including any overlap during which commitments can be acknowledged and concerns carried forward. Where that overlap is unavailable, some obligations can lose their practical addressee even though their documentary trace survives.

There is no indefinitely secure procedure behind this account. Every proposed carrier can depend on further relations whose stability is limited. The claim is local and time-bounded: an identified carrier can provide adequate support for a specified commitment during a specified change. It is not necessary to establish an invariant foundation of all interpretation before making that judgment. It is necessary to disclose which dependencies have been treated as sufficiently stable and what would defeat the judgment. Prior work on heterogeneous diplomacy already connects interpretive divergence to standing and the reopening of arrangements [11].

This local account also permits continuity through termination. A relationship can end while participants preserve pending claims, responsibility for harm, and access to a remedy. Those continuities may matter more than continued joint activity. Conversely, a project can continue while extinguishing the standing of those previously exposed to it. Describing both as persistence would obscure the practical object whose continuity matters.

6.4 Temporal Organization

Different tasks require different temporal arrangements. Detection, interpretation, collective deliberation, immediate protection, and long-term reconstruction need not operate at the same pace. A relation can preserve rapid action through a limited mandate while reserving a slower process for determining responsibility. It can also act slowly in a way that protects deliberation while exposing some participants to accumulating harm. Speed has no uniform epistemic or normative value.

The prior GR trust account already distinguishes learning, anticipation, crisis response, and the restoration of ordinary review after temporal compression [16]. The present concern is what happens when the supports connecting these temporal processes change. An emergency role may remain effective after its route of later accountability disappears. A careful investigation may continue while the people capable of acting on its findings lose authority. Neither process is adequately assessed by its internal quality alone.

A revision window is therefore relative to an object and an intervention. The opportunity to suspend a departure can close before the opportunity to secure return; that can close before the opportunity to compensate a loss. The evidential opportunity to reconstruct the episode may persist longer still. There is no single time at which correction becomes universally useless. Each claim of lateness should identify the action whose opportunity has narrowed or disappeared.

Windows can also be produced rather than merely discovered. Dividing an undertaking into stages can create a point for reassessment. Retaining records can preserve later inquiry. Arranging temporary protection can prevent the demand for immediate clarity from forcing a premature commitment. These arrangements require capacities and coordination; they are not free extensions of time. Their value depends on the exposure they preserve the ability to alter.

Near a transition, the window itself can change as the response regime changes. A review period that previously allowed effective intervention may become inadequate after local authority fragments. Conversely, new mediation may make an alternative available that appeared closed. Fixed procedural deadlines therefore need an account of the functions they are expected to perform. A formally timely response can still be practically late for the relevant purpose.

Table 2: Practical purposes of revision. Availability depends on the particular relation, the affected participant, and the time.

Purpose	Required practical connection	Distinct possible limitation
Prevent exposure	A finding can alter the pending action.	The action has already occurred or cannot be stopped.
Contain consequences	A capable participant can limit continuing effects.	Control over the relevant process has been lost.
Provide remedy	A claim can reach an accountable and capable addressee.	Standing survives on paper while effective recourse disappears.
Revise future interaction	A finding can affect later commitments or protections.	The relation excludes the finding or lacks feasible alternatives.
Reconstruct the past	Records and perspectives remain accessible to inquiry.	Surviving accounts omit relevant experience or provenance.

Temporal coordination also concerns who must wait. One participant’s deliberative time may be another’s period of exposure. A request for patience can preserve the first party’s interpretive flexibility while exhausting the second party’s ability to continue. The assessment should identify this relation between their times, rather than treating delay as an equal quantity experienced by all participants in the same way.

6.5 Practical Revision

A meaningful alternative is an action that remains accessible to the relevant participant and capable of making a difference to the exposure or commitment at issue. Its presence on an official list is insufficient. A nominal right to leave may be unusable because exit destroys access to essential resources; a right to appeal may be unusable because the appeal cannot suspend an irreversible action. Accessibility and consequence must therefore be evaluated for particular participants.

Practical revisability concerns the retention or reconstruction of such alternatives. It differs from reversal of history: a disclosure cannot be made undisclosed, and recognition of an error cannot make a suffered harm never have occurred. Revision can instead alter future conduct, reallocate an obligation, support compensation, or protect exit. The value of future information under irreversible choice is established territory [1]; adaptive pathways also connect action, monitoring, lead times, and future options [4]. The additional question here is whether the interpretive and practical supports required to use an option survive the relational change.

For a correction to affect an identified commitment, an actionable finding, a route to a capable addressee, and a feasible alteration must connect. If the finding arrives after the relevant alternative has closed, improving its accuracy cannot alone recover that alternative. If the alternative remains open but the affected party has lost standing, mere physical reversibility is likewise insufficient. This explains why timing and access must be analyzed together. It does not imply that earlier intervention always improves the outcome: an early but poorly grounded accusation can itself damage the supports on which cooperation depends.

The distinction among possible achievements of correction is summarized in Table 2. The table does not rank them. It identifies why a relation can retain one form of revisability while losing another and why assessment must follow the affected commitment rather than a general claim that an arrangement is reversible.

6.6 Commitment Requirements

Meaningful cooperation can require closing alternatives. Participants invest effort, specialize, and rely on a commitment extending beyond the next opportunity to reconsider it. If every undertaking could be

withdrawn without consequence whenever a more attractive option appeared, some cooperative capacities would never be created. The value of revision must therefore be considered alongside the value generated by durable commitment.

This tension is already present in the prior analysis of trust, possibilities, and irreversibility [16]. Its significance near a transition is that the content and support of a commitment may change while other participants remain dependent on its continuation. A unilateral appeal to revisability can then displace burdens onto those whose plans the commitment helped generate. The existence of uncertainty does not erase that history.

A useful distinction concerns revision of a commitment's terms and release from all responsibility for it. A participant may have good reason to renegotiate an undertaking that has become impossible while retaining reasons to disclose the problem promptly, contribute to a transition, or address resulting harms. Those responsibilities require context-specific justification. Their possibility shows why revisability need not mean costless withdrawal.

Conversely, commitment cannot justify unlimited exposure merely because another participant has come to depend on it. The original undertaking may have had limits, its conditions may have changed radically, or its continuation may impose unacceptable harm. A reasoned assessment should specify the commitment, the change, the relevant expectations, and the feasible alternatives. Neither permanence nor maximal optionality supplies a sufficient principle by itself.

The practical task is to preserve enough determination for participants to act while retaining justified routes for revision. The balance can differ across commitments within the same relation. A duty to preserve records might persist after joint activity ends; a temporary authorization might require renewal before further exposure; a remedy might remain owed even when renewal is refused. Treating these objects separately makes the normative problem more tractable without pretending to solve it by one metric.

6.7 Exposure Allocation

Preserving alternatives consumes resources and distributes exposure. Keeping a project provisional can protect one participant's options while requiring another to maintain staff, absorb uncertainty, or delay other opportunities. Existing GR analyses address the resource conditions of maintaining revisability and the unequal burdens of legibility [12, 14]. The present paper uses these as constraints on its continuity argument, without developing a separate theory of resource allocation.

An assessment of continued cooperation must consequently specify whose options remain available, whose costs finance that availability, and whether those bearing the costs can contest them. Delay can be justified by the prospect of meaningful revision, but that prospect does not make every burden acceptable. Nor is every delay unjust: some temporary burdens may be reciprocally accepted or justified by protection against greater harm. A normative conclusion requires reasons about those burdens and the affected parties' claims, beyond the descriptive fact that a relation can persist.

Urgent protective action can also close alternatives justifiably. If continued exposure threatens serious harm and no adequate protective arrangement is available, preserving the cooperative relation may be the wrong objective. Trust analysis should make that possibility intelligible. Its practical contribution is to clarify the conditions of continued or revised participation, including the possibility that a defensible relation to past commitments survives only through exit.

The burden of maintaining a relation should also be distinguished from the burden of demonstrating that it is safe. A participant with better access to records can demand further proof from someone who lacks that access. A request for clarification can then prolong dependence rather than improve collective understanding. The difficulty is not resolved by the formal availability of review; it concerns the distribution of the means needed to use review.

This possibility makes the interpretation of silence particularly important. A participant may stop raising concerns because the relation has improved, because further challenge seems futile, or because maintaining the challenge has become too costly. Continued participation after silence therefore requires

careful interpretation. Evidence of practical access, supported refusal, and the handling of earlier concerns can help distinguish the possibilities.

Near-critical susceptibility can intensify the distributional problem when changing supports shift who must absorb uncertainty. A coordinator's effort to hold a coalition together may require others to accept exposures they did not previously bear. The coordinator's confidence in eventual repair does not itself authorize that transfer. The trust relation should be assessed from the positions of those whose options and burdens are changing, including affected parties outside the central cooperative pair.

6.8 Defensible Termination

Termination is a possible outcome of a well-conducted assessment. A relation may no longer support acceptable exposure, or the only available form of continuity may require erasing important claims. Refusal can then be a reasoned response to what the relation has become. It need not be diagnosed as a failure to trust sufficiently or an inability to tolerate ambiguity.

At the same time, termination does not make every remaining connection disappear. Responsibilities for records, pending claims, confidentiality, or the consequences of reliance may continue in some form. A comprehensive account should ask which commitments survive and which capacities are needed to make them consequential. This allows the relation's ending to be analyzed without confusing it with the disappearance of its history.

Protected termination can also preserve the possibility of a different future relation. It need not promise reconciliation or oblige an injured party to participate again. Its significance is that ending one arrangement need not require destroying every route for later recognition, responsibility, or contact. Whether preserving such routes is feasible and justified remains a substantive question.

The continuity problem thus has several defensible outcomes. Cooperation may continue through reconstructed supports, narrow to a more limited task, pause while a consequential review proceeds, or end while selected responsibilities persist. The following comparisons examine the different dependencies that can make these outcomes intelligible.

7 Relational History Geometry

The formal investigation begins with the historical object that carries a trust relation. Its purpose is to distinguish the continuation of a name or boundary arrangement from the continuation of the capacities on which a commitment depends. The construction first specifies heterogeneous local processes and their causal order, then a two-dimensional history representation, then composition and the conditions for a sufficient summary. The results concern declared representations. They neither posit physical spacetime for social relations nor derive social dynamics from quantum gravity.

The starting points are inherited. Prior trust work uses a relational configuration, history-conditioned updating, and endogenous observation [16]. The heterogeneous-network account separately specifies local processes, partial propagation, and a combinatorial history model [7]. Keeping those levels distinct prevents the two-complex from acquiring an evolution law merely because it depicts events. Table 3 states the roles of the formal registers used in the following sections.

7.1 Heterogeneous Local Processes

Let I be a finite set of component indices. A component can represent an organizational process, an archive, a mediator, or a participant's relevant activity. It need not represent an entire person. For each $i \in I$, let S_i be its state set, A_i its admissible input set, and E_i its emission set. The sets may differ in mathematical kind. Following the prior notation, the component n_i has the typed structure in Equation 1; $\emptyset$ in the emission codomain is a distinguished symbol for no emission.

$$\begin{aligned} n_i &= (S_i, A_i, E_i, \varphi_i, \epsilon_i), \\ \varphi_i : S_i \times A_i &\longrightarrow S_i, \quad \epsilon_i : S_i \times A_i \longrightarrow E_i \cup \{\emptyset\}. \end{aligned} \tag{1}$$

Table 3: Formal investigation registers. Each construction answers a different question about the same selected trust relation; passage between registers requires the stated additional data.

Register	Analytical question	Required additional data
Historical geometry	Which elements, couplings, and responsibilities continue?	Identity correspondences, causal order, incidence, boundary gluing
Revision operators	Which operations remain feasible, observable, and consequential?	History-sufficient configurations, action domains, observation and target maps
Support fields	Which local mismatches are restored, and which modes lack support?	Local vector spaces, interface maps, metrics, anchoring, evolution law
Critical dynamics	When does a specified restoring regime lose stability?	Calibrated modes, coupling parameters, nonlinear completion, comparison mechanisms

Here φ_i specifies the update and ϵ_i its possible emission. A propagation map $\Pi_{ij} : E_i \rightarrow A_j$ is partial: an emission need not be receivable at every other component. The resulting update at j is performed by φ_j , with its own state and interpretive history. Receipt consequently does not establish identical interpretation.

A changing mediator is represented by another component with its own state and two appropriate propagation maps. This inherited construction allows a review channel to change its intake criteria or authority while the outward message remains the same. A fixed communication edge would otherwise conceal precisely the dependency at issue. No metric between S_i and S_j is introduced, and a joint record of their states does not identify their meanings.

7.2 Causal Cuts

An occurrence records a component, its pre-update state, and the input it consumes. Fix a finite run U of occurrences with a same-component succession relation σ and a delivery relation δ . At each component, succession linearly orders its occurrences and their recorded states follow φ_i from a specified initial state. Delivery must respect the emitted values and partial propagation maps. Assume that the union of succession and delivery has no directed cycle. The strict causal order $\prec$ and a cut D are defined in Equation 2, where the superscript $+$ denotes transitive closure.

$$\prec = (\sigma \cup \delta)^+, \quad D \subseteq U, \quad (v \in D \text{ and } u \prec v) \implies u \in D. \quad (2)$$

Thus a cut is a causally complete initial part of the run. The state assigned to a component at D is the result of its latest included local occurrence, or its specified initial state if none is included. Occurrences unrelated by $\prec$ remain concurrent. A drawing or enumeration can order them for convenience without turning that ordering into a causal fact.

For trust, distinguish the occurrence of a capacity change, the occurrence of a participant's recognition, the institutional uptake of that recognition, and an action affecting exposure. A recognition can precede a departure in one participant's record while its delivery to the actor able to suspend departure follows the departure. The formal object is the relevant chain of dependence, not a universal amount of epistemic delay. If two occurrences are concurrent, the bare order supplies no judgment about how many minutes apart they were.

This treatment preserves the distinction between ordinal ordering and calibrated duration developed in the temporal-emergence account [8]. The differential equations below add a local time parameter explicitly. Their rate calculations are not extracted from Equation 2 alone. Similarly, a causal path documents a stipulated route of influence; establishing that route historically requires evidence of what was delivered, registered, and acted upon.

7.3 Boundary Incidence

The local-process model specifies what can change. A separate representation records the internal composition of a change. Retain the source's boundary notation $\Gamma = (P, C, \iota)$, where P is a finite set of primitive elements, C a finite set of couplings, and $\iota : C \rightarrow \mathcal{P}(P)$ assigns the elements joined by each coupling; $\mathcal{P}(P)$ is the power set of P . Each coupling joins at least two elements and each element participates in at least one coupling. An element is primitive relative to the selected description, not indivisible in reality.

The inherited graph presentation adds the incidence restriction in Equation 3.

$$1 \leq |\{c \in C : p \in \iota(c)\}| \leq 2 \quad \text{for each } p \in P. \quad (3)$$

Under this restriction, graph vertices are couplings and graph edges are elements; an element incident to one coupling is a half-edge. This assignment is important for consistency: it differs from the familiar convention that places actors at vertices and relations on edges. A trust relation is not automatically represented by one edge, and an actor is not automatically one primitive element.

A design might take a particular undertaking, a retained authorization, and a reviewable record as elements, with couplings recording specified dependencies among them. A history-bearing actor can then occupy a labelled subconfiguration containing several elements and couplings. Different actors' descriptions need not share a primitive set. Where an element participates in more than two couplings, the present graph presentation requires an explicit refinement through ports or auxiliary junctions. Whether that refinement preserves the relevant commitments and possible operations must be argued; adding junctions is not automatically a semantically neutral operation.

7.4 Historical Two-Complexes

Following the prior history model, let $F = (V, E, \Phi)$ be a finite oriented two-complex with specified incoming and outgoing boundaries. Its vertices V represent rearrangement events, its edges E represent histories of couplings, and its faces Φ represent histories of primitive elements. The free ends of faces and edges determine the boundary elements and couplings, with incidence inherited from the complex. The symbols E_i in Equation 1 denote emission sets; the unindexed E here denotes history edges. They perform different typed roles.

The term relational spacetime refers here to this incidence and occurrence structure. It supplies neither a Lorentzian metric nor a privileged spatial embedding. A planar diagram is only a presentation. Topological properties belong to the represented complex, while a claim about a social capacity still requires a justified connection to that property [20].

Identity across an event is supplied by partial injections between earlier and later primitive sets. Elements outside the domain terminate; elements outside the image begin. Coupling identities likewise require an explicit correspondence. Accordingly, saying that a claim survives institutional reorganization is an assignment to be supported, not a result obtained from its repeated wording. A dispute about succession can appear as a dispute about which face or coupling edge continues.

For an event v , let $\partial_{\text{in}}v$ and $\partial_{\text{out}}v$ denote its incident boundary configurations. After placing identified couplings in a common label set, the created, terminated, and persisting coupling sets are given by Equation 4.

$$\begin{aligned} \text{Cr}(v) &= C(\partial_{\text{out}}v) \setminus C(\partial_{\text{in}}v), \\ \text{De}(v) &= C(\partial_{\text{in}}v) \setminus C(\partial_{\text{out}}v), \\ \text{Pe}(v) &= C(\partial_{\text{in}}v) \cap C(\partial_{\text{out}}v). \end{aligned} \quad (4)$$

These set differences reconstruct a transformation relative to the supplied identification. A restoration can create a new coupling with the same function as a terminated one without making its history uninterrupted. For example, a review forum can be reconstituted after a period in which no actor had authority to suspend

an exposure. The final boundary may again support review, while the intervening exposure remains part of the relation's history.

The construction is inherited as a representation of histories. The current application adds declared decorations: which component produced an event, which commitment was affected, which party had standing, and which constraint was violated or preserved. Those decorations are needed to connect the history model to the local-process model. The bare incidence structure does not determine any of them.

7.5 History Composition

Two histories F_1 and F_2 can be composed when a specified isomorphism $\alpha : \partial_{\text{out}} F_1 \rightarrow \partial_{\text{in}} F_2$ preserves element and coupling types, incidence, orientation, and the decorations required by the inquiry. Rename cells away from the common boundary so that they are disjoint. Identifying corresponding boundary ends then produces $F_2 \circ_\alpha F_1$. Each continued element and coupling must have exactly one corresponding end on each side. These conditions retain the source's gluing discipline [7].

Proposition 7.1 (Associative history composition). *For three histories satisfying those boundary, freshness, and consistency conditions, sequential gluing is associative up to an incidence- and decoration-preserving isomorphism. It does not require an inverse history.*

Proof. Begin with the disjoint union of the three cell sets. The two chosen seam maps prescribe pairs of ends to identify. Let $\sim$ be the smallest equivalence relation containing both lists of pairs. Taking the quotient first by the first list and then by the induced second list identifies exactly the $\sim$ classes: every identification made is generated by the two lists, and every finite chain from either list becomes identified. Reversing the order of the two quotients produces the same classes. Incidence and required decorations descend because both seam maps preserve them. Face and edge consistency prevent an intended continued cell from acquiring an unmatched seam end, while freshness prevents unintended identifications elsewhere. The induced bijection between the two quotient presentations preserves the resulting cells and their incidence. This is the required isomorphism. The construction only concatenates admitted histories; it supplies no operation reversing an event or erasing its consequences. $\square$

Proposition 7.1 permits a formation episode, a maintenance episode, and a subsequent revision to be investigated in parts without making their assembled history depend on the analyst's parenthesization. Its practical condition is substantive: the end of one episode must be connected to the beginning of the next by a warranted correspondence. If an affected party's claim has no recognized successor, a diagram that simply joins two identically named offices supplies a connection that the case may lack.

7.6 History-Sufficient Configurations

The later operator calculations require a finite configuration space. Introduce a set $\mathcal{H}$ of admitted decorated histories and a summary map $\pi : \mathcal{H} \rightarrow Q$, where Q is its finite image. This finiteness is a modeling restriction, for example to a specified horizon and finite set of relevant distinctions. It is not a claim that relational histories are intrinsically finite-state.

For each operation label a in a finite alphabet $\mathcal{U}$, let $T_a : \text{Dom}(T_a) \rightarrow \mathcal{H}$ append an admitted event or episode. Let $m_{\mathcal{H}} : \mathcal{H} \rightarrow Y$ be a specified observation and $g_j : \mathcal{H} \rightarrow \{0, 1\}$ indicate achievement of purpose j . The subscript j will distinguish preventing exposure from remedying a loss or reconstructing a record. The conditions for transporting these objects to Q are given by Proposition 7.2.

Proposition 7.2 (History-summary sufficiency). *The summary π supports well-defined partial operations f_a , an observation map m , and purpose indicators on Q precisely when histories with the same summary agree on the following data: whether each T_a is enabled; the summary after every enabled T_a ; the observation; and each selected purpose indicator. When these conditions hold, finite admitted operation sequences have summary outcomes determined by their initial summary and operation sequence.*

Proof. For a class $q = \pi(h)$, define $f_a(q) = \pi(T_a h)$ when T_a is enabled. Agreement on domains makes enabledness independent of the representative h ; agreement on successor summaries makes the value independent of that representative. Observation and purpose agreement define $m(q) = m_{\mathcal{H}}(h)$ and the corresponding indicators in the same way. Induction on the length of an operation sequence proves the last assertion: the empty sequence leaves q fixed, and an additional operation has its domain and result fixed by the current summary. Conversely, disagreement on any listed datum makes its proposed value or domain at q depend on the representative, so the corresponding object cannot be well defined through π . $\square$

The intertwining identity expressing the operation part of Proposition 7.2 appears in Equation 5, on the enabled domain.

$$\pi \circ T_a = f_a \circ \pi. \quad (5)$$

An outgoing boundary alone need not satisfy this identity. Two histories can end with the same office, record format, and current authority while only one contains an exposure that can no longer be prevented. If prevention is the purpose, their purpose indicators or subsequent effective operations differ. A sufficient summary must retain that difference, perhaps through an exposure flag and the relevant succession record. Replacing full histories with points is therefore licensed only after the consequences retained by those points have been specified.

The result also explains the analytical value of historical geometry. Formation can create the coupling on which a later inference relies; maintenance can preserve it; rupture can terminate it; renewal can create a different successor. A common endpoint description hides those differences unless it records their practical consequences. The formal investigation does not require a maximal history of everything. It requires enough history for the particular operations, observations, and purposes being studied.

8 Revision Operator Algebra

The operator investigation concerns the relation between what participants can distinguish and what they can still change. Its objective is to give precise conditions for effective revision, including the loss of efficacy through operation order and changing action domains. Starting from a history-sufficient finite configuration space, it constructs operations and an observation algebra, derives a limited-information correction condition, and then calculates purpose-specific reachability. The matrices encode classical operations. Their use introduces no claim that trust is a quantum observable or that social histories possess quantum amplitudes.

8.1 Configuration Operations

Let Q be a nonempty finite configuration set satisfying Proposition 7.2 for the selected purposes. Each $a \in \mathcal{U}$ has a partial transition $f_a : \text{Dom}(f_a) \rightarrow Q$. The domain can depend on authority, standing, retained records, and the phase of an undertaking. An operation available before departure may be unavailable afterward, even when the participant's interpretation improves.

Form the complex vector space $\mathcal{V}_Q = \mathbb{C}^Q$ with its standard orthonormal basis $\{e_q : q \in Q\}$. Basis vectors are labels for classical configurations; linear combinations provide a calculational representation. They do not combine the meanings of different actors' local state spaces. The operation matrix $U_a : \mathcal{V}_Q \rightarrow \mathcal{V}_Q$ is the linear extension of Equation 6.

$$U_a e_q = \begin{cases} e_{f_a(q)}, & q \in \text{Dom}(f_a), \\ 0, & q \notin \text{Dom}(f_a). \end{cases} \quad (6)$$

The zero vector marks a failed composition in this representation; it is not another social configuration. For an admissible word $w = (a_1, \dots, a_k)$, the matrix $U_w = U_{a_k} \cdots U_{a_1}$ follows the operations in their temporal order, with the earliest acting first. If an intermediate operation is undefined, the product on

that initial basis vector is zero. Otherwise induction using Equation 6 yields the basis vector of the final configuration.

An operation can merge configurations, so U_a need not be unitary or even injective. For any subset $S \subseteq Q$, define its projection by $P_S e_q = \mathbf{1}_S(q) e_q$, where $\mathbf{1}_S$ is one on S and zero elsewhere. Let $\mathfrak{A}$ be the unital algebra generated by the U_a , their adjoints, and the observation and target projections defined below. As a finite-dimensional, adjoint-closed matrix algebra with the operator norm, it is a concrete finite C^* -algebra. This states its mathematical type; it supplies no additional feasible actions.

In particular, the operationally admitted products are a selected semigroup of forward operations. The larger algebra also contains sums, differences, and adjoints that need not describe anything participants can do. An adjoint reverses matrix arrows algebraically and can produce a sum of predecessor basis vectors. It therefore cannot be interpreted as a procedure for undoing disclosure or returning to a former relation. This distinction allows operator algebra to investigate irreversible practice without hiding irreversibility inside an assumed inverse.

8.2 Accessible Observation Algebra

Let $m : Q \rightarrow Y$ record the manifestation accessible through a specified channel. Its codomain Y can contain messages, recorded decisions, or other finite descriptions; only the image $m(Q)$ matters here. For a function $g : m(Q) \rightarrow \mathbb{C}$, let M_g multiply a basis vector by the value assigned to its observation. The accessible observation algebra $\mathcal{A}_m$ is defined in Equation 7.

$$\mathcal{A}_m = \{M_g : g : m(Q) \rightarrow \mathbb{C}\}, \quad M_g e_q = g(m(q)) e_q. \quad (7)$$

It is a commutative, adjoint-closed algebra: matrix addition and multiplication correspond to addition and multiplication of g , and the adjoint corresponds to complex conjugation. The constant function one supplies the identity. The state associated with a classical configuration is the evaluation $\omega_q(A) = \langle e_q, A e_q \rangle$. This is positive and unital on the matrix algebra, with no probability interpretation required.

Two configurations induce the same accessible state exactly when their observations agree. The forward direction follows because every $g(m(q))$ then agrees. Conversely, if the observations differ, the indicator function of either observed value yields a matrix that distinguishes them. This elementary result gives a finite classical counterpart of the distinction between a represented configuration and its accessible algebra in prior GR work [20]. The present construction does not import that source's substrate amplitudes or its quantum boundary-state calculation.

An observation refinement is another map $m' : Q \rightarrow Y'$ for which a map $r : m'(Q) \rightarrow m(Q)$ satisfies $m = r \circ m'$. It follows directly that $\mathcal{A}_m \subseteq \mathcal{A}_{m'}$: each old observable is obtained by composing g with r . More observation can thus reveal additional distinctions within a fixed configuration and action model. It does not follow that action domains or transition effects expand. That is a separate change in the f_a .

8.3 Observation-Based Revision

Fix a purpose j and a goal set $G_j \subseteq Q$. Let $K \subseteq Q$ record declared admissibility constraints, independently justified for the inquiry. A goal can be preventing an exposure, providing a remedy, or producing a contestable historical record. These purposes generally have different goal sets. For an initially admissible configuration, the successful one-step operation set is defined in Equation 8.

$$W_j(q) = \{a \in \mathcal{U} : q \in \text{Dom}(f_a), f_a(q) \in G_j \cap K\}, \quad q \in K. \quad (8)$$

For an observation y , let $B_y = \{q \in K : m(q) = y\}$ be its nonempty admissible fiber. A decision using only that observation must select the same operation throughout B_y . Proposition 8.1 states the resulting feasibility condition.

Proposition 8.1 (Uniform revision feasibility). *A deterministic operation selected only from y succeeds for purpose j at every configuration in B_y if and only if Equation 9 holds.*

$$\bigcap_{q \in B_y} W_j(q) \neq \emptyset. \quad (9)$$

Refining the observation, while holding operations, goals, and constraints fixed, preserves any such guarantee on each resulting nonempty subfiber. Perfect discrimination cannot supply a successful operation at a configuration where $W_j(q)$ is empty.

Proof. A successful observation-based choice is one operation belonging to $W_j(q)$ for every possible q ; hence it lies in their intersection. Conversely, any member of that intersection defines a successful common choice. A subfiber imposes a subset of the original membership requirements, so the same operation remains successful. A singleton fiber has intersection $W_j(q)$ itself, which is still empty when no successful operation is available. $\square$

The first part of Proposition 8.1 identifies a genuine information problem: individually feasible corrections can be incompatible across observationally indistinguishable configurations. The last part identifies a different failure: learning which configuration obtains cannot create an absent effective operation. Both failures can coexist when a transforming institution changes its observation channels and its authority to implement review.

This result does not equate a manifestation with all available knowledge. The choice of m fixes a particular channel. Participants may possess other records or practical experience, requiring a refined observation map. Nor does the result show that an information intervention is causally inert. Public disclosure can itself change authority or action domains. Such an intervention changes the operational model and must be represented accordingly; it lies outside the fixed-model refinement comparison just proved.

8.4 Operation Order

A finite example isolates the temporal issue. Let $Q = \{q_r, q_x, q_p\}$, where the subscripts mean ready, exposed, and protected for one specified undertaking. Operation c is an attempted corrective review that can protect a still-pending exposure. Operation d executes departure if protection has not been secured. The transition rules appear in Equation 10.

q	q_r	q_x	q_p
$f_c(q)$	q_p	q_x	q_p
$f_d(q)$	q_x	q_x	q_p

(10)

At q_x review can still occur, but it cannot undo the selected exposure; its effect on this purpose is a self-loop. Other purposes, such as remedy, would require additional configuration data and operations. The absorbing status is relative to prevention, not a claim that an exposed participant has no future at all.

Using the basis order (q_r, q_x, q_p) , Equation 11 gives the matrices derived column by column from Equation 10.

$$U_c = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{pmatrix}, \quad U_d = \begin{pmatrix} 0 & 0 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}. \quad (11)$$

Define the commutator by $[U_c, U_d] = U_c U_d - U_d U_c$. Applying the two orders to the ready configuration gives Equation 12.

$$U_c U_d e_{q_r} = e_{q_x}, \quad U_d U_c e_{q_r} = e_{q_p}, \quad [U_c, U_d] e_{q_r} = e_{q_x} - e_{q_p}. \quad (12)$$

The difference is detectable by the projection P_x onto the exposed configuration: its evaluation after departure followed by review is one, while its evaluation after review followed by departure is zero.

The commutator therefore identifies a difference in the represented purpose, not merely two differently spelled operation sequences.

This calculation is deliberately elementary. It demonstrates that an operation with the same label can cease to perform the same practical task after another operation. It does not establish criticality: the three-state system contains an irreversible undertaking but no specified stability transition. Connecting the loss of this operation to a weakening response regime requires the additional construction in Section 10.

The matrices also expose the adjoint issue concretely. $U_c^* e_{q_p} = e_{q_r} + e_{q_p}$. This algebraic expression lists two predecessors; it is not an admissible restoration of a previous world. The existence of adjoints in $\mathfrak{A}$ consequently supplies no argument that practical reversibility survives.

8.5 Finite-Horizon Recourse

One-step correction is insufficient when participants must first regain standing, locate a responsible successor, and then alter a commitment. For a finite robust model, let $\mathcal{U}(q)$ be the available controlled choices at q , and let $\Delta(q, a) \subseteq Q$ be a nonempty set of possible successor configurations for each enabled choice. The set records specified disturbances or uncontrolled responses; it supplies no probabilities. A policy may observe the current configuration and adapt its next choice. The calculation therefore describes full-state recourse, an upper bound on what a more restricted observer may achieve.

Define $V_0^j = G_j \cap K$. For integer $n \geq 0$, use the backward recursion in Equation 13.

$$V_{n+1}^j = V_n^j \cup \{q \in K : \exists a \in \mathcal{U}(q) \text{ such that } \Delta(q, a) \subseteq V_n^j\}. \quad (13)$$

Here n counts admitted transitions, not elapsed clock time. Reaching the goal permits stopping the modeled task. Safety after that stopping point is a further requirement, so the recursion does not silently promise indefinite future viability.

Proposition 8.2 (Finite-horizon robust recourse). *V_n^j consists exactly of configurations from which some full-state policy reaches G_j within at most n transitions, keeps every configuration up to and including the first goal in K , and succeeds for every admitted successor choice. Once the recursion stabilizes, later repetitions add no configurations.*

Proof. For $n = 0$, immediate success within the constraints is exactly $G_j \cap K$. Suppose the characterization holds for n . A state already in V_n^j retains its policy. At a newly added state, choose the action witnessing the set inclusion in Equation 13. Every resulting state has an n -step policy by the induction hypothesis, so adapting after the observed successor yields success within $n + 1$ transitions. Conversely, an $n + 1$ -step successful policy either needs no extra step or chooses a first action for which every possible successor has a successful remaining n -step policy. Those successors belong to V_n^j , and the initial state is therefore included by the recursion. Finally the update is a fixed set-valued operation; applying it again to a fixed point changes nothing. Monotonicity and finiteness of Q ensure eventual stabilization. $\square$

For Equation 10, with $K = Q$ and prevention goal $G_j = \{q_p\}$, the first backward step adds q_r and every later step leaves $\{q_r, q_p\}$ unchanged. The exposed configuration has no path to this goal within the admitted operations. Additional time alone does not change that fact. Adding a new operation could change it, but that would describe a different practical capacity and must preserve the meaning of prevention rather than rename later compensation as prevention.

Proposition 8.2 is an elementary backward reachability result, not a new general theorem of control. Its role is to separate nominal alternatives from executable, constraint-respecting recourse. If observations are incomplete, actions must also be common to observationally possible states, as in Proposition 8.1. The exact multi-step solution then requires information-state policies; the full-state sets alone do not establish their feasibility.

8.6 Trust-Relevant Consequences

These constructions give different formal meanings to formation, maintenance, and renewal. Formation can enlarge action domains or create distinguishable observations. Maintenance can preserve the paths entering V_n^j even while judgments remain unsettled. Interpretive closure can coarsen the effective observation map; loss of authority can remove transitions without reducing the number of recorded messages. Renewal can reconstruct paths to a new goal without recovering a former goal already foreclosed.

The distinction between information and recourse is consequently structural. It concerns an observation algebra, an operational semigroup, and a family of purpose-specific reachable sets. None is a scalar trust quantity. A favorable orientation may help create these structures or sustain their use, but their existence does not by itself establish trustworthiness or justify continued exposure. Those connections remain part of the philosophical and empirical inquiry.

9 Discrete Support Fields

The field investigation concerns the distributed supports through which cooperation recovers from a disturbance. Its objective is to derive a restoring operator from local compatibility and anchoring assumptions, then identify the modes that lose restoration when a support changes. The construction is a finite classical field model on a boundary of the history representation. It adds local linear structure and a variational functional; neither is supplied by the two-complex alone. The formal result identifies a dependency to investigate, rather than a universal field equation for trust.

9.1 Local Support Variables

Fix a boundary $\Gamma = (P, C, \iota)$ satisfying Equation 3. Its coupling sites $c \in C$ are the vertices of the inherited boundary graph. At each site choose a finite-dimensional real inner-product space $\mathcal{V}_c$ of specified support deviations. A coordinate may describe a deviation in a review capacity, an implementation response, or an authorization procedure relative to a reference arrangement. The coordinate requires an interpretation and a local calibration. It is not an amount of trust.

These spaces may have different dimensions and meanings. Their direct sum $\mathcal{V}_\Gamma = \bigoplus_{c \in C} \mathcal{V}_c$ collects a boundary field $\xi = (\xi_c)_{c \in C}$ without identifying one site's variables with another's. A vector-space description is appropriate only where the selected deviations admit such a local approximation. Changes of category, participant set, or standing can require a new boundary or new spaces instead of another vector in the old space.

Let $P_{\text{int}} \subseteq P$ contain the elements incident to two coupling sites. Choose an orientation on each such graph edge, with endpoints $c_-(p)$ and $c_+(p)$. For each p choose a finite inner-product interface space $\mathcal{W}_p$ and linear restriction maps $R_{pc} : \mathcal{V}_c \rightarrow \mathcal{W}_p$ at its endpoints. Only the particular outputs participating in the interface are compared. A common interface does not require the sites to possess the same complete interpretation or state space.

The interface difference operator $D_\Gamma : \mathcal{V}_\Gamma \rightarrow \mathcal{W}_\Gamma$, where $\mathcal{W}_\Gamma = \bigoplus_{p \in P_{\text{int}}} \mathcal{W}_p$, is defined in Equation 14.

$$(D_\Gamma \xi)_p = R_{pc_+(p)} \xi_{c_+(p)} - R_{pc_-(p)} \xi_{c_-(p)}. \quad (14)$$

Its kernel consists of field assignments compatible at the selected interfaces. Compatibility can mean agreement about a limited coordination requirement, such as which authorization permits a specified action. It does not mean agreement about the relationship as a whole. Even that limited comparison is an assumption to justify; heterogeneous descriptions cannot be subtracted merely because both are written numerically.

Half-edges and external reference conditions enter through a linear anchoring map $B : \mathcal{V}_\Gamma \rightarrow \mathcal{Z}$, where $\mathcal{Z}$ is another finite real inner-product space. Fix an anchor prescription $\zeta \in \mathcal{Z}$. An anchor may represent an independently supported review standard or an implementation capacity that can respond

without the disputed coupling. Independence is a causal property requiring evidence, not a consequence of writing another row in B .

9.2 Restoration Functional

Let W be a positive-definite, self-adjoint operator on $\mathcal{W}_\Gamma$, taken block-diagonal across interfaces for the present construction. Together with the chosen local inner products, it specifies how interface deviations enter the model. The quadratic functional $\mathcal{E}_\Gamma$ is given in Equation 15.

$$\mathcal{E}_\Gamma(\xi) = \frac{1}{2} \langle D_\Gamma \xi, W D_\Gamma \xi \rangle + \frac{1}{2} \|B\xi - \zeta\|^2. \quad (15)$$

This is a finite field-theoretic representation of selected restoring constraints. Its value is a model mismatch functional, not physical energy, moral loss, institutional legitimacy, or aggregate welfare. The relative weights and units therefore have to remain visible. No universal comparison across different trust relations follows from comparing their uncalibrated values of $\mathcal{E}_\Gamma$.

For a variation $v \in \mathcal{V}_\Gamma$, differentiate Equation 15 at ξ in direction v . Linearity gives $\langle D_\Gamma v, W D_\Gamma \xi \rangle + \langle Bv, B\xi - \zeta \rangle$. Move each map to its adjoint under the declared inner products. The resulting gradient and its Hessian L_Γ appear in Equation 16.

$$\nabla \mathcal{E}_\Gamma(\xi) = L_\Gamma \xi - B^* \zeta, \quad L_\Gamma = D_\Gamma^* W D_\Gamma + B^* B. \quad (16)$$

The adjoint $*$ is defined by those inner products. The use of the same symbol for matrix adjoints in the preceding section reflects the same mathematical operation; it still does not supply a practical reversal of a relation.

Proposition 9.1 (Restoring-field kernel). *Under the stated positivity assumption, $\ker L_\Gamma = \ker D_\Gamma \cap \ker B$. The functional has a unique minimizer precisely when this intersection is zero. If it is nonzero, the minimizers form an affine translate of that kernel.*

Proof. For every v , Equation 16 gives $\langle v, L_\Gamma v \rangle = \langle D_\Gamma v, W D_\Gamma v \rangle + \|Bv\|^2$. Both summands are non-negative and the first vanishes exactly when $D_\Gamma v = 0$, because W is positive definite. If $L_\Gamma v = 0$, both summands vanish. Conversely, if both maps annihilate v , their two terms in $L_\Gamma v$ vanish. This proves the kernel identity. The gradient equation is $L_\Gamma \xi = B^* \zeta$. Its right side is orthogonal to the kernel, since $\langle v, B^* \zeta \rangle = 0$ whenever $Bv = 0$. For a finite self-adjoint matrix, the range is the orthogonal complement of its kernel, so a solution exists. Completing the quadratic about any solution shows that the remaining increase is $\langle v, L_\Gamma v \rangle / 2$. The complete minimizing set is therefore that solution plus the kernel, and is a singleton exactly when the kernel is zero. $\square$

Proposition 9.1 distinguishes local agreement from restoration. A perturbation can satisfy every pairwise interface requirement while shifting all sites together in a direction unopposed by anchoring. Conversely, a unique minimizer can have positive mismatch when the anchor prescription and interface conditions cannot jointly be satisfied. Unique settlement does not establish interpretive reconciliation.

9.3 Restoring Dynamics

To make a dynamical claim, add the following constitutive assumption: within a specified local time calibration and frozen boundary, the selected support variables relax down the gradient of $\mathcal{E}_\Gamma$. This supplies the law in Equation 17; it is not derived from the mere existence of the functional.

$$\dot{\xi} = -\nabla \mathcal{E}_\Gamma(\xi) = -L_\Gamma \xi + B^* \zeta. \quad (17)$$

Let ξ_* be a minimizer and $v = \xi - \xi_*$ its displacement. Then $\dot{v} = -L_\Gamma v$. Diagonalizing the real self-adjoint matrix decomposes v into eigenmodes with time dependence $\exp(-\lambda t)$, where $\lambda \geq 0$ is the

corresponding eigenvalue. If the smallest eigenvalue $\lambda_{\min}$ is positive, summing the squared orthogonal mode amplitudes gives Equation 18.

$$\|\xi(t) - \xi_*\| \leq e^{-\lambda_{\min} t} \|\xi(0) - \xi_*\|. \quad (18)$$

A zero mode retains its initial amplitude under this law. Equation 18 therefore identifies a specific restoring mechanism and its failure condition. It does not equate visible persistence with attraction: an unperturbed zero mode can remain unchanged while lacking a restoring force.

The spectrum depends on the constitutive assumptions and chosen metrics. It is nevertheless invariant under consistent orthonormal changes of local coordinates. If T changes the field bases and S the interface bases, then $\tilde{D} = SD_{\Gamma}T^{-1}$, $\tilde{W} = SW S^{-1}$, and $\tilde{B} = BT^{-1}$ imply $\tilde{L} = TL_{\Gamma}T^{-1}$ by substitution into Equation 16. Hence the eigenvalues are unchanged. An arbitrary rescaling without transforming the metrics and kinetic law does not enjoy that invariance and cannot be dismissed as a harmless relabelling.

9.4 Anchoring Loss

A two-site example makes the dependency explicit. Take two coupling sites joined by one internal element, with an additional half-edge at each site. Each coupling then contains two elements, as required by Section 7.3. Only the first half-edge will carry an anchor in this example. Let both local spaces and their shared interface be $\mathbb{R}$, with identity restriction maps, and let $\xi = (\xi_1, \xi_2)^{\top}$. The coordinates represent two calibrated support deviations, not the trust levels of two persons. Choose interface weight $g > 0$, anchor strength $\kappa \geq 0$ at the first site, and $\zeta = 0$. Then $D_{\Gamma} = (-1 \ 1)$ and $B = (\sqrt{\kappa} \ 0)$ produce Equation 19.

$$L_{\Gamma} = \begin{pmatrix} g + \kappa & -g \\ -g & g \end{pmatrix}, \quad \lambda_{\pm} = \frac{2g + \kappa \pm \sqrt{4g^2 + \kappa^2}}{2}. \quad (19)$$

To derive the eigenvalues, expand $\det(L_{\Gamma} - \lambda I) = \lambda^2 - (2g + \kappa)\lambda + g\kappa$ and use the quadratic formula. For $\kappa > 0$, the trace and determinant are positive, so both eigenvalues are positive. At $\kappa = 0$, the eigenvalues are 0 and $2g$, with zero-mode direction $(1, 1)^{\top}$. For fixed g , rationalizing the smaller root gives the limit in Equation 20.

$$\lambda_{\min} = \frac{2g\kappa}{2g + \kappa + \sqrt{4g^2 + \kappa^2}}, \quad \lim_{\kappa \downarrow 0} \frac{\lambda_{\min}}{\kappa} = \frac{1}{2}. \quad (20)$$

The interface continues to suppress differences between the sites while their shared displacement loses restoration. A relation can thus preserve internally consistent responses while losing the independently supported capacity that made those responses dependable. Multiple messages generated within that relation need not expose the loss if they all depend on the same unanchored mode.

Figure 1 displays this exact spectrum alongside the coupled spectrum derived in the next section. The calculations are illustrative and use declared model coefficients. Their evidential value is algebraic reproducibility, not calibration to a political or interpersonal case.

9.5 Structural Reconfiguration

The example changes an anchor within fixed local spaces. A changing interpretive or relational structure can instead alter P , C , the restriction maps, or the relevant spaces themselves. Such a change requires a new field model and a declared comparison between old and new variables. The history representation records which elements and couplings continue; it does not supply a canonical linear identification between every pair of fields.

For example, a successor review body can preserve a documentary claim while dividing its implementation powers between two offices. A field based on the former office's single response coordinate then becomes inadequate. The replacement may require two local coordinates and distinct interface

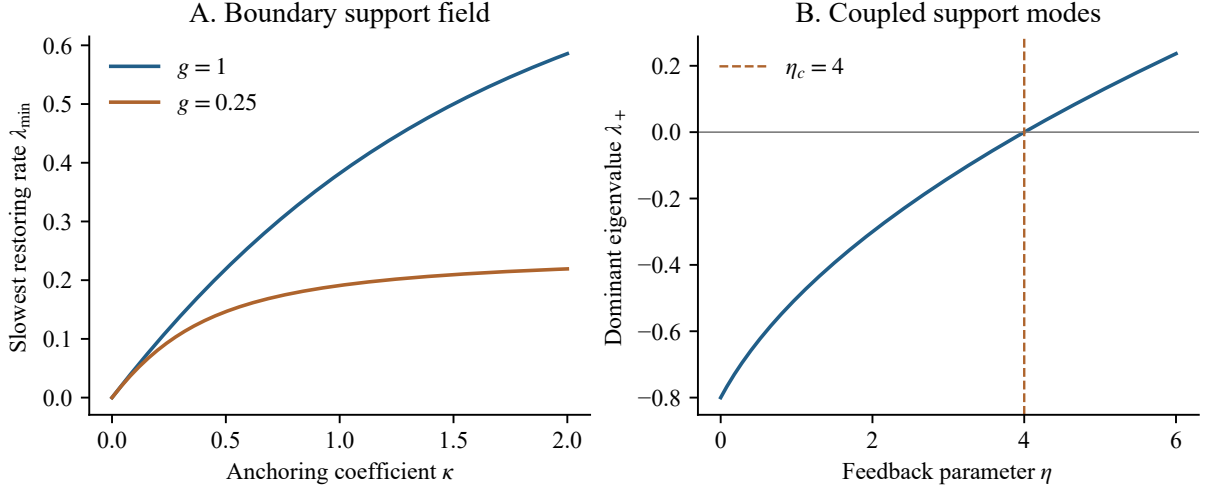


Figure 1: Support restoration spectra. Panel A plots the smallest eigenvalue in Equation 19 for two interface weights. Panel B plots Equation 23 with $a = 1.5$, $d = 0.8$, $b = 0.6$, and $c = 0.5$; the restoring regime loses linear stability at $\eta = 4$. All quantities use model-specific calibration.

maps. Equating their sum with the old response would be an extra assumption, requiring the same kind of sufficiency argument as Proposition 7.2.

This limits what anchoring loss establishes. The vanishing eigenvalue in Equation 20 shows loss of strict restoration in the supplied linear law. It alone does not determine a new social regime, an attractor basin, or a nonlinear transition. The next investigation adds feedback and a separately stated nonlinear completion so that the distinction between weakened recovery and actual qualitative reorganization can be examined explicitly.

10 Coupled Critical Dynamics

The dynamical investigation supplies a specific mechanism through which cooperative performance and interpretive recourse can jointly lose restoration. Its objective is to derive a stability boundary, distinguish that boundary from transient amplification, and calculate the effect of a delayed correction channel. The analysis proceeds through a local two-mode model, an explicit nonlinear completion, and a finite-horizon control calculation. These are conditional mathematical investigations. They establish consequences of specified laws while leaving their applicability to actual trust relations open.

10.1 Support-Mode Reduction

The support-field construction makes a possible reduction explicit. Within one fixed boundary and calibrated interval, take ξ as a displacement from a reference equilibrium, so constant terms have been removed. Suppose the local generator is $G = -L_\Gamma + A_{fb}$, where A_{fb} is a declared linear feedback operator. Choose two orthonormal field patterns, collected in an isometric map $\mathcal{I} : \mathbb{R}^2 \rightarrow \mathcal{V}_\Gamma$. Let $z = (z_1, z_2)^\top$ be their amplitudes. The first pattern concerns performance support and the second concerns interpretive or recourse support. They are operationally defined patterns, not two scalar components alleged to exhaust trust.

An exact autonomous reduction requires the selected subspace to be invariant under G . The condition and reduced generator are stated in Equation 21.

$$(I - \mathcal{I}\mathcal{I}^*)G\mathcal{I} = 0, \quad J = \mathcal{I}^*G\mathcal{I}, \quad \dot{z} = Jz. \quad (21)$$

Indeed, inserting $\xi = \mathcal{I}z$ into $\dot{\xi} = G\xi$, then applying $\mathcal{I}^*$, gives the reduced equation; the first condition ensures that the full derivative has no discarded component. If this condition fails, unresolved modes

can feed back into the retained coordinates. A closed two-mode law is then an approximation requiring error control or a separate model assumption. The calculations below state that assumption rather than infer closure from the choice of two labels.

The prior criticality-preparation paper already separates state, relational structure, interventions, and different transition routes [15]. The present reduction follows that discipline. Its distinctive role within this manuscript is to connect a performance-support mode to a recourse-support mode, then ask how their joint restoration bears on trust assessment.

10.2 Feedback Stability Boundary

Assume isolated restoring rates $a, d > 0$, cross-channel coefficients $b, c > 0$, and a nonnegative dimensionless feedback parameter η . Freeze these coefficients over the response interval. The retained generator is given in Equation 22.

$$\dot{z} = J_\eta z, \quad J_\eta = \begin{pmatrix} -a & b \\ \eta c & -d \end{pmatrix}. \quad (22)$$

The coefficients describe the propagation of deviations in the chosen coordinates. Positive cross-coupling does not mean that cooperation is beneficial: a shortfall in implementation can weaken recognized review capacity, whose shortfall further weakens implementation. The same local sign convention can represent mutually reinforcing departures in either direction. The relative units of the two modes are part of the calibration.

Proposition 10.1 (Coupled restoration threshold). *The equilibrium $z = 0$ of Equation 22 is exponentially stable exactly when $\eta bc < ad$. At $\eta_c = ad/(bc)$ one eigenvalue is zero and the other is $-(a + d)$. For $\eta > \eta_c$, one eigenvalue is positive. The eigenvalues are given by Equation 23.*

$$\lambda_\pm(\eta) = -\frac{a + d}{2} \pm \frac{\sqrt{(a - d)^2 + 4\eta bc}}{2}. \quad (23)$$

Proof. Expanding $\det(\lambda I - J_\eta)$ yields $\lambda^2 + (a + d)\lambda + ad - \eta bc$. The quadratic formula gives Equation 23. The discriminant is nonnegative, the sum of the roots is $-(a + d) < 0$, and their product is $ad - \eta bc$. If the product is positive, both roots are negative; if it is zero, the roots have the stated values; if it is negative, the roots have opposite signs. For a finite linear autonomous system, two strictly negative real eigenvalues give exponential decay, including the repeated-root case through a polynomial factor times a decaying exponential. A zero eigenvector does not decay, while a positive eigenvector grows. These observations establish each stability assertion. $\square$

Proposition 10.1 locates the loss of restoration in a feedback relation. Each isolated channel can retain positive recovery while the coupled system becomes unstable. Conversely, declining isolated recovery can move the system toward the same boundary while cross-coupling stays fixed. The model therefore identifies a dependence beyond merely saying that both capacities change over time.

On the stable side define $\Delta = ad - \eta bc > 0$ and the slow restoring rate $\varepsilon = -\lambda_+ > 0$. Rationalizing Equation 23 gives Equation 24.

$$\varepsilon = \frac{2\Delta}{a + d + \sqrt{(a - d)^2 + 4\eta bc}}, \quad \lim_{\eta \uparrow \eta_c} \frac{\varepsilon}{\Delta} = \frac{1}{a + d}. \quad (24)$$

Recovery time along that mode increases as the restoring rate approaches zero. This is a model-specific meaning of proximity to a transition. It is distinct from a rapid external change or an analyst's surprise.

The same denominator controls a selected static susceptibility. Add a constant input $(0, s)^\top$ to the second channel. At equilibrium, the first row gives $z_1 = (b/a)z_2$. Substitution into the second gives $-\Delta z_2/a + s = 0$, and hence Equation 25.

$$z_* = \frac{s}{\Delta} \begin{pmatrix} b \\ a \end{pmatrix}. \quad (25)$$

Its growth as Δ decreases is conditional on the chosen input direction. Inputs without a component along the soft mode need not have the same response. Moreover, sufficiently large displacements exceed a local linear approximation. The divergence is a warning about the model's local susceptibility, not a prediction of arbitrarily large institutional responses.

10.3 Nonlinear Regime Reorganization

A linear stability boundary leaves the destination of a departure undetermined. To exhibit an actual qualitative reorganization, consider the symmetric specialization with unit isolated recovery, equal cross-couplings $\chi \geq 0$, and an explicitly assumed radial cubic saturation $\gamma > 0$. The vector law is stated in Equation 26.

$$\dot{z} = \begin{pmatrix} -1 & \chi \\ \chi & -1 \end{pmatrix} z - \gamma \|z\|^2 z. \quad (26)$$

The symmetry and saturation are additional constitutive choices. They are not consequences of trust's relational character. Their purpose is to supply a fully solvable witness of a regime change compatible with the linear mechanism.

Let $e_+ = (1, 1)^T/\sqrt{2}$ and $e_- = (1, -1)^T/\sqrt{2}$, and write $z = ue_+ + ve_-$. Orthogonality gives $\|z\|^2 = u^2 + v^2$. Applying the matrix to the two basis vectors and projecting yields Equation 27.

$$\begin{aligned} \dot{u} &= (\chi - 1 - \gamma(u^2 + v^2))u, \\ \dot{v} &= (-\chi - 1 - \gamma(u^2 + v^2))v. \end{aligned} \quad (27)$$

Proposition 10.2 (Saturating support bifurcation). *For $0 \leq \chi < 1$, the origin is the unique equilibrium of Equation 26 and is exponentially stable. For $\chi > 1$, the origin is unstable and two additional locally exponentially stable equilibria appear: $z_{\pm} = \pm\sqrt{(\chi - 1)/\gamma} e_+$. At $\chi = 1$, recovery along $v = 0$ is algebraic rather than exponential.*

Proof. The multiplier of v in Equation 27 is strictly negative for all u, v and $\chi \geq 0$. Every equilibrium therefore has $v = 0$. The remaining equation is $u(\chi - 1 - \gamma u^2) = 0$. For $\chi < 1$ only $u = 0$ is real; at the origin the linear rates are $\chi - 1$ and $-\chi - 1$, both negative. Indeed, the squared norm satisfies $\frac{1}{2} \frac{d}{dt} \|z\|^2 \leq -(1 - \chi)\|z\|^2$, which gives exponential decay. For $\chi > 1$, the origin has a positive u rate and the two stated nonzero solutions exist. At either solution the Jacobian in (u, v) coordinates is diagonal, with entries $-2(\chi - 1)$ and -2χ , both negative. For a displacement w from either equilibrium, the smooth vector field is its diagonal linearization plus a remainder of order $\|w\|^2$. The derivative of $\|w\|^2/2$ is therefore bounded above by $-\alpha\|w\|^2 + O(\|w\|^3)$ for some $\alpha > 0$. In a sufficiently small ball it is at most $-\alpha\|w\|^2/2$, giving local exponential decay. At $\chi = 1$ on the invariant line $v = 0$, integrate $\dot{u} = -\gamma u^3$ to obtain $u(t) = u(0)/\sqrt{1 + 2\gamma u(0)^2 t}$. For nonzero initial amplitude this decays algebraically. $\square$

Proposition 10.2 demonstrates a supercritical pitchfork within the declared symmetric model. The origin's organization of recovery changes and two stable response configurations become available. It supplies an exact model instance of the paper's qualitative transition language. The two signs do not name trust and distrust, or good and bad outcomes. Assigning either branch an institutional interpretation would require a further bridge to the selected support variables.

The example also shows what the formalism does not settle. An asymmetric forcing or a different nonlinear term can change the number and character of equilibria. The linear threshold alone does not select this pitchfork, and the represented state space remains $\mathbb{R}^2$ throughout. A bifurcation here is a change of dynamical organization on a fixed space, not a change of its ambient topology. A two-complex can change for other reasons without producing this bifurcation.

10.4 Stable-Spectrum Amplification

An essential comparison is already available in the prior criticality-preparation paper [15]. Its triangular example permits large finite-time responses while the stable eigenvalues remain fixed. In the equal-rate case, use a sign convention with off-diagonal coefficient $k \geq 0$ and initial disturbance $(0, h)^\top$. Equation 28 states the resulting solution.

$$A_k = \begin{pmatrix} -1 & k \\ 0 & -1 \end{pmatrix}, \quad z(t) = \begin{pmatrix} k h t e^{-t} \\ h e^{-t} \end{pmatrix}. \quad (28)$$

Both eigenvalues are -1 . The second row solves directly; substitution into the first and multiplication by e^t gives $\frac{d}{dt}(e^t z_1) = kh$, yielding the first component. For $h > 0$, that component peaks at $t = 1$ with value kh/e . Its peak can increase without a spectral approach to zero.

Equation 28 is an inherited counterexample, not a new criticality result. It prevents amplification alone from identifying the feedback threshold. A substantive trust case might fit transient routing, an external shock, or a changing action domain while retaining strong asymptotic restoration. The mechanisms require separate evidence. A large reaction to one message does not by itself establish the dynamical regime in Proposition 10.1.

10.5 Linear Access Structure

The distinction between observation and recourse also has a linear counterpart. Add an input $v(t)$ through $B_{\text{in}} = (1, 0)^\top$ and observe $y = Mz$ with $M = \begin{pmatrix} 1 & 0 \\ -a & b \end{pmatrix}$. Thus intervention directly affects the first support mode and observation directly registers that mode. The two relevant rank arrays are given in Equation 29.

$$\mathcal{O} = \begin{pmatrix} M \\ M J_\eta \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ -a & b \end{pmatrix}, \quad \mathcal{C} = (B_{\text{in}} \quad J_\eta B_{\text{in}}) = \begin{pmatrix} 1 & -a \\ 0 & \eta c \end{pmatrix}. \quad (29)$$

Their different off-diagonal entries matter. With a known input and ideal continuous observation, $\dot{y} = -ay + bz_2 + v$ determines z_2 whenever $b \neq 0$. If $b = 0$, changing the initial second coordinate has no effect on y , so it is unobservable through this channel. These are ideal reconstruction statements; numerical differentiation of noisy records introduces additional limits.

Similarly, if $\eta c = 0$, the input never enters the second coordinate, so an arbitrary displacement in that coordinate cannot be corrected through B_{in} . If $\eta c \neq 0$, the columns of $\mathcal{C}$ span $\mathbb{R}^2$. To see the finite-time consequence, the input kernel is $e^{J_\eta t} B_{\text{in}}$. Any vector orthogonal to this kernel for every t in an interval must, by evaluating at zero and differentiating there, be orthogonal to both columns of $\mathcal{C}$, hence zero. The integral of the kernel times its transpose is therefore positive definite on any nonzero interval. For a horizon $T > 0$, initial state z_0 , and requested endpoint z_f , the corresponding Gramian and an unconstrained input are stated in Equation 30.

$$\begin{aligned} \mathcal{W}_T &= \int_0^T e^{J_\eta t} B_{\text{in}} B_{\text{in}}^\top e^{J_\eta^\top t} dt, \\ v(t) &= B_{\text{in}}^\top e^{J_\eta^\top (T-t)} \mathcal{W}_T^{-1} (z_f - e^{J_\eta T} z_0). \end{aligned} \quad (30)$$

Variation of constants gives $z(T) = e^{J_\eta T} z_0 + \int_0^T e^{J_\eta (T-t)} B_{\text{in}} v(t) dt$. Substituting Equation 30, the integral is $\mathcal{W}_T \mathcal{W}_T^{-1} (z_f - e^{J_\eta T} z_0)$, so $z(T) = z_f$. Bounds, delays, and changing domains can still remove that possibility.

This calculation separates knowledge of a support mode from the ability to act on it. For example, $b > 0$ and $\eta = 0$ permit observation of both modes through the first while leaving the second outside that input's control. The example is not near the feedback threshold; it demonstrates that the distinction itself is more general. Near a specified transition, its significance depends on whether the weakly restoring mode remains connected to an effective input.

10.6 Delayed Corrective Capacity

Consider the stable side of a locally calibrated response regime. Project onto one isolated real slow mode with restoring rate $\varepsilon > 0$, and assume the projection is closed for the calculation. Let u be its amplitude, u_0 its initial displacement, and b_{eff} the projection of an available intervention channel onto it. For the closed two-mode law, choose a real left eigenvector ℓ with $\ell^\top J_\eta = -\varepsilon \ell^\top$. Then $u = \ell^\top z$ and $b_{\text{eff}} = \ell^\top B_{\text{in}}$ give the scalar equation by left multiplication. The normalization of ℓ belongs to the declared amplitude calibration. A corrective input $v(t)$ becomes available at local time τ , before a fixed horizon $T > \tau$. Prior to τ the input is zero. The exact scalar equation in this restricted mode model is Equation 31.

$$\dot{u} = -\varepsilon u + b_{\text{eff}} v(t), \quad u(0) = u_0, \quad v(t) = 0 \quad (0 \leq t < \tau). \quad (31)$$

This scalar is a mode amplitude derived from the declared support dynamics, not a trust score. The parameter τ can represent arrival and uptake of a finding in a particular calibrated case, but it is not a general measurement of epistemic lag. Assume, favorably, that the finding at τ permits exact estimation and the model remains valid through T . The purpose is to isolate the remaining capacity limit even under that favorable epistemic assumption.

Multiplying Equation 31 by $e^{\varepsilon t}$ and integrating yields Equation 32.

$$u(T) = e^{-\varepsilon T} u_0 + b_{\text{eff}} \int_\tau^T e^{-\varepsilon(T-s)} v(s) ds. \quad (32)$$

Let $h_\tau(s) = e^{-\varepsilon(T-s)}$ on $[\tau, T]$. Its squared integral is W_τ , specified in Equation 33, including the continuous zero-rate limit.

$$W_\tau = \int_\tau^T h_\tau(s)^2 ds = \begin{cases} \frac{1 - e^{-2\varepsilon(T-\tau)}}{2\varepsilon}, & \varepsilon > 0, \\ T - \tau, & \varepsilon = 0. \end{cases} \quad (33)$$

The zero-rate case is the marginal linear mode, not a replacement for the nonlinear dynamics at its bifurcation.

Proposition 10.3 (Delayed correction requirements). *Assume $b_{\text{eff}} \neq 0$, $T > \tau$, and square-integrable inputs without amplitude bounds. The minimum quadratic input effort needed for $u(T) = 0$ is given in Equation 34 and is attained by $v_*(s) = -e^{-\varepsilon T} u_0 h_\tau(s) / (b_{\text{eff}} W_\tau)$.*

$$E_{\min} := \min_{u(T)=0} \int_\tau^T v(s)^2 ds = \frac{u_0^2 e^{-2\varepsilon T}}{b_{\text{eff}}^2 W_\tau}. \quad (34)$$

With an amplitude limit $|v(s)| \leq M$ for a fixed $M > 0$, exact correction is feasible precisely when Equation 35 holds, using $T - \tau$ for the ratio's value at $\varepsilon = 0$.

$$|u_0| e^{-\varepsilon T} \leq |b_{\text{eff}}| M \frac{1 - e^{-\varepsilon(T-\tau)}}{\varepsilon}. \quad (35)$$

Proof. Exact correction requires $\int h_\tau v = -e^{-\varepsilon T} u_0 / b_{\text{eff}}$ by Equation 32. Cauchy–Schwarz bounds the squared left side by $W_\tau \int v^2$, giving Equation 34 as a lower bound. The displayed v_* is proportional to h_τ , satisfies the terminal constraint, and attains equality. For bounded inputs, positivity of h_τ gives $|\int h_\tau v| \leq M \int h_\tau$. The extreme values are attained by the constant controls $v = \pm M$, and every intermediate value is attained by a constant control of smaller magnitude. Evaluating $\int_\tau^T e^{-\varepsilon(T-s)} ds$ therefore gives both necessity and sufficiency of Equation 35. $\square$

Proposition 10.3 makes three distinct limits visible. As $\tau \uparrow T$, W_τ tends to zero, so nonzero displacement requires diverging unbounded effort and eventually exceeds any fixed input bound. If $b_{\text{eff}} = 0$, the channel cannot affect this mode at all; for nonzero u_0 , no finite-time exact correction follows from better estimation. As $\varepsilon \downarrow 0$ with the other quantities fixed, the minimum effort tends to $u_0^2 / [b_{\text{eff}}^2 (T - \tau)]$.

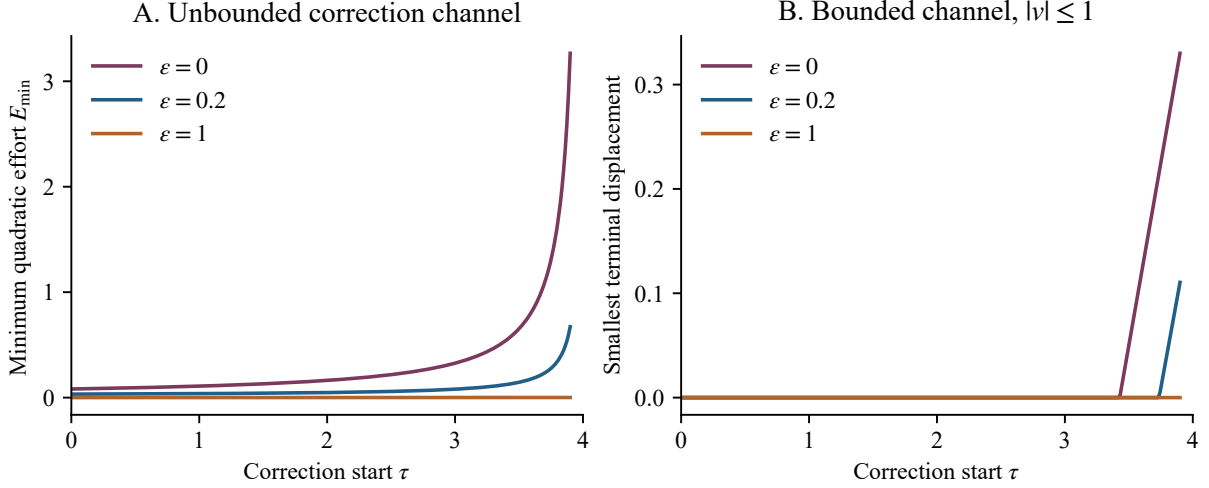


Figure 2: Delayed correction requirements. The illustrative model uses $T = 4$, $u_0 = 0.4$, and $b_{\text{eff}} = 0.7$. Panel A plots Equation 34. Panel B gives the smallest achievable terminal displacement with $|v| \leq 1$, obtained by subtracting the maximal opposing input in Equation 35 from the uncorrected displacement and truncating at zero. No empirical calibration or universal unit of epistemic delay is asserted.

Weak natural recovery and late intervention therefore interact within the selected mechanism, without becoming one variable.

For this specific model, weaker recovery also raises the required effort at fixed $T, \tau, u_0, b_{\text{eff}}$. One can see this without an approximation by rewriting Equation 34 as $u_0^2 / [b_{\text{eff}}^2 \int_{\tau}^T e^{2\varepsilon s} ds]$. The denominator increases with ε for $0 \leq \tau < T$, so the effort decreases with stronger restoration. This monotonicity belongs to the stated one-mode model; other intervention costs, target sets, and changing channels need not preserve it.

Figure 2 illustrates these formulas. The quadratic effort is a control diagnostic in the declared units. It is not a measure of money, moral burden, or the total institutional cost of maintaining revisability. The bounded-input panel shows why unlimited algebraic controllability can coexist with practical failure before a deadline.

10.7 Changing Structures

All spectral results above hold within a specified local representation and a frozen response interval. If a reorganization changes the state space or the support modes, the comparison requires a transport map between old and new descriptions. For example, let $\mathcal{V}_0$ and $\mathcal{V}_1$ be two support spaces with frozen generators G_0 and G_1 , and let $R_{10} : \mathcal{V}_0 \rightarrow \mathcal{V}_1$ be a declared linear comparison at the structural event. Over calibrated intervals $t_0, t_1 \geq 0$, the composed propagator is Equation 36.

$$\xi_{\text{out}} = e^{G_1 t_1} R_{10} e^{G_0 t_0} \xi_{\text{in}}. \quad (36)$$

The comparison map may be rectangular, noninvertible, or inadequate. Its existence is not guaranteed by sharing the word authority across two arrangements. A nonlinear or set-valued correspondence may be required instead. The history geometry supplies a place to record such a change and the identities proposed across it; it does not choose R_{10} automatically.

Equation 36 also shows why frozen eigenvalues alone cannot settle response across changing regimes. The seam map and the order of evolution contribute to the total transformation. Neither independently stable generators nor an unchanged institutional name ensures that the practically relevant output is preserved. Conversely, a well-supported transition map can preserve a commitment while redistributing its implementation. That is a constructive possibility requiring its own case-specific evidence.

10.8 Computational Verification

The accompanying reproducible calculation checks the configuration matrices against direct function composition, enumerates finite operation sequences, checks observation fibers for one-step success, compares field spectra with the closed expressions, verifies the feedback eigenvalues, and substitutes the nonlinear equilibria. Numerical differentiation independently checks their local stability. For the delayed-control result, numerical integration of the proposed control checks both terminal cancellation and quadratic effort against the derived formulas.

These calculations validate implementation of the declared examples; the mathematical arguments carry the general conditional results. They use no observed trust data and estimate no social parameters. In particular, neither a successful numerical check nor a plotted spectral crossing shows that an actual trust relation is near criticality. The empirical inquiry must identify the represented supports, their coupling, the disturbance class, the available channels, and the competing explanations.

The formal contribution to the trust problem is consequently a connected set of discriminations. A history can retain its visible boundary while losing a consequential continuity. An observation can become more accurate while recourse remains unavailable. A field can retain internal consistency while losing independent restoration. A coupled regime can lose stability even when isolated channels remain restoring. And delayed correction can fail through its remaining horizon or channel capacity despite accurate later recognition. Each statement has a declared formal domain; their joint application to one relation remains an additional substantive argument.

11 Comparative Incident Sequences

This section uses a constructed cooperative episode to compare the dependencies identified above. Its purpose is logical discrimination: varying one dependency can show why a conclusion does not follow from another. The sequences are hypothetical. They provide neither historical findings nor empirical evidence of transition susceptibility.

11.1 Shared Cooperative Task

Two public authorities coordinate a relief delivery through a contested crossing. A joint office records permissions, local coordinators secure passage, and a review meeting can pause a delivery after a reported discrepancy. Earlier disputes were contained because coordinators recognized the office's determinations and could obtain local restraint. The parties have some trust in each other's reporting but do not share a complete account of the surrounding conflict. A message stating that the crossing remains available has historically supported limited reliance on a scheduled passage.

The incident is a local refusal to honor a recorded permission. The comparison holds the cooperative task and the words of the reassuring message constant. It varies the response regime, interpretive access, and the remaining opportunities to alter the delivery. These are analytical variations rather than a claim that real cases permit exact experimental control. In particular, calling two incidents comparable would require evidence about the task, exposure, local capacities, and prior history.

11.2 Ordinary Adjustment

In the first sequence, the refusal results from a recently changed scheduling convention. The joint office retains authority, local coordinators can secure restraint, and review remains accessible. Clarification corrects the schedule and the delivery proceeds on revised terms. There is interpretive nonstationarity and a brief delay, but the restoring process functions. Neither the changed message convention nor the need for revision provides a reason to infer near criticality.

The sequence also shows that information can be sufficient for a specified correction when the practical supports are intact. The paper's argument does not require institutional reconstruction whenever interpretation changes. It requires investigation of the dependency that makes reconstruction relevant.

11.3 Recognized Susceptibility

In the second sequence, local coordinators increasingly condition their own compliance on whether other coordinators recognize the joint office. Earlier isolated refusals were contained by reciprocal recognition and intervention. That restoring process is now weakening: each uncontained refusal gives others a reason to withdraw recognition, which further reduces the office's ability to secure passage. The stipulated candidate transition is a reorganization from jointly authorized access to separate local vetoes.

Here the analyst has a specific criticality hypothesis rather than a synonym for turbulence. It predicts that comparable local refusals will propagate differently as reciprocal recognition weakens. The hypothesis could still be wrong in an actual case; an extraordinary shock or a coordinated decision might explain the same pattern. Its explanatory content lies in the proposed change in restoration and propagation.

Participants recognize the weakening promptly because local reports remain accessible through an independent channel. They pause the delivery and negotiate a narrower arrangement with those now able to secure passage. The example demonstrates that the hypothesized susceptibility need not entail epistemic lag or cooperative collapse. Timely recognition and a usable alternative can permit adaptation, although they do not guarantee that all later deliveries will succeed.

11.4 Delayed Reassessment

The third sequence retains the same hypothesized weakening, but the recognized reporting channel depends on the joint office's disputed authority. The office continues to issue the familiar reassurance, and contrary local accounts initially fail to receive a hearing. Participants rely on a designation that no longer establishes the office's effective reach. Some coordinators now treat its notices as proposals requiring local assent; others still treat them as binding permissions. The same designation therefore carries a disputed practical status, which an accurate copy of the notice cannot settle. Both passage and authoritative interpretation now depend on the changing recognition structure.

Before departure, a retained contact brings the local accounts into review. The delivery remains divisible, and participants can suspend the exposed part while addressing the dispute. Recognition is delayed and still incomplete: the parties may continue to disagree about whether the refusal is legitimate. Yet the later assessment can change the planned exposure because a practical alternative and a route to use it remain available. Trust in official assurances can narrow while limited cooperation continues through other capacities.

11.5 Closed Alternatives

The fourth sequence differs in the fate of the pending commitment. The delivery departs before the local accounts receive consideration; it enters a location from which withdrawal cannot be secured. Later recognition improves the account of authority at the crossing but cannot prevent that exposure. A further loss of review standing could also obstruct compensation, although this is an additional failure, not a consequence that follows automatically from departure.

The comparison with the third sequence isolates the purpose-specific loss of practical efficacy. The later account may support responsibility or future protection, but it cannot perform the earlier task of suspending departure. The difference between the two sequences is therefore not simply how much participants eventually know. It includes which action remains feasible when the knowledge becomes usable.

Table 4 summarizes the variations. The first sequence blocks an inference from change to criticality. The second blocks an inference from transition susceptibility to unavoidable misrecognition. The last two distinguish delayed recognition from the closure of a specified practical alternative. None establishes that preserving an alternative is costless or always preferable to prompt action.

The sequences also distinguish possible interventions. An independent reporting channel can improve recognition without restoring passage. Restoring local authority can improve passage without

Table 4: Hypothetical variations in a relief-delivery relation. The rows specify different dependencies, not empirical stages or predicted outcomes for all near-critical relations.

Sequence	Cooperative response	Interpretive access	Practical consequence
Ordinary adjustment	Restoration remains effective after a convention changes.	Clarification is available through recognized channels.	A corrected schedule supports performance.
Recognized susceptibility	Reciprocal recognition weakens; separate vetoes become possible.	Independent reports make the change visible promptly.	A pause permits a narrower arrangement.
Delayed reassessment	The same candidate transition mechanism applies.	The disputed office initially filters contrary accounts.	A later review can still suspend part of the delivery.
Closed alternatives	The same candidate transition mechanism applies.	Relevant recognition arrives after departure.	Recognition cannot prevent the specified exposure; other remedies remain a separate question.

granting excluded participants access to review. Preserving a pause can make later recognition consequential without deciding whose interpretation is correct. These differences explain why a diagnosis of the actual dependency is needed before recommending more information, stronger assurance, or greater patience.

11.6 Collaborative Archive Reorganization

A second hypothetical setting tests the argument beyond coordinated physical access. A research collective maintains a shared archive. Contributors trust one another to preserve provenance, distinguish revision from replacement, and make objections available alongside the material they concern. The archive's curators have both a technical role in maintaining access and an interpretive role in classifying a record as current, superseded, disputed, or withdrawn. Earlier disagreements were contained by preserving versions and allowing contributors to contest classifications.

Suppose the collective reorganizes. A new platform makes some records easier to retrieve, but several contributors no longer recognize the curators' authority to classify their work. Others treat the new platform's designation of a current version as decisive. Technical availability improves while the practical meaning of the designation becomes disputed. A reader who sees more records has more information in one sense, but may have less reliable access to the relation between a designation, an author's commitment, and the history of objections.

This is an interpretive and institutional change, not yet a criticality case. For that additional hypothesis, specify a restoring process and its alteration. Suppose the earlier process depended on contributors remaining willing to submit corrections to a common record. As classifications cease to be recognized, contributors withhold corrections or move to separate archives. Their withdrawal makes the common record less complete, which gives others further reason to leave. The candidate transition concerns a change from a shared, contestable record to fragmented records with incompatible claims to authority.

The proposed mechanism has several observable intermediaries: the disputed classification, contributors' changed participation, the resulting loss of relevant material, and subsequent withdrawal. Merely observing several archives would not establish the mechanism. Plural archives can support healthy disagreement without destroying the ability to trace versions and claims. The transition hypothesis concerns loss of a specified coordination and correction capacity, not plurality as such.

Trust also differentiates within the case. Contributors may continue trusting a curator's care and technical competence while refusing the curator's authority to determine the status of contested material. Readers may rely on preservation while withholding trust in classification. A new arrangement might

retain separate interpretations while preserving common identifiers, provenance, and routes for objections. Such an arrangement would reconstruct selected continuities without requiring every participant to recognize one final account.

The example makes the change in interpretive structure explicit. The central problem is not only whether an old report arrived late. It is what the report's designation now means, who can answer for that designation, and whether a correction remains connected to the material it qualifies. More efficient retrieval can coexist with weaker practical intelligibility if those connections are lost. Conversely, a less centralized arrangement can preserve them if the relevant relations are reconstructed.

11.7 Interpretive Conflict

A further hypothetical case limits the scope of the mechanism. Two collaborators disagree about whether a request for independent verification expresses responsible care or personal suspicion. Their project has reliable records, clear authority to revise the task, and adequate resources for review. The disagreement affects their experience of the relation but does not disrupt the processes through which they can clarify or alter their undertakings.

The collaborators can recognize that they attach different meanings to the request without achieving a shared emotional response. They might agree that verification will proceed while leaving the broader question of interpersonal trust open. They might also reduce their collaboration because the difference matters to them. Neither outcome establishes a critical transition. Ordinary interpretive conflict and reasoned revision can explain the case.

This comparison prevents the conjunction of several relational features from doing too much work. There is shared history, divergent meaning, incomplete understanding, and a decision about future co-operation. These features make the case relevant to trust, but the specified restoring capacities remain effective. The criticality hypothesis has no demonstrated increment merely because the experience is emotionally difficult or the decision consequential.

The case also distinguishes interpretive completeness from practical adequacy. The collaborators may never agree about how the request should feel or what it reveals about their relationship. They can nevertheless make a limited arrangement whose terms are sufficiently clear. That achievement is compatible with an unresolved remainder and does not require treating one account as a delayed approximation of the other.

11.8 Successful Reconfiguration

Return to the relief-delivery example. Suppose the joint office recognizes that its authority no longer secures local restraint. It retains accurate records and acknowledges pending undertakings, but delegates future permissions to a temporary arrangement that includes the actors now capable of controlling passage. Affected participants retain a route to question both an old undertaking and the proposed replacement.

Several continuities and discontinuities coexist. The identity of the authorizing body changes. Earlier records remain relevant to responsibility. New permissions require a different procedure. Trust in the former office's ability to secure passage declines, while trust in its disclosure of limits may improve. The new arrangement must establish its own performance history. There is no single trust quantity that captures all these changes.

The reconstructed relation may contain the local refusal without restoring the former regime. If the hypothetical withdrawal process was indeed making separate vetoes increasingly likely, the new arrangement interrupts that trajectory by changing who participates in authorization. The result illustrates adaptive reorganization rather than return to an identical prior state.

The normative assessment remains open. Including effective local controllers could improve performance while granting power to actors whose conduct is objectionable. Excluded groups might bear new costs, or the temporary arrangement might become difficult to replace. The example therefore does not

establish that reconfiguration is just because it works. It shows which practical dependencies a successful performance explanation would need to identify before a separate evaluation of legitimacy and exposure.

This case also clarifies the role of trust during transition. Participants may need enough confidence in disclosure and limited performance to attempt a revised arrangement, even while withholding broader endorsement. The resulting cooperation can help generate new capacities and evidence. Trust is then part of constructing the relation through which later trust becomes assessable.

11.9 Adversarial Reassurance

One final hypothetical variation introduces deliberate manipulation. An authority retains the capacity to honor a commitment but chooses not to do so. It presents the failure as a consequence of unavoidable transition and invites the exposed party to wait for an investigation it controls. The language of complexity becomes part of an attempt to postpone accountability.

The visible sequence can resemble delayed recognition in the earlier cases. Assurances continue, review takes time, and an alternative closes. The causal explanation differs: strategic choice and control of review may account for the failure without weakening of the relevant performance support. Evidence of intact capacity and deliberate obstruction would therefore challenge the criticality diagnosis, rather than count as another automatic manifestation of it.

The two explanations can also coexist. An actor may exploit a genuine weakening of a cooperative regime, or deliberately accelerate it. A satisfactory account then needs to distinguish the structural susceptibility, the actor's intervention, and the mechanism connecting the two. Attributing all consequences to either structure or intention would conceal part of the relation.

Across the cases, the analytical method remains the same: specify the undertaking, the practical and interpretive supports, their changes, and the alternatives available to affected participants. The cases yield different conclusions because those dependencies differ. Their purpose is to make that discrimination possible, rather than to reproduce one diagnosis across every difficult cooperative episode.

11.10 Formal Case Reconstructions

The formal representations make different parts of these sequences available for examination. In the relief case, a decorated history can record a permission, the delivery of its notice, a local refusal, and a subsequent review as distinct events. Their causal order need not coincide with the order in which an analyst later narrates them. A change in which coordinators recognize the office can then be represented as a coupling rearrangement, provided the primitive elements and their continuing identities have been specified. The boundary alone may show an office and a pending undertaking while omitting a prior exposure or an unresolved objection. Proposition 7.2 states the conditions under which a compressed record still supports the proposed action analysis.

The ready, exposed, and protected configurations in Section 8.4 isolate the difference between the third and fourth delivery sequences. They do not represent the entire relation. Their purpose is the prevention of a particular exposure: review followed by departure and departure followed by review have different outcomes for that purpose. An observation refinement may distinguish the configurations without changing the action that remains possible. A compensation purpose would require a different target and, possibly, an expanded configuration space. The absence of a prevention path therefore cannot establish the absence of every remedy. This purpose dependence is essential to the operator calculation's interpretation.

The field construction addresses a different dependency. Local coordination sites could carry descriptions of the implementation and review capacities that matter for passage. An interface would specify which parts of those descriptions must be compatible for a particular undertaking. Independent review could supply an anchor only if the case supports that interpretation. The unanchored two-site example shows why agreement among sites need not identify a uniquely restored configuration. It does not establish that a joint office should impose uniformity: different local spaces and partial interface maps already allow differences that are irrelevant to the selected compatibility requirement.

The archive case supplies a possible interpretation of the two-mode feedback. Loss of participation can weaken the common record's capacity to sustain contestable classifications; weaker classification and recourse can encourage further withdrawal. Mapping these dependencies to Equation 22 requires a justified choice of amplitudes and a local response law. The verbal sequence alone neither estimates its coefficients nor proves that its state reduction is closed. Likewise, the cubic completion supplies no prediction that an archive must divide into two stable organizations. Its two branches belong to a symmetric illustrative model.

Finally, the delayed-input calculation concerns a remaining intervention horizon within such a calibrated description. In a delivery case this might end when a pause ceases to prevent the specified exposure. In an archive case it might end when a correction can no longer accompany a particular release, even though later attribution remains possible. These are distinct purposes with distinct horizons. The calculation explains how a declared capacity bound can defeat exact correction after accurate recognition; it does not turn either narrative into a measured control system. Together the reconstructions expose the additional evidence needed for each formal translation.

12 Empirical Identification

The hypothetical sequences establish distinctions, not findings. This section specifies the evidence needed to investigate them in actual trust relations. The objective is to make the account vulnerable to correction, including rejection of a criticality explanation when simpler accounts suffice.

12.1 Process Evidence

An inquiry should first identify the cooperative task, the participants whose conduct matters, the period being studied, and the disturbance class. It should then reconstruct how comparable disturbances were previously contained. Records of consultation, local implementation, changes in delegation, and participants' accounts can help identify the restoring process. No single evidence type has automatic priority: official accounts can omit local practice, while retrospective testimony can reorganize experience in light of an outcome.

The criticality hypothesis next requires evidence of a change in that process with consequences for the response regime. Useful observations might include comparable disturbances requiring increasingly extensive intervention, failures of previously effective authorization, or withdrawals propagating through specified interdependencies. The analyst must examine whether the apparent comparison conceals changes in disturbance magnitude or composition. A larger response to a much larger disturbance does not establish altered susceptibility.

The interpretation component requires additional evidence. The inquiry must show how participants received and classified the relevant conduct, which descriptions could enter review, and how a finding could alter an affected commitment. Changes in terms, categories, or recognized speakers should be traced rather than inferred from the existence of disagreement. If a participant privately recognized a problem but could not make it institutionally consequential, the failure differs from ignorance of the problem. Both may matter, but they call for different explanations.

Institutional documents can identify part of this chain. For example, the OSCE's 2011 Vienna Document specifies consultation and requests for explanation concerning unusual military activities, including a response deadline [28]. That documentary fact identifies a procedure one could investigate. It establishes neither effective implementation nor current operation, and it provides no evidence that the relations governed by it were near a critical transition. The gap between a specified procedure and practical efficacy must remain an object of inquiry.

12.2 Historical Reconstruction

A case history should distinguish the sequence of events from the sequence through which those events became known and institutionally consequential. A report can be written early, received late, classi-

fied under an old category, and acted upon later still. A retrospective narrative that assigns one date to recognition would lose the differences among these processes. The distinctions developed in Section 4.5 provide the starting point for reconstructing them.

For each consequential episode, the inquiry can record the undertaking then in force, the participants capable of performing it, the observations available to different parties, the descriptions through which those observations were interpreted, and the routes for revising action. These records should retain uncertainty about timing and disagreement over meaning. A common chronology need not be presented as a common interpretation.

The reconstruction should identify when a later description was unavailable or implausible to the participants themselves. This is essential when categories change. An analyst may use a current category to compare episodes, but should explain its relation to the distinctions operative at the time. Otherwise the analysis can manufacture a story of obvious warning and irrational delay from a history that was materially and interpretively less settled.

Conversely, contextual understanding should not become a reason to erase earlier objections. A concern can have been intelligible and well supported even if dominant institutions did not recognize it. Reconstructing who encountered which evidence, and how a concern was excluded, helps distinguish unavailable understanding from unsuccessful attempts to make understanding consequential. That distinction can affect both the causal explanation and the assessment of responsibility.

The relation's later history should also be followed. A review may change formal policy while leaving practical access unchanged; an apparently failed initiative may preserve records that make later reconstruction possible. The relevant horizon depends on the claim. Evidence of immediate exposure reduction does not establish durable trust, and absence of immediate reconciliation does not establish that a later interpretive achievement was inconsequential.

12.3 Comparative Design

Comparison should be organized around the dependency being investigated. One design might compare similar disturbances before and after a change in delegated authority. Another might compare relations exposed to a common shock but possessing different routes for review. A third might examine interventions that restored one support while leaving another unavailable. These designs answer different questions and should not be treated as interchangeable tests.

The principal danger is selecting cases only because their outcomes fit the proposed mechanism. Comparing an obvious collapse with a smooth success can conceal differences in the task, exposure, and environment. The inquiry should explain why the cases were comparable before the outcome was known and which differences are central to the causal interpretation.

Successful containment is particularly informative when its mechanism can be reconstructed. If a relation facing weakened authority remained cooperative because an independent channel made the change visible and enabled a revised undertaking, that supports a different claim from mere absence of failure. Equally, unsuccessful intervention can reveal that the diagnosed support was not sufficient or that the intervention arrived after its relevant opportunity.

The comparative question should remain specific enough to admit a contrary finding. If ordinary correction works despite the alleged coupled failure, the coupling may have been overstated. If a proposed alternative was usable but participants rejected it, the explanation must address their reasons. If independent observation worsened the relation through a foreseeable reaction, its effects cannot be represented solely as an informational improvement.

12.4 Discriminating Expectations

The proposed coupling has conditional implications that can guide comparison. If weakening authority jointly undermines performance and interpretive recourse, evidence about the partner's continuing sincerity should not by itself restore either function. If an independent channel preserves recognition while the performance support weakens, participants may diagnose the problem promptly yet remain unable to

fulfil the old commitment. If an actionable alternative survives, a later assessment may still change exposure; if it has closed, the same assessment may retain only other forms of efficacy. These implications must be assessed against differences in resources, incentives, and the underlying task.

Several findings would weaken or displace the account. Stable restoring capacities combined with a corrected misunderstanding would favor an ordinary updating explanation. A documented decision to defect, despite intact capacity and recourse, could favor a strategic account. A common external shock could explain correlated failures without the proposed propagation mechanism. Independent interpretive support would defeat the claimed coupling in a case, even if cooperative instability remained. Evidence that a supposedly closed alternative was actually accessible would undermine the timing diagnosis.

These are defeaters of particular claims, not requirements that every case end badly or display a complete cascade. Effective intervention can prevent a transition. Nevertheless, an explanation that invokes an unobserved transition whenever cooperation succeeds and a realized transition whenever it fails would be uninformative. Evidence of the suspected mechanism must be specified independently of the outcome it is recruited to explain.

12.5 Observational Participation

Observation can become part of the relation. A new audit changes what conduct is visible and may change what participants are willing to attempt. Asking members to report doubts can create a route for recognition that was previously absent. Announcing that a relationship is close to collapse can affect confidence, withdrawal, and the authority of those managing it. The observer's role is therefore a possible mechanism to investigate.

This reflexivity does not make evidence impossible. It requires recording the conditions under which evidence was produced and distinguishing an intervention's effects from claims about the prior relation. A review that successfully creates standing cannot be used without qualification as evidence that standing was already available. A warning that changes behavior may reveal a response capacity while also changing the trajectory under study.

The same issue arises in public interpretation of a crisis. A diagnosis can become authoritative because an influential institution adopts it. That adoption may alter the conduct whose interpretation the diagnosis purports to settle. The analyst should distinguish evidence that the account became consequential from evidence that its substantive claims were correct. Relational efficacy remains an object of study rather than a substitute for epistemic warrant.

Reflexive effects can also be constructive. Making a suppressed experience publicly intelligible can enable practical revision. Providing a common description of a limited task can support coordination without resolving every disagreement. Such effects should be assessed openly, including the possibility that the description privileges some participants or excludes others. The objective is accountable inquiry, not an impossible position wholly outside the relations being studied.

12.6 Measurement Limits

Early-warning research does not remove these identification problems. Boettiger and Hastings show that warning methods can produce false alarms and missed detections even under favorable assumptions [3]. Political applications add contested units, selective records, strategic responses to observation, and changing interpretive practices. A measured increase in variability or response time therefore requires an argument connecting it to the proposed mechanism; it cannot serve as a universal criticality certificate.

Quantitative work could become useful where a domain supplies stable observables and defensible comparisons. Qualitative process tracing could instead establish changes in delegation, recognition, and recourse. Mixed approaches may compare event records with contested accounts of their significance. The present analysis selects none as a universal method and supplies no measurement instrument. It requires each method to preserve the difference between observed manifestation, inferred relational support, and the epistemic status of the proposed transition.

12.7 Formal Model Identification

The mathematical investigations add identification obligations to this empirical programme. A configuration summary must preserve the distinctions relevant to the actions and purposes being studied. One practical check compares histories assigned the same summary: do they permit the same interventions, and do those interventions lead to equivalent outcomes? A failure indicates omitted history or an inadequate classification. The conditions in Proposition 7.2 guide that check; they do not guarantee that a convenient institutional database satisfies it.

Observation and recourse require separate records. An inquiry should establish what a participant could distinguish at a given point, what interventions were actually accessible, and what disturbances each intervention could withstand. An observation fiber is a modelling claim about accessible distinctions, not a presumption that all its members were equally probable. A full-state recourse computation can overestimate what a participant could guarantee with that information. Later access to the complete case history must not be inserted retrospectively into the participant's policy.

Field identification requires defensible local variables, interface maps, and metrics before an energy or spectral gap can be interpreted. A norm chosen for computational convenience may weight institutional discrepancies in a substantively inappropriate way. A proposed anchor must have a demonstrated external or independently maintained basis. Internal agreement cannot supply that basis merely by appearing in several correlated records. Sensitivity to alternative metrics and interface specifications is therefore part of assessing the representation.

For the dynamical model, the inquiry must identify a period over which a frozen response law is credible and compare it with plausible alternatives. Increased response magnitude could reflect a stronger input, transient amplification, weaker restoration, or a change in the observation channel. The triangular counterexample in Equation 28 makes one of these alternatives exact. A fitted slow mode also needs evidence that omitted modes do not invalidate the selected closure. Across a structural event, the proposed comparison map requires its own justification.

The correction calculation adds a purpose-specific horizon, input units, and a feasible capacity bound. Accurate knowledge at the intervention time is an explicit favorable assumption of Proposition 10.3; actual uncertainty may require a different target or a robust control problem. The computed quadratic effort is not an empirical estimate of an actor's total burden. These obligations permit partial findings: a case can support a history-sensitive action restriction while leaving the field representation or the criticality mechanism unestablished.

12.8 Evidence Profiles

A useful report should separate at least four claims: what changed in observed conduct, which mechanism is proposed to explain the change, what supports the transition hypothesis, and how the consequences were distributed. These claims can have different strengths of support. The report may document an exclusion from review clearly while remaining uncertain about whether that exclusion contributed to a regime transition. Such asymmetry should be retained.

The empirical vocabulary should follow those distinctions. A documented sequence supports a historical description. A well-supported dependency supports a mechanism claim. Evidence of changing responses to specified disturbances may strengthen the criticality hypothesis. None of these alone establishes the normative conclusion that cooperation should continue. The report should identify the additional reasons supporting that conclusion or leave it open.

This format also makes negative results useful. A study can show that interpretive supports remained effective despite cooperative instability, or that ordinary nonstationarity explains the observations without a transition mechanism. It can identify a practically important burden of delay without finding near criticality. These results refine the boundaries of the argument instead of becoming failures to discover a presumed condition.

For continuing public discussion, revisability of the inquiry itself matters. Source selection, relevant counterevidence, category changes, and unresolved disagreements should remain traceable. The same

distinctions used to study trust can then discipline the presentation of the research: an authoritative account can be influential while retaining limits that later work must be able to identify and revise.

13 Scope Boundaries

The analysis has explanatory, strategic, and normative limits. This section addresses the objections most directly capable of changing its interpretation: that criticality adds only a label, that misrecognition displaces conflict, and that preserving a relation is treated as its own justification. It then states the limited status of the proposed contribution.

13.1 Explanatory Scope

The first objection is that any fragile institution can lose performance and interpretive capacity together. That is correct. Joint vulnerability does not establish near criticality. The restricted criticality account requires a further mechanism through which changes in restoration alter the response regime and make qualitative reorganization a relevant possibility. If evidence supports only ordinary fragility, the argument about coupled dependencies may remain useful, but the criticality description has not earned additional explanatory weight.

The title therefore identifies a conditional domain of inquiry. The paper has analyzed what follows within that domain and how one might assess its applicability. It has not demonstrated that actual trust relations generally occupy it. Even within the domain, interpretive disruption requires the additional dependency specified in Section 3.4. Transparent observation, insulated review, or timely institutional reconstruction can interrupt that dependency. No theorem of unavoidable misrecognition follows.

A related concern is that the analysis expands the trust relation until it contains its entire environment. The functional boundary in Section 2.6 limits that expansion: an included element must help explain expectations, performance, interpretation, or recourse in the identified cooperative task. Its relevance must be demonstrated. The appropriate analytical scale may be a small interaction, an organization, or a wider arrangement; breadth alone does not make the account more relational or more explanatory.

Discontinuity alone presents another problem. A rule that requires every signatory's assent can cause a task to stop abruptly when one assent is withdrawn. That fact can be explained by the rule's structure without showing a changing dynamical susceptibility. A deadline can likewise produce an abrupt change in available options without establishing a critical regime. The empirical inquiry must identify the relevant response process rather than equate a sharp outcome with criticality.

Even a cascade can have a simpler explanation. Participants may follow a common signal, respond to coordinated pressure, or imitate a strategy without the specific weakening of restoration proposed here. An actual study might therefore establish a coordination transition while leaving the stronger criticality description unsupported. The comparative examples are constructed to make a candidate dependency intelligible; they are not proofs that their stipulated cascades uniquely instantiate critical dynamics.

This limitation is consequential for the working title. The manuscript develops an inquiry into near-critical trust relations, not a classification that all its examples have empirically earned. A future case study may retain much of the relational analysis while rejecting the criticality hypothesis. Public discussion should remain able to make that revision without having to abandon every distinction the analysis has developed.

13.2 Trust Classification

A second objection concerns the status of institutional arrangements within a theory of trust. Some accounts will describe reliance on procedures or archives as confidence rather than trust in the interpersonal sense. Others permit broader uses of institutional trust. The present analysis need not settle that terminological dispute to investigate how such arrangements support, constrain, or transform relations in which persons trust one another.

The distinction should nevertheless remain visible. If a participant cooperates solely because sanctions make defection costly, a description of the arrangement's reliability does not establish an attitude of trust. If another participant addresses an undertaking to a representative as an accountable person, the interpersonal dimension can remain important even within a heavily regulated activity. The analyst must identify these orientations rather than infer them from the same observed transaction.

Relational analysis can accordingly operate at two connected levels: the trust orientation itself and the wider configuration that makes it possible or consequential. Calling the second a trust relation does not make every component a bearer of the first. A record is not thereby a person, and an institution is not thereby a unified mind. This distinction preserves the possibility of different philosophical accounts while preventing an infrastructural explanation from replacing the phenomenon it was meant to illuminate.

The objection also limits practical conclusions. An arrangement that makes cooperation safer can be valuable without restoring a damaged interpersonal relation. A recovered personal orientation can matter without making a large institutional commitment reliable. The paper's differentiated analysis permits both outcomes and requires their evaluation on their own terms.

13.3 Strategic Conflict

Misrecognition is one possible source of cooperative difficulty. Participants can also exploit ambiguity, withdraw authority deliberately, or preserve uncertainty to shift costs. Jervis's security-dilemma analysis already attends to exposure to exploitation and the difficulty of distinguishing relevant postures [22]. Wheeler's account places interpersonal trust and signal interpretation within relations between adversarial leaders [30]. The present argument supplements those problems with the possible reorganization of performance and interpretive supports; it does not attribute a general assumption of perfect recognition to either work.

An appeal to changing structures can itself be strategic. A participant might describe a deliberate breach as a loss of control or request indefinite patience while continuing to impose exposure. The distinction between sincerity and capacity therefore creates an obligation to investigate both. It provides no presumption that a failure is innocent. Evidence of culpable conduct can warrant distrust, sanction, or exit even when the surrounding relation is also changing.

13.4 Normative Assessment

The continuity analysis is conditional on independently defensible purposes. A stable arrangement can preserve domination or exclude affected parties. Persistence does not establish mutual benefit, and a formally available review process does not establish equal access. The practical questions concern which exposures are acceptable, whose claims have standing, and which burdens of waiting or revision can be justified.

Those questions cannot be answered by the criticality hypothesis alone. Increased susceptibility may create reasons for restraint in one case and urgent protection in another. A reversible arrangement may preserve useful options while undermining a commitment that others reasonably need. The paper provides distinctions for stating these conflicts, not a decision rule that settles their moral weight. The separate questions of institutional design and distributive justification remain necessary.

13.5 Conceptual Transfer

The examples span institutional cooperation and collaborative knowledge production. Their common vocabulary identifies possible dependencies, not an identity of social forms. Authorization, care, professional responsibility, diplomatic recognition, and archival classification can have different normative structures. A useful transfer must specify which dependency is preserved and which differences remain.

For instance, an organizational record can be transferred to a successor through an explicit procedure. An intimate relation's history cannot be transferred to a new person in the same way. Both involve

memory and continuing consequences, but that similarity does not establish an equivalent mechanism of trust. Likewise, an independent inspection can clarify a material fact while leaving the meaning of an interpersonal undertaking unresolved.

The dynamical models require similar restraint. The proofs in Sections 9 and 10 establish consequences of explicit spaces, interfaces, metrics, and evolution laws. They do not establish those choices for a political relation. In particular, the existence of the support bifurcation in Proposition 10.2 supplies a conditional mathematical instance, not evidence that a particular institution follows its symmetric cubic law. The translation must identify the represented supports and show why the relevant dependencies survive abstraction. Mathematical tractability alone does not establish adequacy.

The GR approach is used here to maintain attention to historical constitution, changing couplings, and the distinction between manifestation and relational efficacy. Those commitments do not require every research problem to be represented through the same formal machinery. A faithful account can retain an unresolved translation instead of treating theoretical unity as an achievement in itself.

13.6 Contribution Boundaries

The contribution is an integrated conditional argument about trust development when the supports of cooperation and interpretation are implicated in a possible transition. Its specific organization connects the portability of shared history, the difference between buffering and closure, and the practical continuity of commitments across changing authority. The comparative sequences separate premises that would otherwise be too easily bundled together.

The formal investigations sharpen these distinctions through history composition, operational order, constrained recourse, support-field kernels, coupled stability, and finite-horizon correction. Their mathematical ingredients include established constructions from finite-dimensional algebra and dynamical analysis. The propositions are derivations for the declared representations, not claims to new general mathematical theorems. The source connections in Sections 7 to 10 also identify which GR structures are inherited and which local assumptions this paper adds.

This organization inherits substantial material. Recursive trust dynamics, interpretive change, delay, practical revision, protected cooperation, and maintenance costs already appear in the cited literature and prior GR working papers. The present analysis does not establish priority for those ideas or a uniquely GR explanation of them. Its targeted source review also cannot certify exhaustive novelty across trust research, political theory, and critical-transition studies. The argument can be assessed for coherence and explanatory usefulness independently of that stronger bibliographic claim.

Further work would need to test the coupled dependency in actual relations and compare it with ordinary updating, strategic defection, and noncritical institutional change. Such work could strengthen, narrow, or reject the criticality component while retaining useful distinctions about trust. That possibility is part of the account's intended epistemic status.

14 Open Research Problems

The developed distinctions leave several substantive questions open. This section identifies what further argument or evidence would be needed to address them. Its purpose is to make the manuscript usable for continuing inquiry: an unresolved question should identify a specific dependency or conceptual difficulty, rather than merely announce that more research is desirable.

14.1 Transition Identification

The first problem concerns the strength of the criticality claim. A study might establish changing interaction rules, altered propagation, or a loss of restoring capacity without establishing a near-critical regime in a stronger dynamical sense. Further work needs to specify which combination of evidence would warrant the stronger description in a particular domain. This includes identifying what a transition means for the task, which observables bear on susceptibility, and which alternatives can produce similar patterns.

An especially difficult case arises when the relevant objects change during the transition. A comparison of return times presumes a sufficiently stable account of what is returning. If the identity of the actor or commitment is being reconstructed, the earlier outcome may no longer be an appropriate reference. A domain-specific analysis must decide which continuity makes comparison meaningful and disclose the consequences of that decision.

This problem does not require postponing all inquiry until an exact metric is available. It does require distinguishing a documented mechanism of relational change from a stronger claim about its dynamical regime. One valuable outcome would be a typology of cases in which the stronger claim adds explanatory content and cases in which ordinary nonstationarity or institutional change already provides an adequate account.

14.2 Interpretive Adequacy

A second problem concerns the assessment of interpretations whose categories differ. Some disagreements can be tested against a shared record. Others concern which record matters, which participant has standing, or what counts as fulfilment. A more developed account must explain how criticism can proceed without assuming that one party's categories are neutral or that every account is equally defensible.

The present manuscript identifies partial criteria such as historical fidelity, attention to contrary evidence, explicit inferential steps, and practical adequacy for a specified task. These criteria can conflict. An account can support immediate coordination while inadequately representing an affected group's experience. A richer account can preserve that experience while leaving a decision unresolved. Further normative and epistemological work is needed to assess those conflicts.

The problem is particularly important for later reconstruction. Subsequent understanding can reveal limitations in an earlier category, but it can also introduce new exclusions. The research task is to identify grounds for comparative improvement while retaining the possibility that improvement is partial, contested, or accompanied by losses. A theory of revisability should be able to describe those mixed outcomes.

14.3 Relational Succession

The third problem concerns the continuity of responsibilities through changing actors. Practical capacity, recognized authority, and responsibility can pass to different successors. An account that follows only the continuing organizational name can miss that separation. An account that treats every successor as entirely new can make earlier reliance disappear from view.

Further work should examine which grounds justify assigning particular continuing responsibilities. Possible grounds include accepted undertakings, control of inherited resources, benefit from earlier co-operation, and the ability to provide a remedy. The present paper does not claim that these grounds are equivalent or that any one is universally decisive. Their interaction requires a more specific normative argument.

For the trust problem, the question is how such responsibility can become intelligible and consequential during a transition, rather than only after a final settlement. Some provisional arrangements may preserve claims without deciding their final allocation. Others may effectively determine the outcome by controlling records or access. Distinguishing these arrangements would sharpen the account of transitional recognition.

14.4 Temporal Coordination

A fourth problem concerns the coordination of different times for inquiry, action, and repair. The manuscript distinguishes purpose-specific revision windows and the unequal burden of waiting. Further work should investigate how those windows can be identified while the relation is still changing. Retrospective clarity about when an alternative closed does not establish that participants could have known the closure in advance.

The problem includes a tradeoff between commitment and continued openness. Delaying a commitment can preserve one valuable alternative while preventing another from being created. Acting can establish a new cooperative capacity while exposing participants to a loss that later recognition cannot repair. A more developed analysis must examine the content and distribution of these possibilities rather than maximize the number of open options.

Some cases may support explicit review intervals; others may require event-sensitive reassessment or distributed discretion. Their adequacy depends on what the review can change and on the resources available to participants. These are questions about specific trust relations, not evidence for one universal temporal design.

14.5 Causal Intervention

A fifth problem concerns interventions that alter the conditions of their own assessment. Creating a review channel can improve access to evidence and change how participants understand the relation. Announcing an intervention can also change conduct before the new procedure operates. A theory of intervention must account for these effects rather than treating the relation as a passive object.

This includes distinguishing the success of an intervention from confirmation of the explanation that motivated it. Independent review might help for reasons different from the alleged critical mechanism. Conversely, failure might result from inadequate implementation rather than a false diagnosis. Further inquiry should specify the mediating changes that connect intervention to outcome and identify evidence capable of separating these possibilities.

Intervention also raises a normative question about authority. A diagnosis of susceptibility does not establish who may reorganize the relation or whose exposure may be used to test a proposed repair. A comprehensive practical account must connect epistemic claims to justified roles and responsibilities.

14.6 Formal Representation

The formal investigations establish a starting structure rather than a completed mathematical theory of heterogeneous trust. Several extensions now have precise objects. The history construction needs a principled account of incidence refinement when one primitive participates in more than two couplings. A useful refinement must preserve relevant operations and continuity claims, not merely produce a graph that can be drawn as a two-complex.

The operator account supplies full-state robust reachability and an exact one-step observation-based condition. Multi-step policies with changing observation partitions require an information-state construction. The hard case is an intervention that changes both what can be observed and which actor has authority to act on it. An ordinary fixed observation model may omit that change.

The field and dynamical models require further work on reduction. When retained modes are not invariant, the effect of discarded variables must be bounded or represented through additional history. Across changing local spaces, the transport map in Equation 36 needs substantive justification. The existence of stable modes on either side does not determine which earlier commitments remain meaningful across the seam.

The nonlinear example proves one conditional bifurcation. Other completions can produce different transitions or remove that transition. A broader investigation should compare asymmetry, time-varying couplings, finite-amplitude disturbances, and endogenous changes in observation or action. The delayed-control calculation likewise requires extension beyond a single calibrated mode before it can inform claims about heterogeneous practical burdens. These are specific mathematical and interpretive tasks, not reasons to replace the relational objects with a universal scalar measure of trust.

14.7 Public Revision

The final problem concerns how this account should evolve through discussion. Its concepts can be useful while some of its connections remain too broad, too narrow, or inadequately supported. Criticism may

show that a proposed criticality mechanism is ordinary coordination failure, that a continuity criterion overlooks an affected party, or that a distinction does not survive a relevant case.

Such criticism should lead to identifiable revisions of claims and scope. It need not be absorbed into an ever-expanding framework in which every outcome confirms the vocabulary. An account of relational revisability should retain the possibility that one of its central terms needs replacement or that an apparently unified problem needs to be differentiated further.

The manuscript is therefore offered as a developed basis for public inquiry. Its continuity through later versions should consist in traceable questions, arguments, evidence, and corrections rather than preservation of every present formulation. That orientation gives knowledge development a practical place in the research process itself.

15 Relational Trust Implications

The inquiry began with trust relations whose histories remain present while the supports that made those histories dependable are changing. It has examined how such relations can form, persist, become misrecognized, and undergo revision or termination. The resulting account treats trust development as a process that can change the conditions of later performance and interpretation. Its objects include participants and commitments as well as the dependencies through which their conduct becomes consequential.

The near-critical case arises when changes in restoring processes make a qualitative reorganization of cooperation a relevant possibility. When interpretive recourse depends on supports implicated in that change, participants can lose capacities to sustain and assess the relation together. This conditional dependency is the central analytical result. It identifies why an account restricted to changed confidence or additional information can omit an important practical source of failure. It also identifies what must be investigated before that explanation is applied to an actual relation.

The formal investigations make several parts of this dependency inspectable. Historical composition requires explicit boundary correspondences, and a reduced configuration must retain the history relevant to its operations and purposes. The revision algebra separates accessible distinctions from feasible recourse; its finite examples show that an operation's practical effect can depend on its order relative to an exposure. The field construction identifies restoring modes through interface and anchoring assumptions. It explains how agreement within a relation can coexist with loss of independent restoration.

The dynamical results then supply a specific critical mechanism. Cross-coupling can overcome isolated restoring capacities, and a stated nonlinear completion reorganizes the stable response configurations. The delayed-correction calculation shows how recovery, remaining time, and intervention capacity interact even when later recognition is accurate. Each result remains conditional on its model. Stable-spectrum amplification, ordinary action deadlines, and strategic obstruction supply different explanations that the empirical inquiry must retain.

The consequences differ across trust development. Formation requires attention to which inferences from shared history remain supported. Maintenance requires distinguishing a temporary allowance for clarification from the exclusion of consequential reassessment. Cooperative continuity requires identifying what commitments, standing, and practical alternatives can survive or be reconstructed through changing actors and procedures. Later recognition matters partly through those connections, even when it remains incomplete and contested.

These implications concern several different achievements. An initial encounter can generate evidence, authority, and exposure in different proportions. Maintenance can preserve cooperative capacity while either retaining or narrowing access to contrary findings. Distrust can support protection without deciding the status of the entire partner. Repair can produce a viable new relation without restoring the old one. The analysis therefore follows the particular commitments, capacities, and interpretations at issue rather than assigning the relation one global level of trust.

Continuity has a similarly differentiated structure. Records, practical performance, responsibility, and standing can survive or disappear separately. Preserving one connection does not establish the preservation of the others. A later account can matter for historical understanding while arriving too late to

prevent a specified exposure. A reconstructed relation can preserve an earlier claim while changing its practical addressee. These distinctions make it possible to evaluate both constructive transformation and the loss of meaningful alternatives.

The account does not recommend maximizing trust, patience, or reversibility. A relation may warrant narrower commitments, protected exit, or urgent action that closes some alternatives. Those judgments require reasons about exposure, responsibility, and burden allocation. Likewise, an explanation of changing trust requires evidence that distinguishes the proposed transition mechanism from ordinary nonstationarity and strategic conduct. Where that evidence is absent, criticality remains a hypothesis rather than an established condition.

The comparative cases have given these distinctions different outcomes. Ordinary adjustment can suffice where restoring supports remain effective. Prompt recognition can permit adaptation despite transition susceptibility. A later interpretation can still change conduct when an alternative and a route to use it survive. A new arrangement can reconstruct cooperation while creating fresh questions of authority and exposure. Strategic reassurance can produce a superficially similar sequence through a different mechanism. These differences are essential to an account that remains capable of being wrong.

The resulting research task is to trace how specified relations reproduce performance and interpretation, identify which supports are changing, and examine what remains practically possible for affected participants. Public discussion can refine the concepts, challenge their application, and revise the proposed connections. The manuscript's contribution to that process is a developed set of arguments whose assumptions and limits remain available for criticism, while trust relations retain their place as the central object of inquiry.

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