

Value Co-Creation amid Plural Valuations: An Inquiry Towards Generative Praxis among Heterogeneous Subjects

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Abstract

Cooperation among heterogeneous participants can generate shared outcomes amid distinct, partly overlapping ways of valuing those outcomes. This paper investigates the philosophical conditions under which contributions become substantively co-creative across plural evaluative practices, including cases in which participants coordinate through local agreements while preserving different horizons of significance. Drawing selectively on value pluralism, generative justice, institutional governance, and theories of recognition and structural responsibility, it proposes a provisional generative-relational analysis distinguishing enabling conditions, co-creative participation, valuation practices, and normative legitimacy. Attention is given to the interpretation and attribution of contributions, power over their conversion and circulation, the return of generated capacities, differentiated responsibilities, and the reproduction of conditions for further value generation. Human communities, ecological relations, institutional arrangements, and artificial tools motivate distinct questions of participation and responsibility; the analysis leaves questions of subjective experience and moral standing open. Constructed cases serve to clarify the proposed distinctions, with an explicit comparative design for assessing incremental explanatory usefulness against established accounts. The paper is an exploratory philosophical inquiry rather than an empirical validation of a general model.

Keywords: value co-creation; heterogeneous valuation; generative praxis; relational capacities; recognition; generative justice

Discussion Paper Note

This exploratory philosophical discussion paper is the fourth study in a four-paper programme on aesthetic unfolding, generative invitation, education, and heterogeneous value co-creation. Its central question is how distinct participants can substantively contribute to the development of one another's capabilities, resources, and relations while retaining partially divergent practices of valuation. The paper approaches this problem through value pluralism, generative justice, theories of institutional governance, and normative analysis of recognition, power, and responsibility.

The manuscript was developed one complete section at a time. The present version contains all twelve planned sections, including cross-domain comparison, evidential requirements, and an open philosophical research agenda. Its cases are constructed analytical scenarios and should not be read as reports of fieldwork or measurements. The paper advances a preliminary generative-relational vocabulary, acknowledging established precedents and remaining open to contrary evidence and criticism.

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Responsible Use and Rights Reservation

Claims concerning cooperation, rights, ecological welfare, and distribution are context-dependent. The analysis does not establish universal moral standing for institutions, organisms, or artificial systems; relevant ethical and legal statuses require specific investigation. Constructed cases are offered to clarify contested concepts, without presenting observed interventions or findings. Attribution, permission, community governance, privacy, and legal obligations require separate scrutiny in concrete applications.

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Notices

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Scholarly independence. References acknowledge prior scholarship without implying collaboration, endorsement, or priority over generative justice, value pluralism, and established social or political theories.

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1 Introduction

The present inquiry examines how heterogeneous subjects and generative-relational systems may participate in the production, preservation, and transformation of value while differing in the ways they identify, experience, express, and evaluate what matters. Its object is cooperation in which participants contribute to one another's generative possibilities amid distinct, partially overlapping standards of value. The inquiry asks what constitutes a contribution across such differences, how shared activity becomes substantively co-creative, who exercises power over the conditions under which value is generated and circulated, and which responsibilities arise when the gains of an encounter are distributed asymmetrically. The method is philosophical and comparative, informed by traditions of value pluralism, institutional analysis, theories of justice, and generative justice. A provisional generative-relational (GR) vocabulary is used to organize these questions; its suitability remains open to criticism, historical refinement, and empirical investigation.

An encounter between distinct practices can produce results recognized differently by its participants. A community historian may regard an archive as a means of sustaining memory and repairing an interrupted lineage. A software developer may regard the same collaboration as an opportunity to design a more reliable system for organizing records. A school may value the encounter for the questions it enables students to ask. An institution providing the facilities may evaluate the project in terms of public access, financial sustainability, or compliance with its legal obligations. These forms of valuation can overlap while remaining different in their objects, temporal horizons, social consequences, and criteria of justification. Some comparisons may become possible through negotiation and practical experience; others may continue to resist conversion into a single evaluative vocabulary. The philosophical task is to understand the relations through which such an encounter develops, rather than to presume in advance either complete agreement or permanent incomparability.

Differences in valuation have long been treated as more than disagreements about the magnitude of a single good. Anderson's account of the plurality of ways of valuing distinguishes relations such as use, respect, and appreciation and questions the extension of market valuation to domains governed by other ethical considerations [3]. Chang's analysis of parity, in turn, challenges the assumption that difficult comparisons must terminate in a verdict of better, worse, or equal value [11]. The present inquiry draws a limited conclusion from these precedents. Heterogeneous cooperation may be intelligible even where a total ranking of participants' ends is unavailable. This is a claim about the possible structure of practical relations, rather than a claim that values are inherently incomparable or that comparison is always inappropriate. Participants may devise local comparisons for specific decisions, revisit them under changed conditions, and retain distinct standards for other purposes.

The phrase *plural valuations* names the coexistence of situated evaluative practices whose criteria may overlap, compete, or change through shared activity. Such plurality admits partial agreement, negotiated thresholds, multiple criteria, and practical decisions under uncertainty, while the possibility of an authoritative comprehensive measure remains an open, context-dependent question. Indeed, an agreement to cooperate can depend on recognizing an unresolved difference. A shared project may advance because its participants find different, mutually acceptable reasons to engage; their reasons need not become identical for the activity to proceed. The distinctive problem is that apparent agreement about an action can conceal disagreement about its meaning, while the apparent plurality of purposes can co-exist with stringent common requirements concerning safety, authorization, or fairness. A theory of co-creation needs to track both features.

The term *value* will be used with deliberate differentiation. *Evaluative value* concerns what a participant or relevant community regards as worthy, desirable, significant, or binding within an identifiable practice of judgment. *Generated value* concerns a change in some capability, resource, relation, opportunity, expressive form, or ecological condition that is taken to matter under an explicitly stated evaluative perspective. *Circulated value* concerns the availability, movement, accessibility, and possible transformation of those conditions across persons, institutions, or living systems. *Normative legitimacy* concerns whether the activity and its distribution of consequences can be justified under relevant ethical, legal, and

political constraints. These distinctions are analytical. They neither presume four separate substances nor imply that the positive evaluation of an outcome by one participant determines its legitimacy for others.

An important precedent is Eglash's account of generative justice, which investigates bottom-up value creation and the circulation of labor, ecological, and expressive value in forms less alienated from their generators [16]. The present study acknowledges that intellectual inheritance and gives it a specific extension. Its central difficulty arises where the participating subjects or systems have partially divergent generative histories and forms of valuation, so that the identification of a beneficial return, an alienated contribution, or a legitimate conversion of value becomes contested. The proposed contribution lies in examining the interfaces through which heterogeneous participants recognize, transform, retain, return, or appropriate the conditions of one another's value generation. This proposal does not claim priority over existing scholarship on generative justice, political economy, commons governance, ecological ethics, or cooperation.

A generative-relational perspective begins from the provisional observation that opportunities to produce significant outcomes are formed within relations. Skills require materials, social recognition, infrastructures, embodied practices, and histories of learning; ecological renewal depends on situated interactions among organisms, landscapes, and changing environments; collective knowledge depends on durable means of interpretation and transmission. The relevant unit of inquiry may therefore extend beyond an isolated producer and a completed product. The present paper treats *generative conditions* as the historically situated arrangements that make further activity, adaptation, inquiry, or regeneration possible. Their causal importance can be investigated without asserting that every value has a single relational origin or that relations alone exhaust the ontology of persons, organisms, or artifacts. The account remains open to individual agency, irreducible material constraints, and domain-specific explanations.

This perspective makes a preliminary distinction between *enabling* and *co-creating*. Providing a resource may enable a subsequent activity while leaving the aims, organization, and products of that activity largely determined by its recipient. Co-creation, as tentatively conceived here, involves consequential interaction among contributions: the trajectories of at least two parties are shaped through the encounter, and the emerging activity depends in a significant way on their differentiated capacities or responses. Reciprocal modification is an important possibility, though it need not appear in equal degree, at the same moment, or within the same evaluative language. The relation should be assessed through a specific counterfactual question: which aspects of the resulting capacities, practices, or conditions would plausibly have differed without each contribution? Such an inquiry cannot, by itself, settle credit, ownership, consent, or justice. It provides one basis for investigating what the participants have actually helped bring about.

The distinction matters because many transactions create a benefit without constituting the kind of participation proposed here. A firm may purchase a prepared artifact and incorporate it into a product. A public institution may provide an open dataset that an independent researcher subsequently transforms. An automated system may supply a useful output within an educational or creative practice. In each case, a contribution can be causally important; its relation to a jointly developed trajectory differs with the allocation of discretion, opportunities for feedback, and dependence of the activity on continued interaction. The present inquiry therefore treats co-creation as a contestable relational characterization requiring evidence about process. It should not be bestowed as a complimentary label on every collaboration, exchange, or technically mediated act of production.

A further distinction concerns the *recognition* of participation. The person who provides a tool, the community whose practices inform a design, and the organization that controls a distribution channel may each offer a different account of the resulting work. The scale and visibility of contributions can differ from their generative importance. Some enabling labor remains routine and unacknowledged; some highly visible acts depend on infrastructures or forms of maintenance that another participant sustains. Attribution may be disputed because participants understand the purpose of a contribution differently, because information about its history is inaccessible, or because organizational rules recognize only certain forms of authorship and production. Recognition in this setting is more demanding than the

assignment of names to an output: it concerns whether the relevant histories and dependencies remain intelligible and whether participants have appropriate standing to contest their representation.

The political dimensions of this problem are already well developed in several traditions. Fraser differentiates redistribution, recognition, and political representation within a theory of participatory parity, and examines both the membership boundaries of justice claims and the processes through which those boundaries are set [20]. Young's account of structural injustice connects responsibility to participation in social processes whose cumulative results are neither controlled nor fully intended by a single actor [51]. These approaches offer analytical resources for examining who is admitted as a participant, who can articulate a claim, and whose activities become institutionally legible. Their arguments have specific political and normative settings. The present paper uses them as points of critical comparison and does not presume that all relations among heterogeneous systems can be evaluated by direct extension of human political citizenship.

In particular, *heterogeneous subjects* requires conceptual care. Human participants may possess different languages, histories, institutional roles, or practices of evaluation while sharing legal and moral standing grounded in relevant institutions and ethical traditions. Organizations act through authorized structures and processes that cannot simply be equated with individual experience. Nonhuman organisms may matter through welfare, ecological relationships, and legitimate responsibilities of care even where their forms of experience and valuation remain difficult to interpret. Artificial systems may participate causally and operationally in creative or productive arrangements, while questions of consciousness, moral standing, and independent legal personality remain unsettled and context-dependent. For this reason, the proposed framework distinguishes an *agent of consequential participation*, an *interpreter or bearer of a valuation*, and a *rights-bearing subject*. Their extensions can differ. Calling an arrangement heterogeneous does not settle which entities instantiate which categories.

A related challenge concerns the temporal distribution of benefits and costs. A collaboration may yield a visible artifact immediately while its deeper value depends on the capacity to maintain it, the continuation of a local practice, or an ecological process unfolding over years. Conversely, a project that appears productive in the short term may deplete a participant's labor, undermine an institution's independence, or consume environmental conditions required for future regeneration. Participants may experience such developments through distinct temporal scales: a research contract, a generation of community memory, a cycle of ecological restoration, or the useful life of technical infrastructure. A provisional assessment of co-creation must remain attentive to this temporal plurality. A positive outcome at one observation point establishes little about the distribution of capacities or burdens across the full trajectory.

Questions of *return* become especially important in such settings. A contribution can be credited publicly while its originator loses effective access to the generated results. A community may receive a summary report while a partner retains exclusive control of the data, instruments, or subsequent uses. A digital platform can circulate material widely while the people whose practices supplied that material face restricted opportunities to shape its representation. Alternatively, a research collaboration can enable new resources to circulate back into a community in forms that support learning, maintenance, and independent future action. Return is therefore considered here as a family of relations involving access, continuing capability, recognition, material support, governance, and the possibility of further transformation. The appropriate form of return depends on context and cannot be inferred solely from the quantity or market price of the outcome.

The governance of shared conditions is consequently part of the analysis. Ostrom's research on common-pool resources documents institutional arrangements through which groups have confronted problems of collective action and resource management, with outcomes that vary across configurations of rules, monitoring, and local conditions [35]. The lesson for the present philosophical inquiry is methodological: the possibility of cooperation should be examined through its institutional arrangements rather than assigned in advance to a single organizational form. An analogy between commons governance and heterogeneous value co-creation may guide questions about participation, boundaries, sanctions, and shared maintenance. It does not establish that educational knowledge, software models, ecological

habitats, and human labor can be managed by one uniform rule system.

The capability-oriented concern articulated by Sen further directs attention to what participants are substantively able to do with resources or achievements, rather than treating resource possession as a complete description of their opportunity [42]. Within the present argument, an actor's access to a final product and the actor's continuing capacity to initiate further work are analytically different outcomes. A workshop that delivers a sophisticated machine while leaving local participants dependent on inaccessible repair services creates a different trajectory from one that also develops maintainable expertise and locally governed technical knowledge. These are contrasting constructed possibilities, not claims about a measured intervention. They help locate the evaluative significance of durable generative capacity and show why the return of a product and the regeneration of agency require separate assessment.

Consider, as a deliberately constructed case, a coastal community, a marine ecologist, and a group of technical volunteers cooperating on habitat monitoring. Community participants contribute observations of seasonal ecological change, histories of local access, and situated concerns about livelihood and stewardship. The ecologist brings sampling methods and interpretive models. Volunteers develop a tool for recording and displaying observations. The actors may consider the same activity valuable for different reasons: the maintenance of local relations to place, the production of research-grade evidence, or the development of reusable technical methods. If a shared monitoring practice emerges, the contributions may be consequential without being reducible to an agreed scalar measure. At the same time, the project could fail ethically if observations are released in ways that expose sensitive ecological locations, if local participants lose authority over representations of their experience, or if promised maintenance resources disappear. The co-production of information, its value under particular standards, and the justification of the institutional arrangement therefore call for distinct inquiries.

A second constructed case concerns a community archive and a generative artificial-intelligence tool. An institution might use machine-assisted transcription or classification to make an inherited collection more searchable. The technical contribution can increase access, while local historians may value continuity of context and careful treatment of names, memories, and culturally sensitive materials. A model provider may optimize system accuracy and scalability; an archive may prioritize warranted interpretation and responsibility to its contributors. The presence of a productive technical interface provides neither a presumption that the artificial system itself possesses subjective valuations nor an authorization to ignore the people and institutions governing the source materials. Questions of provenance, licensing, review, disclosure, error correction, and the capacity to withdraw or restrict particular uses remain central. The same case illustrates how value co-creation may be partially achieved in one sense while ethically deficient in another.

These examples suggest a reason to keep three levels of assessment distinct. At the *descriptive* level, the analyst reconstructs the contributions, interactions, mediating infrastructures, and outcomes of a generative process. At the *evaluative* level, the analyst specifies whose standards are being used to judge benefits, losses, or transformed capabilities, and examines the partial relations among those standards. At the *normative* level, the analyst asks which arrangements satisfy justified constraints concerning consent, welfare, rights, fair participation, accountability, and redress. Descriptive success does not entail evaluative agreement; evaluative agreement does not itself settle legitimacy. Acknowledging the distinct levels permits the paper to investigate a successful but exploitative project, an ethically constrained project with modest outputs, or an encounter in which multiple reasonable valuations endure without a final synthesis.

The problem of power extends through all three levels. Access to computing resources, scientific instruments, organizational recognition, legal advice, land, money, and communications infrastructure can determine who proposes a project and which alternatives are practically available. A participant who owns an interface may make the contributions of others visible only in forms amenable to that interface. Another participant may control the criteria by which success is reported. Negotiation under such conditions is formally possible while its practical terms are sharply asymmetrical. Consequently, a narrative of mutually generated value may conceal extraction or coercion unless it examines who can refuse, revise, leave, retain, and contest. The present inquiry regards these powers as features of the

arrangement to be reconstructed, rather than treating the description *co-created* as a presumption of equality.

An important issue is whether an encounter transforms only products or also the participants' future generative possibilities. The difference is familiar in education, where performing a task and acquiring independent capacity for subsequent inquiry are distinguishable achievements. It also appears in ecological practice, where a temporary improvement in an observed indicator may differ from the restoration of a self-sustaining process, and in technical cooperation, where a functioning deployment may differ from locally maintainable infrastructure. These parallels are heuristic. Each domain requires its own evidence and normative standards. Their joint philosophical significance lies in the possibility that value generation concerns the reproduction and development of conditions for further value generation, alongside the outcomes of a particular activity.

The four-paper series provides a specific intellectual setting for these questions. Its first study examines the realization of poetic form and aesthetic experience across heterogeneous generative systems. The second considers generative invitation as a provisional account of how an offering may enter and transform another's activity. The third examines educational encounters in which a learner develops knowledge through historically situated capacities and asks how that knowledge may remain available to its generators. The present inquiry extends the discussion to cooperation among participants whose valuations, institutional dependencies, and claims to generated outcomes may diverge. It inherits the earlier papers' concern with partial translation and recipient autonomy while opening a more explicit investigation of political economy, ecological responsibility, and the distribution of generative power. The connection is programmatic; arguments advanced in the earlier papers do not become established premises merely through their place in the series.

The paper's proposed contribution is thus a set of distinctions and research questions, rather than a single maximizing principle. It seeks to specify the relational conditions under which heterogeneous contributions become co-creative, the different standards through which those contributions may be valued, the institutional mechanisms that mediate conversion and circulation, and the responsibilities arising from asymmetrical control. It further asks how these distinctions can be used to compare cases in which cooperation expands participants' future possibilities with cases in which the resulting outputs depend upon the exhaustion or appropriation of their generative conditions. Such comparisons would require carefully chosen qualitative histories, institutional records, and, where appropriate, quantitative indicators. The present paper offers a philosophical framework for that work and reports no new empirical findings.

The discussion proceeds through a sequence of analytical tasks. It first clarifies value formation in heterogeneous relational systems and the limits of comparison among evaluative practices. It then distinguishes enabling conditions, contributory dependence, and substantive co-creation; examines recognition and attribution under partial translation; and studies the power exercised through institutional interfaces. Later sections consider circulation, return, and regeneration, followed by the normative responsibilities of cooperating participants and comparative constructed cases involving human, ecological, and artificial systems. The concluding section assesses the explanatory promise of the account and identifies conditions under which the proposed distinctions would require revision. Throughout, the framework remains a revisable philosophical proposal, sensitive to the possibility that some encounters are better understood through established accounts of exchange, coordination, commons governance, care, or justice than through a new category of co-creation.

2 Value Formation in Heterogeneous Relational Systems

An account of co-creation across heterogeneous participants requires an account of the processes through which something comes to matter, the material and relational conditions through which it becomes possible, and the standpoint from which its significance is assessed. This section establishes the conceptual basis for that account. It distinguishes practices of valuation from processes of generating and maintaining capacities; identifies the situated conditions under which new possibilities arise; and examines the

temporal, ecological, and institutional circumstances that qualify claims of value formation. The method is analytical and comparative. The examples developed below are constructed cases designed to expose differences among descriptive, evaluative, and normative claims. They offer neither a general economic law nor empirical evidence that a particular arrangement yields superior outcomes.

2.1 Situated Judgments and the Formation of Value

The philosophical vocabulary of value often places several questions under one name. Participants may ask what they have reason to pursue, what an activity accomplishes, which relationships deserve maintenance, or how an institution ought to distribute a benefit. Although these questions can inform one another, they concern different objects of inquiry. A judgment that a repair has improved a device refers to a change in its performance under stated conditions. A judgment that the repair deserves payment concerns an institutional or moral relation. A judgment that the repaired device matters to a local practice depends on the uses, histories, and future possibilities associated with it. The analytical separation of such claims helps reconstruct cooperation among people who agree that an object has changed while disagreeing about why the change matters.

A useful historical point of orientation is Dewey's *Theory of Valuation*, which places valuation within a philosophical investigation of human conduct and inquiry [14]. Anderson's account of different forms of valuing offers a further reason to resist reducing appreciation, respect, and use to one scale [3]. These perspectives are invoked here as precedents for studying value within situated activities; the proposed generative-relational analysis does not assume that their wider philosophies are equivalent. A further sociological clarification is especially relevant. In an inquiry grounded in economic sociology and the sociology of work, Vatin distinguishes *evaluating* (assessing value) from *valorizing* (the productive activity through which value is generated or increased) [50, pp. 31–33]. Vatin treats this distinction as a way to investigate the relation between judgment, work, measurement, and economic production. It provides an analytical precedent for tracing productive transformations alongside the procedures by which they are assessed. The extension to the wider ethical, ecological, and relational values considered here belongs to the present inquiry and calls for separate justification; productive valorization alone cannot settle the question of ethical worth.

In the present paper, a *valuation practice* is an identifiable, historically situated way of attributing importance, comparing alternatives, making commitments, or articulating obligations. Its components can include experience, language, exemplars, standards, instruments, learned habits, deliberative procedures, and institutional authority. A valuation practice may remain partly tacit. A craftsman may recognize a durable joint through handling it; an ecological practitioner may rely on observation over several seasons; a public agency may translate its goals into indicators governed by administrative rules. The presence of different media of judgment matters because translation among them changes what becomes salient and what can be recorded. A numerical indicator may make trends inspectable while omitting dimensions of a relationship that matter to those who sustain it.

Value formation designates a different analytical object: a process through which an arrangement changes the possibilities, resources, relations, qualities, or experiences that participants can meaningfully assess. The term is deliberately relational. A newly acquired skill depends on a body, prior training, tools, opportunities for practice, and a setting in which its exercise can have consequences. A stable habitat depends on interacting organisms, physical conditions, disturbance regimes, and histories of management. A shared dataset depends on measurement protocols, storage, interpretive communities, rights of access, and continued maintenance. In each case the generated outcome is identifiable only against a specified domain and history. The processes remain open to description in their own disciplinary terms, including causal, ecological, technical, and institutional explanations.

This formulation avoids an automatic inference from generation to benefit. The production of an additional resource may also create a new dependency. Faster information processing may increase an organization's capacity to act while transferring work or risk onto those who maintain its data. A public improvement can expand access for some users while displacing others. The term *formation*

therefore covers the emergence and transformation of conditions whose valence remains to be assessed. Positive and adverse consequences should be attributed to specified subjects, domains, and time horizons. An evaluative claim becomes stronger when the relevant standards and affected participants are made explicit.

2.2 Generative Conditions and Situated Capabilities

A generative condition is an arrangement that contributes to the possibility of subsequent activity or change. It may be material, bodily, cognitive, ecological, technical, symbolic, social, or juridical. A useful piece of equipment can be immediately available while the knowledge required to operate it is distributed unevenly. A legal permission can permit an activity while limited financing prevents its exercise. A skill can persist while an institutional closure deprives it of a practical outlet. These differences suggest that a person's possession of a resource and the person's effective opportunity to use it belong to related but distinguishable descriptions.

Sen's capabilities approach provides a major antecedent for examining substantive opportunities alongside commodities and attained outcomes [42]. The present analysis inherits the importance of effective possibilities while pursuing a narrower descriptive question: which conditions allow particular capacities to emerge, be exercised, and remain available for further generation? Capability language here identifies a useful analytical interface; it does not establish that all ecological or artificial phenomena are bearers of human capabilities in Sen's normative sense. For living systems, the relevant conditions may be ecological functions and reproduction; for software systems, they may be technical affordances, energy and data dependencies, and permitted operations. Different vocabularies remain appropriate to different objects.

Definition 2.1 (Situational generative capacity). For an identifiable participant or system within a specified domain, a *situational generative capacity* is the range of transformations or activities made effectively possible by its present organization, acquired or inherited dispositions, accessible resources, and surrounding relations under stated conditions. The concept concerns feasible possibilities and their conditions. It leaves the worth of those possibilities to a separately identified evaluative standpoint.

Definition 2.1 is a working analytical definition. It is intended to prompt detailed reconstruction of enabling circumstances and opportunities for action. It does not assert a measurable scalar capacity, an exhaustive list of feasible futures, or a metaphysical equivalence among persons, organisms, organizations, and engineered systems. The unit of analysis should be chosen with care. A community's capacity to preserve a language, for example, cannot be straightforwardly reconstructed by summing the vocabulary sizes of its individual speakers. It may depend on intergenerational encounters, public recognition, educational institutions, and occasions for use. Conversely, an organization may possess equipment and expertise while an individual member remains unable to access them. Aggregating capacities can conceal these internal distributions.

A participant's capacities can be connected to an environment in several analytically distinct ways. *Availability* concerns the existence and accessibility of a resource or opportunity. *Appropriability for practice* concerns the ability to incorporate it into an activity with sufficient understanding or control. *Continuity* concerns the conditions under which the opportunity can be renewed or retained. *Transformability* concerns the capacity to revise the resource, practice, or arrangement in response to changing problems. These distinctions are especially consequential where dependence is asymmetrical. A remote service may be accessible to a local institution today, while its continuation is controlled by another organization and its operation remains technically opaque. Current use would then give incomplete evidence about local generative independence.

The relational vocabulary also requires attention to constraints. Productive activity has material costs, including energy, time, care, maintenance, and exposure to risk. Ecological conditions can limit the rate at which a practice may continue without damaging the system on which it depends. Participation can demand labor whose opportunity costs are borne differently across participants. In this framework,

constraints are elements of the generative arrangement rather than external inconveniences added after an outcome has been declared valuable. An account of formation should record which constraints are transformed, which are displaced, and which continue to govern possible activity.

2.3 Material Processes and the Instruments of Recognition

Generative activity often intersects with systems of measurement, accounting, classification, and public justification. Their relation is reciprocal. A measure can identify changes that would otherwise remain obscure; it can also direct effort toward those changes that count within an institutional procedure. A repair workshop assessed by the number of completed jobs may acquire an incentive to favor short interventions. A conservation project assessed by one indicator may emphasize a particular ecological response. Such consequences are contingent on actual governance and implementation; the constructed examples illustrate an analytical possibility rather than a general finding about workshops or conservation programs.

Stark's investigation of multiple accounts of worth in economic life is relevant because organizations can encounter several partially conflicting evaluative logics within the same productive setting [46]. A plurality of standards can make coordination difficult, yet it can also preserve information about dimensions of work that a single metric obscures. The significance for heterogeneous cooperation is methodological. Where a contribution crosses organizational boundaries, an observer should identify the standards operating at each boundary, the procedures through which evidence is accepted, and the persons authorized to contest a decision. The same material change may thereby be recognized as an economic gain, a maintenance obligation, or an ethical risk, without any of those descriptions fully determining the others.

The distinction between formation and recognition can be specified by considering three related records of an event. A *process record* concerns what activities occurred, which resources were transformed, and which dependencies were involved. An *evaluation record* concerns how changes were interpreted, prioritized, and compared by a stated participant or institution. A *governance record* concerns who was authorized to organize the work, interpret its results, claim its outputs, or revise its conditions. These records need not coincide. The absence of a contribution from an evaluation report may reflect a limitation in the report's scope, a failure of observation, or institutional control over the terms of recognition. Determining which explanation is credible requires evidence about the specific case.

Table 1 organizes the principal layers proposed for the present analysis. The distinctions are methodological rather than ontological divisions: one event may be relevant to several layers, and the boundaries among them can be disputed.

The table makes it possible to describe a successful technical intervention accompanied by weak recognition, a formally equitable payment accompanied by ecological damage, or an ethically careful process that produces only a modest immediately measurable result. Each description calls for distinct justification. This analytical separation is particularly important where a publicly celebrated output becomes the principal evidence of a collaboration's success. The output may be visible, while the maintenance, environmental conditions, and knowledge relationships that allowed it to emerge remain comparatively difficult to observe.

2.4 Temporal Horizons and Regenerative Possibilities

Value formation unfolds across different durations. A new artifact can be produced quickly, the skills required for its maintenance may be learned over years, and the ecological consequences of its use may emerge over substantially longer periods. A period of successful operation provides evidence concerning that period; longer-term claims require a further account of recurrence, degradation, repair, and adaptation. This temporal differentiation matters because a positive outcome at one point can coexist with the erosion of conditions required to reproduce it.

Regeneration, in the present framework, concerns the continued or renewed possibility of generative activity after a prior episode has altered its conditions. For a person, regeneration may involve recov-

Table 1: Analytical layers in the investigation of value formation. Each layer requires evidence appropriate to its question; the layers may interact within one process.

Layer	Guiding question	Indicative evidence
Generative conditions	Which opportunities and resources make an activity feasible?	Access histories, technical dependencies, ecological conditions, skills and institutional rules
Transformative process	Which changes occurred through the activity?	Process traces, observations, maintenance records, participants' accounts
Valuation practice	Under which standards is a change judged significant?	Stated reasons, situated practices, metrics, deliberation and disagreement
Recognition and conversion	How is a contribution made legible and connected to rewards or claims?	Attribution rules, reports, contractual arrangements, interfaces and classifications
Normative legitimacy	Which obligations and constraints govern the process and its consequences?	Relevant law, consent and authorization, affected-party testimony, duties of care

ery, learning, social support, and the preservation of discretionary time. For a community practice, it may involve access to materials, apprenticeships, institutions of transmission, and publicly recognized opportunities to use its knowledge. For an ecosystem, the term must be tied to domain-specific ecological processes and measurements. For an engineered infrastructure, relevant conditions may include repairable components, available energy, documentation, and permissions. These uses share an analytical concern with continuity of enabling conditions, while remaining physically, socially, and normatively distinct.

A useful test of a project's generative significance is therefore to examine what remains possible after the immediate product has been delivered. An organization may complete a software deployment but acquire neither documentation nor the ability to change its operating parameters. A community survey may generate findings that are useful to an external research team while leaving residents unable to inspect or contest subsequent interpretation. A conservation effort may improve one observation while leaving the ecological process that supported the improvement vulnerable to recurring disturbance. Each example requires independent empirical investigation before conclusions about durability can be drawn. Philosophically, the comparison shows why a completed product and a regenerative capacity are different analytical objects.

The converse possibility is equally significant. Activity may preserve or extend generative capacities while yielding little immediate market return. Training time, protective infrastructure, ecological restoration, and the maintenance of collective archives can create opportunities whose later exercise is uncertain. Declaring their value in advance requires a defensible evaluative perspective and should remain revisable as outcomes become observable. The generative-relational framework offers a vocabulary for recording the relevant future possibilities, without converting all such possibilities into expected monetary returns. It also leaves room for practical choices where resources are scarce and several worthy commitments compete.

A further issue is the distribution of temporal burdens. A project may supply short-term benefits to one participant while shifting maintenance or environmental costs to another participant or a future generation. The analytic reconstruction should indicate who enjoys immediate use, who bears recurring obligations, who controls continuation, and whose future options are reduced or expanded. Such questions connect value formation with the later analysis of return and justice. At the present stage, their role is to show that assessments of a generated outcome depend on the duration and distribution of the process through which it was formed.

2.5 Ecological and Collective Valuation in a Constructed Case

Consider a constructed collaboration in which residents, technical volunteers, a municipal office, and local ecological practitioners develop a rainwater collection and monitoring system for an urban communal garden. Residents value the garden for food cultivation, companionship, and continuity of neighborhood practices. Technical volunteers seek reliable measurement and a system that can be repaired locally. The municipal office seeks accountable water management and compliance with applicable rules. Ecological practitioners attend to soil moisture, plant health, seasonal variability, and effects on surrounding habitats. Participants may cooperate in installing equipment without ranking all these purposes on a common scale.

The transformation can be described through several layers. The group first assembles tanks, sensors, drainage components, and measurement routines from available materials and skills. This assembly changes the physical and informational conditions of cultivation. Residents then interpret the measurements against memories of earlier seasons, while volunteers assess sensor reliability and the municipality considers whether the reported data satisfy its procedures. Ecological interpretation adds observations for which a simple water-volume record may be insufficient. The same activity thus generates new resources, develops situated knowledge, and creates questions about whose criteria will guide subsequent adjustments. Whether the changes improve cultivation or ecological outcomes is an empirical question that this hypothetical case leaves open.

A critical feature emerges when the monitoring system requires continuing attention. Suppose the volunteers can maintain the software remotely, while the residents control the daily irrigation schedule and the municipal office controls permission to retain the equipment. The arrangement possesses a distributed capacity: its continuation depends on several kinds of expertise and authorization. Technical performance alone would provide an incomplete account of its future. If residents receive usable documentation and can adjust some parameters, their opportunities may expand. If data are available only through an external dashboard or equipment parts cannot be obtained locally, the project may also create a durable dependency. These possibilities concern access and control; their normative evaluation depends on the promises, legitimate expectations, resources, and alternatives present in the actual arrangement.

The diversity of ecological valuations is well established as a problem of assessment. Kenter and colleagues distinguish several dimensions of shared and social values, including the roles of group deliberation and cultural significance, rather than presuming a single category of collective preference [30]. The 2022 IPBES methodological assessment likewise acknowledges multiple ways of conceptualizing and valuing nature and considers the implications of valuation for decision-making [29]. These sources justify treating plural valuation as a serious methodological concern. They do not establish that all participants in the hypothetical garden would share a stable understanding of ecological benefit. The relevant standards would need to be elicited, interpreted, and sometimes negotiated through legitimate procedures.

The garden case also demonstrates why different participants may be appropriately described through different modes of agency. Residents and officials can articulate reasons, make commitments, and exercise forms of political and institutional authority. Plants, soil organisms, rainfall patterns, and other ecological processes participate causally in the results and constrain the available trajectories. Their participation does not itself establish that they exercise human-like evaluative judgment or can consent to a cooperative arrangement. A system's importance to generation can be acknowledged while questions of moral standing and representation remain open. Where environmental interests are invoked by human representatives, the authority and accountability of that representation become further questions for ethical and political analysis.

The project might therefore be called co-creative under some descriptions and merely coordinated under others. Shared installation and consequential reciprocal adjustment would support an account of joint development. A narrow procurement relationship in which each party executes a fixed task may support an account of exchange or service provision. Distinguishing these descriptions requires evidence about how participants influence the changing objectives and conditions of the practice. The present section deliberately leaves that classification provisional. Later analysis will examine the stronger

criteria required for co-creation and for the justified recognition of its contributions.

2.6 Scope of the Generative-Relational Proposal

The conceptual distinctions developed here serve three related purposes. First, they direct attention to how productive possibilities emerge through specific histories and arrangements, thereby allowing an account of generation to include material constraints, maintenance, and the reproduction of capacities. Second, they require evaluative claims to identify their standpoint, standards, and temporal horizon. Third, they distinguish the visibility of a contribution within an institutional assessment from its causal significance and normative legitimacy. Together, these distinctions offer a basis for examining heterogeneous cooperation while retaining disciplinary differences.

Several limits are important. A capacity inferred from a participant's performance may be context-specific and difficult to separate from continuing support. A process record may omit informal labor or tacit ecological relations. Different evaluators may use standards that are mutually illuminating in some respects and irreducible in others. Terms such as *formation*, *generation*, and *return* can obscure adverse consequences if they are treated as intrinsically beneficial. A case study should therefore combine an account of what changed with evidence about who could participate, what remained accessible, and which costs or risks were redistributed. Appropriate evidence may be historical and interpretive, qualitative and observational, formal, or quantitative, depending on the question.

The account also resists assigning a universal kind of valuation to every heterogeneous participant. Human deliberation, ecological causation, organizational decision procedures, and artificial-system operations are different phenomena. A general relational vocabulary can compare dependencies and transformations without implying equivalence of consciousness, rights, responsibility, or welfare. Similarly, the present discussion identifies potential relations among capability, production, valuation, and governance without claiming that one theory subsumes the others. Its philosophical warrant lies in the explanatory distinctions it makes available for further criticism and empirical research.

Value formation, in this provisional sense, concerns the emergence and alteration of conditions that can become significant under identifiable evaluative practices. The process may expand, diminish, preserve, or redistribute possibilities. Whether participants subsequently regard these changes as good, whether they can compare their assessments, and whether the underlying arrangements are justified are further questions. Maintaining these distinctions provides a basis for studying valuation practices and partial comparability in the following section. Co-creation can then be assessed in relation to its actual generative histories, while questions of recognition, conversion, regeneration, and justice retain their own evidential and normative demands.

3 Valuation Practices and Partial Comparability

Cooperation among heterogeneous participants often requires decisions about alternatives whose significance is described in different evaluative languages. The present section investigates how such decisions become intelligible and practically defensible while a comprehensive ordering of value remains unavailable. It first distinguishes the objects and levels of comparison, then examines commensurability, parity, and the partial translation of evaluative reasons. It subsequently reconstructs negotiation as an institutional practice, develops a constructed case concerning community food storage, and identifies limitations of the proposed generative-relational account. The method is philosophical and comparative, with modest formal clarification confined to a working definition. The argument concerns possible conditions of coordination; it does not presume that an agreement demonstrates shared valuation or that cooperation is ethically justified simply because a decision has been reached.

3.1 Evaluative Orders and the Objects of Comparison

An evaluative disagreement is frequently described as a contest over which outcome is best. That description becomes insufficient when the parties identify different kinds of outcomes, establish different units of comparison, or interpret the same event through divergent practical histories. A resident may regard a public building as a locus of collective memory, an engineer as a configuration of materials and safety constraints, an administrator as a site of recurring obligations, and an artist as a setting for expressive possibilities. The ensuing disagreement can concern empirical facts, the meaning of the object, the relevance of a particular criterion, or authority to decide. These forms of disagreement can occur together, yet resolving one provides limited warrant for claiming that the others have been resolved.

The distinction begins with the *object of valuation*. Participants may assess a final product, the process through which it was made, the opportunities that the process created, or the distribution of future burdens. A technically successful result can be judged differently by those who supplied labor, those who experience its consequences, and those responsible for future maintenance. A proposal to compare the projects under one cost estimate may therefore alter the object under consideration: it may replace the question of how a practice affects intergenerational relations with the narrower question of which expenses appear in a budget. Both questions can be practically important, but they describe different dimensions of an arrangement.

Valuation also varies by the *mode of relating to an object*. Anderson's pluralist account highlights how respect, care, use, and other relations can carry different practical expressions rather than constituting interchangeable amounts of one good [3]. A shared object can thus invite distinct kinds of commitments. Such differences are especially consequential where one party treats access as a matter of permission granted by an owner and another regards continuing access as part of the relationship that made the object possible. An account of co-creation should record these distinctions before describing the participants as holding comparable preferences.

An additional distinction concerns the social organization of judgment. Boltanski and Thévenot examine how people justify conduct by appealing to different principles of worth and how encounters among these principles may organize disagreement [7]. Their sociological account offers an established way to attend to the public grammar of justification. The present proposal adopts the more limited insight that participants' reasons are often intelligible only against the institutions and histories that authorize their use. It leaves open whether the particular orders identified in that tradition adequately describe a given setting. Differences between technical, cultural, ecological, and juridical justifications should be reconstructed from the situation rather than assigned to a fixed taxonomy in advance.

A further complexity follows from *evaluative change*. Participation may transform what participants regard as worth pursuing. A community member who originally values an archive primarily for immediate access may come to prioritize its long-term preservation after assisting with cataloguing. An engineer may revise the relative importance of efficiency and maintainability after repeated encounters with local repair practices. Such developments suggest that valuation practices have histories, that these histories can be affected by cooperation, and that the grounds of comparison need not remain constant throughout a project. The analysis of partial comparability therefore concerns trajectories of judgment as well as the structure of a single decision.

3.2 Commensurability, Comparability, and Parity

Commensuration is a process of rendering different entities comparable through a common metric. Espeland and Stevens analyze this process as a socially consequential mode of measurement and classification, emphasizing its relation to power as well as to cognition [18]. A budget, standardized score, or performance index can make alternatives inspectable and support accountable decisions. Its practical value depends on the purpose, reliability, and justified domain of application. The same procedure can redirect attention toward what is easily counted and away from obligations whose significance is conveyed through history, trust, or forms of care. Its usefulness and its exclusions should be assessed together.

Relation	Question addressed	Inference warranted
Technical comparability	Do alternatives meet a stated test or common requirement?	A scoped judgment under specified evidence and thresholds.
Evaluative comparability	Can reasons for valuing alternatives be meaningfully related?	A limited comparison with unresolved dimensions.
Commensuration	Can a common measure capture selected features?	A measure conditional on its construction and domain.
Procedural coordination	Can parties follow an authorized method for choosing or revising an option?	A decision pathway whose legitimacy requires separate scrutiny.
Substantive convergence	Have participants developed compatible interpretations or commitments?	A contingent alignment that may change.

Table 2: Distinct relations in decisions under heterogeneous valuation. The categories are analytical rather than mutually exclusive.

Comparability has a wider scope. Two proposed activities may be compared under a common safety requirement without their cultural or ecological meanings being reduced to safety scores. Participants may also compare how their respective concerns would be affected, whether the available evidence is credible, or whether a procedure treats relevant claims fairly. These comparisons can establish important relations without producing a complete ranking. For example, two designs may both satisfy an agreed minimum energy requirement while one supports familiar community uses and another reduces maintenance work. Those further considerations may remain unsettled or may acquire different priorities for different participants.

A missing complete ranking admits several interpretations: available evidence may be insufficient, the parties may disagree about the relevant evaluative consideration, or the alternatives may stand in a contested relation of value. Chang’s argument for *parity* addresses a more specific philosophical problem. Under a specified *covering consideration*—such as the goodness of two careers as careers—two alternatives may be positively comparable while neither is better, worse, nor equally good. Her proposed fourth relation is therefore distinct from ignorance about a ranking, incomparability, and the borderline application of a vague comparison [11, pp. 661–665, 687–688]. The argument challenges the conventional trichotomy of comparative relations; its application to a particular choice requires a substantive account of the relevant consideration.

The present inquiry uses *partial comparability* in a different, explicitly methodological sense. Several parties may share an evidential test or coordinate under an agreed procedure while continuing to disagree about which evaluative considerations deserve priority. Such an arrangement supplies a *local bridge* for inquiry or action; by itself, it neither establishes Changian parity between the alternatives nor resolves their overall evaluative relation. Researchers should specify the consideration under which a comparison is made, the parties authorized to employ it, and which questions remain open. In this way, the philosophical possibility of parity informs the study of plural valuation without becoming a general label for negotiated accommodation.

Thus, *partial comparability* identifies the explicitly scoped grounds on which participants or investigators can relate alternatives while further evaluative questions remain open. It concerns the structure of a decision context rather than a claim about the ultimate metaphysics of value. A case description should state the objects, considerations, temporal horizons, affected parties, and decision competences to which its comparison applies. Those parameters may change through new evidence or the inclusion of previously unheard participants.

Table 2 separates relations that are often compressed into the simple claim that participants have reached agreement. The table is a conceptual inventory, and an actual case may involve several rows simultaneously.

The relations in Table 2 make a practical point. A technical standard can support defensible exclusion of an unsafe option while leaving the value of remaining options unsettled. A procedure can authorize a choice without transforming the reasons participants hold. Conversely, broad convergence on a goal

may leave its implementation technically uncertain. Analyses that collapse these relations risk mistaking successful calculation for agreement, or agreement for a sufficiently legitimate decision.

3.3 Situated Translation and Comparative Bridges

Heterogeneous evaluative practices can sometimes interact through translation: a participant offers a claim in terms that another can examine, or a joint inquiry develops a representation usable across several practices. Translation can occur through testimony, demonstration, sketches, technical measurements, legal categories, historical narratives, shared work, or carefully designed deliberation. Its success depends on what the translation is expected to accomplish. A schematic may make an engineering constraint understandable to a resident while conveying little about the resident's attachment to a place. A recorded account may preserve a cultural justification while remaining insufficient for calculating electrical demand. Each translation is therefore selective.

Definition 3.1 (Situated comparative bridge). A *situated comparative bridge* is a context-specific arrangement through which participants can make selected claims, evidence, constraints, or reasons mutually inspectable for a defined practical purpose. It comprises an identifiable comparison domain, a set of interpretive or evidential translations, and procedures for questioning their adequacy. It may support coordination while leaving substantive evaluative differences intact.

Definition 3.1 is deliberately narrower than a theory of shared value. A bridge may consist of a bilingual explanation supplemented by a prototype, an accessible risk register, a shared budget with separately documented concerns, or a facilitated meeting in which participants can demand clarification. It is an arrangement among practices, rather than a claim that the participants possess identical internal representations. Its success is local and revisable. It can be assessed by asking whether the relevant claims are faithfully presented, whether the represented parties can challenge the translation, and whether the resulting information has consequences for the available decision.

A comparison domain is especially important. When partners agree to compare costs, they may still disagree about whether an unpaid maintenance obligation belongs inside the financial account. When they assess ecological outcomes, they may disagree about the time horizon or the legitimacy of substituting one habitat condition for another. The boundary of the domain thus affects which considerations become decision-relevant. One task for a responsible comparative practice is to make that boundary visible and open to reasoned revision. Otherwise, apparent consensus may result from a restricted agenda rather than from adequate mutual understanding.

Comparative bridges can also be asymmetric. A local craftsperson may be expected to translate experiential knowledge into a procurement form, while an agency remains free to issue a technical classification without explaining how it affects the craftsperson's work. A community may supply cultural descriptions for an institutional project while the institution retains exclusive authority to determine which descriptions count as evidence. In each case translation imposes labor and can redistribute interpretive power. A bridge is more accountable when those who bear the burden of translation can review, correct, or contest how their contributions are represented, including the right to identify omissions that a technical template cannot readily express.

Partial translation may nevertheless be productive. Participants can discover a common concern within differently organized reasons. An engineer and a local resident may approach repairability through distinct standards of performance and everyday dependence, yet both can identify a meaningful problem in reliance on a single external supplier. The shared concern may be sufficient to design a repairable component even though the parties continue to understand its significance differently. The agreement is specific: it concerns a workable design and its constraints. Its intelligibility does not require proof of a shared ultimate value or a unique common generative history.

There are also cases where a translation should remain incomplete. Sacred associations, confidential experiences, place-specific ecological understanding, or claims involving protected information may have legitimate limits of disclosure. A procedure that demands exhaustive commensuration can become

coercive when it treats the refusal to disclose as absence of value. Responsible practice therefore distinguishes limited public justification from unlimited exposure. Relevant legal obligations and rights of affected parties still apply, and claims of confidentiality cannot automatically defeat public safety, accountability, or legitimate scrutiny. The appropriate boundary must be argued within the case rather than assumed by the general framework.

3.4 Negotiation, Institutional Procedures, and Practical Coordination

A cooperative decision can be achieved through several pathways. Parties may revise a proposal until it satisfies a set of jointly recognized constraints; divide activities so that different participants exercise authority in different domains; establish an agreed sequence of trials; or invoke an authorized rule for deciding among remaining alternatives. They may also recognize that an unresolved issue requires postponement, additional evidence, or external adjudication. These practices can make action possible under continuing disagreement. Their adequacy depends on the stakes of the decision and the relations of power among those affected.

Negotiation involves more than trading fixed preferences. A participant may learn that a technical option has consequences previously unknown to them, while another discovers that a proposed compromise threatens a valued practice. Bargaining can change the feasible set through redesign, shared maintenance, compensation, additional protections, or new obligations. In this sense, negotiation may itself become generative: it can produce a previously unavailable configuration of activities. The resulting solution need not maximize one common value function. It may instead preserve selected concerns within an institutionally acceptable arrangement. Whether it is genuinely co-creative depends on who had the capacity to reshape the proposal and who was confined to accepting or rejecting a finished plan.

Institutional structure matters because participants rarely enter negotiation with equal capacities. One party may own the infrastructure, another may possess indispensable expertise, and a third may be exposed to the consequences without formal decision rights. Authority to define the agenda, select evidence, set deadlines, and record dissent can influence the result as strongly as substantive persuasion. A majority vote, administrative approval, contract, or market exchange can yield a determinate outcome while leaving questions of exclusion or unjustified dependence unresolved. Fraser's account of the political framing of justice offers a relevant precedent for asking whose claims are admitted into the space of decision [20]. Extending that concern to heterogeneous cooperative practices is an interpretive move of the present paper, rather than a claim that Fraser supplies an exhaustive model of co-creation.

Ostrom's work on common-pool resources illustrates why governance should be studied as an arrangement of rules, monitoring, participation, and problem-solving rather than presumed to follow one institutional form [35]. Her later defense of polycentric approaches to climate-related collective action emphasizes the potential for multiple decision sites and experimentation across scales [37]. These insights are useful analogies for practices in which technical, community, ecological, and public responsibilities overlap. They do not entail that decentralized governance is inherently fair or effective in every setting. A fragmented system may evade responsibility, and a single authoritative regulator may be essential for enforcing safety or rights. The normative and empirical merits of a procedure remain context-sensitive.

A defensible process should therefore make explicit at least five matters: the authority through which it is convened; the range of participants and affected interests; the evidence admitted and standards applied; the means available for challenge, revision, or withdrawal where appropriate; and the allocation of future responsibility. Such conditions are evaluative prompts, not a universal checklist that mechanically certifies legitimacy. In settings involving children, employees, dependent communities, or unequal access to resources, nominal consent may conceal constrained alternatives. Protective obligations may also limit which questions are open to compromise. The recognition of plural valuation supports careful institutional differentiation, including enforceable duties where voluntary agreement is inadequate.

Procedural agreement can coexist with enduring substantive disagreement. Participants may accept a temporary pilot project because it generates information, preserves an option to reconsider, and places

enforceable limits on risk. Others may accept a decision under a valid institutional procedure while maintaining a public objection to its grounds. Their acceptance has different meanings, and a record of the process should not erase them. A plurality-sensitive inquiry evaluates the quality of coordination through its ability to accommodate justified contestation as well as its capacity to produce a decision.

3.5 Partial Comparability in a Constructed Food-Storage Project

Consider a hypothetical rural community deciding whether to establish a shared food-storage facility. A producers' cooperative seeks to reduce the loss of harvested goods and preserve predictable access to storage. Technical volunteers propose refrigeration equipment that could stabilize storage conditions, while other residents favor passive cooling techniques that they believe would remain easier to maintain. A municipal office is responsible for applicable construction and safety approvals. Community organizers wish to preserve access for households whose income or harvest volume is irregular, and local ecological practitioners draw attention to energy use, waste, and the effects of infrastructure siting. The proposed alternatives have distinct technical characteristics and may support different future arrangements of labor and access.

An initial comparison might place energy consumption, purchase price, storage capacity, and expected maintenance costs in a shared table. These figures could clarify the financial and engineering constraints once the assumptions and uncertainties are established. They would still leave other concerns: who holds access keys; how fees are set; whether storage decisions privilege larger producers; whether equipment remains repairable with locally available skills; how residents who lack cash can contribute labor; and who inherits operational obligations if volunteer support ends. A monetary cost-benefit calculation may illuminate some choices while leaving those governance questions unsettled. The scope of the calculation should remain visible to those asked to rely on it.

Suppose an engineer argues that a particular refrigerated unit offers more predictable temperature control, while a producer argues that local repairability should receive priority. Both claims can be intelligible and supported by relevant evidence without determining the complete comparison. The group might commission a small test of storage performance and map which components could be maintained locally. Such an inquiry would create a situated comparative bridge: an agreed domain of questions, a way to inspect the claims, and a means for challenging assumptions. The results would likely settle some engineering issues and leave the relative importance of autonomy, cost, and food security open for deliberation.

A second point of contention concerns access. The municipal office may offer a subsidy conditional on formal registration and documented usage. The cooperative may favor membership fees to distribute maintenance costs. Community organizers may argue for a protected allocation to households with little ability to pay. These positions express different institutional and ethical judgments. Their interaction may generate a hybrid arrangement, such as a capacity-limited public-access allocation combined with a transparent maintenance contribution and an independently reviewable complaint process. This is a constructed possibility rather than a recommendation established by evidence. It would require legal review, economic feasibility analysis, and participation by those affected before implementation.

The example distinguishes several achievements. The parties may achieve *technical comparability* through tests of temperature variation and equipment reliability. They may establish *procedural coordination* through an authorized schedule for review and decision. They may develop *practical accommodation* by redesigning access rules or maintenance arrangements. Yet their valuations may remain different: one party emphasizes livelihood security, another institutional accountability, another environmental constraints, and another the persistence of informal mutual aid. Their cooperation can be coherent without a comprehensive conversion of these grounds into a single scale. The nature and extent of co-creation depend on whether the proposal and its governance were genuinely altered through reciprocal participation.

Even successful negotiation can introduce further inequalities. Residents with access to technical vocabulary may dominate discussions of feasibility. Those who maintain the facility may be underrep-

resented once the installation is complete. A public agency might present a disputed arrangement as unanimous because the formal minutes record only the final vote. The repairability of equipment may be represented in a technical score while the social value of informal teaching remains unrecorded. A careful account would examine the documentation, participation, decision rights, and subsequent revisions. The inferred degree of comparability should be grounded in these practices rather than in retrospective claims that a joint outcome proves shared values.

This case also illustrates the distinctive temporal character of partial comparability. After several months, measured energy demand, actual repair burdens, patterns of access, and experience of food loss could alter what participants consider significant. A review procedure might permit the group to improve the arrangement or abandon an unsuccessful component. Conversely, equipment failure or institutional withdrawal might close options that had been available at the outset. Thus the comparative bridge is historically situated: it can expand through learning, narrow through exclusion, or become obsolete when the material conditions of cooperation change. These are empirical possibilities whose relative likelihood remains to be investigated.

3.6 Limits of Partial Comparison and Implications for Co-Creation

The analysis of valuation under partial comparability has a limited but significant philosophical purpose. It explains how participants can coordinate their activities through shared constraints, localized translations, and legitimate procedures while retaining distinct evaluative commitments. It thereby separates a practical ability to decide from a stronger claim of common worth. It also makes visible the possibility that some conflicts persist because the parties disagree about the domain and authority of comparison, rather than merely because they possess inaccurate information. These propositions offer interpretive tools for reconstructing actual cooperative histories; they are open to refinement in light of rival theories and evidence.

Several competing approaches deserve serious consideration. A consequentialist model may identify a sufficiently comprehensive objective function in a bounded policy setting. A contractual approach may explain cooperation by specified rights, duties, and exchanged benefits. A deliberative theory may place special weight on the capacity of participants to exchange public reasons, while an institutional-economic account may explain the outcome through bargaining power and transaction costs. Each approach can illuminate part of a case. The present framework would add explanatory value only where its attention to historically formed generative capacities, translation boundaries, and the return of future opportunities reveals features that the comparison otherwise overlooks. A mere restatement of value pluralism under relational terminology would provide little additional insight.

The proposed comparative bridge also carries an epistemic limitation. An observer cannot infer an individual's complete evaluative commitments from a vote, a price accepted, or a participation record. Reasons may be strategic, partly tacit, or revised after the decision. Statements of satisfaction may reflect power asymmetries or the absence of a feasible alternative. Evidence about valuation should therefore be triangulated across situated interviews, observations of practice, institutional documents, and the actual consequences of participants' decisions, with relevant ethical safeguards. Evaluative uncertainty should remain visible in the account, especially when participants have limited opportunities to contest how their reasons are represented.

An important ontological restraint follows. The partiality of an observer's representation of value establishes an epistemic limit of the account. It does not by itself demonstrate that underlying values lack determinate relations in every possible description. Nor does a locally successful translation prove that the represented participants share one ultimate generative ground. The generative-relational framework can preserve uncertainty about the nature and scope of valuation while making comparatively modest claims about which reasons and capacities have become available in a particular practice. This restraint is especially important when the framework is extended beyond human participants.

Ecological processes and artificial systems can affect the feasible alternatives, mediate information, and generate outcomes that humans evaluate. Their causal or operational importance warrants close

attention to ecological science, system design, institutional authorization, and affected human interests. It does not settle whether a particular organism or artificial system exercises reflective valuation, holds a right to representation, or bears responsibility in the human legal sense. Those questions require separate arguments and, where relevant, domain-specific evidence. An inquiry into heterogeneous co-creation gains clarity when it preserves these differences while asking how the various processes are connected in practice.

The present section accordingly proposes a disciplined progression in analysing cooperation. First, reconstruct the participants' relevant evaluative practices and the domains of their judgments. Second, identify grounds that can be compared and the costs or exclusions imposed by a common metric. Third, examine who controls the translation and decision procedures through which partial correspondence becomes consequential. Finally, follow the arrangement over time to see whether it expands, preserves, or restricts the capacity of participants to generate further value. These steps constitute a research orientation rather than a universal algorithm. They prepare the subsequent analysis of contributions and generative conditions, where the question will shift from how outcomes are compared to how participants become constitutively involved in producing them.

4 Contributions and the Conditions of Generation

An account of value co-creation requires a way to reconstruct how an outcome becomes possible through heterogeneous contributions. The preceding sections distinguish the formation of valuable capacities from practices of valuation and explain how participants coordinate through partially comparable reasons. The present section examines the generative relations underlying a cooperative outcome: resources that make activity possible, interventions that help constitute its form, and dependencies through which several contributions become jointly consequential. The analysis is philosophical and institutionally situated. It develops a vocabulary for tracing participation and considers the evidential limits of attributing individual shares in a collectively generated result.

The central distinction concerns the production of an outcome and the attribution of the relations through which that outcome arises. Material facilities, inherited knowledge, ecological processes, paid labor, informal care, computational systems, and institutional permissions can enter the same history of production. Their involvement may be extensive while the grounds for assigning responsibility, recognition, remuneration, or rights differ. Reconstructing those grounds calls for attention to the kinds of contribution involved, the possibilities available to participants, and the evidential character of the resulting claims.

4.1 Enabling Conditions and Constitutive Participation

A cooperative practice takes place within conditions partly inherited from earlier activity. Shared languages, public infrastructure, access to land, technical standards, ecological cycles, and organizational routines may allow new work to begin. These conditions often have histories of construction and maintenance that extend beyond the project's identifiable membership. An account restricted to those present at the moment of delivery therefore captures only a portion of the generative history.

Enabling conditions refer here to resources, permissions, capacities, and relations that expand the feasible range of a practice. A building available for meetings enables coordination; a navigational chart enables a survey; an established data repository enables comparison over time. Their contribution may remain significant even when their providers take little part in shaping the particular outcome. The category is relational and context-dependent: a resource that functions as background infrastructure in one activity may become the object of intensive joint development in another.

Constitutive participation refers to involvement through which the developing form, procedure, interpretation, or practical direction of an outcome is materially altered. It includes designing an instrument in response to field observations, revising a collective research question, negotiating a procedure that changes whose concerns enter the final plan, or making a technical correction on which subsequent work

depends. Constitutive participation is identifiable through the history of actual interventions and their uptake. It need not imply equal influence, conscious intention in every process, or a claim to equal moral standing among heterogeneous contributors.

The relation between these categories is dynamic. A supplier of equipment may initially provide a standard instrument and subsequently join an adaptive design process. A community organization may provide a meeting space, then contribute to choosing sampling sites and interpreting public feedback. Conversely, a participant who helped formulate the original proposal may withdraw while the agreed procedures continue. Contribution therefore belongs to a temporal relation rather than a permanent label attached to an actor.

Definition 4.1 (Situating contribution trace). A *situating contribution trace* is an evidence-indexed reconstruction of how specified resources, actions, interpretations, or processes enter the development of an outcome within a defined temporal and institutional context. It identifies the relevant contribution, its position in the evolving practice, observable interactions or dependencies, and the evidence supporting the attributed effects. Its unit of analysis is the historically situated relation between a contribution and a developing outcome.

Definition 4.1 establishes a research device rather than a general formula for reward. Its evidential materials may include design revisions, records of deliberation, contracts, observation logs, testimony, experimental results, and maintenance histories. The trace can record disagreement about causal influence and uncertainty about an outcome's dependence on a particular intervention. Its construction should also identify who selected the records, which activities remain poorly documented, and which participants can contest an attribution.

Three propositions should be kept separate when such a trace is interpreted. An *enabling proposition* identifies an expanded set of feasible activities made possible by a resource, capacity, or permission. A *causal proposition* concerns the difference a specified process or intervention made to a realized trajectory, under an identified comparison and with appropriate evidence. A *recognition proposition* concerns the standing of persons or institutions to receive acknowledgement, remuneration, decision rights, or other forms of return. The first two propositions are explanatory; the third requires attention to applicable practices, commitments, rights, and normative reasons. The same contribution may support all three inquiries, while their warrants remain distinct. An available building, for instance, enables a meeting; a participant's proposal may change its eventual agenda; a decision about credit or continuing access invokes further institutional standards.

4.2 Joint Production and Distributed Dependence

Some outcomes result from interactions among inputs whose effects are difficult to separate. In their analysis of team production, Alchian and Demsetz emphasize that a team's output may resist decomposition into separately identifiable products attributable to individual inputs [2]. Their account addresses problems of measurement, incentives, and organizational form in economic production. The present inquiry draws on its diagnosis of nonseparable productive relations while broadening the questions to include interpretive, ecological, and institutionally mediated contributions. Such an extension remains a philosophical proposal requiring domain-specific investigation.

Consider a community-maintained coastal observation network. A sensor yields usable data through the interaction of calibrated hardware, a suitable installation site, reliable energy, maintenance, a defensible measurement protocol, and interpretations that establish what can reasonably be inferred. Reliability may depend on a resident identifying a recurring source of interference, a technician adjusting the hardware, and an institution authorizing access to records. A resulting dataset is jointly conditioned by these activities. Its reliability, public significance, and long-term accessibility arise through partly distinct relations, each of which warrants separate reconstruction.

Dependencies can be *complementary*: a missing calibration procedure may undermine an otherwise functioning sensor network. They can be *substitutable*: an alternative data source may recover some

missing observations. They can also be *transformative*: a participant's suggestion changes the project's question, making earlier resources useful in a new way. Some dependencies concern the generation of an immediate output; others concern its interpretation, preservation, or reapplication. The resulting structure may change as expertise is transferred, equipment becomes obsolete, or new participants join.

A contribution can further generate capacities whose subsequent effects exceed the immediate product. Training an apprentice may support a later maintenance practice. Documenting a local ecological observation may improve a future survey. A transparent calibration protocol may permit other groups to scrutinize and adapt measurements. These consequences depend on continuing access and institutional arrangements, linking the present section to the later discussion of circulation and regeneration.

Social-ecological analysis adds another dimension. Ostrom's framework for examining sustainability treats resource systems, users, governance arrangements, and their interactions as relevant to the possibilities for self-organization [36]. The framework supports attention to interdependent conditions while leaving the specific causal significance of each relation to empirical inquiry. A marsh's ecological functions, for example, may condition the success of a restoration project, even though the question of whether any individual organism participates as an intentional co-author requires separate consideration. The observation of causal interdependence establishes grounds for including ecological processes in the explanatory history; questions of agency, welfare, and rights follow their own lines of justification.

4.3 Counterfactual Attribution and Its Reference Conditions

Counterfactual reconstruction can illuminate contributions by asking how the feasible trajectory might have changed under specified alternative conditions. An investigator may ask whether a survey would have succeeded without a particular protocol, how quickly a repair could have been completed without a resident's testimony, or whether a different institutional authorization would have allowed continued access. These inquiries can identify forms of dependence that remain difficult to recognize from the final product alone.

A counterfactual question requires an explicit reference condition. The investigator specifies the outcome being considered, the relevant time horizon, the background resources held fixed, and plausible substitutions. Removing one participant while retaining all effects of that participant's earlier teaching can produce a misleading reconstruction. Removing an institution while continuing to assume access granted by that institution creates a similar difficulty. A historically grounded counterfactual may therefore require several coordinated changes to describe a coherent alternative trajectory.

The choice of outcome also matters. A project may deliver a report through several alternative production paths while relying on a particular contributor to make its conclusions intelligible to affected residents. An archived file may be reproducible by an automated process while an accessible explanation remains contingent on sustained interpersonal work. Under a narrowly specified output measure, the contributor's difference may appear small; under a broader inquiry into public usability, it may become substantial. Neither perspective is inherently exhaustive. The relevant outcome and its evaluative scope require justification.

Formal cooperative-game theory offers one way to allocate a specified coalition value across members. Shapley's classic solution concept distributes the value of a defined cooperative game under stated axiomatic conditions [43]. Such an approach can clarify how a numerical allocation depends on the chosen participant set, characteristic function, and assumptions about coalitional possibilities. Its applicability to heterogeneous co-creation is conditional. Where actors disagree about the outcome's worth, ecological functions resist representation within a single monetary quantity, or the feasible alternatives depend on changing institutional permissions, a scalar allocation captures only a selected aspect of the situation.

Counterfactual necessity is also distinct from the magnitude or character of an observed contribution. Suppose two trained maintainers can repair a failed instrument. One performs the documented repair; the other remains available to intervene if the first cannot complete it. The first has an observed role in restoring operation, while the second's availability may have enabled a more reliable maintenance plan.

Under a simple removal test, either maintainer may appear dispensable if the other can complete the repair. A counterfactual that removes both changes the feasible trajectory considerably. The inference depends on how substitute action, response time, prior training, and coordination are represented. It may be useful to compare several plausible scenarios and preserve a separate account of actual interventions rather than report one numerical share.

Such dependence can also be *jointly sufficient* across several configurations, *indispensable* only under a narrow time horizon, or *transformative* when a contribution changes which outcome participants seek. The terms identify questions for historical reconstruction rather than a complete classification of causation. A participant can be indispensable under current constraints while exercising little control over the practice's aims. Conversely, making a substantial observed contribution need not entail indispensability. Process records and explicitly bounded counterfactual comparisons together provide a better evidential basis for attribution than either alone.

The ethical interpretation of counterfactual findings requires further reasoning. A causal contribution can be substantial even when it results from a coercive arrangement. An institution may own critical infrastructure while the authority to reuse subsequent intellectual products depends on further legal and contractual grounds. A volunteer may provide decisive expertise under an agreement that limits its reuse. Attribution of causal significance, contractual entitlement, distributive justice, and legitimate recognition therefore remain distinguishable questions. Their relations will be considered more directly in later sections.

An institutional example makes the boundary concrete. The NISO Contributor Roles Taxonomy (CRediT) provides standardized descriptions of scholarly activities such as conceptualization, investigation, resources, and data curation; it explicitly leaves authorship decisions to separate standards [33]. A verified role can accordingly strengthen a record of contribution while leaving open the appropriate form of credit, compensation, permission, or responsibility. Extending this lesson to community or ecological projects is an analogy requiring local justification, including examination of prior commitments, the risks borne by participants, and their opportunities to challenge the resulting record.

4.4 Asymmetric Agency and the Visibility of Work

The vocabulary of contribution must be sensitive to differences among participants and processes. A human participant may formulate reasons, negotiate procedures, refuse an activity, and assume recognized responsibilities. An organization may act through authorized roles, legal rules, infrastructures, and continuing institutional routines. A software system may transform inputs and produce outputs through designed architectures and deployed operations. A coastal ecosystem may sustain physical and biological conditions on which human work depends. These processes can all be consequential within a generative account, while claims about their autonomy, subjective valuation, or moral standing require distinct evidential and normative grounds.

Agency also varies within human cooperation. Some participants define objectives and control publication, while others can influence only local implementation. Some provide expertise whose significance becomes apparent during a crisis; others undertake routine maintenance that allows crises to be avoided. The record of formal meetings may give extensive visibility to the first group and little to the second. A useful contribution trace therefore attends to the forms of labor that conventional records tend to compress: care, translation, repair, accessibility work, quality assurance, and the preservation of collective memory.

Recognition practices shape the available evidence. Project reports often privilege final authorship and measurable deliverables. Procurement systems record paid supplies with relative precision while informal commitments may remain in personal messages or memories. Institutional requirements can make some labor legible only after it has been translated into approved categories. These asymmetries can make apparently neutral contribution accounting depend on prior decisions about whose time is recorded, which forms of expertise are accredited, and what constitutes an admissible outcome.

Attribution can also reproduce asymmetry when recognition becomes a means of controlling future

activities. Credit may be awarded in exchange for exclusive access to a dataset; an organization may recognize community participation while retaining unilateral authority to change the project's purpose. For this reason a contribution record should be evaluated alongside practical decision rights, access provisions, and procedures for contesting an interpretation. The discussion of recognition and institutional control in subsequent sections will address these relations in greater detail.

4.5 A Constructed Estuarine Monitoring Project

A constructed example clarifies the foregoing distinctions. Imagine a coastal municipality developing an estuarine monitoring project with local fishers, school teachers, laboratory researchers, a technology provider, and a habitat stewardship association. The initial institutional objective is to publish periodic measurements of water quality. Fishers seek information relevant to their working practices; teachers seek educational access; researchers value comparability across sites; stewardship participants emphasize changes to ecological conditions. These aims overlap in places while retaining different evaluative purposes. The episode is an analytical construction and makes no claim about the observed effectiveness of a real project.

The municipality secures a modest budget, obtains site permissions, and purchases monitoring instruments. These acts establish important enabling conditions. Laboratory staff propose calibration and sampling procedures. Fishers identify places where tidal changes affect measurements and bring observations accumulated through repeated seasonal activity. Teachers point out that the original sampling calendar would make meaningful student participation difficult. The stewardship association raises concerns about disturbance at sensitive nesting locations. Each intervention can alter the developing procedure, providing grounds for identifying constitutive participation through the decisions and revisions it produces.

A sensor supplier subsequently modifies the mounting design after repeated instrument failures at one site. The change relies on the supplier's engineering work, on a fisher's description of localized currents, and on records collected by the researchers. Once the modified equipment functions reliably, a municipal report credits the procurement and installation teams. The narrower attribution may be factually accurate within a purchasing account, while the wider contribution history includes field observation, diagnosis, adaptation, and ongoing inspection. A more comprehensive trace would link the design revision to each supporting form of evidence and identify uncertainties about the respective causal roles.

Suppose the revised network continues producing data. One laboratory report is subsequently prepared for technical audiences, while teachers and stewardship members develop an accessible interpretation for residents. The existence of the laboratory dataset and its public intelligibility are related achievements with partly distinct dependencies. The technical documentation could remain available while the educational materials disappear after a funding period. A useful evaluation would therefore examine the continuing ability of different participants to interpret, correct, and reuse the knowledge produced.

Counterfactual questions sharpen the case while illustrating their limits. If the municipality had supplied equipment but withheld site permissions, what alternative locations would have remained feasible? If fishers' seasonal observations had been unavailable, would the calibration schedule have detected the same tidal distortions? If the laboratory had withdrawn, could other trained participants have maintained measurement quality? Each question requires evidence concerning feasible substitutions, prior learning, institutional commitments, and the relevant time horizon. A single attribution percentage would conceal these different explanatory tasks.

A dispute eventually arises over whether precise site coordinates should accompany the public dataset. Researchers emphasize reproducibility; fishers express concern about commercial uses of location information; stewardship participants raise questions about protecting sensitive habitats. The disagreement concerns the uses and consequences of the jointly produced record. The parties could develop tiered access, generalize certain locations, or establish a documented review process. The choice would require scientific, legal, and ethical assessment. Its legitimacy would be evaluated through the authority of affected parties, the quality of reasons, and the consequences of the arrangement. Causal

Relation	Evidence to examine	Question opened
Enabling provision	Access, equipment, prior work, permission, infrastructure	Which possibilities became feasible?
Constitutive intervention	Decisions, revisions, prototypes, corrected interpretations	How was the outcome's form changed?
Complementary dependence	Joint tasks, alternative pathways, coordination records	Which combinations mattered for the result?
Continuing maintenance	Repair histories, training, stewardship, documentation	Which conditions preserved later use?
Contribution attribution	Revision histories, testimony, diagnostic tests	What role is evidenced, with what uncertainty?
Recognition and authority	Agreements, rights, credit rules, appeal procedures	Which further grounds justify credit or control?

Table 3: Analytical relations for reconstructing contributions to a collectively generated outcome. Each row identifies a different evidential inquiry, rather than a rank of contributors.

participation in the dataset alone would supply only part of the justification for a particular governance solution.

This constructed history makes visible three distinct levels of analysis. The first reconstructs the resources and activities enabling measurements. The second examines how contributors jointly shaped the sampling system and its interpretation. The third addresses recognition, access, and responsibility after the information begins to circulate. The levels interact over time, but their explanatory and normative questions differ. The value of a generative-relational account will depend on whether tracing these relations reveals decisions and dependencies that a narrower inventory of inputs, outputs, or stakeholder preferences would leave obscure.

4.6 Evidence and Criteria for Reconstructing Contributions

A practical inquiry into contribution should begin with a bounded outcome and reconstruct the sequence by which it developed. It should then identify the material and institutional conditions that enabled participation, the interventions that changed the activity, and the dependencies that connected the interventions. Relevant records include decisions and their revision histories, material tests, maintenance logs, agreements, and testimony from differently situated participants. Where possible, the investigator can compare these materials with feasible alternative arrangements while making assumptions and uncertainty explicit.

Table 3 summarizes several distinct questions involved in this reconstruction. The categories are analytical and can overlap within a single action.

The categories in Table 3 permit a richer account of involvement while preserving the specificity of attribution. An investigator can recognize a material enabling condition without assigning it human intentionality; establish a worker's role in modifying a process without assuming unrestricted ownership of its outputs; or identify an institution's continuing obligations without treating its provision of resources as sufficient evidence of ethical legitimacy. Each judgment requires the appropriate domain of evidence.

The section's central proposal is accordingly modest and operational. An account of co-creation can be made more informative by reconstructing the relations through which participants influence what is generated, how it is rendered usable, and which future activities it enables. The resulting evidence can support comparative and normative inquiries, although the transition from causal description to judgments about recognition or rights requires additional principles. The next section examines contributions under unequal capacities and dependencies, where these distinctions become especially important for analyzing reciprocity, autonomy, and the possibility of meaningful cooperation.

5 Co-Creation Across Asymmetric Capacities

Co-creation frequently joins participants with different resources, competencies, institutional standing, and opportunities for independent action. These asymmetries can make cooperation generative: one participant supplies an instrument, another contributes situated knowledge, and a third sustains the relationships through which their work becomes usable. They can also shape who defines the common task, whose interventions are adopted, and who remains able to benefit from the result. This section analyzes differentiated capacities as a condition of co-creation, examines how dependence develops within cooperative histories, and proposes criteria for evaluating meaningful participation, reciprocity, and the continuity of agency. Its approach is relational and institutional: it reconstructs possible histories of cooperation while keeping causal, evaluative, and normative judgments analytically distinct.

Section 4 described how enabling conditions and constitutive interventions can be traced through the development of an outcome. That reconstruction leaves a further issue: contributions emerge under unequal conditions of possibility. An organization that supplies a laboratory, a participant who possesses local knowledge, and a person who depends on a project for an essential service may jointly influence an outcome while holding markedly different capacities to challenge decisions. The same arrangement may expand their possibilities in one respect and concentrate discretionary control in another. An adequate account therefore attends to both what participants accomplish together and which options remain available to them as the relationship develops.

5.1 Asymmetry as a Situated Relation

Capacity differences have several dimensions. Participants may differ in technical knowledge, financial reserves, time, communicative access, legal entitlements, institutional legitimacy, physical ability, and the availability of alternative cooperative partners. A single ranking of participants obscures the domain-specific character of these differences. A community association may have little formal authority over a university research contract while possessing practical knowledge essential to interpreting field observations. A contractor may control a critical software interface while relying on local practitioners to identify relevant problems. Each relationship contains a particular distribution of influence, and the distribution can change during the project.

Definition 5.1 (Situated asymmetry of co-creative capacities). For a specified cooperative relation, an asymmetry of co-creative capacities is a documented difference in participants' feasible abilities to initiate, modify, contest, sustain, or leave activities contributing to a shared outcome. Its description identifies the activity, relevant alternatives, institutional constraints, time horizon, and evidential basis. The definition concerns a relational configuration; normative evaluation of that configuration requires additional considerations.

The definition in Definition 5.1 allows a distinction between differences that support complementarity and differences that restrict consequential participation. Expertise can facilitate cooperation when its holder explains uncertainty, shares usable procedures, and responds to criticism. It may also confer agenda-setting influence if other participants depend upon that expertise for the project's continuation. Likewise, access to funding can create opportunities for contributors while giving a sponsor the practical capacity to change the task or terminate access to results. Such effects are empirical questions about an arrangement's rules and alternatives, alongside questions about participants' substantive freedoms [42].

Asymmetry is also historically formed. A participant's apparently limited contribution may reflect earlier exclusion from education, infrastructure, or decision-making. Another participant's capacity to supply resources may derive from collectively maintained institutions or inherited advantages. These histories matter when explaining why cooperation begins on unequal terms. A generative-relational investigation can trace how present capacities emerged without presuming that the entire history can be reconstructed from a single project record. It should also recognize legitimate differences in roles and expertise, including safety-critical responsibilities and specialized professional obligations.

5.2 Dependence, Alternatives, and Changes in Bargaining Position

A significant asymmetry appears when one participant's feasible activity depends upon another participant's continuing permission, expertise, or infrastructure. Richard Emerson's account of power-dependence relations treats power as relational and links dependence to the significance of an outcome and the availability of alternative ways to obtain it [17]. This framework supplies an established sociological starting point for analyzing how a cooperative relation can be beneficial to participants while offering them different degrees of practical influence.

Consider a local group that collects environmental observations using instruments owned by an institutional partner. The group gains access to measurement capabilities, and the partner gains observations that would otherwise be difficult to assemble. The participants' contributions are complementary. Yet the institution may control calibration, account credentials, and the decision to renew the arrangement. Dependence becomes especially consequential where alternative instruments, data access, and maintenance services are costly or unavailable. A description of cooperation that records only shared output would miss these conditional powers.

Emerson's relational account helps identify a partner's practical leverage over feasible alternatives, including cases in which reciprocal dependence is substantial [17]. The existence of such leverage establishes an explanatory issue; judgments about its justified exercise depend on the purpose and terms of cooperation, institutional obligations, foreseeable risks, and means of contestation. An administrator may possess the technical capacity to suspend account credentials while an agreement authorizes suspension only for specified security events. Distinguishing *effective control*, *authorized discretion*, and *justified intervention* prevents a capacity to affect others from being mistaken for a normative entitlement to do so.

Dependency relations can evolve in several directions. Participants may gradually acquire skills and access that reduce reliance on the original provider. A provider may become increasingly dependent on contributions from people whose experience cannot readily be replaced. Alternatively, a project can grow more dependent on a proprietary interface as more records accumulate within it. These trajectories suggest assessing dependence repeatedly rather than assigning a permanent status at the outset. For example, a partnership contract might create substantial initial technical dependence and subsequently require transfer of documentation, compatible data exports, and maintenance training. The resulting changes in feasible alternatives are part of what the cooperation generates.

Albert Hirschman's account of *exit*, *voice*, and *loyalty* supplies another established perspective on the options available to dissatisfied participants [28]. Within the present inquiry, exit denotes feasible withdrawal or movement to an alternative, while voice denotes a meaningful opportunity to challenge and reshape collective decisions. Their practical availability matters more than their formal inclusion in a document. Withdrawal from a discretionary collaboration differs materially from withdrawal that threatens access to essential income, educational opportunity, or care. Similarly, a feedback channel may be formally open while participants lack the time, linguistic access, or institutional protection to use it effectively.

Dependence alone therefore provides an incomplete ethical diagnosis. Some forms of dependence are ordinary and valuable features of care, technical specialization, and collective life. Eva Feder Kittay's analysis of dependency work and the situation of caregivers gives reason to attend to the supports required by both those receiving care and those carrying it out [31]. The concern is the organization of dependencies: whether necessary support remains reliable, whether burdens can be contested and redistributed, and whether contributors gain or lose the conditions of continued agency. An arrangement can be deeply interdependent while also being attentive to autonomy and welfare.

5.3 Discretion Across the Stages of Cooperation

Practical participation involves more than presence at meetings or the performance of assigned tasks. It can include authority to identify the problem, select methods, interpret evidence, govern access, and initiate subsequent activity. These forms of discretion may be distributed among several participants

Dimension	Question for analysis	Possible evidence
Problem formation	Who can propose or revise consequential purposes?	Agenda histories; accepted and rejected proposals
Procedural influence	Who can modify methods within justified constraints?	Design revisions; technical explanations; safety decisions
Interpretive standing	Whose evidence can correct an official account?	Dispute records; corrected outputs; interpretive forums
Circulation and access	Who can retain, explain, or reuse the generated result?	Access rules; licensing; export formats; permissions
Continuation and exit	Who can sustain inquiry or withdraw with feasible alternatives?	Training; transition plans; compensation; partner alternatives

Table 4: Dimensions for describing consequential participation under differentiated capacities. The table identifies questions and forms of evidence; actual rights and responsibilities remain domain-specific.

in ways reflecting competence, risk, consent, and legitimate institutional duties. The question for a philosophical account of co-creation is how these distributions are made visible, justified, and revisable.

Sherry Arnstein’s classic analysis of citizen participation distinguishes levels of participation according to the power people exercise over planning decisions [5]. John Gaventa further analyzes the spaces, levels, and forms of power through which participation is organized [24]. Their distinct frameworks show why an invitation to contribute can carry different consequences according to who defines the agenda and controls the setting. The present paper extends this concern to the histories of generating, maintaining, and reusing outcomes across heterogeneous participants. Its specific questions concern the relations through which a person’s intervention can alter the result, the procedures for contesting interpretations, and the options available when roles change.

A provisional analytical device is the *discretion profile* of a cooperative arrangement. For each participant and stage, an investigator records feasible influence over problem formulation, procedural design, interpretation, circulation, and continuation. This profile is a qualitative description supported by records of actual decisions, participant testimony, and available alternatives. It is open to disagreement, and its dimensions need not be reduced to a scalar measure of participation. The description also separates discretion from epistemic competence: a participant may rightly defer to a trained engineer on structural safety while retaining meaningful authority to define the project’s social purposes or to question the accessibility of its implementation.

The distribution of discretion further depends on the kinds of rights at issue. Schlager and Ostrom’s analysis of natural resources distinguishes operational rights of access and withdrawal from collective-choice rights concerning management and exclusion [40]. For the present inquiry, that distinction supplies a bounded institutional analogy: being able to use a resource and being able to alter the rules governing its use are different capacities. A volunteer may enter observations into a shared platform while holding little authority over data-release rules; a manager may alter those rules while lacking direct knowledge of the observations. Their actual powers, formal permissions, and justified responsibilities may diverge. Application to research data, educational materials, or software requires attention to the specific legal and organizational regime, since the original resource-rights analysis establishes no universal rule of informational ownership.

Table 4 identifies five dimensions of inquiry and the evidence through which their distribution might be assessed. These dimensions are offered as analytical questions rather than universal requirements for identical rights in every cooperative domain.

The profile is particularly useful when a project changes phases. Early participation may be substantial during problem formulation and limited during procurement. Later, a contractor may hold technical control while community contributors provide ongoing quality assurance. Decisions about publication may introduce yet another authority structure. Revisability is then assessed through actual procedures: the ability to request explanations, reopen a mistaken decision, correct an attribution, and obtain a reasoned response. Bovens’s account of accountability as a relationship involving explanation, questioning,

judgment, and possible consequences provides a useful institutional comparison [8]. The scope of this analogy is the organization of answerability; it does not establish that all participants should exercise the same formal authority.

The distinction between competence and authority can also be tested across successive decisions. A contributor may document an error and possess strong epistemic grounds for correction, while a different office holds the duty to authorize publication. A sound account records whether the evidence was assessed, who decided, which rules justified that assignment, and what route remained for review. Recognition of expertise and legitimate allocation of decision rights can coincide; where they diverge, the divergence requires explanation at the appropriate epistemic and institutional levels. The existence of a contribution by itself leaves the final allocation of authority open to further inquiry.

5.4 Reciprocity, Care, and the Regeneration of Capacity

Reciprocity under asymmetry can take different forms. Participants may exchange wages and services, share practical knowledge, provide care, coordinate complementary expertise, or maintain conditions enabling the other party's future work. Their reasons for valuing these relations may differ. Some exchanges have explicitly negotiated terms; others unfold through continuing obligations whose contribution becomes visible only over time. The assessment of reciprocity therefore benefits from examining both the present allocation of burdens and the future capacities the relationship leaves available.

An arrangement may appear reciprocal because each participant receives something, while its returns differ sharply in durability and control. A community group might receive a public report, whereas an institutional partner retains a reusable dataset and the professional credentials associated with publication. A technology provider might receive fees for a one-time installation while the recipient bears ongoing operating costs and restrictive renewal conditions. These are analytically different histories of return. Their ethical assessment depends on contractual expectations, prior contributions, legitimate needs, broader institutional responsibilities, and the practical consequences for future participation.

The generative-relational proposal here concerns *reciprocal capacity development*: a cooperative relation has this feature when its history provides credible evidence that participating parties have acquired or preserved feasible abilities to undertake further valued activity, in ways responsive to their different circumstances and roles. This is a provisional evaluative concept. It can describe reciprocal benefits even where the parties value them through different standards. It also creates a substantive inquiry into asymmetries: whether one party's expanded capacity is tied to the progressive reduction of another's available options, and which arrangements enable mutual continuation.

Such assessments require attention to care and maintenance. An important contribution may consist of repeatedly restoring conditions that others use for more visible production. Caregivers, local coordinators, interpreters, system administrators, and volunteer stewards may carry recurring burdens that become identifiable primarily when support fails. Kittay's work illuminates the significance of dependency labor for equality and the need to attend to the situation of those performing it [31]. The present application considers a wider range of cooperative institutions while maintaining the distinction between the moral relations of care and ordinary technical maintenance. Different duties and forms of vulnerability require their own standards of assessment.

Three practical questions follow. First, which capacities does the cooperation develop in each participant, and how durable are they? Second, which burdens and obligations accompany those gains, including responsibility for upkeep or risk? Third, which avenues permit participants to renegotiate those burdens as the project changes? The questions are complementary to tracing contributions in Section 4. They make later agency and sustainability explicit elements of the analysis rather than assuming that the production of a valuable outcome completes the cooperative relation.

5.5 A Constructed Urban Heat-Refuge Partnership

Consider a constructed partnership that develops a network of accessible neighborhood spaces where residents can seek relief during periods of intense summer heat. A municipal department offers premises

and limited operating funds. A neighborhood association recruits volunteers and knows how residents travel through the area. A university team offers temperature-monitoring equipment and technical analysis. A small service provider installs a public information system. Accessibility advocates identify barriers affecting wheelchair users and people who need clear, multilingual information. The case is a philosophical construction; it supplies analytical variation rather than empirical evidence of a successful intervention.

At the design stage, the municipal department selects a set of existing public buildings. The university team proposes measuring indoor temperatures and assessing opening hours. Association members raise concerns about routes that become difficult to traverse in high temperatures. Accessibility advocates observe that one apparently suitable building has an entrance that limits independent access for some users. These interventions revise the relevant problem: feasibility concerns the experience of reaching and using a refuge as well as the temperature conditions inside it. Participants contribute different forms of knowledge, and the adequacy of the outcome depends partly on how their interpretations can modify the design.

A dependence becomes apparent when the service provider operates the system through a proprietary interface. The municipality can fund ongoing fees; the neighborhood association can update opening-hour information only through the provider's staff. At first this arrangement may improve reliability, but delayed corrections begin to matter when volunteer teams encounter schedule changes. In response, the parties consider a documented export format, local editing permissions, and training for association representatives. Their discussion concerns the distribution of feasible discretion and the possibilities for continuity. A technical system's contribution to joint production coexists with questions about who can sustain its usefulness.

A contrasting decision concerns safety. Suppose a qualified engineer identifies a structural hazard in one proposed refuge. Applicable safety responsibilities may warrant immediate temporary closure, even if local volunteers preferred to retain that location. Their route knowledge remains pertinent to choosing an alternative site, and their contribution to access planning merits separate consideration for recognition. The engineer's technical judgment, the department's lawful responsibility, and the volunteers' role in revising the service can each be consequential within the same episode. An account that equates causal importance with final authority would obscure the different grounds for those decisions.

Meanwhile, the association faces an asymmetry of another kind. Volunteers perform many hours of coordination and outreach; the university team receives opportunities for publications and student training; the department can report an expanded service. These outcomes may each be valued. They impose different risks and continuing obligations. If volunteer recruitment declines, the information system may remain in place while the human support network weakens. A practical evaluation should therefore examine the distribution and sustainability of care-like work, the accessibility of training, and the availability of compensation or alternate staffing.

Suppose an advocate requests that the public map include the accessible entrance for each site. A technical specialist warns that a proposed data field could reveal a sensitive visitor pattern if recorded at individual level. The participants can jointly consider a design presenting site accessibility without retaining identifiable visit histories. The example illustrates the need to coordinate differentiated expertise with opportunities for substantive correction. Technical constraints may justify particular restrictions, while the affected people retain a legitimate interest in explaining what the system should enable. The resolution would depend on applicable privacy, accessibility, and public-service rules beyond the philosophical vocabulary offered here.

Finally, imagine that the initial grant ends. The municipal department proposes preserving the service with fewer locations; the provider offers a discounted renewal; the neighborhood association argues for maintaining spaces most accessible to residents with limited transport. The partners can examine several feasible continuation scenarios, including open data exports, decentralized maintenance, and transfer of training materials. A contribution trace would show how the service originated. A discretion profile would show whose priorities shaped its revision. An account of reciprocal capacity development would ask which of the partners can continue meaningful action after the original project ends. These three

descriptions together make more visible the quality and fragility of co-creation across unequal capacities.

The case also indicates the limits of treating diverse entities as homogeneous participants. Buildings and heat flows materially condition feasibility; they are not presumed here to express human preferences. The service platform can process requests and constrain access, while responsibility for its deployment and governance remains with the relevant people and institutions. Participants with distinct degrees of expertise and need warrant domain-appropriate treatment. The vocabulary of heterogeneous generation identifies relations of contribution while leaving questions of moral standing and legal responsibility to more specific inquiry.

5.6 Assessing Cooperation Under Unequal Conditions

The proposed analysis can be investigated with a bounded set of questions. An account should identify the activities jointly generated, the asymmetric capacities under which participants entered the arrangement, and the decisions through which those differences became consequential. It should reconstruct the feasible alternatives available at major moments of the project, including avenues for voice and exit. It should describe how authority over problem formulation, procedures, interpretation, circulation, and continuation shifted during cooperation. Finally, it should examine burdens of maintenance and the development or erosion of future capacities.

The evidence needed is heterogeneous. Formal contracts and budgets can document some rights and commitments; meeting records may reveal actual revisions; interviews can recover differing interpretations of why an intervention mattered; technical records can establish what could be modified or exported; longitudinal follow-up can show whether skills and access persisted. Contradictory evidence should remain visible, especially where a formal statement of participation differs from the options experienced by contributors. These methods require their own ethical safeguards, including attention to confidentiality, consent, and unequal risks of public disagreement.

A comparative inquiry could organize these materials in three parallel records: an *activity record* of actual contributions and dependencies, a *discretion record* of decisions and feasible alternatives, and a *justification record* of the agreements, duties, and review procedures invoked when recognition or authority is allocated. The records should be constructed from independently assessable sources where feasible, with disagreements and missing evidence retained. Their alignment may reveal whether an important intervention was recognized, whether a controlling actor exercised an assigned responsibility, and whether affected participants had a usable opportunity to challenge a decision. Such findings would support, rather than settle, the distinct normative evaluation of the arrangement.

Several alternative explanations warrant comparison. A partnership may succeed because of effective specialization, clear contracting, or institutional stability. The proposed generative-relational account adds a question about changes in the participants' feasible capacities and subsequent participation. Its value would be stronger where those changes explain the trajectory of cooperation or illuminate a decision that the alternative accounts assess differently. The framework should accordingly be evaluated against actual cooperative histories in which meaningful benefits coexist with dependence, and in which apparently generous participation procedures yield different forms of practical influence.

A philosophical assessment also distinguishes productive complementarity from justified authority. The expertise to perform a task can support role-specific discretion, and urgent safety obligations may constrain available choices. The legitimacy of such constraints depends on the applicable context, adequate reasons, and opportunities for suitable review. Equally, equitable treatment may require differentiated support to make participation feasible. The present framework provides questions for institutional inquiry and normative deliberation. It leaves determinate legal entitlements, distributive judgments, and domain-specific duties to the corresponding bodies of law and ethics.

Co-creation across asymmetric capacities is thus an evolving relation in which participants contribute through different means and retain different possibilities for shaping what follows. Its analysis connects contribution tracing to the changing distributions of dependence, discretion, and reciprocal capacity development. A project may generate a valuable result while creating new dependencies, or it may ex-

pand the participants' feasible opportunities for later cooperation. These are substantive differences in generative trajectory. The following section examines the recognition and attribution of heterogeneous contributions, where differences in visibility and interpretive authority further shape which histories of co-creation can be publicly acknowledged.

6 Recognition and Attribution of Heterogeneous Contributions

A co-created outcome may depend on many forms of participation while its publicly recognized history records only a selection of them. The resulting gap matters for explanation, for the practical opportunities available to contributors, and for the legitimacy of decisions concerning the outcome. Section 4 developed the reconstruction of contributing relations, and Section 5 examined how unequal capacities shape the exercise of influence. The present section considers the subsequent work of rendering contributions intelligible, assigning credit, and enabling contributors to contest the record. It develops a situated attribution framework, compares recognition devices, and examines a constructed multilingual warning-network case. Its claims are analytical and normative proposals, supported where appropriate by scholarship on scientific credit, invisible work, epistemic injustice, and data governance.

Recognition and attribution designate related activities with different objects. *Attribution* connects a specified intervention or enabling activity to persons, organizations, tools, or material processes on an evidential basis. *Recognition* concerns how such connections acquire significance in a social or institutional setting: whose work appears in a publication, whose testimony guides a decision, whose name remains associated with a method, or whose maintenance efforts qualify for continuing support. Both are mediated by conventions for deciding which activities count and which records can be consulted. A contribution may be causally significant, adequately documented, and publicly neglected; another may be prominently acknowledged through institutional position even when its relation to a particular result is remote. These are possible configurations requiring inquiry into actual practices of representation.

6.1 Visibility, Records, and the Selectivity of Recognition

Cooperative activity becomes visible through selective indicators: completed artifacts, reports, code commits, attendance records, scientific publications, procurement documents, and spoken accounts. Each indicator reveals some aspects of work and renders others harder to recover. Star and Strauss analyze visible and invisible work as contextually produced categories, with particular attention to the negotiations and representational practices through which cooperative labor becomes noticeable [45]. Their analysis provides a useful starting point for reconstructing the work behind apparently self-contained outputs. A finished dataset can make measurements apparent while obscuring the patient work of repairing instruments, resolving place names, communicating uncertainty, and maintaining relationships with contributors.

The degree of visibility also changes across the life of an outcome. An experimenter's intervention may be documented during data collection and disappear when observations are pooled. A volunteer's translation may be highlighted in a community meeting yet become anonymous in the published interface. A technician may be acknowledged in the project report and excluded from a subsequent adaptation that depends on the same procedure. Recognition therefore has a history. Its analysis calls for identifying the recording device, the point at which a description is condensed, and the authority to correct the condensed account. The availability of earlier records is especially important when contributions acquire new meanings during reuse.

Scientific credit offers a historically studied example. Merton's account of the Matthew effect investigates how existing reputations influence the distribution of recognition within scientific communication and reward systems [32]. The present paper draws on this argument for its attention to cumulative visibility, while treating the transfer to other cooperative domains as a comparative proposal. A well-known institution can become the public face of a joint result through citation conventions or branding even when its partners supplied decisive observations and interpretive knowledge. Similarly, a project may

acquire a recognizable individual author while relying on organizational, relational, or maintenance work that remains difficult to convey within the prevailing credit format.

These examples invite a more exact question: *what does a record enable a later observer to know?* A name on a report can establish that recognition occurred without specifying the kind of contribution. A timestamped edit shows a recorded alteration while leaving its intellectual rationale and surrounding cooperation to interpretation. Testimony can explain why a revision occurred but may depend on memory, consent, and unequal institutional credibility. The interpretation of a missing attribution additionally depends on how the record was made. A narrow reporting category, a lost contribution trace, and an institutionally restricted archive can yield the same visible omission while calling for different evidential conclusions. The comparative protocol in Section 11.3 treats these possibilities separately and requires independent grounds for allegations about their causes.

A defensible reconstruction therefore combines several forms of evidence, recognizes their different limits, and preserves the possibility of correcting an account as more evidence becomes available.

6.2 Attribution as an Evidential and Revisable Practice

The present analysis proposes a *situated attribution record* for relating contributions to an identified outcome and period of cooperation. The device gives an investigator a way to describe causal and interpretive links while leaving ethical judgments about rewards, authority, and rights to subsequent argument.

Definition 6.1 (Situated attribution record). For an outcome o , an observation period T , and a specified cooperative setting C , a situated attribution record $A(o, T, C)$ is a revisable collection of entries identifying (i) a contributor or contributing process, (ii) the activity and its relation to the outcome, (iii) the evidence supporting that relation, (iv) relevant uncertainty and alternative accounts, and (v) the procedures through which affected parties can access or contest the description. The record is an analytical representation whose completeness depends on available evidence and the purposes of inquiry.

Definition 6.1 treats attribution as an accountable historical reconstruction. It permits a person to appear in several roles and allows one activity to be supported by multiple participants. It also leaves room for developments that were documented by no named individual, such as an ecological process relevant to the result. The classification of an entity as a contributing process describes a causal or enabling relation; ascribing testimony, duties, entitlements, or moral standing requires the relevant additional argument. This matters particularly when records include software agents, organizational procedures, animal activity, or physical environmental conditions.

The specification of the outcome and observation period is consequential. An initial design can be attributed to one set of contributors, its operational reliability to another, and its later adaptation to a third. An evaluation of the completed artifact will differ from an account of the institutions that maintain it. A community group that supplies local descriptions may play a substantial role in making an instrument usable, even if the same group did little software development. The situated record captures these variations by linking activities to their effects and keeping each inference visible to review.

A record can support several distinct questions. The historical question concerns who or what contributed to the observed development. The epistemic question concerns the strength of evidence and the plausibility of rival interpretations. The institutional question concerns who can make, amend, preserve, and publish the record. The normative question concerns who merits acknowledgment, compensation, continuing access, or participation in future decisions. Answering one question may inform another, but the transition involves additional standards. A documented causal connection alone leaves open the appropriate distribution of rewards, and a formal contractual right may coexist with a substantive dispute about how the outcome was generated.

There are practical reasons to design attribution records for correction. In longer projects, contributors may have unequal access to documentation platforms and different opportunities to describe their work. Some may face language barriers or confidentiality obligations. Others may be unavailable when an outcome is published. A single final declaration can consequently reflect the institutional capacities

present at the time of publication. Retaining versioned accounts, a record of contested claims, and review procedures can make the historical explanation more durable. Such procedures also require attention to privacy and the legitimate reasons a participant may wish to remain unnamed.

6.3 Credibility, Interpretive Standing, and Contestation

The reliability of a contribution record depends partly on whose accounts enter the evidential process. Fricker’s account of testimonial injustice identifies prejudice-based deficits in the credibility assigned to speakers, while her account of hermeneutical injustice concerns disadvantages associated with limitations in shared interpretive resources [22]. These ideas help identify particular ways that people can be wronged in their capacity as knowers. An institutional archive may, for example, treat a technically certified employee’s account as authoritative while dismissing a community participant’s description because it arrives through unfamiliar terminology or communication practices. A philosophical analysis should inspect the evidence and decision procedure in each setting while identifying the relevant possibility of prejudice or structural interpretive exclusion.

Dotson’s treatment of testimonial silencing draws attention to the vulnerabilities of speakers and to failures of uptake connected with pernicious ignorance [15]. Her account is specifically concerned with oppression and the conditions under which testimony is silenced; it therefore calls for contextual care when extended to ordinary disagreements in a project team. The present inquiry takes from this literature a focused question about *interpretive standing*: under what conditions can a contributor’s account of an intervention be heard, critically examined, and incorporated into an institutional history? Interpretive standing includes access to the decision forum, intelligible evidential standards, opportunities for response, and the capacity to seek revision. It entails serious engagement with contributions, together with the possibility that an assertion will be challenged on supported grounds.

Recognition practices also face genuine evidential conflicts. Two participants can remember the origin of a proposal differently, or a collective practice may have developed through informal exchanges with sparse documentation. Some interventions will be scientifically unsupported despite the contributor’s investment of time or care. Fairness therefore concerns the quality and accessibility of deliberation alongside the resulting description. A process can respect the contributor by recording their account, examining the available traces, disclosing uncertainty, and explaining why the public record adopts a particular formulation. This gives acknowledgment an epistemic dimension without treating an attribution dispute as a simple contest of institutional prestige.

A further distinction concerns what can responsibly be made public. Community descriptions may identify people who contributed under expectations of confidentiality. Local ecological knowledge may involve restrictions on disclosure or downstream use. Commercial contracts may condition publication of certain records, while archival obligations can support a continued internal audit. An attribution system can accordingly separate preservation of evidence, access for affected parties, and public presentation. These layers allow investigators to examine contributions while honoring contextually applicable consent, confidentiality, governance, and legal obligations.

6.4 Credit Formats and Their Institutional Reach

Standardized contributor taxonomies can improve the visibility of differentiated work. The Contributor Roles Taxonomy, formalized as ANSI/NISO Z39.104-2022, provides fourteen roles for describing contributions to research outputs [33]. It offers a concrete example of how a publication system can move beyond a list of names toward structured descriptions of conceptualization, investigation, data curation, validation, software, writing, and other activities. Its designated field is scholarly production. The taxonomy is consequently useful here as a partial institutional analogy, with additional categories and governance arrangements required for many ecological, community, or cross-sector collaborations.

The presence of a structured field is only the beginning of attribution. A research contribution may cross several roles, and participating people may differ over the vocabulary that best expresses their activities. A maintainer’s work may span investigation, data curation, resources, and project administration.

Table 5: Distinct objects and evidence in the interpretation of collaborative contributions.

Object	Focus of inquiry and illustrative evidence
Contribution	Activities affecting the outcome, examined through drafts, observations, and process records
Attribution	Relations between activities and contributors, examined through provenance and testimony
Recognition	Institutional standing of contributions, expressed through named credit, role statements, and assessment
Interpretive standing	Ability to contest the account through accessible review and reasoned responses
Continuing participation	Opportunities to access and shape later use through custody rules and renewal agreements

A community interpreter may develop questions and evidence while appearing in an initial database as a source of local information. A properly designed scheme should permit multiple descriptions, make its definitions intelligible, and document the process for changing a disputed entry. It should also distinguish a role statement from formal authorship requirements, employment rights, property entitlements, or an equitable division of benefits.

Table 5 summarizes five questions that can be distinguished within a cooperative record. The comparison is an analytical proposal concerning institutional arrangements, with actual legal or professional duties determined by the relevant context.

The levels in Table 5 help explain why a well-documented project can still produce disputes about recognition. A provenance record may identify a contribution accurately while the institution’s reward structure gives it little weight. A name may be included on a plaque while the named contributors lose access to the resulting database. A partnership may offer procedures for disputing credit while withholding the information needed to exercise them. These variations are especially relevant when institutional systems translate heterogeneous work into comparatively narrow accounting, publishing, or certification categories.

Culturally and historically specific governance practices call for further care. The CARE Principles for Indigenous Data Governance articulate collective benefit, authority to control, responsibility, and ethics in the context of Indigenous data and interests [10]. Their specific institutional and political setting matters. The principles provide an important example of why recognition of a community’s contribution to knowledge can be associated with authority over the resulting data and its subsequent circulation. The present paper treats this as a contextually situated precedent, acknowledging that distinct communities and legal systems have their own governance arrangements and priorities.

6.5 Agency, Recognition, and the Passage to Institutional Authority

An account of co-creation must distinguish a participant’s capacity to contribute to an outcome from the institutional standing subsequently attached to that contribution. *Generative agency* here concerns situated opportunities to initiate, interpret, modify, or sustain activities that affect a cooperative trajectory. *Recognition* concerns the ways an institution identifies, attributes, evaluates, and makes an activity legible to relevant audiences. *Decision authority* concerns justified control of particular actions such as certification, dissemination, correction, exclusion, or reuse. These concepts track different relations. Their practical connections may be close, but a contribution’s causal importance, its acknowledged status, and the contributor’s authority over subsequent uses can develop along different paths.

The distinction matters particularly at the moment when a collaborative practice enters an institutionally portable format. An apprentice’s field observations may become an authenticated research dataset; a community participant’s interpretive correction may become part of a technical standard; or a learner’s independently developed explanation may be absorbed into a school report. A report can accurately describe the activity yet leave authority over its re-use to a contractual operator. A role statement may assign visible credit while an archive’s access permissions make later correction infeasible. A contributor

may obtain meaningful co-governance without personally receiving prominent public credit, especially where collective acknowledgment or privacy is preferred. These cases require distinct description before a judgment of fairness or exploitation can be justified.

Definition 6.2 (Recognition–agency divergence). For a specified cooperative trajectory and institutional conversion, *recognition–agency divergence* refers to a describable variation between (a) a participant’s evidenced opportunities and realized activities in shaping an outcome and (b) the standing or effective influence accorded to that participant in subsequent institutional representation, evaluation, and use of the outcome. The description identifies the relevant activities, decision points, authorities, practical access conditions, and observation periods. Divergence, so defined, is a diagnostic category; its normative assessment requires independently warranted standards, contextual rights and duties, and an account of the affected interests.

This definition also separates two possibilities often obscured by a single notion of “recognition.” A participant may be *misdescribed*: the public record omits a consequential intervention or assigns it to another actor. A participant may instead be *accurately described but institutionally excluded*: the historical account identifies the contribution while control of later versions, revenue arrangements, or technical access rests elsewhere. A third possibility combines both difficulties. The first calls for evidential correction and attention to attribution procedure. The second calls for examination of how authority was allocated, whether consent and legitimate duties support the allocation, and what feasible alternatives exist. Public praise alone cannot answer either question.

The transition can be traced through four analytical registers. First, a *production record* reconstructs who performed which activities, what information and materials were available, and which interventions changed the outcome. Second, a *representation record* examines the names, roles, classifications, omissions, and uncertainties through which the outcome becomes public or administratively readable. Third, an *authorization record* identifies the relevant contractual, organizational, legal, and ethical bases for custody, certification, publication, or re-use. Fourth, a *continuation record* examines what participants can feasibly do afterwards: correct errors, obtain relevant materials, maintain a role, contest an interpretation, withdraw from optional participation, or develop further work. Each register may contain several competing accounts and incomplete evidence. Disagreement about the first should be settled through relevant evidential methods; disagreements concerning the third require the interpretation of legitimate authority and responsibility in the specific setting.

Table 6: Diagnostic registers for tracing a contribution into institutional recognition and reuse.

Register	Central question	Illustrative evidence
Production	How did participation change the outcome?	Drafts, activity logs, testimony, counterfactual process comparisons
Representation	How was participation rendered institutionally legible?	Role statements, publications, disputed attributions, revision histories
Authorization	Who may decide subsequent uses, and on what grounds?	Agreements, statutory responsibilities, ethics procedures, decision records
Continuation	What influence and investigative capacity remain feasible?	Export rights, accessible archives, resources, correction responses, successor work

The CRediT taxonomy provides a bounded precedent for the representation register: its fourteen standardized roles help differentiate contributions to scholarly outputs [33]. The taxonomy describes work and makes certain forms of participation easier to record; questions of authorship, proprietary control, benefit-sharing, and future institutional authority call for additional rules. The broader analysis in Table 6 asks how a role description becomes connected, or remains disconnected, from a person’s later possibilities. Its practical value depends on recovering concrete decisions rather than replacing one institutional classification with a second, philosophically preferred classification.

Consider an educational–municipal collaboration that develops a public heat-risk map. Students

formulate a question about unequal shade on walking routes, teachers help test measurements, local residents clarify exposure patterns, and municipal technicians establish the map's public information format. One student discovers a systematic time-of-day error and proposes a correction, which the technical team accepts. The report accurately credits the class and publicly thanks the resident contributors. Later, the municipality integrates the map into a proprietary service contract that gives the service operator authority to approve subsequent changes. A student finds an error in the new version but lacks a usable route to submit corrected evidence. The collaboration may have produced real knowledge and contributed to public service, while the successive decisions create a divergence between the original agency of participants and their later capacity to influence institutional representations.

There are several ethically relevant variants. The operator may be obliged to restrict direct editing because published heat-risk advice affects safety; this need not exclude a documented and technically reviewable correction route. The participants may have knowingly agreed to a bounded research role with no continuing administrative responsibility; that agreement bears on legitimate expectations but should be interpreted in light of the actual information and feasible choices available. A resident may prefer collective or anonymous acknowledgment, making public naming an inappropriate measure of recognition. A student may have contributed a decisive correction without qualifying for authorship under an applicable publication policy. These possibilities demonstrate why neither an equal division of administrative authority nor maximal public attribution follows automatically from co-creative activity.

A context-sensitive normative inquiry might ask whether the record fairly represents the work, whether affected contributors had intelligible opportunities to negotiate foreseeable uses, whether safety and confidentiality constraints are proportionate, and whether consequential corrections can be received and assessed by competent decision makers. It might also ask who bears the costs of sustaining access or participating in review. A formally available appeal can impose prohibitive translation, software, travel, or time burdens. Such costs are part of a relationship's operative conditions. The analysis should distinguish a justified denial of an individual request from the absence of a feasible procedure for considering requests at all.

There is a risk of circularity in defining agency only through institutional uptake: a participant whose evidence is rejected would then appear to have lacked agency by the very criterion under examination. In this proposal, agency is assessed through evidence of the participant's situated activities and available opportunities; epistemic merit is assessed through the reasons and standards appropriate to the claim; recognition and authority are assessed through the subsequent institutional arrangements. The distinction permits a claim to be rejected on sound evidential grounds while its contributor retains standing to challenge the reasoning. It also permits deserved institutional praise for a limited contribution without inferring broad self-direction or decision authority.

The incremental research question is whether these registers help explain changes in cooperative participation over time beyond the insights already available from contributorship studies, epistemic-injustice scholarship, institutional analysis, and governance of common resources. A comparative study could reconstruct matched project trajectories before and after a new publication, licensing, or data-custody rule; code each decision independently; solicit competing interpretations from affected parties; and assess later access, corrections, and continued participation. Observed differences would require analysis of role, resources, institutional competence, and selection effects. A finding that established frameworks already identify the consequential mechanisms with equal clarity and lower complexity would limit the added explanatory value of the GR description. Its strongest possible contribution lies in keeping production, institutional legibility, authorization, and continuity analytically connected while allowing their norms and evidence to remain distinct.

6.6 Constructed Case: A Multilingual Coastal Warning Network

Consider a hypothetical partnership that develops short public warnings concerning coastal flooding. Local volunteers identify language varieties commonly used by residents, caregivers explain how alerts reach people with restricted mobility, municipal staff communicate emergency procedures, technicians

build the notification interface, and a research group evaluates the clarity of the draft messages. A speech-generation system produces provisional audio versions under human review. Local patterns of tides and wind enter the technical model as environmental inputs. The collaboration produces a system intended to make warnings more accessible across several communities.

The partners' contributions are heterogeneous in both form and evidence. The technicians leave version-control histories, the research group produces evaluation notes, and the municipal staff approve formal wording. Caregivers and multilingual volunteers may contribute through conversation, informal trials, and revisions that enter the system without an individual byline. One volunteer notices that a warning phrase conveys an inappropriate level of urgency in a local register. Her correction changes both wording and the planned distribution of the message. Another participant identifies an inaccessible notification route; the interface is subsequently redesigned. An output-centered evaluation could recognize the functioning application while offering a much thinner account of the interpretive and practical work that made it usable.

A situated attribution record would first specify the relevant outcomes: alert wording, audio accessibility, distribution procedure, and maintenance plan. It would then connect activities to those outcomes using available drafts, testimony, test reports, recorded decisions, and documents explaining constraints. Where evidence is limited, the account would identify the basis and uncertainty of the inference. Participants would have opportunities to review descriptions of their own involvement and correct substantive misunderstandings, subject to applicable disclosure and safety considerations. A public record could acknowledge community contributors collectively where individuals prefer privacy, while a restricted archive retains additional provenance under an agreed governance arrangement.

The case also shows why acknowledgment alone offers an incomplete picture of recognition. Suppose the municipality publicly thanks the volunteers but retains sole discretionary control over the translations and the user-contact database. The volunteers may receive recognition for prior work while losing opportunities to maintain or challenge later adaptations. Alternatively, a governance agreement might provide funded review sessions, language-access support, correction channels, and a clear allocation of responsibility when the warnings change. These provisions would affect the future generative capacities of the relationship. Their legitimacy would depend on public-safety obligations, consent, practical resources, and relevant institutional and legal requirements.

Artificial and ecological contributions call for differentiated description. The speech-generation system can be attributed a recorded technical role, including the model version, limitations, and human approval procedure. This records its operation while leaving questions of AI moral standing for separate inquiry. Tide dynamics and shoreline features can be included as causal or environmental conditions in the history of the warning system. Their significance may give rise to responsibilities concerning environmental protection and safety through appropriate normative reasoning, with attribution of human credit handled on its own terms. Such distinctions preserve the explanatory value of heterogeneous participation without forcing the several entities into one institution's model of personhood or reward.

Finally, the constructed case contains several plausible explanations for observed recognition differences: the available documentation may favor technical roles, institutions may deliberately select a narrow public presentation, and participants may prefer different forms of acknowledgment. Each explanation requires relevant evidence. Comparative fieldwork could examine whether versioned provenance and accessible correction procedures improve contributors' ability to identify errors, maintain trust, or influence later adaptations. The scenario itself supplies an analytical illustration and makes no claim of demonstrated practical effectiveness.

6.7 Recognition as Part of a Continuing Cooperative Relation

Attribution can influence the subsequent conditions of co-creation. A contributor who receives a usable description of prior work may be better positioned to seek employment, negotiate a maintenance role, or participate in a new project. A community that can correct the archive of its own participation may retain knowledge about the decisions that shaped an intervention. Equally, public recognition can be

disconnected from durable influence if resources, access permissions, or interpretive authority remain concentrated elsewhere. Such consequences explain why recognition deserves analysis alongside the formation and distribution of value.

The account developed here identifies three provisional criteria for assessing recognition arrangements. The first is *evidential traceability*: the description states what is being attributed and on what grounds. The second is *interpretive accountability*: affected contributors can encounter the account, question it, and receive a reasoned response under practicable procedures. The third is *continuity of agency*: the arrangement clarifies what opportunities contributors retain to access, correct, maintain, or contest later uses of the outcome. These criteria remain sensitive to confidentiality, safety, institutional roles, and the distinct rights and obligations operating in particular domains. Their application requires context-specific evidence and normative judgment.

Recognition in heterogeneous co-creation thus involves more than assigning credit at the completion of an artifact. It concerns the historically changing relation between contributions, the records that represent them, and the participants who govern their interpretation. Established work on invisible labor, scientific credit, epistemic injustice, and structured contributorship supplies important precedents; the present paper brings these concerns into a provisional account of continuing generative relations. The following section examines a connected issue: how institutions, standards, and technical infrastructures control the interfaces through which contributions are converted into publicly valuable, transferable, or appropriable outcomes.

7 Institutional Interfaces and Control of Value Conversion

Co-created outcomes enter institutions through particular interfaces: registration systems, technical standards, contractual instruments, procurement rules, data platforms, accounting categories, and procedures for authorizing use. These interfaces help determine which aspects of an outcome become visible to others, which uses are feasible, and who can negotiate the conditions of further circulation. The preceding sections distinguished the generation of capacities, heterogeneous contribution, asymmetries of influence, and the attribution of cooperative work. This section examines a further stage in the same relational history: the institutional conversion of generated outcomes into forms that can be evaluated, exchanged, administered, or appropriated. It develops an analytical definition of a conversion interface, distinguishes the allocation of rights from the exercise of effective control, and examines a constructed coastal-monitoring partnership. The inquiry combines conceptual analysis with selectively verified scholarship on property regimes, commensuration, infrastructures, and informational political economy.

Value conversion here names a situated process through which an outcome acquired in one cooperative setting becomes intelligible and actionable within another institutional practice. A wetland observation may become an entry in a municipal planning database; a community-maintained dataset may become an input to a contracted monitoring service; an informal repair practice may become a certified technical procedure. Each passage involves some combination of selection, classification, authorization, and mediation. Value formation concerns the development of the underlying capabilities and relations, while valuation concerns judgments concerning their significance. Conversion concerns the practical conditions under which a valued outcome acquires a usable institutional form. These processes can overlap historically and can operate under different standards.

7.1 Institutional Legibility and the Passage Between Practices

Consider two partners who jointly develop a low-cost method for monitoring a changing shoreline. The local partner values accessible knowledge of coastal conditions, while a public agency values a standardized indicator suitable for planning. The locally developed method may contribute to both aims. For the agency, however, the observations typically pass through a prescribed file format, quality-control procedure, and authorized reporting route. The procedure makes the observations administratively us-

able; it also selects certain features of the original inquiry for representation. The resulting indicator can travel farther than the activity from which it emerged. Its portability depends on decisions about units, thresholds, terminology, provenance, and accepted uncertainty.

Classification and infrastructural scholarship offers substantial precedents for this observation. Bowker and Star examine how categories and standards enter the material organization of institutional life, including the distribution of visibility and the work required to sustain classificatory systems [9]. Star's account of infrastructure similarly emphasizes that infrastructural arrangements are relational and embedded in practices, tools, standards, and organizational routines [44]. The present paper uses these arguments to investigate a specific transformation: how an institution's rules for receiving an outcome can alter the feasible ways in which its contributors participate in the outcome's later development.

A conversion interface may appear as a mundane administrative detail. A reporting form requires a particular category; a funding contract recognizes only certified laboratories; a licensing portal demands that one organization be named as the authorized data holder. Such requirements can support reliability, accountability, safety, or coordination. They also create different opportunities for those whose work produced the result. A contributor with recognized credentials may be able to certify a dataset, while another contributor with decisive local knowledge must communicate through an intermediary. The resulting difference can be attributable to lawful professional roles, administrative convenience, resource scarcity, institutional power, or some combination of these circumstances. A case-sensitive inquiry should reconstruct these explanations separately.

The language of conversion is useful because a completed artifact need not have one stable institutional identity. Its public meaning can change when the same observations are registered as environmental evidence, sold as a commercial service, used to justify an intervention, or returned as a learning resource. Each setting engages different criteria of quality, control, liability, and benefit. A philosophical analysis therefore follows the interface through which an outcome becomes eligible for a new use and asks which relations remain available after that transformation.

7.2 Property Bundles, Authorization, and Effective Control

Property arrangements are one major institutional mechanism for organizing conversion. In their study of natural-resource regimes, Schlager and Ostrom distinguish *operational rights* of access and withdrawal from *collective-choice rights* of management, exclusion, and alienation [40, pp. 250–252]. Access permits entry, while withdrawal concerns obtaining resource products; management concerns the regulation of use, exclusion concerns the determination of access entitlements, and alienation concerns transferring specified collective-choice rights. Their distinction between exercising a right and participating in the definition of future rights is particularly important for analyzing institutional authority. A contributor may hold substantial operational permissions while remaining outside the procedures that set those permissions for the next period. This property-rights framework was developed for natural resources. Its use here as an analogy for data, equipment, intellectual outputs, or common infrastructure requires an independent account of applicable law, contractual arrangements, and technical capacities.

The resulting vocabulary is relational. A participant may possess permission to read a dataset while another institution governs publication schedules and interface design. An organization may hold a contractual license to operate a sensor network while community partners retain authority over disclosure of sensitive locations. A research group may be authorized to publish an analysis while a municipal body remains responsible for the reliability of information provided to residents. These distributions require attention to the actual rights instruments, applicable legal regimes, customary arrangements where relevant, and the capacities needed to exercise a nominal permission.

The distinction between *formal authorization* and *effective discretion* is particularly important. Permission to participate can be practically weak when access requires unavailable software, specialized interpretation, recurring fees, or institutional credentials. Conversely, an organization with limited formal ownership may exercise substantial operational influence through custody of the only current data copy, the maintenance of an essential interface, or control over authentication systems. Contractual power, pro-

fessional authority, and infrastructural dependence may intersect without being identical. A claim about a legal entitlement demands legal evidence; a claim about effective discretion requires tracing actual decision procedures and feasible alternatives.

Knowledge commons scholarship examines the governance of shared informational resources and the difficulties created by restrictions, enclosure, preservation failures, and unequal access [27]. These concerns provide a relevant comparison while leaving the precise conditions of a defensible commons arrangement for contextual analysis. Open availability may support collaboration in some cases, while confidentiality, privacy, ecological protection, cultural governance, or safety obligations may justify selective disclosure in others. The substantive question concerns which arrangement can be justified for the resource, people, and institutions involved, and how decisions about access are reached and reviewed.

Property arrangements can thus shape conversion through multiple channels: they establish the authority to authorize a new use; they distribute the capacity to withhold, modify, or license a resource; and they affect the bargaining position of participants whose contributions are difficult to replace. A co-creative history supplies information relevant to assessing those arrangements. It does not itself establish ownership, inventorship, copyright, or other legal rights, which arise through the applicable norms and legal tests. The philosophical argument concerns the visibility and justification of relations between contribution and institutional control.

7.3 Standards, Commensuration, and the Selectivity of Value

A second mechanism concerns the standards through which heterogeneous outcomes become comparable. Espeland and Stevens analyze *commensuration* as the comparison of different entities through a common metric and identify its cognitive and political implications [18]. Within co-creation, such a metric may take the form of an index, performance score, financial valuation, environmental certificate, or administrative eligibility threshold. The metric can make coordination possible across organizations whose evaluative practices otherwise diverge. It can also influence which activities become worth recording and which kinds of evidence acquire institutional authority.

Suppose a coastal partnership produces several outcomes: improved local knowledge of tidal variation, a more reliable set of sensor readings, renewed cooperation among residents, and a technical dashboard that a municipality can purchase. An agency may use the dashboard's coverage and error rate to assess a service contract. A community may place greater weight on the accessibility of warnings and continuity of local participation. Ecologists may assess the quality of observations and the protection of sensitive habitats. Each perspective can supply legitimate questions without collapsing into one metric. A standardized procurement score becomes authoritative within a specified procurement procedure; its use as a comprehensive assessment of the partnership's value would require additional justification.

The institutional influence of a metric depends on its location in a decision process. A reporting indicator used for learning may invite correction and comparison with alternative evidence. The same indicator, when attached to payment or exclusive eligibility, can restructure incentives and the distribution of authority. Participants may adapt practices to meet a threshold, even when their original activity served several purposes. The appropriate analysis identifies the authorized use of the indicator, the reason it was selected, the procedures for revising its assumptions, and its observed effects on the practices represented.

Standards can also support participants who would otherwise face unreliable or opaque institutional judgments. Shared metadata conventions may make provenance recoverable; standardized licensing statements can clarify permitted uses; accessible reporting procedures can permit small organizations to participate in procurement. Their distributional effects remain contingent on who contributes to their design, the resources required for compliance, and the possibility of making exceptions or substantive revisions. An institutional interface may therefore increase coordination while simultaneously concentrating authority at the points where standards are set and interpreted.

Table 7: Analytical dimensions of institutional value-conversion interfaces.

Interface dimension	Guiding question and possible evidence
Representation	Which features become visible? Data models, reports, category schemes, and provenance records
Standards	Who defines eligibility and adequacy? Thresholds, certification rules, and appeals records
Authorization	Who can use, alter, disclose, or license the result? Contracts, permissions, and established practices
Custody and operations	Who controls actual availability? Hosting, maintenance, credentials, and export pathways
Revision and review	Who can contest or update the arrangement? Governance minutes, correction channels, and dispute procedures

7.4 A Situated Account of Conversion Interfaces

The preceding arguments motivate an analytical device for investigating conversion without assuming a common scale of value. Its elements are chosen to support historical reconstruction and comparative inquiry, and their boundaries can be refined for particular institutional settings.

Definition 7.1 (Situated value-conversion interface). For a generated outcome o , an institutional setting I , and an observation period T , a *situated value-conversion interface* $V(o, I, T)$ is a revisable account of (i) the representations through which o enters institutional practices; (ii) the standards and procedures determining its eligibility, classification, or valuation; (iii) the actors authorized and practically able to access, modify, transfer, certify, or restrict it; (iv) the decisions and dependencies through which benefits, obligations, or control are allocated; and (v) the procedures available for reviewing those arrangements. The interface is an analytical reconstruction of institutional relations, with its evidential completeness limited by the accessible historical record.

Definition 7.1 identifies a level of analysis complementary to the situated attribution record introduced in Definition 6.1. Attribution asks how an outcome was generated and which activities contributed to it. A conversion interface asks what happens as the resulting outcome passes through further institutional arrangements. The two records can be linked by a common provenance identifier, a shared history of revisions, or another documented connection appropriate to the material under study. Their purposes remain distinct: one reconstructs contribution; the other reconstructs the rules and practical conditions governing subsequent institutional use.

Table 7 distinguishes five common interface dimensions. Each dimension can affect an outcome’s institutional legibility and the later possibilities available to its contributors. The examples are diagnostic prompts, with legal duties and institutional permissions requiring examination in their specific setting.

These dimensions can interact. An organization that holds data custody may set default metadata fields; those fields may determine which contributions are recognized in a certification procedure; eligibility may then affect the organization’s financial position and its capacity to negotiate future rules. Describing this sequence requires evidence of the mechanisms actually present. The framework provides a way to structure such evidence, while leaving causal strength and normative assessment open to further investigation.

7.5 Infrastructural Mediation and the Location of Bargaining Power

A third mechanism concerns the infrastructures on which conversion depends. Digital platforms, repositories, communications networks, and institutional service providers can mediate a large share of the activities through which a cooperative result becomes visible or transferable. Cohen’s analysis of informational capitalism examines how datafication, platform intermediation, and legal institutions reorganize entitlements and economic relations [12]. This scholarship informs the present analysis of infrastructural power while carrying its own specific legal and historical argument.

A service provider can influence co-creation even when it contributes little to the original scientific or community inquiry. Control of the only functioning interface may determine which records can be exported, which contributors can obtain credentials, how fees are calculated, and whether a partnership can move to another provider. Such powers can arise from contractual exclusivity, technical architecture, staff expertise, budget constraints, or combinations of them. They should be investigated as historically produced conditions of dependence. Section 5 distinguished differences in productive ability from differences in discretionary power; infrastructural intermediation supplies one setting in which the distinction can become especially consequential.

Dependency can also be reciprocal. A platform operator may depend on the partners' ongoing observations and local interpretation, while contributors depend on the operator's infrastructure to distribute and maintain the results. Negotiation occurs within this uneven relationship. A municipality may require a dependable single point of accountability; participants may seek a means of retaining their underlying data and the ability to correct later reports. A design that distributes certain operational tasks can support accountability while leaving meaningful consultative or co-governance mechanisms available. The appropriate allocation depends on actual competencies, legal obligations, maintenance resources, and safety requirements.

A useful inquiry compares the real alternatives open to participants. If a data export exists only on paper and the partners lack the means to reconstruct a working service, their feasible bargaining position differs from that suggested by the written permission alone. Similarly, an ostensibly participatory rule-setting process may have little impact when external certification requirements determine the decisive categories. The assessment can examine switching costs, access to documentation, opportunities for independent verification, and the resources available for maintaining a parallel or successor system. These considerations ground institutional power in practical relations that can be investigated, while avoiding assumptions about the motives of any particular organization.

7.6 Constructed Case: Coastal Monitoring and Municipal Adaptation Services

Consider a hypothetical coastal partnership in which fishers, local residents, environmental researchers, and a technical cooperative assemble a series of observations concerning tidal channels and wetland conditions. Residents supply situated observations of seasonal change, researchers develop a quality-control protocol, the cooperative maintains sensors and data services, and an environmental office considers the material for adaptation planning. The resulting collection supports several activities: local learning, public discussion, ecological investigation, and potentially a municipal contract for a monitoring service. The case is a constructed philosophical example; it supplies neither measured environmental effects nor evidence of any actual procurement outcome.

During the project's early phase, records circulate among contributors in several formats. Field notes explain why an observation was made, technical records identify calibration procedures, and community discussions register concerns about particular locations. When the environmental office considers purchasing a service, it requests a standardized series with consistent timestamps, specified confidence statements, and a named organization responsible for ongoing updates. The technical cooperative converts the shared observations into a dashboard that meets these requirements. The institutional conversion improves portability and may support public accountability. It also places the cooperative in a new position: it can operate the public-facing service, certify updates within the contractual procedure, and determine how users encounter the underlying data.

Suppose, further, that the resulting agreement gives the cooperative an exclusive service role for a defined period while leaving individual rights to the underlying observations unresolved. The fishers' field descriptions remain essential to interpreting anomalous data, yet their participation is not specified in the service contract. Researchers can read aggregate reports, while residents receive only a public summary. The service fee recognizes hosting and technical maintenance, and community interpretation is requested informally when anomalies occur. This arrangement may be administratively workable and technically reliable. It also raises distinct questions concerning contractual authority, evidential access,

attribution, and the capacity of the original partners to continue their inquiry.

Several responses are possible, with their suitability depending on the setting. The parties could preserve a versioned archive of source observations under a jointly specified access arrangement. They could establish a funded procedure for community review of interpretive changes, make interfaces for exporting permitted data available, or record the relationship between source observations and indicators adopted by the public agency. In cases involving sensitive ecological locations or personal information, differentiated disclosure and accountable custody may be preferable to general release. The arrangement could also distinguish responsibility for emergency or regulatory decisions from advisory participation in interpreting environmental evidence. The specific allocation would require actual contracts, competent authorities, available resources, and applicable law.

The case highlights at least three forms of divergence. First, *contribution divergence* occurs when actors important to producing observations have limited authority over their later institutional use. Second, *valuation divergence* occurs when service reliability, community learning, and ecological quality remain significant under different evaluative standards. Third, *control divergence* occurs when custody, contractual authorization, and feasible access are held by different actors. These distinctions remain analytical classifications; their presence alone establishes neither exploitation nor an unjust outcome. A normative assessment would examine consent, opportunity, justified expectations, public obligations, welfare, and the distribution of risks and benefits.

The example also shows how conversion changes over time. After several years, a new vendor might provide cheaper hosting, a regulatory standard might change, or the community might develop its own technical capacity. A governance arrangement prepared for revision could maintain the continuity of the observations while allowing contributors to renegotiate their roles. Conversely, dependence on a proprietary export format or a single custodian could make the historical record harder to recover. Whether either pattern occurs is an empirical question. The philosophical framework specifies what an inquiry should trace and what institutional alternatives should be compared.

7.7 Institutional Design and Accountable Value Conversion

The account developed here suggests several provisional design considerations for cooperative institutions. The first concerns *traceable conversion*: representations should, where practicable, retain an intelligible relation to the source practices and evidential records from which they were derived. A second concerns *differentiated discretion*: arrangements should specify the different authorities over access, amendment, certification, disclosure, and future use. A third concerns *practicable contestation*: contributors affected by institutional descriptions should have accessible ways to raise errors and receive reasoned consideration. A fourth concerns *continuity of capability*: institutions can examine whether the resources and permissions supporting future participation are sustained when value enters a new contractual or administrative form.

These considerations are jointly relevant and sometimes in tension. Traceability can expose sensitive information; complete transparency can conflict with legitimate privacy or ecological protection; continuity of service can require a central accountable operator; open-ended revision can burden institutions operating under legal deadlines. A credible institutional design must allocate responsibility for addressing such tensions. Its adequacy calls for explicit identification of the affected parties, the public and private duties involved, and the feasibility of the proposed procedures. In some contexts a controlled archive and periodic review may serve these aims better than unconditional data release or unrestricted access.

A conversion-interface inquiry can proceed through a modest evidence protocol. Investigators first specify the original outcome and the institutional use under examination. They then reconstruct the versions and classifications through which it moved, identify applicable authorizations and actual custodians, and compare the feasible opportunities available to contributors before and after conversion. The inquiry should record uncertainties and alternative explanations, especially where contractual documents, platform logs, or testimony are incomplete. A subsequent normative evaluation can examine whether

the resulting arrangement is justified under the relevant legal, political, ecological, and ethical standards. This separation between description and evaluation supports the paper's broader commitment to plural valuation and accountable philosophical claims.

The resulting contribution is a provisional account of *institutional value conversion* as a consequential stage of heterogeneous co-creation. Earlier scholarship already establishes that rights can be bundled, classifications organize institutions, and infrastructures mediate economic and political relations. The present proposal links these insights to the historical analysis of co-creative contributions and asks whether their subsequent conversion preserves intelligible and defensible opportunities for participation. Section 6 considered how contributions enter records of recognition; the present section has examined how institutional interfaces affect the uses to which the recognized outcomes can be put. The following section considers what happens after conversion, when value circulates, returns unevenly to contributors, and may regenerate the capacities through which further cooperative activity becomes possible.

8 Circulation, Return, and the Regeneration of Capacities

Co-created value can pass through several organizations, uses, and periods after the activity that initially generated it. The institutional interface studied in Section 7 determines part of this passage, while the distribution of benefits and opportunities subsequently changes the capacities available to cooperating participants. This section examines those later relations through conceptual analysis, a provisional account of regenerative return, and a longitudinal extension of the constructed coastal-monitoring case. It distinguishes circulation from distribution, specifies several forms of return, considers the reproduction and depletion of capacities across differing time horizons, and develops an evidential approach to assessing the continuity of heterogeneous cooperation.

The expression *circulation of value* is used here for the successive use, transmission, appropriation, interpretation, and reconfiguration of generated outcomes within and between social practices. It encompasses exchanges of money and contractual services alongside the circulation of knowledge, maintainable tools, trained capabilities, and opportunities for participation. These relations vary in material character. A payment changes financial resources; a dataset transfer changes the information accessible to a recipient; a renewed field practice may improve the reliability of future observations. Their consequences become intelligible through the particular activities and institutions in which they operate. The proposed vocabulary allows these developments to be considered together while retaining their separate mechanisms and evaluative standards.

8.1 Circulation Routes and the Location of Return

A cooperative outcome may travel through a chain of relations that differs considerably from the original organization of its production. A community observation may enter a research database, become part of a technical model, be incorporated into a public report, and eventually support a contracted service. At each transition, participants can gain new opportunities, incur obligations, or encounter restrictions. The resulting circulation can be reconstructed as a sequence of uses and decisions, with attention to the source material, authorized custodians, beneficiaries, and those bearing the costs of maintaining the outcome.

The language of *return* raises a question concerning the destination and practical form of these consequences. For an individual contributor, return might take the form of a fee, an opportunity to use an improved tool, the development of professional skills, or the ability to participate in the next stage of research. A community might seek an accessible archive, a role in deciding future use, or support for locally maintained services. An institution might receive a reliable information service and a publicly accountable arrangement for its continuation. Ecological processes may be sustained through habitat restoration or reduced disturbance, although their evaluation requires the relevant scientific evidence and an explicit normative account of environmental responsibilities. These different returns can coexist within one historical relation, and their distribution can be uneven.

In this account, *distribution* concerns the allocation of specified benefits, burdens, rights, and resources among actors within a particular arrangement. *Circulation* is broader: it encompasses the routes through which those allocations occur and through which outcomes acquire further uses. *Regeneration* concerns whether subsequent activities renew, extend, or transform the conditions for future generative activity. Distribution can affect regeneration, as when a maintenance payment supports the continued operation of a shared sensor network; it can also have little lasting influence if the equipment, skills, and accessible records required for continuation deteriorate. The distinction invites analysis of observable capacities and relations, while a judgment concerning fairness requires additional normative premises.

Eglash characterizes generative justice through the bottom-up circulation of *unalienated value*, including labor, ecological, and expressive forms [16, pp. 373–375]. That proposal supplies an important intellectual precedent for examining who sustains the circulation of generated value. The present study develops a more bounded evidential question: which benefits, access arrangements, responsibilities, and future capacities can be traced to specified participants and affected collectives when their valuations remain partly divergent? A documented payment, licence, or maintenance commitment can count as a *return* in this descriptive sense while leaving its distributive fairness and the degree of control retained by contributors open to separate analysis. Conversely, a participatory arrangement may preserve meaningful control through shared decision procedures even where a discrete transfer is difficult to isolate. The proposed return record accordingly identifies pathways and capacities; judgments about alienation, justice, and legitimacy require additional institutional evidence and normative argument. This extension preserves the distinctive critical purpose of generative justice while supplying an explicit procedure for studying heterogeneous cooperative histories.

8.2 A Situated Account of Regenerative Return

The concept of *regenerative return* identifies a narrower object than the full set of benefits associated with cooperation. The focus is the connection between an outcome’s later circulation and participants’ feasible ability to engage in further valuable activity. This connection may involve direct transfers, shared infrastructures, knowledge transmission, or conditions that sustain ecological and social practices. Because actors have different capacities, a unit of financial return or a common access rule may have markedly different consequences for each. Sen’s capability-oriented account of development provides an established reason to examine people’s substantive opportunities in addition to available resources [42]. The extension to heterogeneous co-creative relations is a proposal of the present paper; the capabilities, interests, and standing of nonhuman and artificial participants require distinct consideration.

Definition 8.1 (Situated regenerative return). For a cooperative outcome o , a participant or affected collective a , an institutional setting I , and an observation interval T , a *situated regenerative-return record* $R(o, a, I, T)$ is an evidentially revisable account of (i) the outcome’s subsequent uses and authorized circulation; (ii) benefits, burdens, resources, access rights, and obligations reaching a ; (iii) the maintenance, expansion, or deterioration of capacities relevant to a ’s future participation; (iv) dependencies and decisions mediating these consequences; and (v) opportunities for correction, renegotiation, or further cooperative activity. The record establishes an analytical object for inquiry. Its causal interpretations and normative significance depend on the available evidence and the evaluative standards appropriate to the setting.

Definition 8.1 extends the contribution tracing of Definition 6.1 and the institutional inquiry of Definition 7.1. The attribution record examines how an outcome was generated. The conversion record examines its passage into authorized institutional uses. The regenerative-return record examines how these uses affect future opportunities and dependencies. A documented sequence linking these three records may help an investigator determine whether changes in capacity plausibly followed from particular interventions, expenditures, restrictions, or continuing arrangements. The records are analytical aids, with their completeness dependent on the evidence available for a particular inquiry.

Table 8 differentiates five routes of return and the corresponding questions for investigation. The

Table 8: Selected routes through which co-created outcomes can return to participants and support future activity.

Return route	Possible institutional form	Evidence concerning future capacities
Material support	Fees, equipment, operating budgets	Resources available for upkeep, participation, and replacement
Knowledge access	Usable archives, documentation, licences	Retrieval, interpretation, correction, and independent reuse
Practical capability	Training, mentoring, operational roles	Demonstrated skill, discretion, and ability to initiate work
Participatory authority	Review procedures, representation, consent pathways	Influence over revisions, conditions of use, and successor activities
Ecological and social renewal	Habitat care, community services, reproductive work	Context-specific indicators of maintenance, burden, and recovery

routes can overlap in practice and admit several institutional forms. Their inclusion in one table supports comparative inquiry without defining a comprehensive metric of welfare or co-creative value.

A return record may indicate different consequences for differently situated participants. A grant of unrestricted access to specialized source code benefits a technically capable organization in one way and a participant requiring accessible documentation, training, or translated instructions in another. The inquiry can therefore distinguish formal availability from practical usability, a distinction already relevant to capacity asymmetry in Section 5. A similar question arises when an organization receives payment for an output while unpaid participants continue to supply the interpretive or maintenance work through which that output remains useful. The adequacy of the arrangement depends on the obligations, expectations, feasible alternatives, and justified interests involved.

The expression *regenerative* is used with deliberate restraint. A record of preserved capabilities offers a descriptive finding; an increase in one participant’s opportunities may entail costs for others; an outcome that supports repeated production can produce environmental damage or amplify unjust institutional practices. The concept therefore identifies a possible condition for continued generation, while the legitimacy of that continuation requires an explicit evaluation of its objects, beneficiaries, and effects. Section 5 already established that productive complementarity and dependence can coexist. A regenerative-return inquiry makes their development over time accessible to further analysis.

8.3 Reproductive Work and the Cost of Continuation

Cooperation often depends on activities whose contribution emerges most clearly after an initial deliverable is completed. A public dataset needs validation, documentation, secure storage, and successive corrections. A technical service requires maintenance, customer support, and replacement of parts. A community collaboration may rely on caregiving, translation, conflict resolution, transport, and the preparation of participants for meetings. Some of these activities are formally contracted; others occur through informal and unequal arrangements. Their allocation can shape both the durability of an outcome and the distribution of its costs.

Fraser’s analysis of capitalist production and social reproduction draws attention to the historical relation between monetized economic activity and the care and maintenance practices that help sustain it [21]. Her argument addresses a specific political-economic structure and its historical crises. It provides an important point of comparison for the present inquiry into how cooperative arrangements obtain and replenish their conditions of continuation. The broader generative-relational account also considers maintenance performed by public institutions, voluntary organizations, and technical infrastructures, while differentiating the political and ethical implications of these activities.

A project can record a substantial return to contributors at the moment of distribution while relying on a future transfer of unpaid or under-resourced work. For example, a cooperative might publish a useful

multilingual knowledge resource, receive a one-time payment, and then depend on community members to update the translations as conditions change. In another arrangement, the revenue might support a maintained review schedule and compensate participants responsible for revisions. The comparison requires evidence of the actual tasks, time, expertise, resources, and consent involved. It also requires attention to participants who have legitimate reasons to reduce their contribution, withdraw, or transfer responsibilities.

The regeneration of capacities should consequently be examined in relation to their *cost of maintenance*. Financial reserves, institutional knowledge, functioning equipment, relationships of trust, and safe working conditions can each affect whether participants are able to continue. These conditions have different modes of deterioration. Equipment may fail gradually, trust may be damaged by a single breach, and a data service may remain accessible while the expertise required to interpret it disappears. The relevant time horizons follow from the activities under investigation. A one-year financing period, a decade of institutional memory, and an ecological recovery interval may intersect without sharing a single appropriate assessment cycle.

Within this framework, a comparatively generous short-term transfer offers partial information about the sustainability of a cooperative relation. An investigator can examine the recurrent obligations associated with the transfer, the durability of supporting infrastructures, the distribution of ongoing work, and the feasible response when expected resources become unavailable. Some arrangements may be appropriately temporary, and termination can be justified when activities become harmful, obsolete, or unwanted. The normative question concerns the defensibility of the chosen responsibilities and transitions under the circumstances, including how affected parties understand and can respond to them.

8.4 Changing Time Horizons and Ecological Renewal

The conditions of cooperative activity can change on different time scales. An institution may revise a budget annually, a technician may replace a failed component within days, and a coastal ecosystem may respond to disturbances over much longer periods. These differences can make immediately visible returns a poor proxy for changes in the longer-term generative conditions of a collaboration. They also create opportunities for temporal displacement: costs incurred in maintaining present activity may be borne by actors who enter the relation only after the original distribution decisions have been made.

Folke and colleagues describe adaptive governance in social–ecological systems through the relations among learning, social networks, bridging organizations, and the capacity to reorganize amid ecological change [19]. Their discussion is grounded in the governance of ecosystems and offers precedents for examining how institutions enable renewal under changing conditions. The present inquiry uses this work to motivate a temporally differentiated account of cooperative capacities. Its application to a particular project calls for environmental evidence, institutional history, and caution regarding the distinct mechanisms through which social and ecological processes develop.

Consider a coastal-monitoring project that receives increased funding after an unusually damaging storm. The immediate return may be new sensors, more data, and a contracted reporting service. A longer assessment might consider whether local observers retain the means to interpret changes, whether the sensors are maintained after the grant ends, whether sensitive habitat records are governed responsibly, and whether adaptation decisions support ecological recovery. Success on one of these dimensions may accompany problems on another. The investigation can examine their interactions while retaining the scientific and normative criteria appropriate to each.

Ecological renewal should be described with particular precision. A restored marsh can have measurable changes in vegetation, sediment retention, hydrology, or habitat quality, yet evidence of one indicator does not establish comprehensive ecological recovery. Similarly, describing an ecosystem as a causal participant in a process need not settle whether it possesses subjective interests or standing comparable to human contributors. Relevant responsibilities may be grounded through environmental law, ecological ethics, public obligations, or other normative approaches. Those frameworks supply the criteria by which a proposed return to ecological conditions can be evaluated.

Intergenerational considerations further complicate circulation. A current partnership can transfer technical knowledge to a successor organization, arrange for long-term preservation of records, or establish obligations for future monitoring. The expected beneficiaries and future conditions remain uncertain. An accountable design can specify maintenance arrangements, revision triggers, and the institutional custodian responsible for reviewing them. Such arrangements preserve possibilities for future deliberation while making present decisions open to scrutiny under the evidence available today.

8.5 Constructed Case: The Later Life of a Coastal Monitoring Partnership

The constructed partnership introduced in Section 7.6 generated coastal observations through cooperation among residents, fishers, environmental researchers, a technical cooperative, and a municipal office. Its institutional conversion produced a standardized monitoring service, while access to source observations and responsibility for future interpretation remained under negotiation. The following continuation is a hypothetical longitudinal extension of that case. It is designed to make differences among circulation, distribution, and regeneration analytically visible, and supplies neither measured outcomes nor evidence concerning an actual coastal community.

Suppose the municipal office enters a three-year service agreement with the technical cooperative. The contract covers routine hosting, calibration, and quarterly reporting. The cooperative receives regular payment and retains responsibility for the service's technical reliability. An archive containing selected source observations is made available to the research group. Community participants receive annual public presentations and may submit corrections through a municipal contact point. During the first year, the service improves the regularity of reporting and makes an intelligible summary available for planning meetings.

The arrangement generates several distinguishable returns. The cooperative receives revenue and operational experience. The municipality receives a maintained service and an accountable contracting party. Researchers obtain a standardized series for further inquiry. Community participants gain a public summary of the observations they helped collect. Yet these returns have different consequences for future capacity. The cooperative can use its revenue to maintain servers and staff; researchers can develop new analyses; the community's ability to interpret anomalies may depend on whether it receives documentation and access to usable records. The same service may therefore support unequal opportunities for subsequent knowledge generation without implying that any participant's valuation of the project is mistaken.

During the second year, suppose that a significant discrepancy develops between dashboard indicators and observations made by fishers in one tidal channel. The discrepancy could reflect sensor drift, an environmental change, a classification mismatch, or error in the field notes. The choice among explanations requires technical and historical investigation. If the fishers can inspect the relevant metadata, document the discrepancy, and participate in a defined review procedure, their contribution can continue through the correction of the shared record. If the permitted data are too aggregated for such inspection, or review meetings are unsupported, the partnership may retain an acknowledged history of contribution while losing a practical route for further inquiry.

A possible revision would allocate part of the service budget to a jointly scheduled interpretation workshop, accessible records for authorized local observers, and a documented response to contested measurements. The technical operator could retain certification authority for regulatory reports, while the participants gain a meaningful route for introducing evidence and requesting correction. The appropriate design would depend on data-protection obligations, operational reliability, participants' capacities, and the lawful distribution of authority. It would also require a feasible account of who prepares the materials, maintains translation or accessibility support, and responds to future requests.

In the third year, suppose that the municipality reviews the contract and considers transferring the service to a different provider. A versioned record of permitted observations, calibration histories, software interfaces, and unresolved questions could make continuity more practicable. A funded transition plan might preserve selected community roles and transfer technical knowledge to new maintainers. Con-

versely, a weak handover could leave a legally accessible dataset without working documentation or available expertise. The contrast shows why recorded access, operational capacity, and participatory authority are separate objects of return.

The scenario also admits competing normative interpretations. A public agency may reasonably prioritize continuity and fiscal accountability; local contributors may prioritize substantive access and recognition of situated expertise; researchers may emphasize standards of reproducibility; ecological advocates may focus on protections for sensitive habitats. Their demands can conflict, and some restrictions may be justified by safety, privacy, or environmental obligations. The analytical record identifies what each arrangement enables and constrains. Normative evaluation then considers the legitimacy of these consequences and the procedures through which affected parties can contest or revise them.

The longitudinal account suggests a useful comparison for actual research: the immediate distribution of contractual proceeds, the accessible forms of a shared outcome, and the continued capacities of contributors can follow different trajectories. Interviews, contract histories, maintenance logs, data-access records, and records of corrections could help test those trajectories. A stronger causal assessment would compare credible alternative explanations for any observed change. The hypothetical case establishes questions and plausible mechanisms, while empirical inquiry remains necessary to determine their occurrence and significance in practice.

8.6 Institutional Arrangements for Continuing Generation

The analysis suggests four provisional considerations for institutions governing co-created outcomes. First, arrangements can specify *usable return*: which benefits or resources reach which participants, through what authorized procedures, and with what practical accessibility. Second, they can establish *maintenance responsibility*: who bears recurring work, which resources are available for it, and how these responsibilities can be revised. Third, they can preserve *continuity of evidence*: what provenance, documentation, and correction history remain accessible for future interpretation. Fourth, they can provide *renegotiable participation*: how contributors and affected groups may influence later uses, subject to legitimate constraints and the actual distribution of authority.

These considerations align with, while remaining distinct from, established accounts of collective resource governance. Ostrom's analysis of common-pool resource institutions highlights institutional arrangements through which participants develop and maintain rules over time [35]. Hess and Ostrom extend commons inquiry to knowledge resources, emphasizing their governance and the conditions of preservation and use [27]. The proposed regenerative-return record links such governance concerns to the particular historical processes through which heterogeneous contributors generate outcomes and encounter their subsequent circulation. It remains a conceptual framework awaiting comparative application.

Institutional design can be attentive to feasible trade-offs. Accessible data may require differential permissions to protect people and habitats. Recurring participation can place a disproportionate burden on volunteers unless time and resources are provided. Stable technical management may concentrate certain operational responsibilities, while review and correction procedures distribute a different form of authority. Ecological recovery can require commitments extending beyond a current contract or organizational membership. The justification for these arrangements is contextual: it depends on the affected interests, applicable law, ethical commitments, operational constraints, and credible evidence of consequences.

An inquiry guided by Definition 8.1 can therefore proceed with a temporal and relational audit. It reconstructs the outcome's circulation history, identifies formal and practical returns, records the continuing work required, and examines changes in the capacities of the relevant participants. It then tests plausible explanations for those changes and makes explicit the normative standards used to assess them. Some returns may support future cooperation, while others may reinforce dependency, transfer burdens, or sustain activities whose value is contested. The account accommodates these possibilities without requiring the participants to adopt a comprehensive common valuation.

Circulation, return, and regeneration consequently form a connected but differentiated part of heterogeneous generative praxis. The production of an outcome creates a field of possible later relations; institutional interfaces shape those relations; subsequent allocations and maintenance practices affect the capacities from which further activity may emerge. The next section turns to the normative responsibilities associated with these developments, including consent, welfare, redress, and the legitimacy of cooperative arrangements under unequal capacities and plural valuation.

9 Normative Responsibilities in Cooperative Relations

Co-creation among heterogeneous participants generates practical obligations alongside valuable outcomes. A cooperative activity may depend on unequal resources, involve participants with different capacities for self-direction, and affect people or environments beyond the group formally recognized as contributors. Earlier sections distinguished causal contribution, institutional recognition, control over value conversion, and regenerative return. This section investigates how those relations become objects of normative assessment. Its method combines conceptual distinctions with existing scholarship on autonomy, dependency, structural responsibility, participation, and remedy. It develops a provisional responsibility record, examines consent and welfare under unequal power, and tests the resulting account through a constructed continuation of the coastal-monitoring partnership. The aim is to provide a disciplined vocabulary for identifying responsibilities while leaving the justification of particular duties to the relevant ethical, legal, and institutional settings.

9.1 The Objects and Grounds of Cooperative Responsibility

Responsibility in a cooperative relation can refer to several distinct matters. An actor may have a *prospective responsibility* to maintain an agreed service, protect participants from foreseeable harm, or provide resources for correction. An actor may bear a *retrospective responsibility* when its conduct contributes to a harmful outcome under the applicable standards. A participant may have an *answerability relation* requiring explanation of its decisions to an appropriate forum. Institutions may also carry *structural responsibilities* arising from their capacity to influence arrangements through which harms and benefits are repeatedly produced. The relations overlap in actual projects, while their grounds and modes of discharge vary.

These distinctions matter because causal contribution alone supplies incomplete guidance for distributing obligations. A technical operator can contribute substantially to an outcome while exercising little discretion over its subsequent public use. A municipal authority may contribute modestly to the underlying data but possess legal authority over a public warning. A resident may provide essential observations while lacking access to the contracting process. Differentiated responsibilities therefore require attention to authority, knowledge, foreseeable consequences, feasible alternatives, institutional commitments, and the interests affected. The record of causal contributions developed in Section 4 can inform this assessment; further normative premises determine how its findings bear on duties and remedies.

Young's social-connection account of responsibility offers an established approach to injustices produced through shared institutional processes. Her analysis emphasizes forward-looking political responsibility among actors whose activities participate in structural processes, with differences in power, privilege, interest, and collective capacity informing their practical positions [51]. The present paper draws on that approach as one resource for examining relations of cooperation. The degree of legal liability, contractual obligation, or ethical responsibility in any concrete case follows from separate investigations. Similarly, Bovens's account of public accountability makes visible the importance of an answerability relation involving an actor, a forum, explanation, questioning, and possible consequences [8]. Institutional forums may perform different tasks, including technical audit, ethical deliberation, mediation, and authoritative legal adjudication.

An ethical account of heterogeneous cooperation also distinguishes among *contributors*, *decision-makers*, *beneficiaries*, and *affected parties*. A person can occupy several positions, and their positions

may change during a project. Community members exposed to a public decision can have legitimate interests even when they supplied no labor to the underlying production. Animals and ecological systems can be affected by cooperative activities and may fall under established welfare or environmental protections, while the grounds for extending moral standing to particular entities remain contested philosophical questions. Artificial systems can shape outcomes through material and computational processes; responsibility for their design, deployment, authorization, and oversight is allocated through identifiable human and institutional arrangements in the cases examined here. This differentiated vocabulary permits practical inquiry without presupposing a uniform model of agency or subjective valuation.

9.2 Consent, Participation, and Continuing Authorization

Consent can authorize specified forms of participation or use within a cooperative arrangement. Its normative significance depends on the decision at issue, the information made available, the feasible alternatives, the conditions under which agreement is obtained, and the authority of the person or body giving it. A signature or an assent to an initial plan can be important evidence of authorization. Continuing uses may raise further questions, especially when observations are later combined with new datasets, commercialized, made public, or used to guide interventions affecting additional parties.

In her discussion of individual autonomy and consent, O'Neill distinguishes valuable forms of autonomous choosing from choice understood merely as independence; the wider book also examines the limits of consent and the conditions of warranted trust [34, chap. 2]. These arguments arise in bioethics and the governance of medicine and science. Their application to cooperative research or public infrastructure here is an explicitly proposed extension, with institutional authority and participants' practical options assessed in their own settings. In this paper, meaningful authorization is considered through three connected questions: which decisions are within a person's competence and jurisdiction; what practical capacities and protections make their decision informed and voluntary; and how authorized activities may later change in ways that call for review or renewed agreement. Some activities can appropriately proceed on other legal or institutional grounds, including statutory public duties and emergency procedures. An investigation must identify those grounds and the safeguards attached to them.

The form of agreement is consequently related to the structure of the activity. Joining a local observation team, permitting publication of one's testimony, licensing software, and authorizing intervention on public property are different decisions. Permission concerning one operation need not establish authority over another. Where a project integrates communal or collectively governed knowledge, authorization may involve recognized representative bodies and context-specific procedures. The CARE principles of Indigenous Data Governance, for example, articulate collective benefit, authority to control, responsibility, and ethics within their particular field of Indigenous data governance [10]. Their relevance to a given project follows from the rights, communities, and institutional relationships involved; they provide a significant precedent for reflecting on collective authority, rather than a generic substitute for distinct legal or cultural arrangements.

Consent also has a temporal structure. A participant who initially welcomed cooperation may later encounter unanticipated visibility, security risks, or substantial changes in workload. A project can specify withdrawal pathways, amendment procedures, record-retention duties, and the limits of reversal after information has been lawfully disseminated or relied upon by others. Reasonable continuity commitments, privacy obligations, and public-interest requirements can constrain the feasible set of later choices. Their legitimacy calls for explanation and scrutiny in relation to the activity and affected interests. A responsive institution can make these boundaries intelligible at the outset and provide means for revisiting them when circumstances change.

Participatory governance supplies another layer of authorization. Fung distinguishes who participates, how participants communicate and make collective judgments, and the authority linking those processes to public action [23, pp. 67–70]. These are dimensions of institutional design rather than steps on a universal scale of legitimacy: the appropriate relation among consultation, expertise, shared rule-making, and delegated authority depends on the decision and its governing standards. An arrangement

may provide ample speaking opportunities while reserving the consequential decision for an official or contractor. Another may use a narrower but justified decision forum, complemented by transparent reasons and an effective avenue for review. Ethical evaluation should trace both the lived accessibility of participation and the decision rights through which participants' contributions can influence action.

9.3 Welfare, Vulnerability, and the Distribution of Burdens

The production of a collectively useful outcome may place substantial burdens on some of its participants. A volunteer may absorb travel costs and repeated data-entry work; a caregiver may reorganize daily responsibilities to support participation; a technical maintainer may face a recurrent emergency duty; and a coastal community may experience loss of privacy when local observations enter a public map. These consequences can remain outside the measures through which project success is reported. An assessment of cooperative responsibility therefore needs evidence concerning the burdens of participation as well as the outputs and recognized benefits.

Kittay's work on dependency and equality emphasizes the political and moral significance of care relationships and the position of those providing dependency work [31]. Tronto's account of democratic care introduces *caring with* as a question of whether arrangements for meeting needs remain compatible with shared commitments to justice, equality, and freedom; her discussion of democratic caring also examines how institutions distribute the work of understanding and meeting others' needs [48, pp. 23, 147–148]. The two approaches offer related resources for examining support work, unequal vulnerability, and the public allocation of responsibilities. This manuscript extends their concern to heterogeneous cooperative arrangements, where care may involve repair of infrastructure, protection of affected parties, and the organizational capacity to renegotiate burdens. The legitimacy of those particular duties remains a context-specific question.

Welfare is itself a plural evaluative object. Participants may prioritize safety, income stability, recognition, privacy, ecological recovery, or the ability to continue meaningful work. A defensible inquiry can elicit these concerns and investigate the consequences of particular decisions without presuming that a single preference scale resolves their differences. Where measurable risks are at stake, domain-specific evidence may establish thresholds or feasible protective measures. Public health obligations, contractual standards, environmental rules, and human-rights protections can provide independently relevant constraints. Value plurality does not erase such constraints; it increases the importance of identifying the appropriate normative source and the authority by which decisions are made.

An institution's resources and decision authority affect what protections it can feasibly provide. Accessible meeting schedules, interpretation, adequate compensation for recurring tasks, safe equipment, documented workload limits, and technical support may improve the practical conditions of participation. Each intervention can be evaluated through observable changes in exposure, burden, access, and participant capabilities. Some measures impose costs on other participants or alter the sustainability of a service. The analysis should make these trade-offs visible and evaluate them with the people and institutions entitled to take part in the relevant decisions.

Environmental welfare introduces a further distinction. An ecological process may be causally indispensable to a project and simultaneously vulnerable to its methods. Monitoring equipment may disturb habitats; public disclosure of rare-species locations may increase interference; a restoration initiative may redirect water or sediment with uncertain downstream consequences. An assessment can examine exposure and ecological indicators through the relevant environmental science. Judgments about obligations toward habitats, species, future generations, and individual animals additionally depend on articulated legal and ethical grounds. Treating ecosystems as heterogeneous generative participants serves an analytical purpose in this manuscript; it does not resolve debates concerning consciousness, welfare interests, or moral personhood.

Table 9: Selected responsibility relations in heterogeneous cooperation and the evidence relevant to their assessment.

Responsibility relation	Possible practical form	Evidence for assessment
Authorization	Consent, mandate, agreed scope of use	Information, representation, feasible options, revisions
Preventive care	Risk assessment, protective work, maintenance	Foreseeability, resources, burdens, protective outcomes
Decision accountability	Explanation, documentation, independent review	Authority, reasons, records, competence of reviewing forum
Corrective response	Error correction, restoration, compensation	Harm, causation, applicable duties, feasibility of remedy
Continuing stewardship	Handover, training, monitoring, renegotiation	Ongoing obligations, capacities, access, future risks

9.4 Differentiated Duties and Institutional Legitimacy

Responsibility can be distributed across several institutional positions. A local participant may be well placed to notice an anomalous observation. A technical organization may be best equipped to test sensor calibration. A public authority may have the statutory competence to publish a warning. An independent review body may be better placed to examine complaints about the exercise of that authority. Their respective roles can be complementary while their capacities for prevention, correction, and remedy remain unequal.

A useful provisional object for reconstructing these relations is defined below. Table 9 summarizes selected normative relations and evidential questions. The rows are analytical positions that may coexist in one actor or institution. An institutional arrangement can assign the functions to different bodies when independent review, specialized knowledge, or the protection of vulnerable participants warrants such differentiation.

Definition 9.1 (Situating cooperative-responsibility record). For a cooperative arrangement c , a set of contributing and affected parties A , an institutional context I , and an interval T , a *situating cooperative-responsibility record* $Q(c, A, I, T)$ is a revisable account identifying (i) relevant decisions, conduct, omissions, commitments, and foreseeable consequences; (ii) the actors and institutions possessing authority, knowledge, resources, and practical discretion concerning them; (iii) the interests, rights, vulnerabilities, and burdens affected; (iv) applicable legal, contractual, professional, and ethical standards and the forums competent to interpret them; and (v) opportunities for prevention, explanation, challenge, remedy, and reassessment. The record organizes evidence and competing normative reasons. A specific assignment of duty or liability requires the relevant substantive and procedural justification.

Definition 9.1 extends the earlier contribution, attribution, and return records by placing normative grounds and decision authority at the center of analysis. It can be used prospectively to identify decisions requiring safeguards and retrospectively to reconstruct a disputed sequence of events. The record supports different findings when a harm arises from technical negligence, a justified emergency decision, a misunderstanding of authorization, a structural lack of accessible channels, or an independently changing environmental condition. These explanations may interact, and their evaluation requires evidence appropriate to the disputed events.

Institutional legitimacy depends partly on who is authorized to decide, the fairness of the procedure, and the accountability of its consequences. Ansell and Gash’s review of 137 cases of collaborative governance identifies prior conflict or cooperation, resource and power imbalances, leadership, institutional design, and trust-building processes as relevant to collaborative forums [4]. Their research concerns particular forms of public–private collaborative governance and supplies a comparative context for designing and evaluating cooperation. Its results neither establish a universal formula for legitimacy nor resolve disagreements about substantive rights. In the current framework, an investigation can combine

participatory evidence with legal mandates, professional responsibilities, and the reasons advanced by affected participants.

Legitimacy also changes during the life of a project. An initially defensible allocation of tasks may become questionable when new risks emerge, previously excluded groups are affected, or the costs of maintaining a service shift. A revisable division of responsibility can specify the event that triggers reassessment, the evidence required, who may request review, and which body has authority to decide. These arrangements connect the normative account developed here to the processes of circulation and regenerative return described in Section 8.

9.5 Consequential Voice and the Conditions of Review

A project can invite extensive participation while concentrating authority over the decisions that give contributions their subsequent effects. To evaluate this configuration, the inquiry distinguishes four institutional capabilities: *access to a forum*, through which a person can introduce information or concerns; *agenda influence*, through which a question can receive consideration by an appropriate body; *decision authority*, through which an actor may determine or constrain a consequential action under applicable rules; and *review standing*, through which a person can request a competent examination of an outcome or procedure. These are separable capabilities. Their distribution can vary across decisions, participants, and time, and an actor's expertise or causal contribution may extend well beyond its formal decision rights.

The distinction carries a limited normative implication. The number of opportunities to speak supplies only partial evidence of adequate governance. Equally, the exercise of specialized authority can be justified by public duties, technical competence, or legally established responsibility, provided that affected interests receive the protections appropriate to the decision. Fung's participatory-design dimensions illuminate the institutional possibilities, while the responsibility record proposed here asks how those arrangements are justified and revised. The present proposal therefore evaluates the *fit* between a decision's consequences and the available channels for relevant evidence, representation, reason-giving, and review; the appropriate distribution of authority remains context-dependent.

Consider two variations on the coastal-warning case. In the first, residents are invited to comment on a public dashboard and may attend frequent meetings, yet the authority issuing an advisory has no stated procedure for receiving and deciding a documented correction request. The volume of participation may be high while the consequential route from evidence to reconsideration is weak. In the second, a qualified public officer is required to issue an urgent advisory under a statutory mandate, but contributors and affected residents have accessible routes to present contrary evidence, receive reasons, and seek timely review where a review is legally and practically available. A narrower initial decision forum can coexist with stronger subsequent answerability. Whether either arrangement is justified depends on its risks, legal competences, protective obligations, and actual performance.

An empirical investigation could therefore follow a *contested contribution* across four observable moments: submission of an observation, its placement within an institutional agenda, the reasoned disposition of the relevant decision, and any later review or correction. Records could include submission receipts, meeting agendas, decision logs, published rationales, appeal outcomes, and evidence of practical barriers to use. Investigators would record both successful and unsuccessful requests and compare similar disputes to assess whether response procedures work across different participants. This protocol tests the operational relationship between voice and consequential authority; it leaves the applicable standard of legitimacy to independent normative and legal argument. The distinction becomes particularly important when institutional recognition is granted without corresponding influence over subsequent uses of jointly generated knowledge.

9.6 Redress, Contestation, and the Scope of Remedy

Redress addresses harms, disputed obligations, and failures of accountable cooperation. A meaningful process gives affected parties a route to present a concern, access relevant information, receive a

reasoned response, and obtain an appropriate decision or remedy where grounds exist. The proper form may include correction of a public record, renewed authorization, restoration of access, an apology, compensation, alteration of an unsafe procedure, or referral to a competent legal body. These responses differ in their evidential requirements and effects. Their appropriateness depends on the harm, the governing law or agreement, and the rights and interests involved.

The United Nations Guiding Principles on Business and Human Rights provide a specific institutional precedent. Their third pillar concerns access to remedy for business-related human-rights harms. Principle 31 sets out seven effectiveness criteria for State-based and non-State-based non-judicial grievance mechanisms: legitimacy, accessibility, predictability, equity, transparency, rights compatibility, and continuous learning. It adds engagement and dialogue as a further criterion for operational-level mechanisms that enterprises help administer [49, principle 31 and commentary]. In the present philosophical discussion these criteria serve as a carefully delimited analogy; public agencies, research partnerships, and community initiatives may be subject to other legal mandates and complaint procedures. An internal channel also operates alongside, and must preserve access to, applicable judicial and independent non-judicial remedies. The existence of a procedure and its usability or remedial effectiveness are distinct findings.

Accessible contestation requires attention to practical barriers. A formal mailbox may be sufficient for a routine correction from a well-resourced organization and difficult to use for a participant lacking the language, documentation, or time the procedure assumes. A credible process can specify assistance, appropriate confidentiality, protection against retaliation, response periods, and a reviewer with genuine authority to order or recommend action. An independent appeals path may be particularly valuable when a dispute concerns the body responsible for the original decision. Each design choice entails institutional costs and legal considerations, making context-sensitive evaluation necessary.

A distinction between *repairing an outcome* and *repairing a relation* is also useful. A corrected data point may improve the record while leaving a contributor unable to participate in later interpretation. Restored access or a changed review procedure can address that continuing problem, although deeper conflicts may persist. Conversely, maintaining future cooperation may be inappropriate when serious harm or coercive dependency warrants separation. The relevant normative inquiry concerns which forms of remediation are warranted and feasible, as well as how the rights and discretion of affected parties are respected during the process.

9.7 Constructed Case: A Contested Coastal Warning

The following constructed scenario extends the coastal-monitoring partnership examined in Sections 7.6 and 8.5. It is a philosophical case designed to distinguish responsibility relations; it reports neither an actual incident nor an observed policy outcome.

Suppose a municipal office uses a contracted monitoring service to issue a coastal advisory during a period of unusual tidal variation. The service combines calibrated sensor readings with reports submitted by participating fishers. The operator's quality-control procedure flags a subset of observations for further review, but the public dashboard presents the advisory without displaying the outstanding uncertainty. Some residents interpret the advisory as applying to a channel whose conditions differ from those captured by the nearest calibrated sensor. At the same time, a local observer identifies a possible location error in the source record and sends a correction through the general municipal contact form.

Several responsibility questions arise before causal conclusions can be drawn. The operator is responsible for obligations specified in its service agreement and any applicable standards governing data quality. The municipal office holds the relevant authority for issuing the public communication and for explaining the evidential basis of its decision. The observer supplied evidence that may be material to subsequent correction, although the observer's contribution alone establishes neither responsibility for the advisory nor authority over emergency communications. Residents using the advisory have interests in clarity and safety independent of whether they contributed observations. The local ecology may also be affected by any subsequent intervention, and such effects require separate environmental assessment.

Assume further that the observer's original agreement permitted research and planning use of the submitted reports, while the subsequent advisory service was introduced through a later municipal contract. The scope of consent becomes relevant to the data's new use, alongside the municipality's public duties, privacy obligations, and other lawful grounds for processing and communicating information. An institutional assessment can identify which activities were authorized, which required additional review, and whether the practical means of notification and objection were adequate. Different answers may follow for public reporting, retention of identifiable notes, and the publication of sensitive locations.

The immediate response may require technical and public-administrative actions. The operator could preserve the disputed source record, check calibration and coordinate transformations, and communicate uncertainty to the municipal office. The office could review the advisory, provide a reasoned correction or confirmation, and explain its decision to affected residents through accessible channels. A separate forum could examine whether the correction process met the agreed standards and whether an omission produced a remediable harm. Each action addresses a particular responsibility, with the evidence and jurisdiction necessary for that action stated explicitly.

The case also reveals longer-term responsibilities. If contributors routinely supply local observations yet lack access to correction histories, the partnership may weaken the practical basis for continued cooperation. If a new public-warning purpose changes exposure to privacy or safety risks, governance arrangements may require revision. Funding for translated updates, a documented provenance trail, and a periodic review of data uses could support a more accountable process. These measures would still need evaluation against their costs, the actual risk environment, confidentiality requirements, and the competences of the institutions involved.

The constructed scenario therefore yields several possible, distinguishable outcomes. One investigation might find that the advisory was justified by the available evidence but communicated with insufficient clarity. Another might identify an avoidable processing error. A third might conclude that the technical service complied with its specifications while the institutional allocation of review responsibilities was inadequate. The evidential record can discriminate among those interpretations; a normative judgment additionally requires the standards governing the actions concerned. The scenario shows how a responsibility record can organize inquiry without presupposing that all parties experienced the same value or that the same actor bears each obligation.

9.8 Normative Assessment under Plural Valuation

The proposed account offers a procedure for examining cooperative responsibility under heterogeneous valuation. An investigator begins by specifying the relevant activities, decision points, and affected interests. The contribution and conversion records identify how an outcome arose and who gained control over its subsequent use. The regenerative-return record then traces its continuing consequences for capacities and access. Definition 9.1 adds the applicable normative grounds, the forums capable of interpreting them, and the options for prevention, explanation, and redress. The records can be assembled together while remaining distinct in what they establish.

Four provisional qualities guide the resulting assessment: *grounded authorization*, concerning the legitimate scope of decisions and uses; *differentiated care*, concerning foreseeable burdens, vulnerabilities, and feasible protections; *institutional answerability*, concerning reason-giving, consequential voice, and competent review; and *effective revisability*, concerning correction, remedy, and adaptation over time. These are analytical criteria proposed for the present inquiry. They are informed by established philosophical and institutional traditions, and their relative importance must be justified within particular contexts. Different legal systems, professional practices, and communities may organize the relevant duties through different procedures.

Evaluation under plural valuation can reach defensible decisions through partial agreement, properly established authority, or the application of rights and procedural standards. Participants may retain divergent priorities concerning income, safety, cultural continuity, privacy, scientific reliability, and ecological stewardship. A legitimate decision need not erase those differences; its justification can make

them visible and provide authorized routes to challenge its consequences. Where evidence is incomplete, provisional decisions and scheduled reassessment can be appropriate. Where harm is urgent or rights are at stake, protective action may have an independently justified priority. The responsible institution should make the basis and limits of its decision intelligible.

The empirical study of such arrangements would require more than a description of formal procedures. Contracts, consent records, maintenance logs, dispute files, meeting observations, interviews, and records of remedial action could disclose differences between declared rules and feasible participation. Longitudinal comparison could examine whether correction requests receive responses, whether burdens shift, and whether access to jointly generated knowledge remains usable. Causal conclusions would require consideration of alternatives such as resource changes, external ecological events, and prior institutional relationships. These methods would test the framework's practical usefulness, while the grounds of normative legitimacy would remain open to philosophical and legal argument.

Normative responsibility consequently supplies an additional dimension of generative praxis: the conditions under which shared production can be authorized, sustained, criticized, and repaired. Contribution traces help identify causal participation; institutional records show authority and conversion; return records track future capacities; responsibility records make the relevant standards, interests, and accountable decisions explicit. These linked inquiries can support cooperation among participants with differing valuations while respecting the distinct moral and legal positions they occupy. The following section examines how the resulting account varies among human, ecological, and artificial encounters, with particular attention to domain-specific evidential and normative boundaries.

10 Co-Creation in Human, Ecological, and Artificial Encounters

Co-creation in heterogeneous relational systems requires an account of participation that remains useful across different material and institutional settings. A human contributor can negotiate a project, a living organism can change the conditions of its development through biological activity, and an artificial system can transform data or coordinate a technical operation. These activities may enter the same generative history, yet they involve different kinds of agency, evidence, vulnerability, and normative authority. This section develops a comparative account of such encounters. It first distinguishes several dimensions of participation, then examines human–ecological relations and artificial systems, and finally applies the distinctions to a constructed estuarine restoration partnership. The argument is conceptual and comparative. It offers a way to trace heterogeneous contributions while preserving domain-specific criteria for understanding and evaluating them.

10.1 Dimensions of Participation Across Heterogeneous Systems

The expression *co-creation* can describe the historically interdependent generation of an outcome through the activities and conditions of multiple participants. In a narrowly institutional sense, participants are usually persons or organizations that can undertake roles, make claims, and authorize decisions. In a broader analytical sense, the generating history may also include living organisms, material environments, and technical artifacts whose responses change the range of possible outcomes. The broader sense expands the investigation of causal and productive relations. The institutional and ethical significance of those relations remains a further question. Table 10 previews the domain-sensitive questions developed below.

Four dimensions help distinguish these cases. *Causal participation* refers to a process whose activity makes a difference to the outcome under specified conditions. *Responsive capacity* concerns the ability of a system to alter its activity as conditions change; its mechanisms may be biological, behavioral, computational, or institutionally organized. *Evaluative orientation* concerns the standards through which an outcome is regarded as beneficial, harmful, meaningful, successful, or otherwise significant. *Normative standing* concerns the grounds on which interests, claims, duties, and authoritative decisions acquire ethical or legal recognition. These dimensions interact, although their correspondence varies

Table 10: Domain-sensitive questions for examining heterogeneous co-creative encounters. The dimensions are analytically distinct and their interpretation depends on the particular entity and institutional context.

Dimension	Human and institutional relations	Ecological and living relations	Artificial and technical relations
Causal contribution	Practices, decisions, labor, organizational dependencies	Organism activity, ecological interactions, material feedback	Data transformations, sensing, control, infrastructural dependencies
Responsive capacity	Interpretation, negotiation, adaptive practice	Physiological, behavioral, and ecosystem responses	Configured computation, optimization, adaptive control
Valuation evidence	Expressed reasons, practices, justified claims	Welfare or conservation criteria requiring explicit interpretation	Design objectives, metrics, operator evaluations
Normative assessment	Consent, rights, duties, political and legal authority	Welfare, ecological protection, stewardship and contested standing	Human and organizational oversight, accountability, affected interests

across domains. A temperature-control algorithm, for example, may be highly responsive to changing measurements, while the justification for its deployment and its treatment of affected people remain matters for human and institutional decision-making.

The concept of a *generative contribution* developed in Section 4 is most directly concerned with the first two dimensions and with the historically situated dependencies between them. Sections 6 and 9 subsequently examine attribution and responsibility. A cross-domain comparison can therefore retain multiple evidential records. It may establish that an organism materially affected an intervention, identify a human group that proposed the intervention, and locate the institution authorized to approve it. Each account answers a different question about the same encounter.

An additional distinction concerns *functional roles* and *subjective experience*. Functional descriptions may establish that a device selects among actions according to an objective function or that a living system maintains physiological organization through adaptive processes. Claims about felt experience, interests, or morally relevant subjectivity require additional arguments and evidence suited to the entity concerned. The present paper adopts a position of ontological restraint. Its comparative vocabulary supports inquiry while leaving contested questions about consciousness and moral status open. It also distinguishes the social convention of treating an institution as an actor from claims about the subjective life of any organizational entity.

The table entries indicate different evidential approaches and offer a selective comparison of persons, living systems, and technologies.

The table also indicates a methodological risk: a common descriptive term can conceal different mechanisms. *Learning*, for example, may designate changes in human understanding, adaptive behavior in organisms, or parameter updates in a computational model. A comparison becomes informative when the mechanisms, observations, and practical consequences are stated in each case. The analysis then permits interaction among domains without treating their vocabulary as automatically interchangeable.

10.2 Human and Ecological Relations in Generative Praxis

Human–ecological encounters make the dependence of value generation on living and material processes especially visible. Farmers, fishers, researchers, and local institutions may contribute knowledge, labor, tools, and stewardship to a project. Soil organisms, vegetation, currents, and seasonal species interactions also shape the outcome through their own causal processes. The resulting relations can include cooperation in an institutional sense among people and coordinated intervention in an ecological system whose responses may support, frustrate, or transform their plans. Describing the entire process as co-creation

can be analytically useful when the account specifies which relations concern intentional collaboration and which concern ecological participation.

Ostrom's framework for the study of social–ecological systems provides an established precedent for relating resource systems, resource units, governance arrangements, and actors within an institutional and environmental context [36]. It supports the investigation of interacting processes while retaining the distinctions needed for causal explanation. Haraway's account of *sympoiesis*, or making-with, offers a different philosophical orientation: it draws attention to multispecies relations and histories of interdependence [26]. The present study draws selectively on these traditions, keeping Ostrom's institutional and analytic concerns distinct from Haraway's multispecies philosophical commitments. Neither source is treated as establishing a universal equivalence among organisms, institutions, and engineered systems.

The valuation of ecological outcomes further complicates comparison. The IPBES assessment of the diverse values and valuation of nature documents multiple ways of understanding and appraising nature, including approaches that extend beyond instrumental benefits to people [29]. Its disciplinary and policy synthesis provides important context for the present paper's account of plural valuation. A human community might appraise a restored wetland in terms of storm protection, customary practice, habitat conservation, livelihood continuity, or the integrity of living relations. These appraisals can coexist and sometimes conflict. Ecological evidence may constrain claims about the consequences of an intervention, while the weight assigned to different outcomes remains a matter for justified deliberation and applicable normative standards.

Ecological participation is also heterogeneous internally. A planted reed, a migratory bird, a tidal channel, and a microbial community enter an estuarine project through different mechanisms. Their relevant conditions of persistence vary, as do the methods available for observing changes. Habitat quality, reproductive success, disturbance, water chemistry, and long-term ecological resilience require different measurements. Some organisms may have welfare interests under particular ethical frameworks or applicable protective law. Other entities are evaluated through conservation, ecological integrity, or environmental governance. A project should therefore identify the living entities and processes under consideration before attaching the language of return, benefit, or care to them.

This distinction bears on *regenerative return*, introduced in Section 8. For human participants, return may consist of usable records, compensation, knowledge, and sustained decision-making opportunities. For a habitat, the corresponding empirical investigation may examine restored hydrological exchange, successful establishment of native vegetation, or reduced pressure from disturbance. These are different forms of evidence about future generative conditions. A claim that an intervention benefits an ecosystem requires specified indicators, a relevant time horizon, and an account of the ecological trade-offs. Decisions about which ecological outcomes ought to be protected involve additional normative commitments.

Several difficulties follow. An intervention that improves one indicator of habitat function may displace another species or create burdens for people using the same area. A short-term productivity gain may coincide with deterioration of the ecological conditions supporting longer-term renewal. The participating institution can address these possibilities through baseline observations, monitoring, thresholds for review, and accessible procedures for incorporating local evidence. Such arrangements provide means of learning from ecological responses while keeping human authorities answerable for their choices.

10.3 Artificial Systems within Sociotechnical Production

Artificial systems can enter cooperative production as sensors, analytical models, generative tools, coordination software, or embodied devices. They can transform contributions by selecting observations for review, proposing interpretations, generating code and reports, or controlling physical equipment. Their outputs may become indispensable to an institutional process. The relevant generative history then includes training data and design decisions, material computing infrastructure, maintenance work, deployment conditions, and the ways people interpret or act upon system outputs.

Suchman's examination of human–machine configurations offers a basis for investigating the situ-

ated organization of action and the distribution of agency at technological interfaces [47]. Research on sociotechnical fairness similarly cautions that technical abstractions can obscure organizational context and the social consequences of deployment [41]. Birhane’s relational ethics of algorithmic injustice attends to asymmetries of power and the experiences of people affected by computational systems [6]. These approaches help situate artificial contributions within their practical histories. They support analysis of the relations through which a system has effects, while leaving the evaluation of each deployment to empirical and normative inquiry.

A distinction between *operational discretion* and *normative authority* is particularly important. An automated system may choose among technically available operations through a learned policy or pre-defined optimization rule. A public institution may decide which uses are authorized, which evidential thresholds apply, who may contest a result, and what remedies are available after an error. The two forms of selection can be causally connected, yet the institutional attribution of responsibility depends on the human and organizational arrangements governing the deployment. Describing an artificial system as a functional participant thereby indicates a role in generation. It leaves questions of personhood, rights, and subjective valuation for separate inquiry.

The apparent success of an artificial contribution can depend on what an institution decides to measure. A classifier can improve the regularity of data processing while reducing the visibility of atypical local observations. A text generator can produce comprehensible explanatory material while introducing uncertain attributions or simplifying disagreements. An autonomous monitoring platform can extend coverage while creating new maintenance and energy demands. The relevant assessment therefore examines the full chain from data selection and system design to human review, physical effects, and subsequent correction. Technical reliability, social usefulness, and legitimate governance require related yet distinguishable forms of evidence.

The record of contributions considered in Section 6 can document the technical role of an artificial system, its model or software version where relevant, the source of its inputs, and the interventions of operators and reviewers. An attribution record can acknowledge computational assistance without treating the system as a legal author or automatically assigning it the status of a moral subject. It can also disclose the work of dataset creators, annotators, maintainers, and affected communities, subject to applicable privacy, contractual, and professional obligations. This approach allows careful examination of AI-mediated co-production without collapsing its histories into either the output of a machine or the intentions of a single operator.

The distinction remains relevant for more autonomous technologies. Systems capable of initiating tasks, coordinating with other systems, or adapting behavior over prolonged periods would expand the questions of causal influence, monitoring, and institutional control. Their practical capacities would need to be investigated empirically. Normative assessments would still require explicit premises concerning possible interests, affected parties, obligations, and authorized forums. Future philosophical or scientific findings concerning artificial experience could change those premises. The present account keeps this possibility open while relying on currently identifiable human and institutional responsibility for the constructed cases considered here.

10.4 Evidential Interfaces and the Authorization of Ecological and Technical Claims

Cross-domain co-creation introduces a problem of *evidential mediation*. An ecological response becomes available to a public decision through sampling practices, classifications, expert interpretations, and reporting formats. A technical system may transform the same observations into a forecast or a recommendation. These mediations influence what an institution comes to regard as a contribution, a risk, or a benefit. An account that traces only the original ecological process and the eventual institutional choice would therefore omit some of the relations through which observations acquire practical authority. The object of inquiry includes the sequence linking an event, its representation, its assessment, and the decision for which the representation is used.

Three claims should be distinguished. A *mechanistic claim* concerns a process that causally affects

an outcome: for example, tidal exchange changes salinity and thereby alters the conditions for vegetation establishment. An *evidential claim* concerns the warrant for representing that process through a particular indicator, sensor, model, or local observation. An *authoritative claim* concerns a decision made under an identified competence, such as whether a municipality may alter a restoration schedule or approve the release of a warning. One claim can support another, while each requires its own grounds. Reliable sensing supports a description of environmental conditions; it leaves the choice of permissible intervention to applicable obligations and decision procedures. Similarly, identifying a contributor to the evidence does not alone establish that contributor's contractual ownership of the resulting dataset.

Consider a constructed disagreement over an estuary's seasonal disturbance indicator. Automated classification reports an apparent decline in disturbance, whereas fishers and local observers report events that the model's categories classify differently. Several explanations are possible. The sensors may miss an important site or time interval; human observers may apply a broader definition of disturbance; calibration may have changed; and a genuine ecological trend may be unfolding alongside a shift in reporting practices. The responsible investigation would preserve the original observations, make the classification criteria inspectable to appropriate reviewers, and compare the descriptions against an explicitly chosen ecological question. Expert interpretation, community testimony, and model performance would each contribute evidence with distinguishable limitations. A municipal decision could then explain which considerations it adopted and how the remaining uncertainty affected its action.

This example highlights the importance of *translation authority*: the practical capacity to establish categories, decide which observations count as evidence, or define the conditions under which a discrepancy can initiate review. It is analytically distinct from the capacity to produce observations and from statutory decision-making authority, even when the same organization exercises several of these powers. Sociotechnical research on abstraction has shown why the location of a system's boundaries matters to the social phenomena represented within it [41]. The IPBES assessment likewise provides a reason to examine how valuation approaches select and express different values of nature in decision processes [29]. The present synthesis adds a procedural question: which persons or institutions may challenge a translation between an observation, an indicator, and a consequential decision?

A cross-domain research record can answer that question by following five linked elements: the originating ecological or social process; the observation and its provenance; the categories and transformations applied to the observation; the forum that interprets it; and the authorized action, subsequent review, or documented refusal. This is an analytical trace rather than a presumption of continuous transparency. Researchers should state where proprietary systems, privacy requirements, ecological sensitivity, or gaps in historical records constrain access. Restricted evidence can justify a qualified conclusion, while the fact of restriction alone leaves the motive and effects of that restriction to be established independently.

The scope of *co-creation* also requires a significance condition. Almost every material setting is causally connected to countless processes. Identifying a generative contribution calls for an outcome-specific account of the mechanism, its temporal or functional relevance, and a defensible reason to include it in the explanatory boundary. A counterfactual comparison can be useful when feasible, but interacting ecological processes may resist independent intervention, and some dependencies are established through mechanistic or historical evidence. The inclusion criterion should therefore be declared, tested for sensitivity to reasonable boundary changes, and kept separate from judgments of moral worth. A process that falls outside a particular explanatory boundary may remain ethically relevant as an affected condition or legally protected interest.

These distinctions preserve an important asymmetry. Organisms and habitats provide material responses and may be entitled to protections under ethical or legal standards specific to the case. Technological systems mediate evidence and operations through designed or learned procedures. Persons and institutions may possess obligations and decision competences that require justification, contestability, and accountability. In a particular cooperative history, all three domains can be consequential. Their different forms of consequence make the cross-domain comparison informative precisely when the evidential and normative boundaries remain visible.

The evidential interface must also be examined when a method travels between contexts. A sensor

and classification model may use the same technical specification in two estuaries, while the relevant ecological baseline, seasonal pressures, access to observations, and authority to issue warnings differ. Comparable model outputs establish a technical relationship under the conditions of validation; they leave open whether the outputs represent equivalent ecological phenomena or enter equally legitimate decisions. The problem resembles the *portability trap* examined by Selbst and colleagues: a technical procedure developed for one social setting can encounter different institutions and practical meanings elsewhere [41]. Their argument concerns sociotechnical fairness systems. Its relevance here is a methodological analogy about contextual transfer, rather than direct evidence about environmental monitoring.

A proposed transfer therefore requires an explicit account of *what travels*. Investigators can distinguish the calibrated physical measurement, the interpretation of an indicator, the model's predictive relation, and the institution's permission to act on the result. A salinity estimate might remain physically comparable after appropriate calibration while a classification of "acceptable disturbance" depends on site-specific organisms, ecological objectives, and applicable decision standards. Similarly, a digitally recorded consultation may take the same form in two municipalities while differing in the legal force of its recommendations and the protections available to participants. Transferability is a claim about a particular component under stated boundary conditions, with the surrounding institutional relations available for separate examination.

The generative-relational description gains precision when it records this layered transfer and its consequences for later participation. An inference about the causal role of an observation can remain warranted even where the associated decision procedure is contested. An institution may possess formal authority while its chosen evidence translation lacks adequate validation. An affected person can have a justified ground to request review even where the technical indicator performs well against its designated benchmark. These cases recommend a comparative protocol in which technical equivalence, interpretive validity, and practical authority are assessed with different evidence. They also permit a narrower conclusion whenever only one of these levels can be established.

10.5 Constructed Case: An Estuarine Restoration and Monitoring Partnership

Consider a hypothetical estuary where residents, fishers, ecological researchers, a municipal authority, and a technical cooperative establish a joint restoration and monitoring programme. Residents document seasonal changes and locations of concern. Researchers propose habitat indicators and methods for evaluating water quality. The municipality authorizes interventions within its jurisdiction. The technical cooperative maintains sensors and an AI-assisted analysis service that organizes observations and generates provisional classifications. Reed communities, sediment processes, tidal exchange, and visiting organisms shape the physical results of the intervention. The case is constructed to compare distinct participation relations; it reports no observed restoration outcome or empirical performance of an AI system.

At the programme's beginning, community participants and researchers propose a trial intervention to improve tidal exchange in one channel. The programme establishes baseline observations concerning salinity, sediment movement, vegetation, and selected species. A predictive model combines previous measurements with current sensor readings and proposes a schedule for inspecting the site. Municipal staff review the recommendation alongside local observations, legal constraints, and available resources. Each participant's role can be recorded without treating the collective outcome as the additive sum of independently measurable contributions.

Suppose the initial ecological response differs from the forecast. Some reeds establish successfully near the channel margin, while an area used by a protected species shows signs of disturbance. Local fishers also report a timing discrepancy between the model's recommended inspection period and the conditions observed in their routine work. The discrepancy generates several lines of inquiry. The researchers can inspect sampling assumptions and the ecological indicators. The technical cooperative can examine sensor calibration, data filtering, and model behavior. Residents can submit geolocated observations through a procedure that accommodates local categories and concerns. The municipality

can determine whether continued intervention is lawful and justified under its conservation and public responsibilities.

This sequence illustrates why the roles of ecological and artificial participants deserve separate descriptions. Vegetation and species interactions causally shape the restoration trajectory; those processes can be investigated through ecological observation. The model influences scheduling through a computational recommendation; its contribution can be examined through performance records, input provenance, and operator use. Human participants interpret evidence, contest classifications, and make decisions through authorized procedures. Ecological processes provide feedback concerning the intervention's effects, while artificial systems help transform measurements into actionable representations. Neither description settles the moral standing of every living entity or of the computational system.

The case also illustrates heterogeneous valuation. Fishers may prioritize safe access and livelihood continuity. Researchers may emphasize ecological evidence and the reliability of monitoring. The municipality may consider statutory responsibilities, budgets, and public safety. Residents may place significance on cultural practice and accessible information. Conservation concerns may receive protection through legal requirements and explicit ecological commitments. A defensible decision can acknowledge these different reasons, specify which considerations carry legal priority, and make the evidence and discretionary judgments available for appropriate challenge.

Now suppose the technical cooperative later proposes to license the resulting monitoring platform to other municipalities. The platform incorporates software developed by the cooperative, data from public sensors, selected community observations, and ecological knowledge produced through the original partnership. Its circulation generates possible returns and new questions of authorization. Which data are covered by the existing agreements? Who can correct or withdraw a sensitive observation? Which contributors retain access to the improved documentation? Who funds continued monitoring of the original habitat? The causal importance of the ecology to the model's development is a reason to investigate environmental dependencies and obligations; it supplies no automatic allocation of intellectual-property rights. Similarly, the functional role of the AI-assisted service does not determine legal authorship or entitlement.

An accountable arrangement might establish distinct agreements for source-data access, privacy-sensitive locations, software licensing, and public summaries. A review forum could include contributors with sufficient technical and local knowledge to examine disputed classifications. The municipal authority could retain final statutory decisions while publishing reasons and documenting changes. Ecological monitoring might continue after commercial transfer, financed through specified maintenance obligations. These arrangements represent design possibilities whose suitability would depend on cost, law, governance capacity, and the affected community. Their consequences could be examined longitudinally through access records, dispute histories, maintenance indicators, and ecological data.

The constructed encounter therefore supports a comparative observation. The same outcome may depend on socially negotiated practices, living ecological processes, and computational transformations. The relevant contribution traces share a historical relation while requiring different evidential accounts. The distribution of authority and responsibility becomes intelligible through the institutions governing the relation, and the evaluation of its continuation depends on both social and ecological consequences.

10.6 Comparative Criteria and Evidential Boundaries

The proposed generative-relational account can be evaluated through a set of linked inquiries. The first concerns *mechanistic adequacy*: whether an account identifies the processes through which a participant or condition affected an outcome. The second concerns *interpretive fidelity*: whether participants' expressed reasons and local categories are represented with appropriate care, and whether claims concerning organisms or machines remain tied to defensible observation. The third concerns *institutional attribution*: whether the record distinguishes productive contribution, control over decisions, and the applicable grounds for credit and responsibility. The fourth concerns *continued capacity*: whether subsequent uses of the outcome sustain or diminish the practical conditions for future activity. The fifth

concerns *revisability*: whether conflicting observations and claims can lead to correction through competent and accessible procedures.

These criteria share concerns with existing approaches in social–ecological governance, multispecies scholarship, and sociotechnical studies. Their proposed combination is intended to organize a particular line of inquiry into value co-creation under plural valuation. Its additional usefulness remains subject to comparison with those approaches. An empirical investigation would ask whether the combined record identifies important dependencies, harms, or opportunities that existing institutional accounts tend to overlook, and whether those findings can improve explanation or practical judgment at a reasonable cost. A comparative study would need common cases, explicit coding rules, and independent evaluation of differences among interpretations.

Evidence is likely to remain uneven across domains. Interviews and documentary records can disclose some human intentions and institutional commitments, while their reliability depends on context and corroboration. Ecological indicators can establish specified material changes, subject to sampling and measurement limitations. Model logs and computational tests can disclose parts of an artificial system’s operation, while training provenance, deployment context, and internal behavior may be incompletely documented. Differences in observability are thus properties of the inquiry, and an accountable record should disclose them where they affect consequential judgments.

Ethical evaluation also requires attention to affected parties whose contributions to production are small or absent. Residents exposed to an ecological intervention, workers involved in maintaining AI infrastructure, and organisms affected by changes in habitat may have claims or protection needs grounded in different normative frameworks. An analysis of co-creation can support recognition of these relations while leaving distributive justice, rights, and welfare to arguments adequate to their respective domains. This distinction preserves the analytical reach of the generative-relational vocabulary together with the authority of established legal, ecological, and ethical inquiries.

Co-creation across human, ecological, and artificial encounters can therefore be studied through shared questions about generation, transformation, circulation, and regeneration. The answers require domain-sensitive accounts of participation and responsibility. Human deliberation and institutions supply one set of relations, ecological processes another, and artificial systems a further set of technically mediated relations. Their historical interdependence motivates a comparative framework whose explanatory value and normative implications remain open to sustained scrutiny. The following section will examine the alternatives and methodological requirements needed to assess that proposal more rigorously.

11 Comparative Explanations and Evidential Requirements

The generative-relational account of value co-creation requires comparison with established explanations and a specification of the evidence through which its proposed distinctions might be assessed. Cooperative activity can be understood through production organization, institutional governance, valuation practices, asymmetrical dependence, and the reproduction of capacities. These inquiries already possess substantial philosophical and empirical literatures. The present section therefore examines the explanatory relations among them, identifies observations that could distinguish competing mechanisms, and proposes a research design for studying co-creation across heterogeneous participants. It proceeds through comparative interpretation, evidential specification, methodological integration, a worked research protocol, and conditions of theoretical revision. Its purpose is to render the proposed account accountable to evidence and rival explanations while preserving the independent philosophical questions concerning value and legitimate action.

11.1 Explanatory Traditions and the Scope of the Proposal

The relevant comparison is between explanatory accounts with overlapping objects and distinct priorities. Work on team production studies the organization and monitoring of jointly generated outputs;

institutional approaches examine collective-action arrangements and their durability; sociology of valuation studies how categories, metrics, and judgments make objects comparable; theories of power examine dependency and control; and capability-oriented approaches consider the substantive opportunities available to persons. The generative-relational proposal seeks to connect selected questions from these areas by following a historically situated sequence: productive participation, the interpretation and conversion of outcomes, the circulation of benefits and burdens, and the subsequent alteration of capacities. Its usefulness depends on whether such a connected inquiry clarifies mechanisms or normative problems that are otherwise treated separately in the concrete cases under investigation.

Alchian and Demsetz's analysis of production, information costs, and economic organization offers an influential starting point for studying team outputs and the difficulties of observing individual contributions [2]. The present account shares an interest in joint production and attribution. It also raises questions concerning contributors who occupy different institutional positions, the way outputs move into subsequent projects, and the continued ability of those contributors to participate. These questions can be introduced within an expanded economic account; a distinct theoretical vocabulary is warranted only where it provides greater analytic precision, integration, or practical insight than that expansion.

Cooperative game theory supplies another rigorous account of contributions to collective outcomes. The Shapley value, for example, evaluates marginal contributions across coalitions under assumptions that include a specified characteristic function and transferable value [43]. Where a defensible common outcome measure and well-defined coalitions exist, such tools may illuminate attribution and allocation. In relations characterized by plural kinds of worth, legally restricted rights, changing membership, and historically accumulated capacities, the specification of a single characteristic function becomes itself a substantive modeling decision. A research design may therefore use cooperative-game allocation as an appropriate comparison in a bounded setting while separately investigating how the model's units, feasible coalitions, and evaluative currency were established. This distinction concerns the domain and interpretation of the model rather than a general defect in mathematical allocation.

Institutional analysis offers a particularly strong alternative to any claim that sustained cooperation requires a new general model. Ostrom's work examines conditions of collective self-organization and the configuration of actors, governance arrangements, and ecological systems [35, 36]. Collaborative-governance research further identifies the relevance of prior conflict, participation incentives, resource inequalities, leadership, and institutional design [4]. A generative-relational study should begin with the expectation that much of what it observes can be explained through these established resources. Its particular question is whether tracing changes in contribution, interpretive control, circulation, and regenerative capacity across successive projects reveals additional dependencies that a bounded study of a governance arrangement may leave less visible.

Sociology and philosophy of valuation offer a second major point of comparison. Espeland and Stevens examine commensuration as a social process implicated in power, judgment, and the use of common metrics [18]. Anderson's pluralist approach distinguishes ways of valuing qualitatively different goods, while Chang's discussion of parity complicates the assumption that practical comparison always follows a single ranking [3, 11]. These approaches already supply resources for assessing the limits and institutional consequences of valuation procedures. The present proposal applies such insights to an extended history of co-production, including who establishes the evaluative interface and how a decision changes subsequent opportunities. Its intended contribution is a specific object and organization of inquiry, rather than the discovery of value plurality.

The same discipline applies to explanations of asymmetry. Emerson's account locates power in relations of dependence, connecting an actor's dependence to valued goals and the availability of alternatives [17]. A claim that one institution controls a data platform, payment channel, or decision procedure becomes explanatory when that control can be shown to alter feasible actions. The generative-relational vocabulary of *conversion interfaces* may help locate particular mechanisms of dependence, although a dependence account could explain the same facts. An inquiry should consequently compare the two descriptions on shared evidence before asserting an added contribution.

Table 11 organizes these comparisons as provisional research alternatives. Its entries describe partic-

Table 11: Selected explanatory accounts and the discriminating questions of a generative-relational study. The traditions overlap; their comparative value depends on case-specific operationalization.

Account	Explanatory emphasis	Comparative evidential question
Team production and allocation	Joint output, information and contribution measurement	Does a documented allocation account explain participation and distribution over the specified interval?
Commons and collaborative governance	Rules, incentives, institutions, power imbalance and cooperation	Do rule arrangements and governance mechanisms explain continuity and change?
Plural valuation and commensuration	Evaluative distinctions, categories, metrics and justification	Which judgments become consequential through particular valuation procedures?
Power-dependence analysis	Control over valued resources and feasible alternatives	Does interface control affect dependence beyond the resources and alternatives already recorded?
Generative-relational proposal	Linked contribution, conversion, circulation and future capacity	Does following these links identify additional mechanisms or practically relevant omissions?

ular uses of broad traditions, rather than exhaustive statements of their intellectual scope.

11.2 Units of Observation and the Structure of Evidence

Empirical assessment begins by specifying what constitutes the case. A cooperative project, a governed resource, a contract, an outcome, an organization, and a participant's historical trajectory are possible units of analysis, but each supports different inferences. A municipality's restoration programme might encompass several contracts and monitoring cycles. An individual sensor reading might affect one recommendation while leaving a broader partnership unchanged. A worker's opportunity to challenge a data-processing decision might vary across service providers even when the formal project rules remain stable. A study that alternates among these scales without documenting its transitions risks attributing a project-level outcome to a participant-level process or treating an institutional declaration as an observed practice.

A feasible design would identify a *bounded cooperative episode*: a named activity or sequence of connected activities, an explicit observation interval, relevant institutional and material settings, specified outcomes, and a justified account of inclusion. The episode should retain both its external conditions and the historical relations that substantially shape it. An investigation might begin with a single deployment, then extend backward to its data-provenance and consent arrangements or forward to a subsequent capacity-renewal decision. The extension should be declared in the protocol because boundary changes can alter which contributions and costs become visible.

Within such an episode, several distinguishable records are useful. A *participation record* describes activities, conditions, dependencies, and temporal order. An *interpretive record* identifies evaluative claims, criteria, institutions, and disagreements about meaning. A *conversion record* tracks authority over the transformation of contributions into usable, tradable, publishable, or actionable outputs. A *circulation record* follows the subsequent access, allocation, burden, and reuse of those outputs. A *capacity record* documents changes in resources, skills, infrastructure, ecological conditions, and other relevant possibilities for future activity. A *normative record* separately identifies applicable rights, duties, consent arrangements, claims for remedy, and competent forums. The records correspond to distinctions developed in Sections 4–10; their conjunction remains a research proposal rather than a validated measurement instrument.

Definition 11.1 (Comparative evidential record). For a bounded cooperative episode, a *comparative evidential record* is a documented association of six separately interpretable records of participation, valuation, conversion, circulation, capacity, and normative standing, together with their time boundaries, observation sources, uncertainty annotations, and candidate rival explanations. The association supports cross-record questions while preserving the evidential standards appropriate to each record.

Definition 11.1 describes a protocol for assembling evidence. It leaves open whether each record

can be completed and whether connections among records can sustain a causal conclusion. The object is deliberately documentary and analytic. A philosophical claim concerning recognition may remain open when interviewees offer conflicting accounts, an ecological response may require specialist measurements, and a contractual right may have a settled documentary basis while its practical exercise remains uncertain. Such differences should appear in the record as differences of evidential status.

The distinction between an indicator and the concept it purports to measure is central here. Adcock and Collier's account of measurement validity emphasizes the relation between conceptualization, operationalization, and contextual interpretation [1]. The number of meeting invitations, for example, can measure opportunities to attend while providing limited evidence about the ability to affect a decision. A revenue figure may describe monetized returns while leaving knowledge access or ecological consequences outside its scope. A computational system's output count may establish task completion while providing little evidence of who controlled its design or deployment. Before constructing an index of "co-creation," researchers would therefore need a defensible conceptual definition and a demonstration that its indicators track the relevant phenomena.

Observation itself can produce asymmetry. Institutions commonly hold contracts and system logs; contributors may hold contextual memories or records of maintenance; environmental evidence may depend on specialized sampling; affected residents may possess information that a project archive omits. Access to the relevant records is often governed by the same institutional relations under investigation. An evidence protocol should document provenance, lawful access conditions, missingness, redaction, and the authority under which information was recorded or interpreted. Where a source is unavailable, the investigator can state how its absence constrains inference. Missing data may be a consequential feature of a governance relation, although it provides evidence of power only when the relevant access mechanism is independently established.

11.3 Evidential Asymmetry and the Interpretation of Missing Records

A comparative evidential record also has a history of its own. Institutions and participants differ in their ability to create documents, retain files, specify reporting categories, and authorize inspection. These conditions can affect what researchers are able to reconstruct, especially where the very institution controlling the records also exercised authority over a contested contribution or decision. A complete analysis therefore examines the production and accessibility of evidence alongside the production and circulation of value. The two histories can be causally connected, although their connection requires independent demonstration in each case.

An investigator should distinguish at least four evidential situations. In the first, a dated and authenticated record supports the occurrence of a specified intervention. In the second, sufficiently comprehensive records, combined with a defensible account of their coverage, support the nonoccurrence of a specified event within a bounded interval. In the third, relevant materials were never created, have been lost, remain lawfully inaccessible, or cannot be authenticated. In the fourth, credible records or accounts support conflicting interpretations. The latter two situations warrant an explicit classification of *undetermined* or *contested*, with the unresolved propositions described. A blank field in a project register can mean that a task was omitted, that an unregistered person performed it, that the category did not exist, or that the person responsible for entry lacked information. The meaning of the blank therefore depends on the recording process.

Rubin's statistical account of missing data shows why inferential treatment depends on assumptions about the mechanism producing missing observations [39]. The present use is an analogy about the need to examine record production; statistical ignorability conditions remain specific to their formal setting. Collier's process-tracing framework evaluates observations by their diagnostic force relative to articulated hypotheses and prior knowledge [13, pp. 823–826]. For a claimed nonoccurrence, investigators should therefore specify which trace the event would ordinarily produce, how reliably it would be recorded and preserved, and whether a rival mechanism would predict the same absence. The absence of a document has evidential force only within a defensible account of the documentation process.

Table 12: Proposed classifications for evidence about a bounded cooperative event. These are research-design distinctions rather than a validated coding instrument.

Record condition	Evidential question	Appropriate inferential treatment
Documented occurrence	Does a credible trace identify the event, actor, time, and relevant decision?	Describe the event; assess its causal role separately
Documented nonoccurrence	Would the recording system reliably capture the event if it occurred?	Restrict the absence claim to the covered event and interval
Unavailable or unrecorded	Was material never produced, lost, restricted, or outside the study's access?	Report the proposition as undetermined and examine the documentation process
Contradictory accounts	Which interpretations have independent support, and what could discriminate them?	Preserve the disagreement and test specific rival claims

Table 12 organizes these distinct record conditions for an investigator who must state what has been established and what remains open. Its classifications describe evidential status; the adequacy of any causal or normative conclusion still depends on the relevant recording system and rival explanations.

Consider a constructed dispute over contributions to an estuarine warning system. A municipal report lists paid engineering work but gives little detail about local observers' seasonal corrections. The report alone supports a claim about the institution's formal attribution; it establishes the observers' actual causal role only to the extent that other credible materials trace their interventions. A dated issue log, a corrected model version, and separately preserved field notes might provide such a trace. Their absence, however, leaves several possibilities open. A researcher could investigate the document templates, submission permissions, record-retention periods, and the practical routes through which field observations entered the project. The result may show an attribution omission, an adequately scoped technical report, or a causal claim that remains unresolved. These conclusions should be differentiated even when participants reasonably dispute the institution's description.

Access restrictions demand similar care. Confidentiality, privacy, ecological protection, contractual duties, and security requirements may provide legitimate reasons to withhold a record from public release. Where a consequential claim depends on restricted material, lawful and proportionate alternatives may include independent examination by an authorized reviewer, a redacted decision trail, a trusted intermediary, or an auditable summary of relevant procedures. Each alternative has limits; an authorized reviewer may still lack the technical competence or independence required for the claim at issue. If adequate review cannot be achieved, the research should state the resulting uncertainty and avoid implying that disclosure is invariably the appropriate remedy.

Evidential asymmetry itself can be a research finding when a demonstrable institutional mechanism determines who can submit, retain, revise, or inspect relevant records. That finding concerns the structure of documentation. A further allegation of deliberate suppression, unequal recognition, unlawful conduct, or unjust allocation requires its own supporting evidence and normative or legal analysis. The framework gains explanatory discipline by allowing outcomes in which the records remain incomplete, an institution has legitimate custody, or its selective documentation has no established effect on the cooperative result. Comparative tests should apply the same standards of source authentication, access disclosure, and uncertainty annotation to the generative-relational account and its strongest alternatives.

11.4 Competing Mechanisms and Discriminating Observations

An explanatory proposal becomes more informative when it can be placed alongside alternatives that predict different observable sequences. The present framework invites several provisional expectations. They are research hypotheses whose applicability depends on the cooperative setting and the availability of suitable observations. Their formulation does not establish that the proposed mechanisms occur widely or that they possess unique causal force.

A first expectation concerns *conversion-interface control*. In otherwise relevantly comparable episodes, differences in authority over licensing, technical standards, data access, or procurement may

affect which contributions gain recognition and which participants can use the outcome. Evidence would include dated policy changes, decision rights, logs of rejected or approved uses, interviews with parties holding different positions, and traces of subsequent distribution. An alternative explanation might locate the observed allocation in pre-existing contracts, participant preferences, or changes in the resource budget. A persuasive account would show how a specific decision at the interface affected feasible action and why the alternative mechanisms were insufficient to explain that particular transition.

A second expectation concerns *regenerative return*. A project may deliver a large immediate output while also changing the capacity of contributors to participate in a later cycle. The relevant observations would distinguish output volume from continued access to training, infrastructure, maintenance resources, health, habitat conditions, and opportunities for initiative. The comparison could examine successive project cycles with similar initial resources or carefully matched external conditions. Declining participation could equally reflect unrelated employment changes, seasonal ecological variation, or altered preferences. Establishing an effect of return arrangements would require temporal evidence connecting an identifiable allocation or exclusion to the later capacity change.

A third expectation concerns *cooperation under plural valuation*. Participants may maintain divergent rankings of outcomes while coordinating through limited agreements, institutional rules, or rights-respecting procedures. Interviews, deliberative records, and successive decisions could establish whether relevant differences of valuation persisted, how conflicts were addressed, and whether cooperation continued. A competing explanation might find stable underlying preferences for a common practical objective or a dominant authority that secured compliance. The research question is whether documented mechanisms of negotiation and partial agreement explain participation more satisfactorily than a presumed unified evaluative scale. Continued cooperation alone would be an insufficient indicator of mutual authorization or normative legitimacy.

A fourth expectation concerns *recognition and corrigibility*. More complete contribution provenance may support timely error correction or recognition where contributors possess usable access to the record and a competent forum for contestation. The associated evidence would include version histories, attribution decisions, complaint pathways, actual corrections, and participant accounts. A rival account might attribute improved correction to technical quality-control procedures, staffing changes, or more stable operating conditions. The proposal should therefore distinguish visibility of records from the practical capacity to use them and evaluate each contribution separately.

Discriminating evidence requires a declared inferential strategy. Collier's treatment of process tracing emphasizes diagnostic observations interpreted within causal sequences [13]. For a specific deployment, one might observe a request for data access, a recorded refusal under a licensing rule, the consequent inability to conduct an independent check, and a later institutional decision taken without that check. Such observations could support an account of interface-mediated limitation. Their strength would depend on documentary authenticity, plausible alternative routes to verification, the timing of decisions, and evidence concerning the likely effect of the missing check. A sequence alone does not settle the counterfactual question.

11.5 Incremental Explanation under Shared Evidential Conditions

The proposed framework should be evaluated against the *strongest applicable baseline*, rather than against a deliberately narrow version of an established theory. For a study of the estuarine partnership, a baseline might combine commons governance, resource dependence, ordinary contract analysis, and a domain-specific ecological evaluation. A generative-relational explanation would organize the same history through contribution, valuation, conversion, circulation, and subsequent capacity. Since the vocabularies overlap, superiority cannot be inferred from the mere appearance of additional categories. The comparison must identify which inferential or practical difference those categories make.

An informative test would separate two questions. First, does the additional relational organization improve the explanation of a specified outcome when the competing accounts receive *equivalent access to the underlying records*? Second, does the proposed organization direct investigators toward relevant

Table 13: Illustrative tests of incremental explanatory value under shared records. The baseline accounts are intentionally substantive; observed results may favor either account or their combination.

Outcome under study	Baseline explanation to assess	Possible incremental GR inquiry
Contributor withdrawal	Compensation, recruitment, institutional trust, and changed project preferences	Whether a documented conversion or reuse decision changed future feasible participation after these factors are considered
Disputed ecological report	Sampling quality, category validity, model calibration, and expert disagreement	Whether control of the translation from observations to official indicators changes whose evidence receives consequential review
Maintenance discontinuity	Budget cycles, procurement terms, contractor performance, and environmental shocks	Whether the circulation of earlier outputs changes access to the capacities required for a later monitoring cycle

evidence that would otherwise have been omitted, and at what cost? A positive answer to the second question establishes a possible advantage in research design or problem discovery; it does not establish a superior causal theory under shared evidence. Both achievements deserve recognition, with their evidential bases stated separately. This distinction also makes the cost and accessibility of information part of the comparative evaluation.

The investigation could register a small set of rival expectations before examining a later project cycle. Table 13 gives illustrative contrasts. Each row describes a feasible discriminator rather than an empirical finding or a prediction that necessarily holds in every institutional setting.

One approach is a *nested comparison*. Investigators would first reconstruct an episode with the usual institutional and domain-specific categories, document unresolved outcomes or ambiguities, and then apply the linked generative-relational record. A second team, with comparable expertise and access to the same materials, could assess whether the additional relations improve identification of mechanisms, the explanation of observed changes, or the recognition of consequential omissions. Differences in training and interpretive judgment would require disclosure. A later episode, set aside during conceptual development, could test the stability of the proposed distinctions. This design offers a way to limit retrospective fitting, although it does not transform an interpretive framework into a predictive instrument by itself.

An explicit *adverse comparison* is equally valuable. Suppose a revised licensing arrangement coincides with a decline in local monitoring, yet contracts, interviews, and financial records establish that seasonal employment and the termination of stipends explain the change. The result favors the resource-based explanation for that outcome. Suppose a model revision improves ecological classification, and independent validation attributes the improvement to sensor calibration, while the contribution and review arrangements remain stable. The result supports the technical explanation and gives no evidence of an additional interface-control effect. Conversely, a documented rule change followed by rejected access requests, lost independent checks, and a consequential decision made without those checks would justify closer examination of a mechanism connecting institutional authority and evidential circulation. Even here, the strength of the causal claim depends on the plausibility of alternative paths.

Evaluation should distinguish *discrimination*, *validity*, and *feasibility*. Discrimination concerns whether the framework helps identify which rival mechanism operated. Validity concerns whether a concept such as “continuing capacity” is represented faithfully by the proposed observations; the distinction between concepts and operational indicators follows the general methodological issue articulated by Adcock and Collier [1]. Feasibility concerns the cost, lawful availability, interpretive burden, and privacy or ecological risks of collecting the additional records. A framework that obtains a richer description only through extensive inaccessible records may be impractical for the institutions it seeks to inform. A framework that consistently improves interpretive precision with a manageable record can have use even where its causal explanations overlap with established theory.

Finally, the normative inquiry deserves its own appraisal. More accurate prediction of participation or ecological response would establish an empirical achievement. A justified judgment concerning consent, responsibility, recognition, or remedy requires argument from applicable rights, obligations, and

ethical premises. An empirical comparison might reveal whose interests were left outside an official indicator without resolving the proper balance among those interests. The resulting philosophical work concerns the authority of valuation and review. It can be worthwhile even if a parsimonious institutional explanation accounts for the observed outcome. Keeping these standards distinct allows the generative-relational proposal to be tested seriously while preserving the normative questions that motivated it.

11.6 Concept Validity and the Transfer of Indicators

A comparative explanatory test depends on the validity of the descriptions it compares. The presence of an administrative record does not establish that it measures the theoretical relation attributed to it. Adcock and Collier distinguish a broad background concept, a systematized concept specified for inquiry, operational indicators, and the resulting scores or qualitative classifications of cases [1]. Their methodological account provides a useful discipline for the present proposal: concepts such as *consequential voice*, *translation authority*, and *continuing generative capacity* must be specified independently of the easiest documents available to an investigator. Their analysis also separates the validity of a measure from the distinct problem of establishing a causal explanation.

For *consequential voice*, a systematized concept could refer to a participant's institutionally recognized ability to introduce a reason or objection into a decision procedure and obtain an accountable response. An indicator might combine a recorded submission, its entry onto a decision agenda, the grounds given for accepting or declining it, and an available route of challenge. A count of speaking turns or meeting attendance would measure visible activity while leaving the consequential relation underdetermined. For *translation authority*, the relevant concept concerns control over the categories and transformations through which evidence receives institutional significance. An analyst might examine who can amend classifications, demand an independent check, authorize an indicator's adoption, and contest an interpretation. Possession of source code is an informative technical fact, although the institution able to define official categories may be a different actor. For *continuing capacity*, records of funds distributed or training sessions delivered are possible inputs. Evidence that people can actually conduct a subsequent inquiry, maintain a service, or decline a restrictive arrangement would be more closely aligned with the proposed relational capability.

Table 14 records examples of these distinctions. The indicators are possible research instruments requiring validation, with no claim that the table supplies a universal scale.

Table 14: Provisional construct-to-evidence checks for a comparative research design. Proposed records require independent validation in each setting.

Construct to specify	Candidate evidential record	Misclassification or rival reading
Consequential voice	Submitted reasons, decision dispositions, review access, recorded revisions	Attendance or consultation volume may coexist with fixed decisions
Translation authority	Indicator protocols, revision permissions, category decisions, independent challenge records	Technical custody may differ from authorization of official interpretation
Continuing generative capacity	Follow-on access, usable resources, independent maintenance, feasible renewal or exit	Expenditure and training counts may precede little practical continuation

Validation can proceed through several complementary checks. *Content scrutiny* asks whether the defined construct includes the aspects relevant to the research question. *Convergent and discriminant scrutiny* compares classifications with appropriately related and different observations, while allowing for divergences that expose an incorrect operational assumption. *Nomological scrutiny* examines whether the construct enters theoretically expected relations without using those expectations to predetermine its score. Adcock and Collier discuss these as families of evidence for validity, within a framework that accommodates both quantitative and qualitative classification. Here, independent coding of documentary episodes, scrutiny of discrepant cases, and interviews with differently situated participants could support the checks. Agreement among coders would contribute evidence concerning reliability; validity would

still require that the classifications capture the stated concept. Interview testimony and institutional records each require attention to position, missingness, and the possibility of pressure on respondents.

Transporting an indicator to a new cooperative setting introduces a second question: whether its *meaning and evidential relationship* remain sufficiently stable. The same number of public comments could signify access to an influential procedure in one setting and compliance with a purely consultative formality in another. Equivalent document formats may conceal different rights of inspection, appeal, or data reuse. Likewise, ecological measurements standardized at the sensor level can enter distinct conservation judgments. A cross-case protocol should therefore document local definitions, institutional competences, sampling conditions, and the cases excluded by missing records. It should test whether classifications change under plausible alternative thresholds and whether a proposed comparison survives the loss of an indicator that is valid only in one site. An inability to establish meaningful equivalence calls for narrower, context-specific findings rather than a forced common score.

For comparative coding, investigators can publish a construct-to-record map before examining the outcome episodes, preserve alternative classifications, and report disagreements between independent reviewers. These practices make the measurement claims inspectable while allowing the subsequent causal and normative analyses to proceed under their own standards.

11.7 Research Designs Across Methods and Time Scales

Different inferential tasks call for different methods. Interpretive inquiry can reconstruct the meanings and institutional histories of cooperative practices. Process tracing can examine proposed mechanisms within episodes. Comparative historical work can investigate changes in legal status, property relations, professional norms, and technological infrastructures. Quantitative designs can estimate specified relationships when observations and identification assumptions support them. Formal models can make assumptions concerning strategic interaction, allocation, and dynamics explicit. Computational simulation can explore implications of those assumptions and sensitivity to alternative parameter settings. The methods are complementary to the extent that their distinct evidential claims remain visible.

A within-case design is especially relevant when temporal ordering matters. Such research could document the origin of a cooperative project, the transformation of its aims, disputed contributions, changes in governance, and the subsequent distribution of returns. The unit of explanation should be an identifiable mechanism, such as the exercise of a licensing right or the withdrawal of maintenance support. Accounts from differently positioned participants and documentary sources can be compared to reconstruct the event sequence. Researchers should examine rival descriptions at the same resolution and distinguish a participant's sincere interpretation from an independently established causal relation.

A cross-case comparison can investigate whether similar mechanisms appear under different institutional circumstances. Cases could be selected for variation in data-control arrangements, participant autonomy, ecological dependencies, or procedures for redress. Selection should also include cases with apparently successful coordination and cases in which it deteriorated, while reporting the consequences of selection on outcomes. A configurational approach may be useful where causal conditions operate in combinations. Ragin develops set-theoretic methods for studying such configurations, with attention to calibration and the relation between case knowledge and cross-case patterns [38]. Their use here would require transparent thresholds and a defensible account of which conditions are necessary to the inquiry. Small case collections may support bounded comparison and mechanism development while providing a limited basis for population-level generalization.

Quantitative research might employ project-level panels tracking access arrangements, recognition disputes, maintenance expenditures, contributor retention, or ecological indicators. The selection of a dependent variable would determine which question the analysis answers. Institutional changes might sometimes permit interrupted time-series analysis, matched comparisons, or other quasi-experimental approaches, contingent on credible identification assumptions. Where the introduction of an access procedure coincides with a change in funding, leadership, technology, or environment, an estimated association would remain vulnerable to confounding. Longitudinal data can improve the description of

sequences while leaving causal identification dependent on additional assumptions and evidence.

The relationship among methods also calls for intellectual discipline. Goertz and Mahoney describe significant differences in qualitative and quantitative research traditions concerning concepts, causal analysis, and inferential goals [25]. A multi-method programme should preserve the meaning of each method's conclusions. Evidence that a mechanism operated in one case, an estimated association across a population of projects, and an ethical argument about justifiable decision-making occupy different levels. Convergence across methods can strengthen a bounded claim when the methods address sufficiently aligned objects and their errors are meaningfully distinct. Divergent findings may reveal measurement mismatch, heterogeneity of cases, or genuine problems with the explanatory proposal.

Time scale is a further design choice. A restoration intervention may show rapid improvements in monitoring coverage, delayed ecological responses, and still slower changes in legal governance or community trust. A technical platform may change in weeks, employment capacities over months, and habitat conditions over years. Investigators should identify these intervals, the frequency of observation, and the reasons for linking them. A single before-and-after comparison may otherwise combine processes with different temporal relations. Claims concerning regeneration especially require observation intervals commensurate with the alleged renewal or depletion, together with an explicit account of baseline conditions.

11.8 Valuation Plurality and Measurement Boundaries

The empirical study of plural valuation encounters a challenge: the objects of interest may be evaluatively heterogeneous even when their consequences can be described with numerical indicators. An estuarine project might produce measurements of water quality, changes in household access to warnings, revenue for a contractor, paid hours for local observers, and participant statements concerning cultural continuity. These observations can each be meaningful while remaining sensitive to different standards of validity. A common score that combines them would be a deliberate evaluative construction, with weights, normalization decisions, and authority over the weighting procedure requiring explicit justification.

A more restrained practice begins with a *plural outcome profile*. The profile records outcomes under named dimensions, their units and sources, the parties for whom they matter, and the applicable standards of interpretation. Some dimensions can support quantitative comparison within an established measurement framework. Others may support ordinal judgments, qualitative interpretation, or the documentation of disagreements. The profile can express uncertainty and conflicting evidence without resolving every difference through aggregation. Where decision makers require a composite index, its construction can be treated as an object of institutional inquiry alongside its possible practical usefulness.

Commensuration may itself produce a causal intervention. A performance metric can alter reporting incentives, remuneration, and which forms of effort receive recognition. The social effects of commensuration described by Espeland and Stevens are therefore relevant both to the study of valuation and to the study's own procedures [18]. Researchers should examine how published indicators affect the participants they describe, whether incentives reward the appearance of contributions, and whether important activities become less visible. Reflexive auditing of measurement choices can help limit the risk that the investigation reconfigures its object in ways it subsequently treats as neutral observation.

An inquiry into contributions also needs to distinguish *observed input*, *causal difference*, and *justified entitlement*. Hours of work, a supplied dataset, or a biological process can be recorded as inputs. Their causal significance depends on a specified outcome, relevant alternatives, interactions, and the chosen counterfactual. Credit, compensation, and protection depend additionally on contractual, political, or ethical grounds. A technique such as marginal-contribution allocation can provide information under its assumptions while leaving questions of legal rights, institutional obligations, ecological stewardship, and distributive justice for separate inquiry. Treating these as distinct allows empirical and normative arguments to inform one another with greater precision.

Measurement should attend to disagreement within groups. Community representatives, members of an organization, and users of a technical service may differ in their priorities and access to informa-

tion. A single organizational preference may be an authorized decision for specified purposes, while the plurality of affected perspectives remains relevant to interpretation and legitimacy. Individual interviews, meeting records, formal votes, complaints, and administrative actions provide different kinds of evidence. Researchers should document which claims are attributed to participants, which represent institutional decisions, and which are interpretive conclusions reached by the research team.

11.9 Constructed Research Protocol: Estuarine Monitoring Partnership

The estuarine partnership introduced in Section 10 can be extended into a research protocol that makes the distinctions operational. The partnership is a constructed illustration rather than an observed empirical study. Assume a municipal authority, coastal residents, a scientific group, a contracted service provider, and ecological monitoring sites jointly sustain an estuary-restoration and warning initiative. Residents contribute observations; researchers develop monitoring practices; the contractor provides software and maintenance; the municipality authorizes communications and procurement; ecological processes affect the physical outcomes. The research objective is to explain how observed contributions become consequential, how the products circulate, and how later capacities change under varying governance arrangements.

The research team would begin with a declared boundary: one planning cycle, one deployment cycle, and one subsequent renewal decision. A preceding period would establish baseline access rules, maintenance arrangements, data sources, and relevant environmental conditions. The team would identify institutional actors and affected participants, describing its inclusion choices and any populations whose interests require independent attention. Agreements and lawful access permissions would determine the sources available for study. Sensitive ecological locations and personal information would be protected through procedures justified by the applicable professional, ethical, and legal requirements.

The first comparison would concern two possible interpretations of an apparent decrease in resident participation. A resource-based account might attribute the decline to reduced stipends or the end of a monitoring grant. An interface-control account might predict that a change in data licensing and feedback access reduced the practical ability of residents to benefit from their contributions. A plural-valuation account might find that the project goals changed toward commercial analytics, with fewer participants regarding the activity as worth pursuing. These explanations can operate together. The protocol should specify the temporal and documentary observations capable of identifying their respective contributions, and it should allow for findings in which one or several explanations adequately account for the decline.

The second comparison would concern the interpretation of an improved technical service. If forecasting accuracy improved, the researcher would examine calibration changes, sensor coverage, software updates, and the use of local observations. A claim about contributors' roles would be tied to the available technical and process evidence. A judgment concerning fair acknowledgment would rely additionally on relevant agreements and the actual organization of contributions. The service's usefulness to residents would require separate evidence concerning access, clarity, timeliness, and consequential decisions. Ecological benefit would require appropriately designed environmental observation over a suitable period. These are linked questions about one project, although their standards of evidence differ.

Table 15 states a feasible set of documentary targets. They are proposed observations, not results attributed to an existing project.

A credible analysis would establish how each observation was produced, which researchers could inspect it, and what alternative accounts remained plausible. Where an analysis invokes participatory legitimacy, it should additionally trace whether submitted evidence entered a decision agenda, received an accountable disposition, and remained open to a competent form of review (Section 9.5). Formal opportunities to comment and actual authority over institutional action should be coded separately. If the contractor's logs were unavailable, the team could assess claims from accessible inputs and outputs while qualifying the inferred role of internal model changes. If residents' accounts diverged, the study could document the differences and examine their institutional context. If ecological observations extended across an unusually warm season, the environmental explanation would require that condition to

Table 15: Illustrative evidential protocol for a constructed estuarine partnership. Each row specifies a question and records capable of supporting or challenging a bounded inference.

Question	Proposed evidence	Rival or validity concern
Contribution to technical output	Sensor provenance, maintenance logs, model versions, validation records	Data quality, other model changes, missing baselines
Institutional conversion	Licences, procurement rules, access-request records, decisions	Existing contractual obligations, resource scarcity
Plural valuation and participation	Participant accounts, meeting minutes, disagreements, decisions	Representative authority, expressed versus enacted preferences
Circulation and return	Payment records, archive access, training, maintenance allocations	External employment, budget and policy changes
Ecological and public effects	Domain-specific environmental measures, advisory histories, user studies	Seasonal variation, sampling, exposure and selection
Correction and responsibility	Complaint routes, decision audit trails, remedial actions	Formal procedure versus usable remedy, jurisdiction

be addressed. Independent verification would be especially important where the investigator's access depended on the institution whose conduct was being assessed.

The protocol also permits a prospective design. Investigators might specify in advance how to document licensing changes, contributor access, correction opportunities, and subsequent maintenance decisions. A subsequent evaluation could then compare the registered expectations with the observed sequence, recording deviations and newly discovered mechanisms. Where intervention is ethically and institutionally permissible, alternative arrangements for feedback or data access could be evaluated. Observational alternatives remain appropriate when random assignment would interfere with public services, rights, or ecological protections. The decision to intervene carries its own normative responsibilities and should be evaluated independently of the explanatory programme.

11.10 Disconfirmation, Refinement, and Comparative Value

The proposed framework should be revised through findings that challenge either its conceptual distinctions or its empirical usefulness. Several outcomes would be particularly instructive. A carefully studied cooperative setting might possess transparent contribution records, a stable shared measure of output, and adequate rules for allocating returns. Established production and governance models might explain the observed outcomes and subsequent participation with sufficient precision. In such a setting, a generative-relational redescription might offer little additional explanatory value. The appropriate conclusion would delimit the framework's useful scope or treat it as an integrative vocabulary for that domain.

A different challenge would arise if the records proposed in Definition 11.1 repeatedly failed to support reliable distinctions. Researchers might find that valuation and conversion cannot be separated in a particular practice, that changing episode boundaries alters the inferred contribution so strongly that comparisons become unstable, or that indicators of future capacity lack acceptable validity. Some difficulties may be resolved by improving case definitions and measurement practices; persistent failures would warrant revising or abandoning particular constructs. A framework that accommodates every possible outcome through retrospective relabeling would offer limited explanatory discipline.

Evidence could also favor an alternative mechanism. Suppose changes in access rights appear related to participation in a preliminary analysis, yet interviews, contracts, and temporal records indicate that participants withdrew because the core project goal had changed. The evidence would then favor the preference or valuation explanation for that episode. Suppose a programme appears to preserve long-term participation through the return of resources, but a comparison with otherwise similar projects shows that recruitment practices account for the observed continuity. The alleged regenerative-return mechanism would require qualification. Researchers should describe these results as informative tests of bounded claims, including cases in which the framework's proposed causal links receive weak support.

The normative components require a separate form of criticism. An empirical finding that a decision

was widely accepted cannot by itself establish that it satisfied rights, valid consent, or environmental responsibilities. Conversely, a justified ethical criticism may remain relevant even where a cooperative arrangement produces substantial output and stable participation. Philosophical argument, applicable legal norms, and evidence concerning affected parties should be brought together at their appropriate levels. A revision might narrow a normative claim, differentiate duties among institutions, or identify an evaluative perspective previously left out of the analysis.

There is also a substantial risk of theoretical overreach in cross-domain comparisons. Ecological processes, human intentions, institutional agency, and technical functionality can be described relationally, yet their evidential and ethical differences matter. The framework should retract a proposed cross-domain equivalence where it obscures domain-specific mechanisms, or where the corresponding evidence supports only a more limited analogy. Its openness to heterogeneous participation provides an orientation for inquiry rather than a presumption of shared subjectivity, interests, or moral standing.

For a research programme, *comparative value* can be assessed through several criteria: explanatory discrimination among rival mechanisms; validity and reproducibility of its evidential descriptions; clarity about its domain of application; ability to reveal neglected consequences or affected interests; and practical feasibility relative to the burden of collecting and interpreting records. A comparison should evaluate these properties against a well-specified institutional, economic, or sociological account applied to the same cases. If the proposed framework yields distinctive insight only by using a richer dataset, the incremental value of the conceptual account should be distinguished from the value of the additional observations.

The comparative verdict should identify the outcome and interval studied, the evidential access actually achieved, the rival mechanism that received strongest support, and the specific contribution—if any—of the generative-relational description. These bounded findings offer a more accountable basis for conceptual revision than a general declaration of theoretical superiority.

12 Conclusions and Open Philosophical Problems

The inquiry into value co-creation among heterogeneous subjects has examined a practical possibility with philosophical consequences: participants may transform one another's conditions for future activity while retaining distinct and sometimes competing accounts of what makes the resulting activity worthwhile. The question is particularly consequential where production depends upon social infrastructures, ecological processes, inherited practices, and technical systems whose contributions enter different economies of recognition. The concluding section reconstructs the proposed contribution, clarifies the possibilities and limits of cooperation amid plural valuations, and identifies the conditions under which its generative character should be assessed. It then examines unresolved philosophical questions and specifies a programme of comparative research and accountable practice. The conclusions remain provisional: the preceding analyses establish conceptual distinctions and reasons for inquiry, while their explanatory and institutional usefulness awaits testing in particular settings.

12.1 The Philosophical Contribution of a Generative-Relational Account

The central proposal is to study value co-creation through the relations connecting *contribution*, *valuation*, *conversion*, *circulation*, and the *regeneration of capacities*. Each term identifies a different analytical question. Contribution concerns the processes and conditions that causally or constitutively enter an outcome. Valuation concerns the practices through which significance is assigned, contested, or revised. Conversion concerns the institutional and technical arrangements through which one kind of contribution becomes legible, usable, compensable, or authoritative in another setting. Circulation concerns the paths by which opportunities and burdens move or become accessible. Regeneration concerns the subsequent capacity of participants and environments to sustain further activity. The terms provide a connected sequence of questions while accommodating different event histories: a practice can include simultaneous conversion and contribution, recurrent negotiation, interrupted circulation, or irreversible loss.

A major advantage of distinguishing these questions lies in the ability to separate an outcome's significance for a participant from the processes that brought it about and from the legitimacy of its production. A coastal observation may be scientifically valuable, economically usable, politically consequential, and locally meaningful for different reasons. The contribution of a resident who interprets a warning may be essential to its actual use, even when formal reporting systems treat the warning as the product of a monitoring platform. The recognition of that contribution, in turn, can coexist with restricted access to the resulting records or with the continued exposure of the resident to risk. An analysis that traces each relation can identify the specific point at which cooperation becomes beneficial to some participants, burdensome to others, or vulnerable to the loss of its own supporting conditions.

The provisional generative-relational vocabulary offers a possible organization of these observations. It focuses on historically formed capacities and on encounters through which participants' possibilities are modified. A strong claim that every such modification constitutes co-creation would obscure the difference between supplying an enabling condition and participating in the formative development of a shared activity. Sections 1–11 therefore retain a narrower, contestable use of the term. A characterization of *co-creation* should be supported by evidence that consequential, differentiated contributions enter the development of a common or interdependent trajectory, together with a defensible account of its boundaries and relevant alternatives. The effects can be unequal and may become visible over different intervals. A shared project is likewise capable of generating losses, dependencies, and contested obligations alongside benefits.

The contribution is consequently both conceptual and methodological. Conceptually, the proposed distinctions prevent causal contribution, acknowledgment, ownership, welfare, and normative entitlement from collapsing into one another. Methodologically, they encourage investigators to follow a cooperative episode beyond its immediately reportable product, asking who controls its evaluation, where its benefits travel, and what happens to the conditions of subsequent participation. These questions already have important antecedents in political economy, generative justice, sociology of valuation, institutional studies, and theories of recognition. Eglash's generative-justice perspective, for example, supplies a substantial precedent for asking how generated value returns to the conditions and communities of its production [16]. The present account's proposed extension concerns the philosophical and evidential treatment of heterogeneous modes of valuation and the interfaces that translate among them. Its merit should be assessed by comparison with the strongest available accounts of the same events.

The organizing vocabulary is also open to revision at the level of individual concepts. An empirical inquiry might show that a proposed category of conversion adds little explanatory precision beyond a documented dependency relation, or that the distinction between contribution and regeneration is inseparable in a particular cooperative practice. Such findings would improve the account by specifying its domain or displacing an unhelpful distinction. Philosophical inquiry gains from concepts whose conditions of use and possible failure can be made explicit.

12.2 Cooperation under Persistent Differences in Valuation

The phrase *plural valuations* foregrounds the coexistence of distinct practices of appraisal within a shared generative process. Their criteria may be locally compatible, only partly comparable, or subject to continuing contestation. Substantial common ground can nevertheless develop through particular tasks, procedures, and commitments. Participants may agree on a task, accept local standards of evidence, follow a legally required procedure, and coordinate their efforts while retaining different reasons for participating. Their practical arrangement may involve partial comparisons, negotiated thresholds, context-specific equivalences, and deliberative acknowledgment of goods that remain difficult to compare. Qualitatively plural modes of valuing provide one background for this formulation [3]. Chang's parity supplies a distinct philosophical possibility concerning the comparative relation between alternatives under a specified consideration [11]; the cooperative arrangements considered here may develop even where that substantive value relation remains unresolved. The present contribution concerns how such coordination reshapes ongoing relations of production and dependence.

Common action under plural valuation is intelligible because agreement about a decision may arise through more than one evaluative path. A farmer may support an estuary intervention for its protective effect on a livelihood; a field researcher may support it for ecological knowledge; a municipality may support it for its statutory responsibilities. Their reasons can converge on the intervention while diverging on the distribution of costs, acceptable uncertainty, public access to data, and conditions for renewal. The resulting arrangement should be examined as a historically situated agreement with specified scope. Its stability depends partly on whether participants can learn about its effects, retain opportunities to revise authorization, and contest changes that redirect their contributions toward purposes they did not anticipate.

This analysis yields an important boundary on the value of plurality itself. Diversity of reasons can enlarge the possible basis for cooperation, while legitimacy remains a separate ethical and political question. An agreement obtained under severe dependence, opaque terms, or unequal opportunities to refuse may be formally valid under a particular rule while remaining open to ethical and political criticism. Equally, the pursuit of a common measure may be defensible in a bounded domain, especially where transparent public comparison protects people from arbitrary decisions. The question is which kinds of commonality serve a given practice, under whose authority, and at what cost to other relevant goods. The philosophical problem concerns the situated conditions under which translation, comparison, and the preservation of difference are appropriate.

An account of coordination must also distinguish *agreement about procedure* from *agreement about ends*. A cooperative arrangement may need binding procedures to allocate scarce resources, address imminent danger, or resolve a dispute within an institutional deadline. Those procedures can deserve support because they make action possible under continuing disagreement. Their legitimacy, however, depends on more than operational efficiency: who is represented, what evidence may be introduced, which rights constrain the decision, and what avenues of challenge remain available are independent questions. The persistence of plural valuation therefore increases the importance of institutional design and responsible judgment. It also gives a reason to preserve records of dissent and of evaluative concerns that a final decision temporarily leaves unresolved.

Differences in valuation may themselves change through cooperation. Participants can learn new uses for an artifact, develop a shared expressive practice, or discover previously unrecognized vulnerability. Such changes deserve study without presuming convergence as the proper endpoint. A constructive outcome may consist in a better-articulated disagreement, an arrangement for peaceful coexistence, or a durable practice of partial translation. Conversely, an apparent consensus may reflect the withdrawal of less powerful participants or the exclusion of their claims from the relevant forum. Historical investigation must therefore distinguish changing convictions from changing opportunities to express them.

12.3 Control of Conversion and the Responsibilities of Participation

The relations through which contributions become recognized outcomes are institutionally organized. A data standard decides what can be recorded. A contract allocates control over reuse. A reporting procedure gives some forms of evidence a formal route to decision-makers. A publication or attribution system makes some contributors visible while permitting other forms of sustaining labor to disappear into the background. These arrangements are *value-conversion interfaces* in the limited analytical sense proposed in Section 7: situated procedures and infrastructures through which the standing and usability of contributions are transformed. Their study connects questions of technical design with economic power and normative authority.

The mere existence of an interface reveals little about justice. Transparent technical standards may facilitate cooperation among participants who require comparable observations. Licenses may protect a common resource against enclosure. An established hierarchy may assign clear responsibility when a rapid public-safety decision is needed. The pertinent questions concern whose aims the arrangements serve, the alternatives available to affected participants, the durability of their protections, and the distribution of discretion to revise the rules. A configuration can be productive and restrictive at once. Even

a project whose overall outcome is widely valued may concentrate the power to redirect its future uses in an institution that supplied only part of its generative conditions.

Attribution deserves particular care because it mediates both descriptive history and subsequent opportunity. A record that omits local knowledge, maintenance labor, translation, or correction work can alter the ability of those contributors to claim recognition, obtain remuneration, influence design, or participate in a later phase. Reconstructing provenance may therefore contribute to capacity formation. Distributive entitlement and governance authority additionally require their own grounds of justification. A person can be causally indispensable without acquiring an unrestricted right over every future use; a participant can possess a legal right that is independent of the magnitude of an identifiable contribution. The investigation of actual contribution must be accompanied by an inquiry into contracts, rights, legitimate expectations, vulnerability, and public obligations.

The account consequently distinguishes three questions that cooperative rhetoric often combines. The first is *explanatory*: whose acts and conditions helped produce the result? The second is *institutional*: who has effective power to evaluate, use, convert, or distribute the result? The third is *normative*: which powers and distributions are justified, and to whom is an explanation or remedy owed? An answer in one register can inform the others while remaining insufficient to determine them. Responsibilities are likely to vary with control, knowledge, avoidability, benefit, dependency, and the vulnerability of those affected. The institutions that administer shared resources may bear duties of public explanation that differ from the responsibilities of individual contributors. A person with little control over an imposed procedure may have a justified claim to redress despite having participated in the productive relation.

This separation creates space for ethical judgment under value plurality. Consent, continuing authorization, welfare, transparent contestation, and the possibility of withdrawal form different dimensions of cooperative legitimacy. They require domain-specific interpretation. In a public service, lawful duties to affected residents may constrain what can be negotiated among project partners. In an ecological intervention, protecting living conditions may take priority over an institution's ability to extract a measurable benefit. In a research collaboration, the intelligibility of data provenance and the correction of misleading claims may be central obligations. The framework's normative ambition is to make these differentiated responsibilities visible and arguable, leaving their assignment to context-sensitive ethical, legal, and political judgment.

12.4 Circulation, Time, and the Preservation of Generative Conditions

A completed outcome is only one temporal point in a cooperative relation. Information requires continuing care; an instrument requires repair; a learned practice requires opportunities for transmission; and an ecological intervention may alter material conditions across periods longer than the project that funded it. The paper has therefore proposed *regenerative return* as a question about the movement of resources, opportunities, recognition, authority, and care back toward the capacities implicated in a productive history. Return need not take the same form as the original contribution. Payment, restored access, maintenance, shared governance, protected habitat, and the creation of opportunities for subsequent inquiry can all be candidates for contextual assessment. Each requires a specification of recipient, relevant capacity, causal connection, institutional authority, and evaluative perspective.

These possibilities reveal why equality of immediate exchange is an incomplete description of co-operation over time. Two parties may obtain comparable present benefits while their future capacities diverge sharply. A community may receive a report while losing control over the records from which it was produced. A research institution may distribute useful software while transferring the continuing cost of maintaining the associated data to a less-resourced partner. A technically successful restoration project may leave the monitoring infrastructure dependent on funds that disappear when its first contract expires. Historical reconstruction can show whether a distribution supports further participation, produces an expanding dependence, or exhausts a condition that subsequent work will require.

Temporal extension also makes normative claims more difficult. Some burdens emerge after contributors have departed. Some gains depend on the labor of successors who had no part in the initial

agreement. Ecological changes may be uncertain, delayed, or partly irreversible. A present decision can reshape which parties and forms of life will encounter its consequences. The relevant obligations cannot simply be inferred from a fixed roster of original participants. A defensible analysis needs explicit observation horizons, a justification for including later-affected parties, and procedures that accommodate discoveries beyond the first assessment. The longer time scale increases uncertainty; it does not authorize speculative attribution of a determinate future benefit.

The term *regeneration* must also remain qualified. Restoring a measurable capacity may be compatible with loss of an irreplaceable relation, place, organism, or historical practice. A replacement resource can compensate for certain functions while leaving other consequences beyond comparison. In such cases, the language of return should preserve the difference between partial remedy, continued support, and the restoration of a prior condition. The mere possibility of producing further value provides insufficient grounds for accepting an avoidable injury. Regenerative praxis therefore includes the recognition of limits, the protection of conditions whose loss is grave, and an accountable approach to harms that persist after a project has ended.

12.5 Unresolved Problems of Agency, Value, and Relational Identity

Several philosophical difficulties remain prior to, or partly independent of, the proposed empirical tests. Their importance lies in specifying what further argument would be required for a more general account of heterogeneous co-creation. The open problems concern the individuation of relations, the interpretation of value, the status of participants, and the temporal and normative boundaries of an encounter.

Individuating a co-creative relation. A history of production contains indefinitely many enabling conditions. A library, a prior scientific result, a maintenance worker, a material supplier, a public institution, and an environmental process may all be indispensable under one counterfactual description. A useful account of co-creation must explain which interactions belong to the relevant cooperative episode and which remain background conditions for the purpose of a particular inquiry. This is a problem of justified individuation, with consequences for causal inference and normative recognition. Episode boundaries may be selected according to a research question, a legal relationship, a historically constituted practice, or an evidentially salient dependence. Those criteria can yield different legitimate descriptions. Future work should clarify the relationship among them and examine when a difference of boundary becomes a substantive disagreement about the object of inquiry.

Evaluative perspectives and the identity of generated value. If a single event is beneficial under one perspective and harmful under another, the phrase *value generated* requires a specified standpoint. One possibility is to describe changes in capabilities, relations, ecological conditions, and artifacts before making any evaluative judgment about them. Another is to understand a value-bearing transformation as already situated within an identifiable practice of appraisal. The paper uses both types of description, marking their different roles, but a general theory would need a more detailed account of the relation between descriptive transformation and value attribution. Further questions concern the conditions under which separate valuations refer to the same object, the historical revision of evaluative languages, and the grounds for criticizing a valuation practice that systematically excludes affected participants.

Participation and agency across heterogeneous systems. The framework permits the causal importance of human action, ecological processes, institutions, and artificial systems to be studied in a common relational field. Such a field retains their differences in intentionality, experience, responsibility, and moral standing. Institutions act through organized practices and delegated authority. Organisms sustain and transform environments through biological activity with diverse capacities for responsiveness. Contemporary artificial tools can contribute to productive processes through designed operations while their deployment, maintenance, permissions, and consequences remain embedded in sociotechnical institutions. A philosophical account must state the sense in which each entity is a *participant*. Questions

of subjective experience and ethical status require separate philosophical arguments and appropriately differentiated evidence.

Collective agency and asymmetric transformation. Interdependent participants may generate a result whose meaning and direction emerge through their interaction. Whether their encounter constitutes a collective agent is a further issue. Joint activity can occur through a negotiated arrangement without a unified intention, and some institutions can act collectively while constraining the discretion of individuals within them. The paper's account of co-creation concerns consequential interdependence and the development of capacities. A stronger theory of collective agency would have to examine authorization, shared intention, procedural representation, and the ability to answer for actions in the name of a group. An especially difficult case arises when one participant substantially reshapes the opportunities of another while controlling the description of the supposedly common purpose.

Normative authority under enduring disagreement. Where participants retain partially different evaluative worlds, procedures for making common decisions acquire exceptional importance. Such procedures require justified limits of jurisdiction, avenues of challenge, and an account of affected interests. Procedural inclusion requires substantive review, and substantive protections may themselves be contested. The unresolved problem is to explain how a cooperative order can remain practically decisive while preserving ethical criticism and the possibility of revision. The legitimacy of a collective decision, the justice of its distribution, and the reasons each participant has for accepting it may diverge. A satisfactory theory will need to address those divergences rather than subsume them under a single conception of consensus.

Historical succession and the changing bearer of obligations. Generative histories outlast particular organizations and agreements. Data custodians change, ecological responsibilities persist, and communities can be transformed by migration or technological restructuring. A new institution may inherit the benefits of a contribution without sharing the historical circumstances in which it was made. When does the benefit establish an obligation of return, disclosure, or care? What happens when the capacity to comply is itself unevenly distributed? How should retrospective acknowledgment relate to current vulnerability and prospective repair? Answers require careful interaction between historical explanation, institutional authority, applicable law, and normative theories of responsibility. The proposed framework identifies the continuity problem but leaves its general resolution open.

Ontological reach and epistemic restraint. The wider generative-relational programme invites questions about whether relations and histories have philosophical priority in explaining the emergence of subjects and their capacities. The present paper supplies a bounded practical analysis of cooperative situations, leaving the ultimate ontology of persons, social relations, organisms, and technologies open. Relational descriptions may be indispensable for certain explanations while remaining compatible with several metaphysical interpretations. The status of generative order, the possibility of non-relational primitives, and the relation between historically situated descriptions and fundamental ontology remain independent subjects of investigation. A productive programme can examine these questions while sustaining an epistemic distinction between useful modeling and ontological commitment.

These open problems bear directly upon one another. A change in the individuation of a cooperative episode can alter which participants appear relevant; a different theory of agency can alter which consent practices are appropriate; and a longer temporal horizon can expose losses previously hidden by a positive account of generated value. Their interdependence suggests an agenda of carefully scoped philosophical investigations in dialogue with legal, ecological, historical, and social-scientific inquiry. The conceptual vocabulary accordingly remains subject to independent criticism.

12.6 Comparative Research and Accountable Institutional Praxis

The preceding analysis supports a research programme organized around a limited comparative question: in which cooperative settings does following contribution, valuation, conversion, circulation, and future capacity reveal mechanisms or obligations that a well-developed alternative account leaves less visible? Answering requires suitable cases, clear observation periods, explicit rivals, and evidence adequate to the claims being made. Cooperative production models, institutional governance frameworks, valuation studies, and power-dependence accounts remain important interlocutors. Their explanatory success in a given case is a finding to incorporate. A generative-relational study makes a useful contribution when its additional distinctions support more discriminating interpretation or more accountable action at a proportionate evidential cost.

A tractable first stage would follow a bounded collaboration through at least two connected periods of decision and use. Investigators could document initial authorization, relevant contributions and supporting conditions, changes in the valuation or attribution of results, arrangements for access and reuse, and subsequent opportunities for participants to continue or contest the work. The protocol outlined in Section 11 provides one possible starting point. Documentary records, interviews, field observation, administrative histories, and domain-specific measurements would illuminate different parts of the same episode. Their integration requires attention to evidential provenance, confidentiality, positionality, and the risks incurred by participants when sensitive dependencies are made visible. The study should also specify how absent and contested records affect its conclusions: a documented event, an adequately established nonoccurrence, and an unresolved proposition require distinct reports. Where access is restricted for legitimate reasons, an appropriately authorized and independent form of review may strengthen the evidence while preserving necessary protections.

A second stage would compare cases selected for theoretically consequential differences. A programme with an established common metric could be compared with a programme coordinating several evaluative perspectives. Projects that distribute continued governance rights might be compared with projects granting access to outputs while retaining centralized control over reuse. Recurrent collaboration could be examined where partners possess realistic alternatives and where one partner is highly dependent on the other. These comparisons could help discriminate the effects of valuation plurality from those of institutional rules, resources, technical architecture, and historical selection. They should avoid treating differences in sector or ecological context as incidental variation. Meaningful comparison depends on specifying what remains comparable and where domain-specific interpretation is necessary. The proposed concepts also require explicit links from definitions to qualitative classifications or numerical indicators, with local validation and an account of how those links travel across cases. A common metric can simplify coordination while recording only one part of the relevant relation. A comparative finding should therefore state which measures retained their meaning, which needed context-specific reconstruction, and which normative questions remained open.

The corresponding practical agenda concerns the design and revision of cooperative interfaces. Before deploying a reporting metric or a data-sharing arrangement, an institution could ask how the metric selects valued outcomes, which contributions it leaves difficult to recognize, who may correct the record, and which future uses require renewed authorization. During a project, an accountable process might preserve multiple perspectives on the purpose of the work, record unresolved objections, and distinguish technical reliability from justified use. At renewal or closure, participants could examine whether maintenance burdens, legal control, opportunities for future participation, and relevant ecological responsibilities have changed. These practices are provisional candidates for evaluation; their appropriateness and effects require assessment in each cooperative setting.

Institutional prudence also requires evaluating the costs of the proposed inquiry. Detailed provenance can protect attribution while creating surveillance risks. Greater visibility of contributions can expose vulnerable people or culturally sensitive knowledge. Participatory procedures can expand voice while placing additional unpaid demands on those already carrying significant burdens. Rights of contestation can be meaningful only when the participants can use them without unacceptable retaliation or loss. The generative-relational perspective therefore applies reflexively to its own instruments: a procedure

intended to improve recognition, return, or participation should be assessed for the new dependencies, exclusions, and costs it produces. Its operation must respect relevant law, research ethics, and context-specific duties of care.

The principal empirical test concerns the increment secured by this extended view of cooperation. If observing a longer trajectory uncovers an unrecognized mechanism of exclusion or a consequential pathway of regenerative return, the finding should identify how the mechanism operates and which rival explanation it distinguishes. If the same insight follows sufficiently from an established governance or power analysis, that success should be acknowledged. A theory that learns from explanatory competition is more useful than one that accumulates new vocabulary for familiar events. A practice that allows affected participants to revise its descriptions and procedures is likewise more accountable than one that equates a completed output with a completed relation.

12.7 A Continuing Orientation for Generative Praxis

The philosophical possibility considered throughout the paper can now be stated with greater precision. Co-creation among heterogeneous participants may be sustained through consequential, differentiated interactions even when the participants' reasons for valuing the resulting activity remain partly divergent. Such interaction acquires its fuller significance within a history of resources, recognition, governance, and changing capacities. A project can succeed according to one measure while diminishing conditions of participation elsewhere; a formally equal exchange can lead to unequal possibilities of continuation; and a shared outcome can remain subject to several irreducible interpretations. These observations motivate careful analysis rather than a presumption of harmony.

Generative praxis names, provisionally, a mode of inquiry and action attentive to the conditions through which future possibilities are formed. Its normative quality depends on responsible decisions about recognition, institutional power, welfare, authorization, repair, and the distribution of opportunities to participate. Its explanatory value depends on whether its distinctions remain intelligible and discriminating in comparison with established theories and actual evidence. Its philosophical openness depends on maintaining the difference between an analytically useful relation and a final claim about the kinds of beings that inhabit that relation.

The most consequential question is thus also an enduring one: how can cooperative institutions preserve the possibility of further, differently valued activity while answering for the conditions, transformations, and injuries generated through their own work? An adequate answer will vary across contexts, and some disagreements will remain. The present inquiry offers a structured way to investigate those variations and a reason to keep the histories of contribution, conversion, and return open to criticism and renewal. Its conclusion is an invitation to comparative research and accountable practical judgment, with the generative-relational account itself remaining among the objects of inquiry.

Research Ethics and Source Provenance

Evidence and research status. Scenarios are constructed philosophical cases. This manuscript reports no original intervention, human-participant data, measured ecological intervention outcomes, or evidence regarding artificial subjective experience. No ethical approval was sought because no human-participant research was conducted.

Source status. References used in Sections 1–12 were checked online against publisher, journal, official assessment, and catalogue records before manuscript insertion. The verification scope and outstanding primary-text passage limits are recorded in `refs/VERIFICATION_LEDGER.tsv`.

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References

- [1] Robert Adcock and David Collier. "Measurement Validity: A Shared Standard for Qualitative and Quantitative Research". In: *American Political Science Review* 95.3 (2001), pp. 529–546. DOI: 10.1017/S0003055401003100.
- [2] Armen A. Alchian and Harold Demsetz. "Production, Information Costs, and Economic Organization". In: *The American Economic Review* 62.5 (1972), pp. 777–795. URL: <https://www.aeaweb.org/aer/top20/62.5.777-795.pdf>.
- [3] Elizabeth Anderson. *Value in Ethics and Economics*. Cambridge, MA: Harvard University Press, 1993. ISBN: 9780674097322.
- [4] Chris Ansell and Alison Gash. "Collaborative Governance in Theory and Practice". In: *Journal of Public Administration Research and Theory* 18.4 (2008), pp. 543–571. DOI: 10.1093/jopart/mum032.
- [5] Sherry R. Arnstein. "A Ladder of Citizen Participation". In: *Journal of the American Institute of Planners* 35.4 (1969), pp. 216–224. DOI: 10.1080/01944366908977225.
- [6] Abeba Birhane. "Algorithmic Injustice: A Relational Ethics Approach". In: *Patterns* 2.2, 100205 (2021). DOI: 10.1016/j.patter.2021.100205.
- [7] Luc Boltanski and Laurent Thévenot. *On Justification: Economies of Worth*. Trans. by Catherine Porter. Princeton, NJ: Princeton University Press, 2006. DOI: 10.2307/j.ctv1zm2tzm.
- [8] Mark Bovens. "Analysing and Assessing Accountability: A Conceptual Framework". In: *European Law Journal* 13.4 (2007), pp. 447–468. DOI: 10.1111/j.1468-0386.2007.00378.x.
- [9] Geoffrey C. Bowker and Susan Leigh Star. *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press, 1999. DOI: 10.7551/mitpress/6352.001.0001.
- [10] Stephanie Russo Carroll et al. "The CARE Principles for Indigenous Data Governance". In: *Data Science Journal* 19, 43 (2020). DOI: 10.5334/dsj-2020-043.
- [11] Ruth Chang. "The Possibility of Parity". In: *Ethics* 112.4 (2002), pp. 659–688. DOI: 10.1086/339673.
- [12] Julie E. Cohen. *Between Truth and Power: The Legal Constructions of Informational Capitalism*. New York: Oxford University Press, 2019. DOI: 10.1093/oso/9780190246693.001.0001.
- [13] David Collier. "Understanding Process Tracing". In: *PS: Political Science & Politics* 44.4 (2011), pp. 823–830. DOI: 10.1017/S1049096511001429.
- [14] John Dewey. *Theory of Valuation*. Vol. 2. International Encyclopedia of Unified Science 4. Chicago: University of Chicago Press, 1939.
- [15] Kristie Dotson. "Tracking Epistemic Violence, Tracking Practices of Silencing". In: *Hypatia* 26.2 (2011), pp. 236–257. DOI: 10.1111/j.1527-2001.2011.01177.x.
- [16] Ron Eglash. "An Introduction to Generative Justice". In: *Teknokultura: Revista de Cultura Digital y Movimientos Sociales* 13.2 (2016), pp. 369–404. DOI: 10.5209/rev_TEKN.2016.v13.n2.52847.
- [17] Richard M. Emerson. "Power-Dependence Relations". In: *American Sociological Review* 27.1 (1962), pp. 31–41. DOI: 10.2307/2089716.
- [18] Wendy Nelson Espeland and Mitchell L. Stevens. "Commensuration as a Social Process". In: *Annual Review of Sociology* 24 (1998), pp. 313–343. DOI: 10.1146/annurev.soc.24.1.313.
- [19] Carl Folke et al. "Adaptive Governance of Social-Ecological Systems". In: *Annual Review of Environment and Resources* 30 (2005), pp. 441–473. DOI: 10.1146/annurev.energy.30.050504.144511.
- [20] Nancy Fraser. "Reframing Justice in a Globalizing World". In: *New Left Review* 2.36 (2005), pp. 69–88. URL: <https://newleftreview.org/issues/ii36/articles/nancy-fraser-reframing-justice-in-a-globalizing-world/>.
- [21] Nancy Fraser. "Contradictions of Capital and Care". In: *New Left Review* 100 (2016), pp. 99–117. URL: <https://newleftreview.org/issues/ii100/articles/nancy-fraser-contradictions-of-capital-and-care>.
- [22] Miranda Fricker. *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford: Oxford University Press, 2007. DOI: 10.1093/acprof:oso/9780198237907.001.0001.
- [23] Archon Fung. "Varieties of Participation in Complex Governance". In: *Public Administration Review* 66.s1 (2006), pp. 66–75. DOI: 10.1111/j.1540-6210.2006.00667.x.
- [24] John Gaventa. "Finding the Spaces for Change: A Power Analysis". In: *IDS Bulletin* 37.6 (2006), pp. 23–33. DOI: 10.1111/j.1759-5436.2006.tb00320.x.
- [25] Gary Goertz and James Mahoney. *A Tale of Two Cultures: Qualitative and Quantitative Research in the Social Sciences*. Princeton, NJ: Princeton University Press, 2012. DOI: 10.23943/princeton/9780691149707.001.0001.

- [26] Donna J. Haraway. *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, NC: Duke University Press, 2016. DOI: 10.1215/9780822373780.
- [27] Charlotte Hess and Elinor Ostrom, eds. *Understanding Knowledge as a Commons: From Theory to Practice*. Cambridge, MA: MIT Press, 2007.
- [28] Albert O. Hirschman. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States*. Cambridge, MA: Harvard University Press, 1970.
- [29] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. *Summary for Policymakers of the Methodological Assessment Report on the Diverse Values and Valuation of Nature*. Bonn: IPBES Secretariat, 2022. DOI: 10.5281/zenodo.6522392.
- [30] Jasper O. Kenter et al. “What Are Shared and Social Values of Ecosystems?” In: *Ecological Economics* 111 (2015), pp. 86–99. DOI: 10.1016/j.ecolecon.2015.01.006.
- [31] Eva Feder Kittay. *Love’s Labor: Essays on Women, Equality, and Dependency*. New York: Routledge, 1999. ISBN: 9780415904131.
- [32] Robert K. Merton. “The Matthew Effect in Science: The Reward and Communication Systems of Science Are Considered”. In: *Science* 159.3810 (1968), pp. 56–63. DOI: 10.1126/science.159.3810.56.
- [33] National Information Standards Organization. *ANSI/NISO Z39.104-2022: Contributor Roles Taxonomy (CRediT)*. ANSI/NISO standard approved January 2022, published February 2022. 2022. URL: <https://credit.niso.org/> (visited on 10/30/2026).
- [34] Onora O’Neill. *Autonomy and Trust in Bioethics*. Cambridge: Cambridge University Press, 2002. DOI: 10.1017/CB09780511606250.
- [35] Elinor Ostrom. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press, 1990. DOI: 10.1017/CB09780511807763.
- [36] Elinor Ostrom. “A General Framework for Analyzing Sustainability of Social-Ecological Systems”. In: *Science* 325.5939 (2009), pp. 419–422. DOI: 10.1126/science.1172133.
- [37] Elinor Ostrom. “Polycentric Systems for Coping with Collective Action and Global Environmental Change”. In: *Global Environmental Change* 20.4 (2010), pp. 550–557. DOI: 10.1016/j.gloenvcha.2010.07.004.
- [38] Charles C. Ragin. *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago: University of Chicago Press, 2008. DOI: 10.7208/chicago/9780226702797.001.0001.
- [39] Donald B. Rubin. “Inference and Missing Data”. In: *Biometrika* 63.3 (1976), pp. 581–592. DOI: 10.1093/biomet/63.3.581.
- [40] Edella Schlager and Elinor Ostrom. “Property-Rights Regimes and Natural Resources: A Conceptual Analysis”. In: *Land Economics* 68.3 (1992), pp. 249–262. DOI: 10.2307/3146375.
- [41] Andrew D. Selbst et al. “Fairness and Abstraction in Sociotechnical Systems”. In: *Proceedings of the Conference on Fairness, Accountability, and Transparency*. ACM, 2019, pp. 59–68. DOI: 10.1145/3287560.3287598.
- [42] Amartya Sen. *Development as Freedom*. Oxford: Oxford University Press, 1999. ISBN: 9780192893307.
- [43] Lloyd S. Shapley. “A Value for n -Person Games”. In: *Contributions to the Theory of Games, Volume II*. Ed. by Harold W. Kuhn and Albert W. Tucker. Princeton: Princeton University Press, 1953, pp. 307–318. DOI: 10.1515/9781400881970-018.
- [44] Susan Leigh Star. “The Ethnography of Infrastructure”. In: *American Behavioral Scientist* 43.3 (1999), pp. 377–391. DOI: 10.1177/00027649921955326.
- [45] Susan Leigh Star and Anselm Strauss. “Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work”. In: *Computer Supported Cooperative Work (CSCW)* 8.1-2 (1999), pp. 9–30. DOI: 10.1023/A:1008651105359.
- [46] David Stark. *The Sense of Dissonance: Accounts of Worth in Economic Life*. Princeton, NJ: Princeton University Press, 2009. DOI: 10.2307/j.ctt7pg4h.
- [47] Lucy Suchman. *Human–Machine Reconfigurations: Plans and Situated Actions*. 2nd ed. Cambridge: Cambridge University Press, 2007. ISBN: 9780521675888.
- [48] Joan C. Tronto. *Caring Democracy: Markets, Equality, and Justice*. New York: New York University Press, 2013. ISBN: 9780814782774.
- [49] United Nations Office of the High Commissioner for Human Rights. *Guiding Principles on Business and Human Rights: Implementing the United Nations “Protect, Respect and Remedy” Framework*. HR/PUB/11/4. New York and Geneva: United Nations, 2011. URL: https://www.ohchr.org/Documents/Publications/GuidingPrinciplesBusinessHR_EN.pdf.
- [50] François Vatin. “Valuation as Evaluating and Valorizing”. In: *Valuation Studies* 1.1 (2013), pp. 31–50. DOI: 10.3384/vs.2001-5992.131131.

- [51] Iris Marion Young. *Responsibility for Justice*. New York: Oxford University Press, 2011. DOI: 10.1093/acprof:oso/9780195392388.001.0001.