

University Hospital Volunteer Commons

Institutional Mediation, Relational Proximity, and Generative Value Circulation

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Abstract

This paper examines the conditions under which university hospital volunteer commons might connect independently accessible disciplinary inquiry, authorised voluntary service, and separately authorised research involving people or restricted information, without conflating their permissions or purposes. Building on public-service value theory, governed knowledge commons, volunteering scholarship, generative justice, and studies of institutional learning, it distinguishes initial participation from the historical reproduction of research and service capacities. The proposed generative relational reconstruction separates ontological suspension, historically effective relationships, and partial situated manifestations. An activity-specific design grammar identifies fifteen candidate infrastructure functions without prescribing fifteen administrative bodies. A typed temporal vocabulary separates the occurrence of relationships, records and evidentiary warrants, scope-specific permissions, competent decisions, opportunities for value return, actual uptake, and changes in the capacities of contributors and maintainers. The paper specifies a unified, claim-level protocol for comparative and disconfirming tests against ordinary documentation, institutional analysis and established governance practices, distinguishing a model's incremental explanatory performance from the effects of a real institutional intervention. The contribution is a theoretical and research-design proposal, not evidence of superior governance, justice, participation or clinical outcomes. No hospital partnership, access to protected data or authorised intervention is presumed.

Keywords: university hospital volunteer commons; generative relational theory; institutional infrastructure design; generative value circulation; historical recoverability

Preprint Status and Scope

This is an independent, internationally oriented *theoretical preprint candidate*. It examines university hospital volunteer Commons as possible institutional configurations, not an existing University of Tokyo Hospital programme, a clinical guideline, an approved research protocol, or an evaluation of any hospital's performance. Its examples and comparative case materials are explicitly hypothetical. No institutional endorsement or access to protected information is claimed.

The analysis distinguishes independently accessible learning and research; voluntary activities that require the relevant institution's specific approval; and any research involving people or restricted information that requires its own applicable review and permissions. The paper proposes fifteen candidate infrastructure functions, typed and historically situated relations, and a prospective comparative research protocol. These are analytical proposals to be compared with existing institutions and simpler representations, not established evidence of superior governance or outcomes.

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Introduction

This paper investigates the institutional conditions under which voluntary public service and disciplinary inquiry may become mutually generative in a university hospital setting. Its immediate object is neither hospital recruitment as an administrative technique nor a digital platform for managing volunteer labour. It is a proposed *university hospital volunteer commons*: a governed arrangement in which independently accessible research resources, legitimately organised voluntary service, and separately authorised research can form productive connections while retaining their respective purposes, rights, and responsibilities. The inquiry is conceptual, institutional, and constructive. It develops a framework for the constitution of such an arrangement, specifies what must be engineered before participation can be offered on credible terms, and identifies conditions under which the arrangement might fail.

A university-affiliated hospital is a useful, but not privileged, institutional configuration for investigating how public-service questions meet disciplinary research. Clinical care, teaching, research, and nonclinical support may coexist within a wider university setting, and student communities may be proximate in space, communication networks, or research interest. The relevant relations are activity-specific: a department may provide an academic introduction without being able to authorise a hospital visit, access to a patient record, or a change in volunteer scheduling. Conversely, an independent scholar may construct a lawful research benchmark without any hospital partnership. We therefore treat university affiliation as a candidate mediator whose operation must be traced, not as evidence that a commons is already present or that its members share a common mandate. Comparisons with non-university hospitals and other knowledge commons are necessary to determine how much this institutional setting actually explains.

The first temporal problem is the constitution of an initial relationship. A person who has never volunteered at a particular hospital may nevertheless recognise a research question relevant to existing disciplinary interests. An independent, reproducible scheduling problem can support mathematical investigation before that person has any relationship with the hospital as a service organisation. The resulting learning or research activity must not be presented as evidence that the person has volunteered, consented to a future assignment, or qualified to perform one. Initial participation can therefore take more than one form, including research contribution, inquiry about service, and an informed decision not to join. The theory must explain the conditions of encounter, comprehension, credible choice, and distinct authorisation, rather than simply treating the number of recruited volunteers as an outcome to maximise.

The second problem concerns *historical reproduction*. A programme that has operated for decades may possess documents, tacit practices, mentoring relations, accumulated trust, and settled responsibilities. Their existence does not ensure their transmission. An archive can survive while the reasons for its contents cease to be intelligible; practical knowledge may survive through mentoring without appearing in an official report. Nor does the mere preservation of old procedures warrant their continued use. What matters for future generative capacity is whether relevant historical experience remains recoverable, criticisable, and appropriately reusable in a changed situation. This involves archives and version histories, but also normative authority, resources, contextual explanation, the permission to dissent, and sometimes the obligation to restrict or delete records. Historical preservation is thus itself a social and political-economic activity, with costs and distributive consequences.

These problems meet in the circulation of value. The patient who receives appropriate assistance, the volunteer who develops competence, the mentor who transmits practice, the researcher who constructs a method, and the institution that acquires better organisational knowledge do not necessarily experience a single homogeneous benefit. Public-service scholarship has examined value creation across linked service ecosystems, warning against identifying service production with its full value in use or in life context (Osborne et al., 2022, 2021). Knowledge-commons research likewise treats collective knowledge sharing as an institutionally governed practice, rather than the simple absence of exclusion (Frischmann et al., 2014a). Generative-justice scholarship places special emphasis on the relations through which creators of value participate in its benefits and productive conditions (Eglash, 2016; Eglash et al., 2024). The present paper uses these established arguments as distinct sources of orientation. Its proposed exten-

sion examines how they can be brought into a temporal account of initial entry, interdisciplinary mediation, contribution rights, historical recoverability, and subsequent capacities to create additional kinds of value.

The institutional design problem is how to make these connections credible without supposing that scholarly usefulness confers permission to act. A repository may assist discovery, but it cannot by itself grant access to protected information, authorise service, establish valid reuse rights, or provide evidence of continued capacity. This paper calls the analysis and context-sensitive construction of the relevant conditions *constitutive institutional engineering*. The expression denotes a method for identifying which institutional functions are necessary for a specified activity, who may perform them, which existing arrangements already suffice, and which proposed additions create burdens or new dependencies. It does not designate fifteen offices, an obligatory platform, or a fixed order of implementation. Where an ordinary institutional procedure satisfies the relevant constraint, the proposed Commons has no independent entitlement to replace it.

The central research question is whether, and under which historical and institutional conditions, connections among independent disciplinary inquiry, voluntary public service, and separately authorised research can support legitimate, non-extractive and sustainable opportunities for generating value. Four narrower questions structure the inquiry. What allows an initial encounter or research contribution without turning it into an assumed service commitment? Which normative, epistemic and organisational interfaces permit particular activities, while preserving the authority of those competent to decide? By what mechanisms can a contribution remain recoverable and appropriately reusable across historical changes? Under what circumstances does an opportunity for value return become actual uptake or a change in someone's future generative capacity, and who bears the cost of maintaining that possibility?

The paper makes three types of contribution that require different forms of assessment. Its *conceptual reconstruction* combines, without claiming to originate, scholarship on public-service value, governed knowledge commons, voluntary participation, generative justice and organisational learning. Its *proposed analytical devices* comprise the author's three-level generative relational interpretation, an activity-specific grammar of fifteen candidate functions, and typed temporal records that distinguish historical relations, reports, evidence, permissions, decisions, realised use and capacity changes. These are inventions of analysis, not evidence that such relations operate as hypothesised. Finally, its *comparative research agenda* asks whether the proposed distinctions actually change reasoned judgments at a defensible cost when compared with ordinary mentoring, institutional analysis, expert review, and well-kept records. The claimed distinctiveness lies in the joined historical and cross-domain question, not in discovering that rights, organisational memory, or public value matter individually. The primary tests in Section 25 concern explanatory discrimination; any claim of improved volunteering or clinical outcomes would need a separate, appropriately authorised evaluation.

Methodologically, the manuscript suspends claims about the ultimate ontological status of institutional or normative entities, studies historically effective relations and powers as relational questions, and analyses the partial, observer-dependent traces through which those relations appear. A dated record, an observer's justified inference, a competent institutional decision, a person's voluntary assent and a later benefit are not interchangeable. This discipline preserves both normative limits, which cannot be validated through a performance score, and empirical hypotheses, which may fail. In particular, an unchanged output may conceal a consequential permission or maintenance difference; conversely, an ordinary version register may make the same difference visible without any typed model. The latter possibility is a meaningful counterexample rather than an implementation defect to be excused.

The argument proceeds in four stages. Sections 1–4 establish the institutional object, its theoretical foundations, the generative relational commitments, and the conditional role of university mediation. Sections 5–6 introduce the institutional design grammar and the fifteen-function architecture. Sections 7–21 investigate those functions individually, from public-problem constitution and normative standing to voluntary participation, decision processes, contributor rights, value return, and maintenance. Sections 22–25 integrate the functions, reconcile their typed temporal descriptions, examine hypothetical comparative configurations, and specify discriminating empirical questions. The Conclusions delimit

the proposed contribution and outstanding tests. The analytical sequence is not a mandatory implementation sequence; each institution must examine its actual authority, history, participants, resources, and possible alternatives.

1 Institutional Configuration of University Hospital Volunteer Commons

This section defines the institutional object before assessing its supposed value. It identifies the activity boundaries, persons, rights, and resources that would make a proposed university hospital volunteer commons describable without implying hospital sponsorship. A distinction is required between an analytical configuration of potentially related practices and a legally constituted organisation with authority to act. The section consequently defines the commons provisionally, distinguishes three permission-bearing spheres of activity, and establishes which basic capacities an independent research commons should demonstrate before publicly inviting contributions. Later sections explain the mechanisms rather than treating this definition as their proof.

1.1 University Hospitals as Heterogeneous Institutional Settings

University hospitals operate within institutional environments where clinical care and professional responsibility coexist with research, teaching, student life, and administrative governance. This coexistence makes several kinds of potentially relevant relation visible. A hospital's nonclinical volunteer service may encounter questions of accessibility, public communication, learning, organisational continuity, library provision, or administrative coordination. University disciplines may contain methods capable of studying some of these problems, while students may have intellectual interests and practical circumstances that make such inquiry attractive. University structures may furnish communications, teaching occasions, disciplinary mentors, existing laboratories, or other resources through which these potential relations can become intelligible.

Organisational relations need to be specified for each activity rather than inferred from shared affiliation. A university, faculty, hospital, student association, independent researcher, and separately governed Commons may share a campus or public mission while possessing different decision competences. For example, an authorised hospital volunteer coordinator might arrange an approved service assignment without thereby acquiring authority to approve human-participant research. Similarly, permission to quote a public hospital report does not confer access to internal records or permission to imply that the institution endorses the quotation's interpretation. Independent research conducted with lawfully available or synthetic material need not wait for hospital collaboration. The analytical configuration must therefore specify not only possible connections but also where there is *no* organisational or legal interface.

Definition 1.1 (University hospital volunteer commons as an analytical object). A *university hospital volunteer commons* is a proposed, explicitly governed configuration of shareable knowledge resources, voluntary participation opportunities, institutional interfaces, and historically maintained practices oriented to problems associated with university-hospital nonclinical service. Its defining feature is not the possession of hospital records or delegated hospital authority. It is the capacity to support legitimate research, learning, contribution, reuse, and critical revision across distinguishable institutional and disciplinary relations, while any hospital service or human-participant research proceeds only under the applicable separate authorisations.

The definition is deliberately weaker than a claim that a functioning Commons already exists. A repository containing lawfully reusable files could provide a material starting point yet remain an ordinary archive if there is no accountable process for maintaining sources, interpreting permissions, correcting errors, or managing contributions. Conversely, an existing hospital volunteer programme can provide valuable public service without maintaining independent disciplinary research resources. Drawing on the governance questions of the knowledge-commons framework (Frischmann et al., 2014a), this paper

asks what resources are shared, who can decide their conditions of use, whose interests remain outside the group, and what happens when practices conflict. A distinctive proposed question is whether and how these governance arrangements also affect later participants' ability to undertake independent research.

1.2 Three Differentiated Spheres of Activity

The institutional object is easier to govern when three spheres are separately described. The separation does not prohibit interaction; it prevents the existence of an activity or permission in one sphere from being misread as a permission in another.

Independent commons inquiry. Publicly available, legitimately licensed, or deliberately synthetic materials may support a disciplinary problem, methodological experiment, historical reconstruction, learning module, or open-source contribution. The commons may arrange access and criticism within its own legitimate control. Its organisers may not infer rights in external institutions' assets or other persons' works merely because those works are related to its inquiry.

Hospital-authorised volunteer service. Nonclinical activities take place under the hosting institution's current participation rules, training, safety arrangements, and role permissions. A commons member who also serves as a hospital volunteer must respect the distinction between authorised service and independent research. Contact with a patient during service does not by itself permit recording, interviewing, observation for research purposes, or reuse of patient information.

Separately authorised research. Projects involving human participants, controlled organisational records, potential clinical interference, or other restricted materials have their own legal, ethical, contractual, and institutional conditions. A volunteer badge, a public affiliation, or an open-source release does not supply research approval or a basis for secondary use. Some research may fall outside a particular formal ethics-review regime, yet determining that status still requires attention to applicable rules and competent institutional judgment.

A plausible collaboration may connect two or all three spheres, but the connections must be represented as explicit, authorised interfaces. Consider a synthetic scheduling benchmark developed independently from publicly stated opening hours and fictional participants. Its authors might publish the model and tests under suitable licences. A real hospital would be free to consider whether these methods are useful, but no result thereby establishes an operational staffing requirement or a safe assignment. Applying the model to real volunteer records would require lawful access, appropriate review, relevant permissions, compatible purposes, and validation of constraints in the institutional setting. If those conditions are absent, the independent benchmark remains an academically legitimate activity without being an operational intervention. This independence is a design feature rather than a failure of collaboration.

1.3 Participating Subjects, Resources, and Relational Positions

The analysis distinguishes participants from the roles they may occupy. A student can be a potential volunteer, research contributor, library user, course participant, or none of these. A member of a hospital's staff can be an institutional source of public documentation without becoming a collaborator. An affected patient can be a rights-bearing recipient of care without being a research subject or a provider of data. A disciplinary mentor may review an algorithm while having no managerial responsibility for hospital services. The commons must not infer a continuing commitment, transferable permission, or fixed interest from the presence of a person in any of these categories. Roles arise in relation to specified activities and are bounded by evidence, consent, authority, and time.

Likewise, a resource's availability depends on its type and legal condition. The proposed commons may contain an authored tutorial, a source inventory, an annotated bibliography, a mathematical problem, a synthetic dataset, a software implementation, a lawfully contributed testimony, or a historical decision record. Their sharing conditions differ. A method as an abstract idea is not identical to the copyrighted

explanatory text or executable implementation through which it is communicated. A citation creates a scholarly dependency, not automatically a joint property right in every later result. Sensitive information may remain restricted even when other aspects of its context can be discussed publicly. Accordingly, resources must have individually recorded provenance, scope, custody, permissions, restrictions, version, and correction history before they can be responsibly circulated.

This requires a further distinction among four relational positions. A *contributor* creates or supplies something relevant to an activity; a *rights holder* is an actor legally empowered to authorise particular uses; a *steward* maintains specified shared arrangements; and an *affected party* may bear benefits or risks without occupying any of the first three positions. One actor can occupy several positions, but those positions should not be collapsed. A researcher who uploads a document may lack its rights. A volunteer who contributes an idea may deserve recognition without automatically meeting a later publication's authorship criteria. A patient may be affected by the promotion of a research commons despite never joining it. Governance should identify these asymmetric positions before assigning decision authority.

1.4 Institutional Mediation and Relational Neighbourhood

The university may mediate between different disciplinary communities and hospital-related public problems by making information, mentors, facilities, and research questions mutually encounterable. In this account, mediation is not simply an institutional hierarchy but a set of historically constituted relations that can reduce some costs of finding, understanding, and evaluating collaboration possibilities. An independent commons can build translations between a service problem and disciplinary research languages, even when no university faculty formally sponsors its work. Such translations, however, remain invitations to inquiry rather than binding expressions of the university's intentions.

Research on innovation distinguishes geographical, cognitive, organisational, social, and institutional proximity, while warning that geographical closeness alone is neither necessary nor sufficient for learning and that excessive proximity can produce lock-in (Boschma, 2005). The present paper draws on that established typology and treats *temporal feasibility* as a separate question arising from the schedules of hospital service and academic work. It does not add a sixth element to Boschma's own fivefold taxonomy. Distance, a student's available hours, disciplinary intelligibility, existing channels of introduction, formal authority, and organisational trust can vary independently. Nearness in one dimension cannot compensate automatically for the absence of another. A student may live next to the hospital and remain unavailable during all approved activity hours; a remote researcher may make a valuable contribution to an open dataset without entering the hospital; a university-affiliated group may lack appropriate privacy arrangements despite strong administrative ties.

Relational neighbourhood is consequently analysed as a *conditional opportunity structure*, not as a measure of superior character or latent altruism. Its role is to affect which encounters become possible and what resources are needed for them to become informed, legitimate, and sustainable. An adequate design must also examine those who are not proximate: community residents, non-university researchers, people with caring responsibilities, and individuals whose schedules or access needs are poorly represented by a student-centred model. University mediation can expand some opportunities while narrowing others. The effects are comparative questions to be tested, not axioms of institutional type.

1.5 A Commons Distinguished by Its Generative Conditions

A public noticeboard can communicate a service need; it cannot by itself supply the conditions of independent disciplinary inquiry. A candidate research Commons might instead provide a well-specified problem, warranted literature, permitted source materials, baseline methods, valid criticism criteria, and means of making an original contribution. An engineering participant could compare robust scheduling procedures on a genuinely synthetic instance, including failures under availability or fairness constraints; an education researcher could analyse an explicitly hypothetical learning arrangement; a legal researcher could map the jurisdiction, temporal validity, and authority of publicly available normative sources. These environments might generate scholarly value independently of any person's decision to

serve in a hospital. Whether they do so is a substantive research question: a tutorial rebranded as an “open problem” is not necessarily a research environment.

Such an infrastructure must not become a device for requiring unpaid service in exchange for academic opportunity. The research materials should remain available under their declared conditions regardless of whether an individual chooses to become a hospital volunteer. Formal research assistance or a researcher’s substantial specialised work may also raise employment, compensation, authorship, and supervision questions that cannot be solved by calling all participants volunteers. The institutional design should specify who performs recurring review and maintenance tasks, how demanding those tasks are, how contributors can reject unwanted assignments, and how any promised benefit can actually be obtained. The participant’s right not to enter the relation, or to leave on appropriate terms, is part of the configuration’s legitimacy.

Assumption 1.2 (No automatic compatibility of value claims). Patient benefit, disciplinary learning, intellectual ownership, organisational reputation, public trust, and scientific output are distinct evaluative objects. Their positive coexistence cannot be inferred from the establishment of a shared activity, and they are not presumed to admit a universal exchange rate. Claims of mutual benefit require actor-relative and context-specific argument or evidence, including attention to displaced costs and omitted participants.

The assumption prevents a project from declaring a successful exchange simply because researchers publish while volunteers or patients supply the setting. The creation of knowledge does not by itself prove that the people whose service made the work possible have benefited. Equally, a participant’s satisfaction need not prove that a method is scientifically sound, that patients are safer, or that the institution has improved. These are distinct outcomes requiring different reasons and, where appropriate, different forms of evidence.

1.6 The Minimum Conditions of Independent Constitution

An independent Commons can be constituted without advance hospital endorsement, provided its materials are lawfully available and its public status is accurate. The minimum design work is activity-specific rather than a fixed constitutional checklist. For an open synthetic benchmark, a maintainer should establish the problem’s sources and limitations, artifact-level rights, a feasible baseline, a way to acknowledge and correct contributions, and a truthful statement of responsibility and maintenance. The same arrangement would be inadequate for recruiting hospital volunteers, collecting individual experiences, or changing a real schedule. It may be enough for a small initiative to identify one accountable steward and a transparent record; a fictional board or elaborate platform adds no legitimate authority. The relevant test is whether each proposed action can be supported, corrected, and if necessary stopped within its own lawful boundaries.

The first instance should be judged through concrete questions. Can an unaffiliated newcomer reconstruct the source and assumptions behind a published problem? Can the newcomer reproduce its baseline with lawful materials? Can a contributor determine whether a proposed reuse is permitted, receive accurate recognition, and seek correction if a contribution is omitted? Can the maintainer state what happens when a citation is false, an upstream licence is incompatible, or restricted personal information appears in a submission? Can participants use the open research resources without committing to hospital volunteer hours? Is there a credible path to stop an unsafe or unsustainable activity? A negative answer identifies an infrastructural deficiency even where the website, branding, and membership statistics appear successful.

The form of the first disciplinary problem also matters. A synthetic numerical experiment may be reproducible and technically interesting while still being a poor model of an actual hospital. A well-sourced legal interpretation may be useful for conceptual work without authorising institutional action. A historical timeline may preserve dates without conveying why previous actors made a contested choice. The commons should therefore state what a resource *can establish*, what it *cannot establish*, and what

further validation is required. A failure to distinguish those limits can convert the appearance of openness into misplaced trust.

The following sections analyse how the institutional setting relates to existing literatures, initial participation, value creation, historical preservation, and legal and governance infrastructures. The practical construction problem is examined methodologically in Section 5. The present section establishes the referents that those subsequent analyses must preserve: multiple institutional spheres, heterogeneous contributors, actor-relative values, prospective permissions, and explicitly maintained boundaries between possible collaboration and actual authority.

2 Theoretical Foundations of Generative Public-Service Commons

This section identifies what existing scholarship already explains before proposing additional relational distinctions. Public-service ecosystem work examines situated value and its possible destruction; knowledge-commons scholarship supplies a framework for governed sharing; volunteering theory addresses entry and sustained commitment; generative justice raises the problem of value circulation and control over productive conditions; and organisational-memory and proximity research examine historical transmission and institutional learning. These accounts are not stages of a single theory, and their objects and normative commitments should not be conflated. The present reconstruction asks whether their juxtaposition, when expressed through activity-specific authority, research conditions, and temporal rights, helps identify failure mechanisms or institutional choices that a less elaborate account would miss. That explanatory advantage remains an obligation to test, not a contribution already demonstrated by adding a new vocabulary.

2.1 Public-Service Value Creation and Situated Benefits

Public-service theory provides a substantive reason not to identify the value of volunteering with administrative outputs. In their public service ecosystem account, Osborne et al. (2022) distinguish institutional, service-system, individual, and belief levels and examine their interactions. Their integrative framework locates public value, collaborative governance, public service logic, and behavioural public administration at different analytical levels rather than treating them as rival comprehensive accounts. Public services operate within social and institutional conditions in which individual participants, their life contexts, public organisations, and broader norms can all matter. Osborne et al. (2021) make a distinct analytical move: their model differentiates the loci, elements, and processes of public-service value creation and destruction, treating co-production as one process among others rather than as a proxy for value actually realised in use. Neither source establishes that a university hospital volunteer Commons produces positive value or that temporal value return can be read from output counts.

Consider an ostensibly simple nonclinical service: a volunteer assists a visitor to locate a diagnostic department. The administration might record a completed assistance episode, the visitor might value an understandable explanation, the volunteer might learn how to communicate across uncertainty, and an employee might subsequently notice a confusing public sign. These are different possible consequences. They need not all occur. Moreover, the employee's observation does not itself establish that a sign was changed, and the visitor's favourable response does not entail an improvement in public trust. The analytic problem is to identify the relevant subjects, the experienced or claimed benefits, and the conditions under which an event may have consequences beyond its immediate service moment.

For a university-affiliated hospital, the possible relation between service and academic work adds a further distinction. A scheduling benchmark developed from public descriptions and synthetic cases might generate disciplinary learning or methodological insight, even where it has no observed effect on patients. Conversely, a valued patient-facing service may leave no reusable scholarly artefact. The same institutional setting can support more than one type of value without converting every service episode into research material. A general framework must thus maintain the distinction between value in service

use, value in disciplinary inquiry, and the institutionally authorised processes through which one might eventually inform the other.

Public-service value is not reducible to the host organisation's output figures. The public-service ecosystem account helps reveal value judgments formed in service users' own circumstances; the present proposal carries that insight into the formulation of an institutional problem, without assuming that every interaction is mutually beneficial. A visitor may welcome a brief direction and reject further assistance; a volunteer may experience a role as meaningful while it imposes an unwanted demand on somebody else. A patient may have a defensible interest in refusing research observation even where it would help scholars. These are potentially conflicting evaluations, not merely missing positive outcomes. The institutional design question is who can make or contest a claim of benefit, how that judgment becomes known, and which limits on action remain authoritative despite the claimed benefit.

2.2 Knowledge Commons and Governed Collective Production

A research commons is not constituted by the presence of openly available documents alone. The knowledge commons framework developed by Frischmann et al. (2014a) treats resources, contributors and affected nonmembers, surrounding legal and cultural environments, action arenas, formal and informal governance, and the assessment of outcomes as connected empirical questions. Its analytical structure adapts the Institutional Analysis and Development (IAD) tradition described by Ostrom (2005); Ostrom (1990) supplies influential evidence about collective governance of natural-resource commons rather than a transferable constitution for knowledge production or care settings. The knowledge commons editors also caution, on the basis of their early comparative cases, that the evidence does not yet yield generally successful design principles (Frischmann et al., 2014b). The present proposal accordingly seeks a context-sensitive vocabulary of infrastructures and their dependencies, not a presumed successful institutional template. The distinction is consequential: IAD and knowledge-commons research already ask about rights, actors, rules, legitimacy, resource flows, and outcomes; merely relabelling those questions as Commons infrastructure would not be an independent discovery.

Commons-based peer production also has an established account of cooperation that cannot be explained solely through salary, ownership, or direct exchange. Benkler and Nissenbaum (2006) examine the institutional conditions and ethical possibilities of collaboration among heterogeneous participants. Yet the mere absence of monetary compensation is not evidence of freedom, non-extraction, or fair governance. A public repository may shift maintenance and quality-assurance labour to a few unpaid participants. An ostensibly open data collection may be practically unusable without specialised instruments, credentials, or mentoring. The relevant institutional question concerns who can genuinely participate in collective production, on what terms, and with what continuing control and support.

Medical knowledge commons scholarship has already investigated the different public and institutional arrangements through which biomedical knowledge is governed; a hospital-related research Commons is thus not a novel object simply because it involves a medical setting. Our specific question concerns whether the separation and historically conditioned coupling of independent inquiry, authorised service and separately approved research yields an incremental explanatory distinction. The latter remains a proposal to test, rather than an empirical result of the medical-commons literature (Strandburg et al., 2017).

The proposal involves three spheres governed by different permission structures: independent research with public, licensed, or synthetic sources; authorised nonclinical service; and separately approved studies involving people or restricted institutional information. Knowledge-commons governance can examine shared academic resources, but membership of that Commons supplies no mandate over the other two spheres. A Commons charter may regulate its own submissions and discussions yet cannot authorise a clinical observation, patient survey, internal-data release, or volunteer assignment. Conversely, the lack of a hospital partnership need not prevent reproducible independent inquiry. This asymmetry is a boundary condition that the proposed theory must model rather than a barrier that greater integration is presumed to remove.

The knowledge commons perspective also complicates an overly unitary image of the collective. A university student may contribute a software benchmark, a librarian may help organise a public bibliography, an unaffiliated historian may correct an institutional timeline, and a hospital staff member may decline any external collaboration. Such actors need not be members of the same legal entity or pursue a collective purpose in identical terms. Membership, contribution, consultation, access, endorsement, and authority are different statuses. A sufficiently precise framework must keep them distinguishable before proposing mechanisms of governance or value circulation.

2.3 Voluntary Motivation and the Conditions of Initial Participation

The first formation of a voluntary relation differs analytically from continued participation by an experienced member. The functional account of volunteering developed by Clary et al. (1998) identifies six motivational functions: values, understanding, social, career, protective, and enhancement. Its findings include the importance of matching communications or experiences to different motivations in particular study settings. These results provide grounds to consider multiple routes to participation, but do not justify classifying a new volunteer by an inferred psychological type, predicting the motives of students at a particular university, or inducing someone to volunteer through concealed pressure.

The new entrant has a history, but not necessarily a shared history with the prospective host organisation. A student interested in computational optimisation may encounter an open scheduling problem through coursework, student communications, a public research repository, or an independently published technical note. The student's existing disciplinary interest can thereby become connected with a previously unfamiliar public-service problem. This connection is a possible condition of inquiry; it is not equivalent to agreement to work without compensation, much less consent to perform hospital tasks. The person may legitimately use an openly licensed research module and never become a hospital volunteer. Conversely, a volunteer may serve patients without any desire to produce an academic paper.

Recruitment communication has spatial and temporal conditions. A university's proximity may reduce travel effort for some students, but their class schedules, caregiving responsibilities, financial circumstances, and eligibility can make participation impracticable. Outreach at an accessible location and at an intelligible point in the academic calendar may create an opportunity for consideration, while over-targeting affiliated students may exclude equally willing participants outside the institution. A theory of initial entry should therefore distinguish discoverability, correct comprehension, availability, willingness, eligibility, and authorised commencement. A high number of applications cannot substitute for evidence about the transition between those states.

Initial commitment may change after experience. A meaningful first session, an unpleasant misunderstanding, a mentoring relation, or the discovery of a new research question can alter the basis on which a participant decides to remain. That temporal transition provides an interface between initial participation and organisational learning. It is also a reason not to turn the newcomer into a resource unit whose future participation is assumed from the moment of recruitment. A defensible Commons must make refusal, withdrawal, and a decision to participate solely in research intelligible options, rather than report each such decision as a failed recruitment conversion.

2.4 Generative Justice and the Conditions of Value Return

Generative justice is an established normative concept associated with Ron Eglash, not a term coined by the present framework. Eglash (2016) articulates bottom-up and unalienated circulation of ecological, labour, and social or expressive value, together with generators' opportunities to shape the conditions of production. Eglash et al. (2024), with collaborators, develops a computational-reparations account that links control of productive conditions and value circulation in historically different social contexts. The substantive concern is not exhausted by distributing rewards after production: extraction may also weaken the future capacity of value generators and their communities. These arguments are the sources' own intellectual contributions. Identifying a particular attribution record, permission pathway, maintenance commitment, or temporal research dependency as one possible mechanism of legitimate

return is an interpretation proposed here. Neither cited text establishes an automatic legal entitlement to subsequent authorship, a conserved quantity of value, or a ready-made governance model for hospital volunteering.

For a research contribution, at least four questions arise. First, what did a person actually contribute, and what evidence supports the attribution? Second, which legal rights and contractual permissions subsist in that contribution? Third, what other capabilities or opportunities does the Commons make available to the contributor through learning, access, collaboration, or governance? Fourth, what later benefits have actually occurred, and which remain hypothetical? The answers cannot be collapsed into a single “return” amount. Recognition, use permission, lawful access to derivatives, participatory influence, and negotiated revenue entitlements have different conditions of validity.

Suppose contributor *a* lawfully publishes a synthetic dataset with documentation, contributor *b* later publishes an improved optimisation algorithm, and contributor *c* develops a software interface using both. The provenance of the later work may refer to the earlier artefacts; however, a documented dependency is not itself a transfer of ownership to *a*, a promise of automatic coauthorship, or a perpetual entitlement to downstream revenues. Whether the earlier contributor may reuse the later result depends on its actual licence or agreement. A project that promises such use without obtaining the necessary rights offers a symbolic rather than operative return mechanism. Conversely, the possibility of open reuse must not be used to erase the original creator’s copyright, attribution claims where applicable, or the separately acquired rights of later contributors.

There is also a distinction between a positive return and the preservation of generative capacity. An attribution in a publication may help establish a contributor’s historical role without providing a new research method or opportunity. A later open benchmark may create substantial educational possibilities without producing income. A volunteer may have gained significant practice and meaningful relationships while deciding not to continue. For these reasons the Commons should preserve multidimensional benefit claims, identify who is reporting them, and resist claims that benefits to one actor compensate for rights violations or burdens imposed on another.

The proposed extension concerns intertemporal relations rather than the claim that value itself is a conserved substance. A dataset contributed now may later be reused in a method, incorporated into an educational exercise, or rendered obsolete; different actors may recognise different benefits and bear different costs. Historical provenance alone does not show causal influence, lawful permission alone does not secure practical access, and acknowledgement alone does not establish a return of resources or capabilities to earlier contributors. The paper therefore proposes to track these distinguishable relations while permitting broken pathways, asymmetrical gains, and legitimate non-reciprocity. The resulting temporal account must eventually outperform a simpler chronological or licensing record on an identifiable question.

2.5 Organisational Learning and Historical Recoverability

Research on organisational learning provides a prior account of how experiences may be created, retained, and transferred. Argote (2013) analyses organisational knowledge with attention to the persistence, loss, and transfer of learning across settings. This work helps separate the fact of past activity from the preservation of a capacity to perform a relevant activity now. A highly experienced volunteer may carry procedural knowledge that is not represented in a handbook; a carefully preserved handbook may contain procedures that no longer correspond to actual service conditions. The two situations involve distinct problems of knowledge retention and institutional use.

For the proposed Commons, preservation and epistemic recoverability identify different institutional problems. Preservation concerns the continued existence of identifiable traces, artefacts, or embodied practices. Recoverability is question-relative: could an appropriately situated later investigator, within legitimate access limits, reconstruct enough sources, assumptions, reasons, and uncertainty to assess the earlier work critically? A preserved numeric result may lack its synthetic-data generator; a decision chronology may omit the alternatives considered at the time. Conversely, a later actor might recover the

limitation of an obsolete method and reject its reuse on sound grounds. Such critical non-reuse can itself become a significant form of institutional learning, without implying that the past has been perfectly recovered.

The proposed importance of recoverability should not be confused with a claim that historical experience can be replayed in full. Contemporary records are partial, situated representations, and historical interpretation is itself an activity conditioned by subsequent concepts and interests. The object of an archival design is to make warranted reconstruction possible, not to guarantee perfect recovery of historical subjectivity. A useful record may therefore preserve the issue, participants' legitimate roles, available evidence, competing interpretations, the decision-maker's authority, contemporaneous uncertainties, subsequent corrections, and reasons for supersession. Which details may be retained depends on the rights and privacy of those concerned, as well as the actual purpose and duration of retention.

Historical preservation is also a political-economic undertaking. Someone must maintain the archive, review links, check licences, translate obsolete formats, redact restricted records, and explain why a past decision may no longer apply. These costs may be borne unequally. Moreover, the authority to decide what counts as institutional history may favour formally recognised contributions while obscuring patient experiences, volunteer mentoring, or dissenting professional judgments. A historically generative Commons should make the selection and revision of its own memory open to appropriate challenge without treating unrestricted disclosure as an unconditional good.

The distinct proposed claim is that historical knowledge may become a condition for future value creation when later actors can not only retrieve it but also understand and criticise its earlier application. This remains a conditional hypothesis. Where an obsolete method continues to dominate because its archived status grants it undue authority, historical preservation may instead inhibit new inquiry. The same infrastructure can support continuity and path dependence; the effect depends on its governance, interpretation, and surrounding institutional conditions.

2.6 Multidimensional Proximity and University Mediation

Boschma (2005) distinguish geographical, cognitive, organisational, social, and institutional proximity in innovation and interactive learning. Their central caution is that geographical nearness alone is neither necessary nor sufficient for knowledge exchange, and excessive proximity can produce lock-in. A university-affiliated hospital may be physically close to classrooms and laboratories, and its institutional setting may provide identifiable academic channels, but these features do not establish willingness, suitable competence, or permission. The different dimensions of proximity must therefore be treated as partially substitutable or complementary conditions requiring investigation rather than aggregated into a simplistic university advantage.

The present paper additionally treats *temporal availability* as an operational dimension in the proposed hospital-related configuration. This is a context-specific analytical addition, not an element attributed to Boschma's original five-part classification. A student may live nearby but have no period free during authorised service hours. Another participant may be geographically distant but able to contribute to an openly licensed mathematical or legal research module asynchronously. Geographical proximity and temporal proximity may interact with disciplinary preparation, financial cost, social accessibility, and institutional permissions. Their effects on first participation may be non-linear and, across groups, unequal.

University mediation involves more than publicity. A university may provide channels through which disciplinary questions become intelligible to students, supervisory capacity becomes available, or differently trained people can identify shared questions. Yet the university, a faculty, a laboratory, a particular hospital, and independent researchers have different legal positions and decision rights. An intermediary may coordinate introductions without becoming the owner of the research, the authoriser of hospital activity, or the guarantor of a participant's future professional benefit. The proposed Commons must make these role distinctions operative, especially when public communication could otherwise imply affiliation or endorsement that does not exist.

The substantive research challenge is to explain how an already established disciplinary capacity can meet a legitimately described public problem without erasing its disciplinary standards. Engineering students may require feasible optimisation instances, strong reference solvers, and negative comparisons; legal scholars need authoritative legal sources, jurisdiction and ratio/holding distinctions; education researchers need justified learning outcomes and ethical observation conditions. The organisational mediator's success should be judged by whether it creates usable opportunities for independent inquiry, not merely by whether the same project slogan reaches more disciplines.

2.7 Constitutive Norms and Institutional Decision Processes

The broader sense of *engineering* relevant to this paper has an established intellectual precedent in the study of designed systems. Simon (1996) argues for systematic inquiry into purposive artificial arrangements, including organisations and their decisions. Its relevance here is methodological: one can analyse how an institutional arrangement is designed to operate under constraints without claiming that it can control every consequence. The IAD tradition articulated by Ostrom (2005), together with its knowledge-commons adaptation by Frischmann et al. (2014a), adds the importance of locally operating rules, action situations, actors, governance arrangements, and empirically diverse institutional configurations. These traditions support the inquiry into design requirements but cannot establish an optimal volunteer-commons constitution in advance.

A normatively adequate infrastructure requires at least a distinction among ethical justification, binding law, contracts and licences, professional standards, an institution's authorised procedures, and an independent project's own proposed practices. Their force, issuing authority, addressees, effective periods, and available remedies differ. A drafted handbook may help someone understand an issue without becoming a hospital policy or valid legal opinion. A licence may permit reproduction of specified copyright material without permitting clinical access or creating a property right in abstract mathematical ideas. A court judgment requires attention to its legal system, facts, holding, subsequent treatment, and the limit of analogies with a different institutional setting. These are problems of institutional recognition and practical reasoning, not merely document retrieval.

Decision-making consequently requires more than storing norms. An actor must recognise a problem, establish the applicable authority, construct feasible alternatives, understand uncertainties, compare consequences, take or request a legitimate decision, communicate it, and review what happened. The procedure can be supported by planning tables, scenario exercises, optimisation, simulation, or written decision records. But a simulated event schedule is not an approved activity plan. A mathematical assignment that meets availability and capacity constraints may still be invalid because a person has not consented or an authorised officer has not approved the activity. Conversely, an ethically attractive objective does not make missing resources or permissions disappear.

This suggests a distinction between *decisional feasibility*, *normative permissibility*, and *empirical adequacy*. A plan may be executable in a model yet impermissible. It may be permissible yet produce poor outcomes. It may be promising in an experiment yet impossible to maintain with the available people and institutional capacity. The Commons should therefore provide processes for documenting assumptions, modelling alternatives, obtaining decisions from competent actors, monitoring consequences, and revising an intervention without treating simulation as proof of authority. Section-level design of such an infrastructure is a separate task; the present discussion establishes why it is necessary.

2.8 Information Infrastructure, Communication, and Epistemic Validation

Information has to be discoverable and intelligible before it can support a new relationship, yet information availability is not identical to communication or legitimate use. Star and Ruhleder (1996) analyse information infrastructure through the interaction of technological systems, institutional practices, local conditions, and users' learning. Their study shows that technical availability and favourable user opinion can coexist with obstacles to effective access and participation. This is a useful warning against identifying a repository, website, or searchable database with a functioning Commons. The concept of

infrastructure is relational: an arrangement is usable in virtue of connections among practices, standards, persons, and the circumstances of its adoption.

For the proposed Commons, *information organisation* concerns how participants can find reliable documents, understand versions and provenance, see access constraints, and identify which resources are usable for which research questions. *Communication* concerns how questions, opportunities, decisions, criticisms, invitations, and results can be expressed and exchanged. Publicity and independently published research notes can make an initiative visible even before any organisation endorses it. But visibility may also mislead if materials imply authorisation, conceal open limitations, or confuse a proposal with a validated result. The design question is thus not how to maximise promotion, but how to create accurate, comprehensible, reciprocal and appropriately situated communicative possibilities.

Epistemic validation concerns the standing of claims produced through those channels. Different disciplines require different evidence and modes of criticism. An optimisation claim may demand proofs, baseline comparisons, robust tests, and disclosure of synthetic inputs; a legal claim may require examination of authoritative provisions and distinguishing facts; historical analysis must address source selection and the evidential implications of archival silence. The FAIR principles of research-data stewardship offer useful guidance on findability, accessibility, interoperability and reuse (Wilkinson et al., 2016), but FAIR accessibility can depend on appropriate conditions and cannot justify the disclosure of sensitive patient or volunteer records. Making information available does not certify its correctness; citing an open file does not authorise every proposed use.

The infrastructures of information sharing, communication, validation, and historical preservation therefore connect without merging. A current research question might be discoverable through a public catalogue; its discussion might occur in an open seminar; its results might be assessed by appropriate scholarly methods; and its history might be archived with source and correction records. A single platform may implement several of these activities, but the corresponding responsibilities must remain distinguishable. Their implementation also requires resources, attention, technical or professional competence, and decision authority. A small commons may have to accept narrower but well-maintained functions rather than promise fully open and comprehensive services it cannot govern.

2.9 Source-Specific Mechanisms, Analytical Transfer, and Rival Explanations

The relationship among these literatures requires a more exact comparative standard than thematic compatibility. An established account may already identify a phenomenon that the proposed Commons vocabulary appears to name anew. Conversely, a concept developed for public-service use, natural-resource collective action, or innovation networks may illuminate an independent research setting without transferring its original empirical warrant. The purpose of this comparison is to state the originating mechanisms, their limits of application, and the narrower propositions that remain available for research. This is a conceptual adjudication of potential explanations, not evidence that the proposed architecture has been implemented.

Public-service value and intertemporal contribution relations. The two public-service analyses support different but complementary starting points. Osborne et al. (2021) distinguish where value is created or destroyed, which elements are at stake, and how production and use contribute to that process. Osborne et al. (2022) instead situate value within interacting institutional, organisational or service, individual, and belief levels. Neither paper treats a publication count or a volunteer work log as a sufficient measure of experienced public value. However, the present Commons cannot infer from these accounts alone that a later reusable research method has returned value to its earlier contributor. Such a claim requires a specified beneficiary, a defensible criterion for benefit, an available route of lawful access, and evidence of actual use or capacity change. A less elaborate explanation might simply track a service outcome and later learning through an ordinary evaluation study. The proposed relational reconstruction would add something only if its differentiated temporal paths reveal a materially different attribution, permission decision, burden, or capability that the simpler evaluation leaves hidden.

Action situations and the proposed infrastructure functions. The IAD framework examines interactions in situated action arenas, including rules in use, participant positions, information, and possible outcomes (Ostrom, 2005). The knowledge commons framework makes the resource’s background legal status, community boundaries, affected outsiders, patterns of appropriation and contribution, and institutional legitimacy explicit objects of comparison (Frischmann et al., 2014a). Their questions already anticipate much of what the fifteen-function catalogue examines. The catalogue is therefore not advanced as a competing universal taxonomy of institutions. Its more limited design hypothesis is that, for a specified research or volunteering activity, separating epistemic warrant, permissions, safety jurisdiction, communication, stewardship, and actual use can expose particular dependency and responsibility failures that a general action-arena map might not readily display. A conventional IAD or knowledge-commons case study is an appropriate comparator. If it identifies the same critical interfaces with less documentation and lower participant burden, the proposed catalogue should be simplified rather than declared superior by definition. This remains consistent with the editors’ reluctance to claim universal design rules from early knowledge-commons cases (Frischmann et al., 2014b).

Unalienated circulation and claims of return. Eglash’s generative justice directs attention to extraction, control over productive conditions, and the circulation of benefits and capacities back to generators and communities (Eglash, 2016; Eglash et al., 2024). The present work does not convert that normative position into an automatic copyright, authorship, payment, or access claim. Instead it proposes a question-relative evidentiary test: whether a putative return is a recorded acknowledgement, a presently valid permission, an actually accessible opportunity, an observed benefit, or a further capacity that the person can exercise. Some valuable assistance can remain deliberately non-reciprocal; there is no demand that a beneficiary repay each volunteer. Other cases may involve harmful extraction despite formal acknowledgement. An ordinary rights and licence register, supplemented by voluntary interviews or resource-use records, is a serious rival to the full typed history proposed later. The additional notation is warranted only when relationships across time, contributors, incompatible permissions, or changing circumstances materially affect a contestable inference.

Proximity, boundary objects, and accountable mediation. Boschma (2005) show why the five distinct forms of proximity cannot be compressed into distance alone and why excessive closeness may inhibit learning. Star and Griesemer (1989) describe how boundary objects and methodological standardisation helped differently situated participants cooperate in a historical scientific setting without requiring identical perspectives. For the prospective Commons, a shared synthetic scheduling model might likewise be a translation resource, but the analogy cannot guarantee shared interpretation, soundness, consent, or the right to organise hospital work. Temporal availability is an additional proposed operational variable, not a sixth dimension retroactively attributed to Boschma. A simple research collaboration with an accessible syllabus, reviewable model, and clear roles may already enable adequate mediation. The more elaborate boundary and temporal vocabulary would have explanatory value only if it identifies a consequential mismatch between apparent cooperation and the participants’ actual capabilities, obligations, or understanding.

Differentiating hypotheses at the three reality levels. At the level of ontological suspension, none of the cited theories resolves the final nature of value, institutional being, or a person’s relation to an artefact. At the relational level, their established mechanisms concern service use, rules in action, governed sharing, unalienated production, heterogeneous collaboration, and the historical conditions of learning. At the manifestation level, the present study proposes evidence-bearing records that may reveal those mechanisms without being identical to them. A research claim must specify which inferential step moves from a record to an actual relation and which additional evidence or authorisation is needed. This is also the point at which the present theoretical contribution becomes falsifiable in a practical sense: if ordinary evaluation, IAD case analysis, knowledge-commons governance review, or a straightforward provenance ledger accounts for the observed decisions and effects as well or better, there is no basis for

crediting the GR reconstruction with a distinctive explanatory advantage. Negative comparisons, unresolved cases, and reasonable choices not to expand the infrastructure form part of the proposed research design.

2.10 Relational Mechanisms and Discriminating Implications

The integrative proposal gains explanatory content only when it identifies conditions under which apparently similar activities should be judged differently. This does not require treating the theoretical sources as inadequate. On the contrary, an IAD analysis, public-service evaluation, or knowledge-commons study may already reconstruct a relevant relationship in sufficient detail. The proposed additional object is the *historically conditioned join* among different domains of judgment: the same artefact may be epistemically sound, subject to limited reuse permission, unrelated to an authorised service decision, and valuable to one contributor while imposing maintenance costs on another. Those assessments are connected by a history, but neither their evidence nor their institutional authority is transferable merely because they refer to the same artefact.

Four conditional mechanisms make this claim vulnerable to counterexamples. First, an *entry differentiation* mechanism may allow a person to contribute independently to inquiry while declining service; its distinctive implication concerns mistaken attribution of volunteer status, not higher recruitment. Second, *authority separation* may prevent a competent research finding or editorial approval from being mistaken for permission to perform a hospital activity; its competing explanation is an ordinary, well-communicated authorisation procedure. Third, *historical reconstruction* may reveal that the date of a reported decision, the event it reports and the normative source then applicable differ; conventional archival scholarship or an adequate version history may already do so. Fourth, *qualified return* may show how a traceable and lawfully reusable contribution creates an opportunity for future use without establishing actual uptake or a net improvement in future capacity. Public-service value, generative justice, and existing rights management already motivate important parts of this analysis; the incremental hypothesis concerns whether their cross-temporal combination alters an inference or responsibility that would otherwise be missed.

The four mechanisms concern different counterfactuals and should not be collapsed into one latent “generativity” score. Entry can increase without institutional integration; stronger permission checks can appropriately prevent a planned action; a recorded return opportunity can remain unused; and an actor’s acquired skill can coexist with exhausted maintainers. An empirical comparison should select the mechanism relevant to its unit, hold source information and interpretive opportunity as constant as practicable, and report both category-error reduction and the costs of applying the additional distinction. The specified comparator should include a careful ordinary narrative or ledger, not only an artificially impoverished control. The bounded tests of Section 25.2 and the cross-domain design of Section 25.10 translate these implications into prospective research tasks. An adequate ordinary account, a null advantage, or a harmful documentation burden limits the proposed apparatus; it does not invalidate the independently grounded ethical significance of autonomy or competent permission.

These implications operate at distinct analytical levels. The inquiry does not derive a determinate ontology of value or persons. It hypothesises relationships, powers, and burdens that may operate in historically situated organisations, and proposes to observe them through partial traces subject to rival interpretation. Formally aligning two records can indicate where to investigate a connection; it cannot constitute the connected relation or issue an authorisation. This constraint is carried into the typed temporal model of Section 23 rather than being presented as a result of that notation.

2.11 Explanatory Scope and Research Obligations

The surveyed literatures establish important starting points. Public-service scholars already analyse value as situated within interacting service ecosystems. Knowledge commons scholarship already supplies frameworks for examining collective knowledge governance. Volunteer research already treats motivations as heterogeneous. Organisational learning already studies knowledge retention and transfer. Inno-

vation studies already demonstrate that proximity extends beyond geography. Generative justice already presses the question of contributors' relation to their productive conditions. Design and infrastructure research already demonstrate why artefacts, people, institutions, and routines must be considered jointly. The present article claims none of these discoveries as its own.

Its proposed contribution is instead a disciplined integration of four problems that often occur in distinct empirical or theoretical registers. The *entry problem* concerns how disciplinary interests and independently usable resources enable first encounters with a public-service question without establishing compulsory labour. The *constitutional problem* concerns what rights, authority, decision procedures, information practices, and safety boundaries must exist for the encounter to become a legitimate form of cooperation. The *intertemporal problem* concerns how contributed artefacts and practical experience remain recoverable and may become conditions of future work. The *return problem* concerns when and through what legitimate means value or additional capability becomes available to the contributors and communities that helped create it. The four are connected, yet an observed positive result in one does not prove that the others are satisfied.

This integration imposes research obligations. First, each proposed infrastructure must have an identifiable object and operating function, not merely an evocative name. Second, its governing constraints and design choices must be located in the actual institutional context, with a separation between valid rights and imagined entitlements. Third, the framework must supply alternative pathways and failures: a successful research module may coexist with no new volunteers; recorded contributions may receive attribution without further returns; preserved archives may hinder rather than assist innovation; organisational communication may raise expectations beyond actual permissions. Fourth, practical construction requires a way to determine what is in place, who is responsible, what is missing, and when activities ought to be paused or revised. Finally, any claim that a Commons improves public value, participation, justice, or future research capacity requires evidence capable of discriminating this explanation from ordinary mentoring, selection effects, general educational resources, or changes in the external institutional environment.

The design task that follows is therefore not a programme for installing a uniform technological platform. It is the investigation of *constitutive functions* and their context-dependent realisations. Normative sources, historical records, knowledge-creation conditions, communication channels, voluntary entry, decision procedures, provenance, rights, safety and resource stewardship may be organised differently across institutions. What matters is whether a particular configuration can make legitimate action and critical learning possible, preserve the ability to correct itself, and remain open to a reasoned finding that an envisaged form of value generation does not occur. This theoretical boundary prepares the subsequent relational analysis and the expanded institutional-engineering architecture without pre-deciding the results of either.

3 Generative Relational Analysis of Institutions and Heterogeneous Value

This section states the analytical commitments of the author's generative relational (GR) programme for the present institutional inquiry. It does not infer institutions from abstract networks or derive normative rights from formal edges. Instead, it asks how historically formed persons, roles, capacities, artefacts, and permissions interact, and how situated observations can support or misrepresent claims about these relations. The three-level distinction is used as a constraint on inference, not as a claim to have settled the ontology of institutions. The section then distinguishes heterogeneous evaluations and several temporal pathways often compressed under "value generation." Its methodological usefulness will depend on whether these distinctions identify consequential alternatives missed by existing institutional descriptions.

3.1 Ontological Suspension and the Scope of Institutional Explanation

Drawing on the institutional accounts in Section 2 (Osborne et al., 2022; Frischmann et al., 2014a), the analysis distinguishes *ontological reality*, *relational reality*, and *manifestation reality*. These terms classify the status and reach of an institutional claim; they do not assert three independently measurable substances. Ultimate ontological commitments are suspended. At the relational level, a historically constituted position or capability is proposed as an explanatory object when its effects can be argued for and subjected to inquiry. At the manifestation level, interviews, documents, reported experiences, schedules, and outputs provide partial, situated access to that object. A person may act as a contributor without being exhausted by the contribution recorded; a successful protocol may be observable without validating a metaphysical claim about the participants. Each level thus restricts what may legitimately be inferred from the others.

The second level identifies *relational beings and structures*: historically constituted subjects, resources, positions, capacities, rules, dependencies, expectations, and practices that may be sufficiently stable and consequential to become objects of analysis. An institution may continue to affect conduct through role expectations, accumulated competences, valid permissions, reputational commitments, material arrangements, and shared histories even when a particular employee or software system is replaced. The relational account does not infer that every apparent regularity is an autonomous institution. It asks whether the putative structure has specified conditions of formation, persistence, difference-making, and transformation. The third level addresses the forms through which these relations are expressed or encountered in particular contexts. Manifestations can include a patient-facing service, a conversation, a public research note, a schedule, an approval record, a volunteer's decision not to participate, or a scholarly result. They offer evidence, though neither complete nor uniformly reliable evidence, of the underlying relational organisation.

Definition 3.1 (Three-level analytical distinction). For the purposes of this paper, *ontological suspension* means refraining from treating an institutional model as a determination of ultimate being. *Relational reality* denotes historically conditioned entities and relations provisionally identified through warranted explanatory and practical commitments. *Manifestation reality* denotes the situated presentations, inscriptions, performances, and measurements through which particular aspects of those entities and relations become accessible and interpretable. The three levels specify different explanatory obligations; none licenses an automatic inference to the other two.

This distinction matters particularly in settings where ethical and scientific vocabulary overlaps. Recognising a person as a rights-bearing participant is a normative and legal commitment that cannot be derived from the existence of a network edge or from measured usefulness to others. Conversely, ethical concern for a person's dignity does not establish whether a proposed project produces an educational benefit, satisfies a lawful data-use condition, or can be scheduled safely. The relational framework can clarify where explanatory and normative questions interact without replacing the substantive jurisprudential, ethical, empirical, or professional reasoning appropriate to each. It must also permit disagreement about the best account of an institution's relations while recognising that some permissions and duties are already fixed by an applicable legal order.

3.2 Relational Beings, Role Differentiation, and Institutional Asymmetry

The university hospital volunteer commons contains heterogeneous participants whose interests, roles, and institutional positions cannot be assumed interchangeable. A person may be a student, prospective volunteer, independent researcher, hospital employee, service recipient, rights holder, or affected non-participant. The categories describe possible positions within specific relations, not permanent identities or a universal hierarchy of value. One person can simultaneously occupy more than one position; another may be affected by a project without joining it. A hospital department may have authority over its service schedule but no authority to licence an independently created tutorial. A commons steward may publish a synthetic dataset but have no power to authorise observation of patients. These examples are

consequential because the same superficial description, such as “collaborator”, can conceal different legal capacities and different burdens of responsibility.

Definition 3.2 (Situated relational position). A *situated relational position* is a historically and institutionally bounded combination of roles, capacities, interests, expectations, permissions, obligations, and exposures to consequences, considered in relation to specified others and activities. Membership of a broad category, such as *student* or *volunteer*, does not by itself establish a particular permission, consent, competence, or continuing commitment.

Relational positions are also asymmetric. A patient may have a legitimate claim to privacy without controlling the commons’ public research agenda. A novice volunteer may be able to identify recurring navigational difficulties but lack the experience needed to propose an operational change. A faculty member may contribute methodological knowledge while being unable to speak for an entire university. A contributor may hold copyright in an original explanatory document while someone else maintains the infrastructure that distributes it. The analysis should therefore represent at least four distinctions: the ability to affect an outcome, the authority to authorise it, the exposure to its consequences, and the standing to question it. These do not co-vary. In particular, capacity to generate value is neither a sufficient ground of governance authority nor a sufficient reason to impose uncompensated obligations.

A relational being need not be a formally incorporated organisation. A mentoring practice, a maintained source register, or a durable norm of review may become consequential through repeated enactment and recognition. Nevertheless, calling an arrangement an *infrastructure* requires more than observing that it has happened once. It should exhibit an identifiable function, users or affected subjects, a mode of maintenance, applicable constraints, and conditions under which it can fail. A signed agreement with no operational knowledge of its terms may be normatively present but practically ineffective. A routinely followed handbook with no identified issuing authority may influence conduct but cannot therefore be asserted to bind hospital personnel. The relational question concerns how a purported rule acquires practical efficacy, while a separate normative question concerns whether its purported authority is legitimate.

The commons itself can consequently be considered an evolving configuration rather than a unitary actor with a single preference. The public-facing presentation of a commons may speak in one voice, but its contributions are generated by distinguishable persons under potentially divergent commitments. The apparent coherence of its outputs must not erase those relations. The possibility of withdrawal, critical dissent, or an independent project is relevant to its identity: a commons that depends on suppressing disagreement may preserve a branded repository while undermining the participation conditions through which it claimed to be generative. The consequences of such a change would require evidence, but its possibility belongs in the theory from the outset.

3.3 Manifestation, Observability, and the Limits of Representation

Institutional analysis usually encounters records of activity rather than exhaustive access to the activity’s meaning. A service log records what a recording practice makes legible. A scheduling table records a proposed assignment under specified categories. A publication count records recognised outputs according to a bibliographic convention. A participant’s testimony presents an experience through language, memory, expectations, and a particular setting. Each can be valuable evidence, yet none is equivalent to the whole relation that made it possible. An absence from the log can reflect inactivity, restricted access, nonrecording, voluntary non-participation, or a decision to protect confidentiality. The interpretation depends on how the record was produced and what it was meant to capture.

It is useful to describe representation as a *situated, potentially partial operation*. Let R_t denote an analytically specified configuration of relations at time t , and let o designate an observer, institution, or recording procedure operating under a question q . Write

$$M_{o,q,t} = \mu_{o,q,t}(R_t; l_{o,q,t}), \quad (1)$$

where $l_{o,q,t}$ represents the available instruments, access rights, categories, and interpretive conventions. Equation (1) is a conceptual representation schema, not a claim that relational reality is fully known or algorithmically recoverable. The operation $\mu_{o,q,t}$ may be undefined for some questions, may omit relevant circumstances, and need not have a unique inverse. Distinct relational configurations can produce the same recorded count. A change in reporting practice can produce a different record even where the relevant activity changes little. Inference from manifestation to relation therefore requires explicit assumptions and independent corroboration where feasible.

Measurements can illuminate institutional relations without exhausting them. A rise in registrations may indicate interest, simpler forms, greater publicity, or short-lived willingness; the evidence does not by itself establish sustained, autonomous service. An optimised schedule may satisfy stated constraints yet omit fatigue, consent, changing needs, or supervision. Citations may record scholarly use, routine acknowledgements, criticism, or field conventions, without measuring the value returned to the contributor. A missing archive entry may represent neglect or a justified restriction. Each observable therefore requires a production history, a scope of inference, and plausible rival explanations. The three-level discipline is informative only if it changes such judgments, not if it merely renames observations as “manifestations.”

Manifestations may also transform the relations they purport to describe. Information-infrastructure research already cautions against viewing accessible technical artefacts in isolation from organisational practice (Star and Ruhleder, 1996). Publicising a programme can alter who participates. Introducing a performance indicator can alter volunteers’ priorities. Publishing a handbook can standardise practices and create expectations, even before its formal adoption. A research paper can make an unrecognised problem intelligible to another discipline. These are possible feedback relations between records, interpretations, norms, and subsequent action. They should be investigated rather than assumed universally. This feedback is one reason that information-sharing, communication, epistemic validation, historical preservation, and governance cannot be treated as interchangeable functions: they change the circumstances under which representations are created, distributed, trusted, criticised, and used.

The manifestation schema also clarifies the burden of theoretical comparison. If two institutional configurations yield the same ordinary report, a GR interpretation may propose that their historically effective rights, dependencies, or burdens differ. That proposal becomes informative only when some independently defensible evidence or consequence can distinguish the configurations. If every possible observation can be explained retrospectively by an unobserved relational difference, the hypothesis ceases to discriminate. Conversely, privacy, professional duties, and institutional confidentiality can prevent collection of the needed evidence; a responsible analysis must then retain uncertainty rather than claim a hidden mechanism has been confirmed. The cross-domain mechanisms specified in Section 2.10 are therefore candidate causal or interpretive explanations, whereas a dated source record is a manifestation and a lawful or competent decision has additional normative conditions that the source record alone cannot supply.

3.4 Historical Conditioning, Coupled Relations, and Institutional Change

The relational organisation of the commons is historically conditioned. Research on organisational learning already analyses knowledge creation, retention, and transfer (Argote, 2013); the present inquiry examines how such processes interact with rights, voluntary entry, and the conditions of future generativity. Present capacities depend in part on earlier practices, resource allocations, decisions, conflicts, and possibilities that were not taken up. A volunteer may learn a route through informal guidance accumulated over years; a student may inherit a benchmark assembled by unknown predecessors; a steward may rely on a licence selected when contributors had different expectations about reuse. The fact that these relations influence present action does not mean that the institution develops along a predetermined path. Historical continuity may permit reproduction, constrain experimentation, propagate error, or become the object of deliberate revision.

The analysis must therefore attend not only to relations among subjects at a single moment, but

also to *relations among relations* over time. A mentoring practice can shape communication norms; those norms can influence whether an ambiguous event is reported; accumulated reports can affect a decision procedure; that procedure can change the incentives for mentoring. A contribution record can influence who is recognised as an expert; that recognition can alter who is invited to govern a project; governance decisions can change which contributions are preserved. Such couplings show why dividing the commons into infrastructure functions is analytically useful but cannot establish causal independence among the functions. An institutional arrangement can perform several functions, and one function may depend on several arrangements.

Three temporal conditions should be differentiated. *Persistence* occurs when some relevant relation or capability continues despite changes of personnel or artefacts. *Recoverability* concerns whether later actors can reconstruct enough of its origin, limits, and reasons to interpret it critically. *Reproduction* concerns whether conditions become available for subsequent competent and legitimate activity. A preserved decision record may support recoverability while the necessary skills have disappeared. Informal mentoring may support reproduction while leaving little recoverable evidence. An archived error can be valuable because it enables future researchers to avoid a previously unnoticed failure, even if the old procedure is never reinstated. Conversely, persistent inherited practices may impede new participants if they have become opaque or exclusionary.

Institutional history is therefore neither a stock of automatically valuable facts nor a mandate for preservation without limit. Keeping records consumes attention, labour, storage, maintenance, and governance capacity. Certain personal information should not be retained or disclosed merely to improve historical analysis. The use of historical materials depends on copyright, confidentiality, consent, applicable retention rules, and the needs of affected persons. At a theoretical level, the commons should be capable of retaining *reasons for not retaining* particular material, at an appropriate level of abstraction, when that is legitimate. The history of exclusions, corrections, and uncertainties may be as important to future critical inquiry as the history of successful projects.

This temporal account also changes the meaning of institution-specific design. An organisation with an established, reliable archival practice may not need a new repository, but may require a better way for students to interpret existing records. A small independent commons may have no formal board, yet can still preserve dated decisions and identify a responsible steward. A hospital volunteer programme may possess extensive procedural competence but lack permission to share internal documents externally. The engineering question is what relational function remains unmet and through which lawful, resource-sensitive configuration it could be fulfilled, not which standardised institutional apparatus should be installed.

3.5 Heterogeneous Value, Recognition, and Normative Judgment

The term *value* requires special care because a commons may enable multiple goods that belong to different registers. A patient may value dignity, accessibility, or the freedom not to receive unwanted assistance. A volunteer may value meaningful service, companionship, competence, or the ability to set boundaries. A researcher may value explanatory adequacy, originality, reproducibility, or criticism that reveals a mistaken assumption. An institution may value safe continuity, legitimate accountability, or the reduction of avoidable administrative burden. These valuations do not come pre-expressed in a common unit. Their bearers, conditions, time horizons, and methods of justification differ. Some may be compatible, while others may come into direct conflict.

Definition 3.3 (Situating value claim). A *situating value claim* identifies a subject or affected community, an object or event, a context and time, an articulated evaluative criterion, a claimed kind of benefit or harm, and the grounds on which the claim may be assessed. It does not assert that the claimed value is transferable, commensurable with other values, or accepted by every affected subject.

For analytic purposes, a claim about value can be recorded through the tuple

$$\mathbf{J} = (s, x, c, t, \kappa, \varepsilon, \nu), \quad (2)$$

where s is the identified subject or community, x the relevant object or event, c the context, t the time, κ the criterion of assessment, ε the supporting or challenging evidence, and ν the relevant normative standpoint or qualification. Equation (2) is a recording discipline for questions rather than a universal calculation of value. In particular, a criterion may be qualitative, a claimant may disagree with an institution's assessment, and uncertainty may remain unresolved. The formal tuple does not transform the relation between persons and institutions into a scalar commodity.

Three forms of judgment must remain separate in a situated evaluation. *Experiential claims* concern what a person reports or undergoes and require care about voice and interpretation. *Epistemic claims* concern what evidence or disciplinary argument can warrant, with limitations specific to the method used. *Normative claims* concern permissibility, duty, justified priority, and remedy, with sources of authority that a descriptive model does not create. A volunteer's satisfaction cannot alone establish respect for a patient's choice; a feasible allocation cannot alone establish fairness; lawful publication cannot establish educational usefulness. Conversely, a plausible anticipated benefit cannot override an applicable restriction. Because these judgments can conflict, the framework should preserve their authors, reasons, and status rather than combining them into a single apparently objective value score.

Aggregation creates a further problem. Suppose a project improves the accessibility of a public research module for some students while requiring substantial uncredited maintenance work from a few stewards. Counting downloads may identify one dimension of dissemination, but cannot settle whether the arrangement is sustainable or non-extractive. Likewise, a more efficiently staffed event may reduce managerial planning time while increasing the scheduling burden borne by volunteers. No net benefit follows until the relevant subjects, rights, resource costs, and evaluative standards are made explicit. Where trade-offs are unavoidable, the theory should demand a legitimate decision process rather than conceal distributive choices inside a single performance score. Some constraints, especially applicable legal prohibitions and patient safety conditions, cannot simply be traded away by assigning them low numerical weights.

The recognition of value is itself relationally mediated. An academic paper may be regarded as successful by reviewers, useful by another researcher years later, and irrelevant to the immediately affected service community. An original contribution can remain valuable to its author even if it receives little public attention. Institutional prestige, language accessibility, disciplinary familiarity, and publication channels can influence what becomes visible or credible. Hence communication and epistemic validation require independent analysis. More publicity is not necessarily more justified recognition, while lack of recognition does not establish lack of generative potential. This matters when designing contribution credit and access to subsequent research opportunities: a fair scheme should not simply equate the most visible downstream result with the entirety of the upstream work on which it depended.

3.6 Value Pathways and the Reproduction of Generative Capacity

The proposed temporal vocabulary distinguishes five relations that may come apart. *Generation* is the appearance of an activity, artefact, or capability that can become valuable for a specified actor under stated criteria. *Recognition* concerns its situated identification and appraisal. *Propagation* concerns subsequent uptake, transfer, or transformation. *Return* concerns an actual or realistically accessible, legitimate benefit or generative opportunity reaching an earlier contributor or affected collective, without assuming a right to every downstream result. *Reproduction* concerns whether conditions for later creation remain available after maintenance and other burdens. A documented lineage can establish historical connections without proving any return; a published benefit can exist without renewing the capacity that helped create it. Nothing in the model entails that value is conserved through a closed circuit.

The processes are analytically non-equivalent. A new scheduling method may be devised but remain inaccessible to others. An archived method may be recognised as inventive without being adopted. A widely distributed tutorial may draw on earlier work while failing to confer a new benefit on its initial author. An earlier contributor may gain appropriate credit without gaining a right to a later independent invention. A commons may distribute open resources and yet cease functioning when maintenance labour

is exhausted. Positive development in one dimension does not entail improvement in the others, nor does it cancel harms experienced elsewhere in the system. The temporal theory must also accommodate delay: a legitimate benefit may arise after the initial contributor has departed, and its form may not be foreseeable at the time of contribution.

Generative capacity can be understood provisionally as a *context-dependent set of feasible future activities* supported by subjects' abilities and the relations through which those abilities can legitimately be exercised. A student may learn an optimisation method but remain unable to conduct further research without access to a computer, suitable problems, dependable sources, or someone able to review technical difficulties. A skilled volunteer may lack any permissible route to use a newly developed research tool in hospital service. An institution may hold extensive documents but lack the interpretive competence needed to make them useful. Thus the possession of an individual skill, the availability of an artefact, and the institutional capacity to mobilise them are distinguishable explanatory objects.

Assumption 3.4 (Conditional generative opportunities). For an identified subject and activity, a claimed expansion of generative capacity is treated as a hypothesis about newly feasible or better-supported possibilities under stated normative, material, epistemic, and relational conditions. Its existence and desirability are not inferred solely from the creation of an artefact, the addition of a participant, or the formal adoption of an infrastructure.

This assumption helps distinguish *access* from *capability* and *capability* from *outcome*. A document can be technically accessible while remaining linguistically incomprehensible. A research kit can be usable while its problems have little scholarly significance. A participant may gain a genuine new option but freely decline it. A new collaboration may generate publications while undermining the future availability of volunteer time. The empirical evaluation of a commons should therefore ask what options became available to whom, at what cost, by which permissions, and over what historical horizon. The return of value cannot be established merely by documenting that some downstream artefact cites an earlier contribution.

3.7 Illustrative Relational Contrasts and Counterexamples

The distinctions developed above can be examined through idealised configurations that require no access to hospital data. Consider first an independent synthetic scheduling benchmark. A researcher constructs fictional volunteer profiles and explicit constraints using public methodological literature. Students develop competing algorithms, test edge cases, and publish reproducible results. Disciplinary learning and methodological contribution are possible manifestations, with no claim that patient care has improved. If someone later wishes to translate a method into an operational hospital schedule, the relational configuration changes: competent decision-makers, actual constraints, permissions, safety review, and continuing responsibility enter the explanation. A computational improvement cannot substitute for this institutional transition.

Consider next an independently written public handbook explaining possible ethical and organisational issues in volunteer work. The handbook may provide understandable questions and references; it may be corrected by readers and incorporated into teaching or research. Its publication remains an independent scholarly act unless a competent institution adopts particular provisions. Neither favourable reception nor historical preservation converts its interpretations into binding hospital instructions. Indeed, its legitimacy may depend on clearly distinguishing legal propositions, professional advice, authorial interpretation, and hypothetical design. Here, the manifestation of expertise in a polished document could otherwise obscure the absence of delegated authority.

A third configuration involves an interdisciplinary contribution chain. An education researcher develops a training framework; a computer scientist converts some aspects into a synthetic experimental environment; a legal scholar identifies conditions under which parts of that environment might be inappropriate for real participants. Each may contribute new knowledge, but the intellectual relations among their works need not imply joint authorship of every subsequent publication. Source attribution, research

credit, copyright licences, confidential information duties, and any financial arrangements are distinct. A commons may enable later contributors to cite, criticise, reproduce, or extend earlier works according to applicable conditions, yet cannot promise original contributors unrestricted use of all downstream results. Apparent continuity of intellectual influence is not identical to a legal chain of entitlement.

Finally, imagine a small commons that receives considerable attention following successful independent publicity. Participation requests grow faster than its steward can review proposed datasets, correct misleading research claims, or respond to copyright questions. Its manifestation-level popularity has increased, while its capacity for safe, well-governed work may have declined. A defensible generative interpretation must include the possibility that communication success creates resource burdens and reduces future options. A temporary pause on accepting new contributions could then be consistent with responsible stewardship, notwithstanding a short-term reduction in activity counts. The significance of the example is not that pauses are always beneficial, but that the normative and material conditions of maintenance must be considered in judging generative success.

3.8 Design Implications for Constitutive Infrastructure Functions

The preceding reconstruction supplies an analytical basis for later institutional engineering without determining one institutional solution. First, every proposed infrastructure should identify the relations it is meant to constitute or maintain, not merely a document or tool that might be installed. A normative infrastructure must identify sources of authority, rights, interpretive responsibility, and mechanisms of revision. An information infrastructure must make claims and resources discoverable with their status and access conditions. A communication infrastructure must enable accurate exchange and reciprocal response. A decision infrastructure must connect alternative construction and conditional simulation to legitimately authorised judgment and subsequent evaluation. None of these functions can be established from software deployment or publication alone.

Second, the three-level distinction creates separate evidential questions for each function. At the relational level, who actually possesses the capacity or authority to act, and through which historically formed arrangements? At the manifestation level, what traces are available, who produced them, and what claims can they support? At the ontological level, which stronger interpretations have been left unresolved rather than silently imposed? These questions also discipline the treatment of participants: an affected person cannot be reduced to the record generated about them, and a participant's refusal to provide information cannot be presumed to signify a deficiency in the person or the commons.

Third, heterogeneous value means that infrastructure adequacy is not reducible to one optimisation objective. A single arrangement may enable disciplinary publication, impose maintenance burdens, strengthen public access to a method, and increase risk of institutional misunderstanding. The design process needs separate criteria for epistemic quality, voluntary choice, legitimate rights, safety, distributive consequences, and future capacities. Where conflicts arise, an accountable governance process must determine which standards apply and who has standing to contest the result. Equations (1) and (2) cannot replace such judgment; they only help state the relevant explanatory and evidential questions.

Finally, an infrastructure's effect is historically contingent and must remain revisable. A useful research module can become obsolete; a respected handbook can contain a mistaken interpretation; a well-intended publicity effort can imply unavailable institutional endorsement; a preserved dataset can acquire unforeseen risks under new conditions of linkage. These possibilities motivate records of original reasons, context and uncertainty, alongside mechanisms for correction, retirement, restricted reuse, and responsible exit. The later architecture distinguishes fifteen constitutive functions to make such obligations analytically visible. That number is a provisional classification of functions to investigate, not a prescription to create fifteen departments or an assertion that the proposed taxonomy is complete. The test of an institutional configuration is whether its arrangements legitimately support the relevant functions, permit critical examination of their consequences, and preserve the practical possibility of justified revision.

4 University Mediation and Multidimensional Relational Proximity

This section examines university affiliation as a possible *mediating condition*, not an institutional advantage presumed from proximity or rank. Its explanatory object is the activity-specific relationship among public service questions, students, disciplinary resources, and the competent organisations that govern them. The argument distinguishes possible encounters from realised cooperation, institutional referral from authorisation, and research participation from hospital service. Geographical, temporal, cognitive, organisational, social, and institutional circumstances may affect these pathways in different combinations. Countercases involving remote researchers, non-university organisations, and exclusion within close networks are needed to determine what university mediation contributes beyond ordinary mentoring, recruitment, and network access.

The theoretical status of the argument is important. Research on proximity in innovation, on boundary objects, and on knowledge translation already supplies established accounts of mechanisms relevant to heterogeneous cooperation (Boschma, 2005; Star and Griesemer, 1989; Carlile, 2004). The proposed extension concerns their use in examining initial voluntary relations and the prospective constitution of an independently accessible research commons associated with, but not necessarily authorised by, a university hospital. The argument identifies possible enabling conditions and burdens. Whether the resulting arrangements actually increase participation, public value, or disciplinary learning remains an empirical question.

4.1 University Affiliation as a Heterogeneous Mediating Relation

University hospitals may bring patient care, clinical training, scientific inquiry, teaching, and nonclinical support into spatially or organisationally adjacent settings. The actors involved nevertheless operate under different sources of competence and responsibility. A faculty member may supervise an independent theoretical project without being authorised to recruit patients; a hospital coordinator may organise permitted volunteer activity without being empowered to approve an external study; a student may access university research resources without belonging to the hospital's service workforce. Each mediating relation should therefore be stated in terms of its originating actor, intended activity, receiving actor, time, and relevant permission. Shared names and institutional reputation are possible conduits of attention, not substitutes for these distinctions.

For analytical purposes, we distinguish *organisational linkage* from *institutional mediation*. An organisational linkage is an established association, such as administrative affiliation, shared facilities, or a formal cooperation agreement. Institutional mediation refers to the activity through which an existing or newly constructed relation enables actors to encounter, interpret, assess, coordinate, or potentially transform a problem across institutional positions. The two can coincide, but an organisational linkage can exist without active mediation; mediation can also arise through a publicly accessible document or an independent scholarly discussion where no formal partnership has yet been established.

Five potential mediation functions help distinguish an actual interface from symbolic affiliation. *Discovery* makes a problem encounterable by an actor previously outside it; *interpretation* makes the question comprehensible within a discipline without declaring disciplinary equivalence; *referral* identifies a competent actor without pre-approving a request; *coordination* aligns limited, revisable commitments; and *knowledge recombination* allows methods or problems to be reworked for a new setting. A public project note may perform the first two functions while the last three remain absent. A university librarian may provide a lawful resource pathway without any role in hospital decision-making. The research task is to find traces of who actually performed each mediating function, at what cost, and under which constraints, rather than attributing successful cooperation to "the university" as a unitary agent.

A commons thus cannot be characterised adequately as an intermediary institution occupying a single position between the hospital and students. Some relations are direct, others mediated through faculties, associations, libraries, volunteer groups, or public research artefacts. Their orientation may change over time: a volunteer may later join a research project; a researcher may remain an external contributor; an independent publication may be criticised by hospital professionals without thereby becoming an official

Table 1: Analytical dimensions of proximity in prospective university hospital volunteer commons

Dimension	Possible enabling condition	Distinct limitation or countercondition
Geographical	Repeated travel or face-to-face contact is practicable	Nearness does not establish interest, accessibility, or permission
Cognitive	Relevant concepts, questions, or methods are sufficiently intelligible	Shared vocabulary can conceal conflicting assumptions
Organisational	Reliable channels connect relevant roles and units	Administrative connection can be rigid or exclude outsiders
Social	Introductions and sustained ties may support cooperation	Insider dependence can produce gatekeeping or deference
Institutional	Compatible rules and familiar practices facilitate coordination	Shared affiliation does not transfer operational authority
Temporal participation	Available time windows permit the relevant activity	Timetables, care obligations, and episodic demand can diverge

Note. The first five categories follow Boschma’s established analytical distinction; the temporal participation category is an extension proposed for this paper. The table describes possible mechanisms, not empirically established advantages of university hospitals.

hospital report. A relational analysis should record the mediating path and the resulting authority status, not infer institutional endorsement from a shared university name.

Definition 4.1 (Situated university mediation). A *situated university-mediated relation* is a historically and institutionally specific connection in which an actor, practice, or artefact associated with a university changes the practical possibilities for discovering, interpreting, legitimately referring, coordinating, or critically developing a question involving hospital-related public service. The definition does not imply that the university controls every participant, that the relation is productive, or that the mediating actor has authority to permit subsequent action.

This definition concerns the relational level specified in Section 3. The corresponding manifestations can be identifiable invitations, documented problem statements, workshops, referral letters, research repositories, recorded approvals, and actual voluntary activities. These are distinguishable sources of evidence, not interchangeable indicators of the underlying relation. A large number of publicly advertised projects may coexist with little disciplinary understanding; a small number of carefully mediated enquiries may support rich independent research without producing new service volunteers.

4.2 Multidimensional Proximity as a Conditional Structure

Proximity is commonly understood in everyday institutional discussion as nearness in physical space. Geographical nearness can matter when participation requires repeated journeys, access to a particular library, or attendance at a time-constrained activity. Yet the claim that a student is located close to a university hospital says little about whether the student can contribute to an accessible research project, understands its technical requirements, is able to satisfy a hospital’s entry procedures, or wants to participate. Relational proximity therefore requires several distinguishable dimensions and attention to their interaction.

Boschma’s analysis of proximity and innovation differentiates geographical, cognitive, organisational, social, and institutional proximity, and cautions against treating geographical closeness as a sufficient condition for learning and innovation (Boschma, 2005). We retain the provenance of those five categories. For the present object, we *add temporal participation proximity as a proposed analytical extension*, reflecting the specific time commitments of education, research, care, and volunteering. The extension is not attributed to Boschma, and it need not define a universally independent sixth proximity dimension in every innovation setting.

Proximity dimensions need neither share a metric nor vary monotonically with the desirability of cooperation. A trusted senior colleague may enable entry while inhibiting dissent; shared methodological

training may accelerate coordination while discouraging alternative problem definitions. Geography matters to a person who must attend an authorised shift but may matter little to a remote contributor working with synthetic examples. Organisational links may clarify referral routes while strict separation remains essential for privacy or research ethics. A useful comparison therefore changes one proximity condition while examining participation costs, substantive understanding, permission, and the quality of the resulting relation. The predicted advantage should fail in cases where a distant or organisationally independent actor gains adequate access and the nearby group does not.

To keep the representation modest, let i denote a potential participant, q a specified form of activity, and t a time or period. We may describe a *proximity profile* as

$$\mathbf{p}_{i,q,t} = (p^{\text{geo}}, p^{\text{cog}}, p^{\text{org}}, p^{\text{soc}}, p^{\text{inst}}, p^{\text{temp}})_{i,q,t}. \quad (3)$$

Each component of Equation (3) is a question-specific descriptor to be operationalised, where possible, with appropriate evidence. It is not presumed to be a number, and the notation specifies neither a distance metric nor additive weights. The relevant comparison may instead be ordinal, categorical, narrative, or partly indeterminate. A proposed scalar “participation proximity score” would require its own empirical and normative justification. It should not be assumed that low travel time compensates for absent consent or that a familiar university procedure compensates for lack of required training.

The relational structure is also dynamic. Timetables change across semesters; supervisors leave; organisational units reorganise; a public handbook acquires a new revision; a repeated conversation changes the intelligibility of a problem; a reputation for unreliable governance affects willingness to participate. As a result, a proximity profile must be situated in time and connected to the historical formation of the relevant paths. Even where stable institutional affiliation is present, the practically available routes of cooperation can expand, contract, or disappear.

4.3 Student Participation and Temporal Feasibility

Students are not a homogeneous reserve of available volunteer labour. They may have classes, supervised laboratories, examinations, paid employment, caregiving responsibilities, disability-related access requirements, immigration or financial constraints, and varying interests in research or service. These conditions can influence both their opportunity to undertake independent inquiry and their ability to accept recurring public-service commitments. It would be misleading to infer an advantage from student status without examining the concrete activity and the distribution of its costs.

Temporal feasibility is distinct from motivational commitment. Someone can find a project intellectually valuable while lacking the time to attend its scheduled activities. Another person may have available hours but lack interest in the proposed field of inquiry. A third may have both interest and time but be unable to satisfy a hospital’s applicable role requirements. A public research commons can make some kinds of participation asynchronous, modular, or remote. However, hospital-authorised activity may require supervision, presence, continuity, confidentiality training, or operational handover. These are not logistical inconveniences that a research commons is entitled to override.

An independent engineering project illustrates the distinction. A student may devote irregular evening periods to evaluating scheduling algorithms on fully synthetic problem instances. The research environment can provide reproducible inputs, known constraints, baselines, and an explicit account of which quantities are hypothetical. The student can make a scholarly contribution without appearing at the hospital and without making a commitment to patient-facing work. If an eventual opportunity for voluntary service becomes available, that second activity has different temporal, normative, and institutional requirements. A commons that makes access to the research materials contingent on performing unpaid hospital work would conflate two legitimate but separable relations and could make participation coercive or extractive in practice.

A useful feasibility assessment consequently addresses several questions before any particular scheduling technique is chosen: what activity is proposed; which commitments require synchronous coordination; whose time is being counted; what training, supervision, and recovery costs exist; which

activities are eligible for asynchronous participation; how unforeseen absences are treated; and which person or organisation bears the cost of schedule instability. Formal optimisation of assignments becomes meaningful only after these obligations and permissible choices are established. If a timetable optimises the number of filled posts by transferring unpredictable costs onto volunteers or hospital staff, its apparent efficiency may conceal a deteriorating relational condition.

The proposed extension to temporal proximity should also be open to empirical criticism. A comparison might find that proximity to the academic calendar is less important than trusted supervision, paid transport, or accessibility of disciplinary resources. The contribution of temporal proximity would then be contingent rather than defining. Its function here is to prevent the theoretical model from silently treating participation capacity as a stable property of membership in the category *student*.

4.4 Disciplinary Problem Formation and Generative Entry

University mediation is especially pertinent when a public-service difficulty can be examined through methods developed in different fields. Yet the initial problem is seldom presented in a form already appropriate to each discipline. The statement “volunteer scheduling should be improved” does not determine a mathematically valid optimisation objective, an empirically responsible educational design, a lawful collection of information, or a defensible account of distributive consequences. A disciplinary research environment must make the problem sufficiently explicit for independent inquiry while preserving the right to question whether its formulation is appropriate.

For engineering, a plausible infrastructure may supply a problem contract stating the abstract decision variables, feasibility constraints, temporal assumptions, objective alternatives, and known limitations of synthetic instances. A classical integer-programming baseline can help evaluate more experimental heuristics; formally defined counterexamples can expose situations in which an alleged improvement violates fairness or availability constraints. Such a setting may support inquiry into optimisation, robustness, uncertainty, algorithm comparison, or simulation. The object of research remains an intentionally constructed problem rather than a representation of actual hospital operational data. A method developed in this environment does not thereby become fit for operational adoption.

For education or learning sciences, the same public-service theme may become a question about situated learning, knowledge transfer, feedback, or the accessibility of preparatory materials. A useful infrastructure would then include distinguishable pedagogical claims, suitable evidence, accessible learning artefacts, and procedures for evaluating outcomes without presuming that participants’ self-reports establish competence. For legal scholarship, the object might be the relation among the terms of an independent Commons licence, institutional authority, and the boundaries of volunteer roles. It would require jurisdictionally specified legal sources and a clear difference between binding norms and proposed ethical principles. For historical inquiry, the concern might be how a documented practice changed over time, what reasons were preserved, and where the available record remains silent.

These projects share a public context but are not interchangeable research tasks. They have distinct criteria for originality, validity, ethical acceptability, and reusable outcomes. A shared problem statement can enable recognition among disciplines, yet substantive research begins when the participants can reformulate, criticise, and investigate it within their own methods. The commons should therefore offer both common contextual resources and specific disciplinary environments. A comprehensive digital catalogue that lacks usable research problems is insufficient; conversely, a technically sophisticated optimisation benchmark without contextual or normative explanation may encourage irrelevant or misleading conclusions.

The initial participation mechanism proposed here is consequently not a simple exchange in which academic benefit purchases volunteer hours. Independently useful research infrastructure may provide a credible reason to encounter a public problem, learn its context, and possibly establish a relationship with other participants. The encounter might subsequently lead to research cooperation, public discussion, authorised service, or no further involvement. The framework treats these as distinct possibilities. An invitation to participate should communicate the actual available pathway rather than imply guaranteed

publication, professional advancement, institutional endorsement, or future hospital access.

4.5 Interdisciplinary Translation and Boundary Objects

The cooperation of heterogeneous disciplines involves more than the transfer of information between people who use different words for the same object. Research problems may embody incompatible purposes, standards of evidence, classifications, or allocations of responsibility. In a foundational account of heterogeneous scientific cooperation, Star and Griesemer (1989) examine boundary objects and methodological standardisation as means through which different social worlds can coordinate while retaining distinct viewpoints. Carlile (2004) distinguishes syntactic, semantic, and pragmatic knowledge boundaries and relates them to processes of transfer, translation, and transformation. These are prior contributions on which the present institutional design inquiry can draw; the proposed GR interpretation does not originate either concept.

A candidate boundary object for the Commons might be a versioned research problem description that includes its public-service context, the abstract variables used for one engineering formulation, applicable rights and restrictions, and a record of contested assumptions. An engineering researcher could use its formal constraints; an education researcher could question how the problem teaches or conceals organisational knowledge; a legal researcher could examine whether a purported permission is supported by its source. The artefact permits coordination because its provenance and interfaces are sufficiently stable, not because every reader assigns it the same meaning.

However, a boundary object can also fail. A category such as “volunteer availability” may appear self-evident to an optimiser yet omit unpaid preparation, uncertainty, social pressure, or constraints on a person’s ability to decline. A “successful event” may denote punctual execution for an organiser, a positive learning experience for a participant, or burdensome disruption for someone whose needs were not represented. Conceptual translation must therefore allow the object itself to be altered or rejected. Insisting on one vocabulary as the price of participation risks turning mediation into disciplinary domination.

A defensible translation procedure would record what question each discipline believes it is addressing, the source of its terminology, the transformations made when formalising it, and the aspects of the original situation that remain outside the formalism. The result may be a shared dataset schema, a glossary with unresolved discrepancies, a seminar, a method note, or an independently reviewable research protocol. These are illustrative forms, not mandatory software products. Where disagreements matter to downstream use, the Commons should preserve them rather than seek premature consensus. In this sense, interdisciplinary mediation is also historical and normative: translation changes what becomes visible as a problem and whose account counts as relevant.

The university may help make such encounters likely by bringing disciplinary communities into a partly shared educational environment. Nevertheless, the competence to interpret another discipline cannot be inferred from administrative affiliation. Translation requires time, scholarly attention, acknowledgement of power asymmetry, and appropriate mechanisms for criticism. A one-person Commons may begin by documenting assumptions and inviting independent review rather than asserting that a fully functioning interdisciplinary community already exists.

4.6 Institutional Permissions and the Asymmetry of Authority

Relational proximity is not legal permission, and scientific interest is not a sufficient reason to undertake an intervention. The distinctions introduced in Section 1 remain essential: independently accessible Commons research, hospital-authorised voluntary activity, and separately authorised research involving participants or institutionally controlled data occupy different governance spheres. Their connections should be possible only through the relevant legitimate procedures. The university may support a referral or identify a suitable expert, but it may lack authority to grant a hospital’s operational approval. A clinical service may permit a volunteer activity without permitting an independent study of its participants.

It is useful to separate the feasibility of contact from the permissibility of action. For a specified proposed action a , participant i , and institutional context q at time t , let $I_{i,a,q,t}$ express the existence of an intelligible opportunity, $F_{i,a,q,t}$ the practical feasibility of participating, and $L_{i,a,q,t}$ the satisfaction of applicable permissions and constraints. A modest statement of *eligible practical entry* is

$$E_{i,a,q,t} = I_{i,a,q,t} \wedge F_{i,a,q,t} \wedge L_{i,a,q,t} \wedge V_{i,a,q,t}, \quad (4)$$

where $V_{i,a,q,t}$ denotes a voluntary, sufficiently informed choice by the participant. Equation (4) is an analytical checklist for a specified activity, not an algorithm for deciding whether someone has consented, nor a comprehensive account of legal eligibility. Its terms acquire their content from institutional, practical, and normative enquiry. For some independent research activities, the relevant permissions may consist of open-licence conditions and the contributor's own decisions; hospital-facing activities demand additional authorisations. An unknown permission is not converted into an affirmative one by a favourable proximity profile.

The status of an artefact is not determined by the prestige of the place from which it appears to originate. An independently written handbook remains a research proposal until a competent institution adopts it. A simulated patient-flow or volunteer-scheduling model remains an analytical construction until its assumptions and intended use receive appropriate scrutiny. A public project description can invite dialogue without representing the university or hospital. Each transition should identify who can affirm the new status, which review has occurred, and which uses remain excluded. These are standing questions for normative interpretation, information classification, and governance, not misunderstandings remediable by clearer advertising alone.

Institutional boundaries may nevertheless be productive rather than merely restrictive. Clear separation can enable an independent Commons to begin legitimate scholarly work without needing premature approval for nonexistent clinical activities, while also preventing claims of service authority that its members do not possess. It can protect hospital professionals from unexpected supervisory obligations and protect volunteers from being recruited into ambiguous arrangements. The purpose is to construct reliable interfaces, not assume that all cooperation should be maximised.

4.7 Power, Exclusion, and Unfavourable Proximity

The prospect of university-mediated value creation also raises distributive and political questions. Students associated with recognised research groups may more readily encounter invitations, receive mentorship, and obtain credit than local residents who have substantial service knowledge but no academic status. Researchers with prestigious disciplinary credentials may dominate the formulation of problems, while patients or experienced volunteers are represented only through the categories chosen by others. Even an open repository can privilege persons with advanced technical skills, reliable internet access, discretionary time, or familiarity with academic English. Accessibility and inclusion therefore concern the substantive terms of participation, not solely the public visibility of materials.

There is also a risk that a research Commons becomes a means of extracting unpaid labour under the promise of future intellectual benefit. A student may experience reputational pressure to accept tasks presented by a faculty member. A volunteer may be expected to contribute experiences or documents without being given meaningful opportunities to contest their use. An institution may celebrate research outputs while failing to maintain the service functions on which the research narrative depends. A contributor may receive attribution while having no practical means to reuse their own contribution or challenge an inaccurate record. These are possible mechanisms of value co-destruction, not outcomes presumed to occur in every arrangement (Osborne et al., 2021; Frischmann et al., 2014a).

High proximity may intensify these problems. Dense social relations can make refusal difficult; common organisational membership can discourage criticism; disciplinary homogeneity can normalise methods that obscure the experiences of other participants. Low proximity is not automatically bad: an external historian, an independent legal researcher, or a community organisation may identify missing sources and assumptions that an insider group overlooks. A viable Commons should preserve routes for

outsiders, permit contributions without compulsory hospital service, make withdrawal and disagreement possible, and allow contributors to maintain distinguishable intellectual positions.

The analysis also needs to recognise institutional resource costs. Making opportunities legible takes editorial work; translating disciplinary problems consumes expert time; safeguarding patient boundaries requires competent review; supervising novices can burden hospital staff; and maintaining a public reputation creates obligations of correction. A design that increases inquiries while leaving these costs invisible may produce more apparent engagement and less sustainable generative capacity. Comparative evaluation must therefore ask who bears the work of mediation, whose needs are deferred, and how the burdens and benefits change over time.

4.8 Comparative Institutional Configurations and Discriminating Observations

University hospitals are an analytically useful type, not the only institutional setting in which a volunteer commons could exist. A general hospital may have enduring partnerships with municipalities, local schools, professional associations, or civic groups. An independent research institute may provide stronger methodological support than a nearby university department. A geographically dispersed university may sustain accessible online research projects without repeated on-site contact. Conversely, a university hospital may retain strict administrative separation among research, education, and voluntary service, with few feasible channels for new participation. These are potential configurations requiring institutional study, not interchangeable empirical cases.

The explanatory contribution of university mediation should therefore be assessed through the actual paths by which actors encounter and act upon a problem. Useful comparisons would distinguish university-affiliated institutions with effective interdisciplinary translation from those with nominal affiliation only; adjacent and distant participants with similar research resources; hospital programmes with and without independent open problem environments; and university-mediated projects from civic-network-mediated alternatives. Such comparisons should control, as far as their design permits, for prior motivation, available time, supervision, institutional permission, and differences in participant populations. Otherwise an apparent university effect could reflect selection, reputation, or programme resources rather than mediation itself.

At least four propositions are open to discriminating investigation. First, the existence of an accessible disciplinary entry environment may improve a prospective participant's understanding of the research opportunity, even where it has little effect on hospital-service recruitment. Second, reliable translation and provenance may make cross-disciplinary reuse more feasible than publicity alone. Third, the relation between geographical proximity and actual service participation may be moderated by scheduling and supervision conditions. Fourth, a tightly connected university network may produce less diverse contributions when its gatekeeping costs exceed its coordination advantages. Each proposition admits plausible counterexamples. The present paper does not report evidence sufficient to confirm them.

Observations should also be appropriate to the three analytical reality levels. At the relational level, the investigator seeks evidence of sustained referral capacity, legitimate coordination, the actual ability to question assumptions, and the preservation of participant autonomy. Manifestations may include documented communications, uptake of open materials, research artefact reuse, recorded decisions, or changes in participation. Such records should be interpreted with attention to their production and access conditions. No single count of impressions, volunteer applications, or repository downloads establishes that generative relations have formed. The ontological suspension described in Definition 3.1 also prevents the framework from treating those counts as an exhaustive measure of persons or value.

4.9 Implications for Constitutive Infrastructure Design

The analysis yields a set of design obligations for the subsequent infrastructure chapters. A public-problem infrastructure should make clear who initially formulated a question and whose perspectives may have been omitted. An information-sharing infrastructure should make research opportunities discoverable while marking the legal and epistemic status of their underlying resources. A communication

infrastructure should allow independent presentation and critical feedback without claiming hospital endorsement. A disciplinary value-creation infrastructure should supply genuinely usable methods, evidence, and open problems rather than an invitation without scholarly substance. An interdisciplinary mediation infrastructure should preserve contested translations and field-specific standards. Participation and decision-making infrastructures should make the temporal and normative conditions of proposed commitments legible, while retaining the right to decline and the ability to adapt plans to changing circumstances.

These functions need not become separate offices or digital systems. A small independent Commons may realise several of them through a maintained source register, a carefully written research problem contract, a transparent public invitation, and a process for receiving corrections. A larger institution may distribute the functions among existing departments and formal committees. The assessment should ask what is actually maintained, who can legitimately act, how records support later understanding, and what happens when a required relation fails. Institutional heterogeneity changes the design configuration but does not eliminate the need to account for these functions.

Above all, the university's distinctive potential is not an automatic supply of compliant volunteers. It is the possibility that existing disciplinary, educational, and public-service relations make new forms of legitimate intellectual and social cooperation thinkable and practicable. The process can support research without service, service without research, and certain authorised connections between them. Its ethical and generative adequacy depends on the configuration actually constituted, including the rights and capacities of those who do not participate. The later treatment of initial voluntary participation will examine the actual formation of such relations more directly; the expanded institutional-engineering programme will specify how the relevant conditions may be designed without imposing a single blueprint on heterogeneous institutions.

5 Context-Dependent Methodology of Institutional Infrastructure Design

This section sets out a method for constituting infrastructure functions without prescribing a single administrative arrangement. It asks how an institution can determine what an intended activity actually requires, which functions existing practices already perform, and what a new arrangement would add after accounting for authority, participants, history, evidence, and maintenance. The methodology is broader than software or organisation charts. It begins with activity-specific design questions, then connects three-level relational analysis to normativity, decision procedures, coupling, proportionate sequencing, and revision. The resulting grammar supplies a common audit language for the fifteen subsequent infrastructure functions, not a list of offices that every university hospital should establish.

A deliberate institutional arrangement belongs among the objects of inquiry in the sciences of design, but it is not equivalent to a technical artefact with stable inputs and fully specified outputs. Simon's analysis of artificial systems offers a useful foundation for understanding purposeful arrangements under constraints (Simon, 1996); the knowledge-commons research framework makes rules, resources, participants, and governance relevant analytical objects (Frischmann et al., 2014a). Ostrom's institutional analysis similarly invites attention to action arenas and rules in use rather than inferring practice from formal declarations alone (Ostrom, 1990, 2005). Design-science scholarship also distinguishes contributions to design knowledge from the mere production of a particular artefact (Gregor and Hevner, 2013). Research on infrastructure shows that functionality also arises relationally, through situated use, membership, local practices, and changing organisational environments (Star and Ruhleder, 1996). These contributions inform, but do not themselves establish, the design grammar advanced here. Our proposal is a context-dependent synthesis whose value must be examined through explicit design cases, counterexamples, and eventual empirical investigation.

5.1 Constitutive Functions and Their Institutional Realisations

An artefact is evidence of an infrastructure only to the extent that it helps perform an identifiable function. A handbook may describe procedures without having authority to bind an institution; an archive may hold records without preserving their interpretive context; an open research page may list attractive problems without the baselines needed to investigate them. Conversely, a small Commons may have adequate source review, contribution attribution, and correction processes through one responsible steward and carefully maintained records. The design inquiry should therefore specify the proposed action, the actor who could perform it, the arrangements already available, the observable failure of those arrangements, and the marginal benefit and burden of an additional mechanism. A visual or technological upgrade is not itself an institutional improvement.

Definition 5.1 (Constitutive infrastructure function). For a specified institutional context, question, and period, a *constitutive infrastructure function* is a recurrently supportable arrangement of legitimate capacities, relationships, knowledge, and procedures that makes a class of otherwise difficult, uncertain, or unavailable cooperative actions feasible and examinable. The definition does not imply that the intended actions occur, that they are beneficial, or that the function requires a separately constituted office or digital system.

The design grammar also requires a *proportionality and substitution test*. Before constituting a new function-specific organisation or requiring a new record, investigators should examine whether an existing lawful practice, competent person, public resource, or simpler combination of arrangements already enables the specified activity. An additional infrastructure is justified only by a defensible improvement in access, accountability, intelligibility, safety, research capacity, or another stated objective relative to its burdens. Such a judgement cannot be made from document counts alone; evidence may expose adverse effects on less-resourced participants. Neither functional differentiation nor apparent organisational complexity is itself a normative achievement.

This definition treats provision, use, and effects as separate analytical objects. Establishing a source register may support discoverability; it does not prove that prospective participants can understand or lawfully reuse its contents. Establishing a dispute procedure may create a channel of contestation; it does not demonstrate that a vulnerable contributor can use it without retaliation. A functioning decision process is not the same as a morally correct decision. Accordingly, inquiry must distinguish the asserted purpose of an arrangement, the authority and resources actually supporting it, the practices through which it is accessed, and the consequences manifested over time.

The fifteen functions are provisional distinctions among design problems: public-problem constitution, normative interpretation, governance, safety, historical recoverability, information sharing, epistemic validation, disciplinary research conditions, interdisciplinary mediation, communication, voluntary entry, decision coordination, contributor rights, value return, and resource reproduction. Their separation prevents a single artefact from silently doing the work of unrelated authorities. A public decision log may support governance, history, and communication, but its disclosure rules may differ for each use. A contributor register may support attribution without conferring legal ownership or any actual benefit. A proposal to create fifteen separate departments would therefore misread the framework. Functions can share arrangements or remain intentionally uncoupled where confidentiality, conflicts of interest, or participant autonomy require separation.

5.2 Institutional Context as a Design Variable

The relevant context is not simply a hospital's size, country, or affiliation. Institutional constitution involves the intersection of available resources, social and professional relations, formal authorities, historical trajectories, lawful information access, public expectations, and participants' capacity to act. A single organisation may contain differentiated contexts: a student laboratory, a hospital volunteer coordination unit, a community organisation, and a patient-facing service may occupy adjacent space but

possess different obligations and decision makers. The same proposed activity can be legitimate in one sphere and require additional permission in another.

A contextual specification should therefore identify the institutional actors and affected nonparticipants, the relevant activity and its purpose, the territorial and professional sources of authority, the resource and labour commitments, the available evidence, and the time at which the specification is considered valid. It should also record relevant uncertainties rather than turning missing information into presumed approval. Historical path dependence matters because a programme’s inherited practices, relationships of trust, prior failures, and language of description affect which interventions are intelligible or acceptable. A proposed method of receiving student research contributions may work in a laboratory with formal supervision and fail in an independent volunteer collective without such supervision. Neither is the universal case.

$$\mathcal{D}_{I,q,t} := \mathcal{D}(\mathbf{F}_q, \mathbf{X}_{I,t}, \mathbf{N}_{I,t}, \mathbf{H}_{I,t}), \quad \mathbf{d}_{I,q,t} \in \mathcal{D}_{I,q,t}. \quad (5)$$

where I designates the institutionally relevant configuration, q the design question, t the time, $\mathbf{F}_q$ the functions under examination, $\mathbf{X}_{I,t}$ the situated actors, relations, and resources, $\mathbf{N}_{I,t}$ the applicable normative and authorisation conditions, and $\mathbf{H}_{I,t}$ the historically available evidence and constraints. The set $\mathcal{D}_{I,q,t}$ denotes the context-indexed candidate arrangements that can be proposed for examination, while $\mathbf{d}_{I,q,t}$ denotes one such candidate, not a known optimal solution. This design domain is distinct from the typed dependency claims $\text{Dep}_{I,t}$ of Equation (42). Equation (5) does not assert that this set can be exhaustively enumerated or computed. Its purpose is to make explicit why a design considered appropriate for one question and institution may be inadequate when the context, rights, knowledge, or time changes.

Institutional comparison must occur at the level of actual capabilities rather than labels. A university hospital may have unusually direct academic connections while a community hospital has deeper local trust and more established volunteer mentoring. An independent research Commons may support methodological exchange across borders without having any competence in hospital operations. The same designated infrastructure may therefore be adequate for one activity and unsuitable for another. Following the institutional sensitivity of Ostrom’s analysis (Ostrom, 2005), we compare available actors, resources, rules, and action situations, while explicitly leaving open whether a new Commons contributes anything beyond established partnerships or teaching programmes. Successful application of a design grammar is not established by classifying more activities.

5.3 Ontological, Epistemological, and Normative Design Inquiry

The design process follows the three reality-level distinctions developed in Section 3. At the level of ontological suspension, a Commons theory refrains from identifying persons with operational roles, measuring value as an intrinsic scalar property, or claiming to have settled the ultimate constitution of an institution. At the relational level, it identifies sufficiently durable and consequential relations: permission to act, capacity to teach, ability to criticise, dependence upon specialised knowledge, and institutional responsibilities. At the level of manifestation, it investigates the particular documents, reports, interactions, artefacts, and records through which some aspects of those relations become accessible. These distinctions govern claims about the status and success of the designed infrastructure.

An ontological question asks what kinds of beings and relations the project assumes: whether a “contributor” names a copyright holder, a volunteer, a researcher, an affected outsider, or a person occupying several roles. An epistemological question asks how we could learn whether a relevant relation exists and how uncertain that judgment remains. A normative question asks what a person or organisation is entitled, required, or forbidden to do, who can make an authoritative determination, and what kinds of objection are admissible. These questions condition one another but are not interchangeable. A volunteer’s recorded attendance may be evidence of a service event, but does not establish a valid research consent or an entitlement to reuse clinical information. A licence declaration may manifest one party’s intention without settling title to underlying material.

Table 2: Common inquiry fields for context-dependent infrastructure design. The fields specify accountable design questions, not predetermined institutional arrangements.

Design field	Question requiring a situated answer
Constitutive object	Which action possibilities, subjects, and relations are at issue?
Ontological and epistemic scope	What assumptions identify these relations, and what evidence could qualify the assumptions?
Normative status and authority	Which sources of obligation, permission, and legitimate decision apply to this activity?
Contextual configuration	Which actors, resources, procedures, and organisational forms are available or contestable?
Operational mechanisms	How are decisions made, work performed, exceptions handled, and records maintained?
Interfaces and dependencies	Which other functions and external institutions supply necessary conditions or impose limits?
Resource and burden allocation	Who provides maintenance, skilled judgement, time, money, and opportunities for criticism?
Assessment and historical revision	What counts as malfunction, adverse effect, justified suspension, correction, or redesign?

Consider a public scheduling demonstration. At the relational level, participants may have capacities to formulate constraints, reproduce benchmarks, and challenge fairness assumptions. The manifestations may be an open dataset, a mathematical specification, versioned experiments, and a critical discussion. At the normative level, the demonstration must distinguish genuinely synthetic or lawfully supplied data from institutional records, ensure that licences are accurate, and prevent a hypothetical schedule from being presented as an authorised operational instruction. At the ontological level, even a mathematically optimal assignment cannot claim to have exhaustively represented human welfare, participation, or value. The same distinction is needed for a handbook: an explanatory research draft may offer valuable knowledge without being an institutionally approved procedure.

The design investigator consequently must consider *claims of need*, *evidence of need*, *authority to respond*, and *capacity to sustain the response* separately. This methodological separation is not a refusal to act under uncertainty. It is a condition for making provisional actions intelligible, revisable, and accountable.

5.4 The Constitutive Design Grammar

The proposed grammar is an inquiry procedure applied to each infrastructure function. It specifies what must be asked and documented while leaving substantive solutions open. Table 2 provides its common analytic structure. The categories are presented as mutually conditioning questions rather than as a linear checklist that guarantees a satisfactory institutional result.

These questions have at least three uses. In prospective design they prevent premature investment in a visible artefact whose authority, beneficiaries, or maintenance are unclear. In comparative analysis they allow functionally analogous yet institutionally different arrangements to be compared without pretending they are materially identical. In historical analysis they preserve the reasons why earlier designers considered an arrangement adequate, so that successors can reconstruct and criticise decisions when conditions change. The grammar is therefore both constitutive and historiographical.

The grammar also requires attention to differences among kinds of outputs. A *normative source register* may specify the legal provenance, version, domain, and authority of a rule. A *handbook* may instead explain what particular personnel are expected to do and which decisions require escalation. A *simulation specification* identifies an artificial environment, assumptions, permitted inputs, scenario changes, and comparison criteria. A *communication plan* identifies whom a message attempts to reach, what can truthfully be claimed, and how its recipients may respond. A *disciplinary problem contract*

sets out what can be learned, what counts as a field-relevant question, which materials can be used, and how its hypotheses may fail. Their forms differ because the relevant institutional actions differ.

A common design grammar should not erase the independence of these artefacts. For example, an informative public document is not thereby a valid consent form; a governance vote does not thereby decide ownership of third-party copyright; and a successful research benchmark does not constitute clinical verification. A design record should mark its own status and the source of any authority it claims. Where conflicting sources or ambiguous conditions are discovered, the record should preserve the conflict and route the decision to a competent interpreter rather than silently selecting the convenient answer.

5.5 Normative Admissibility and Institutional Authority

An important methodological limitation on institutional creativity is that not every imaginable arrangement is a legitimate candidate for implementation. Normative conditions do not merely modify a score assigned to an otherwise acceptable design. They may exclude particular uses of information, assignments of responsibility, interventions, or modes of recruitment. A Commons cannot create hospital authority by writing an internal charter. Conversely, a hospital's service permission does not automatically extend to research involving human participants, institutional records, or public representation of results. The authority of each relevant decision maker must be examined in relation to the act they are asked to authorise.

For design purposes, it is useful to distinguish binding law and effective contractual obligations; applicable professional and institutional rules; the Commons' self-adopted commitments; and explanatory or critical proposals. Their interactions are not reducible to one universal hierarchy. Which source controls a particular question may depend on jurisdiction, the parties, governing law, professional context, and the action in question. Jurisprudence requires its own source criticism: jurisdiction, court, operative reasoning, procedural history, subsequent treatment, and factual relevance must be verified before a case is used to support an institutional recommendation. A legally relevant handbook can be revised, but its revision cannot retrospectively grant previously absent authority.

$$\mathcal{D}_{I,q,t}^{\text{leg}} = \{d \in \mathcal{D}_{I,q,t} \mid A_{I,q,t}(d), R_{I,q,t}(d), S_{I,q,t}(d)\}, \quad (6)$$

where the predicates designate, respectively, activity-specific authorisation, compatibility with applicable rights and normative constraints, and the relevant safety or safeguarding conditions. Equation (6) is a *conceptual filter*, not a legal decision procedure or a claim that legality and ethical justification can be mechanically evaluated. These predicates may be indeterminate until a competent authority examines the case. Indeterminacy is not permission: an activity depending upon unknown clinical authorisation should remain outside implementation until its status is resolved. Designs surviving this screening still require scrutiny of fairness, distributive burdens, participant voice, scientific validity, and institutional sustainability.

Normative admissibility also needs channels for objection and correction. Rights claims may be mistaken; a contribution's provenance may be disputed; a communication may inadvertently imply university endorsement; a participant may initially agree and later withdraw from an arrangement when withdrawal is legally and practically possible. The design should specify who receives such concerns, who is empowered to act, how interim restrictions or suspension may occur, and what record of the reason can be kept without compounding a privacy harm. Operational handbooks are valuable here when they make the distinctions between guidance, routine authority, and emergency escalation intelligible to actual actors.

5.6 Decision Processes, Simulations, and Action Under Uncertainty

Decision-making infrastructure is broader than the mathematical optimisation of a schedule. It is the constitution of a legitimate and sufficiently informed process by which relevant actors identify a question, formulate and compare alternatives, examine uncertainty, allocate responsibilities, authorise feasible activity, and revise decisions in response to consequences. The designer must distinguish decision

rights from the capacity to prepare information for a decision. A researcher may legitimately construct a synthetic event simulation while lacking authority to reserve a hospital facility or direct volunteers; a coordinator may possess operational authority but require specialist advice on methodological or legal questions. Neither kind of competence subsumes the other.

For a proposed nonclinical public event, design inquiry begins with the meaning and legitimacy of the proposed objective. The investigation may then identify the people potentially affected, alternative formats, required roles, available volunteers, time windows, accessibility conditions, anticipated conflicts, material costs, and relevant institutional approvals. Models may compare candidate schedules or simulate disruption scenarios. However, the treatment of human commitments as parameters can be justified only within stated ethical and epistemic limits. A simulated availability matrix is not evidence that actual individuals consent, and an optimal allocation under assumed constraints does not establish that those constraints adequately represent participants' experiences.

The proposed decision record should distinguish at least five statuses: *hypothetical alternative*, *analytically feasible arrangement*, *normatively and operationally reviewed proposal*, *authorised decision*, and *observed implementation*. These statuses must not be collapsed. A hypothetical schedule can be published as a research benchmark; an event plan intended for real hospital use requires institutional decisions that cannot be generated by its mathematical properties. A failed simulation should be preserved where it reveals model limitations; a failed authorised event requires additional historical attention to actual consequences, affected persons, and justified reporting boundaries.

Iterative design also includes reasonable stopping conditions. Discovery of unlawfully obtained information, a serious unresolved safety concern, absence of required supervision, or coercive pressure on unpaid contributors can justify suspension even when simulations show high predicted efficiency. By contrast, uncertainty about the comparative academic value of two permitted synthetic methods might justify experimentation rather than suspension. The distinction depends upon the normative status of the uncertainty and the reversibility of action, not merely on its magnitude as estimated by a model.

5.7 Infrastructure Coupling, Information, and Communication

The infrastructure functions form a coupled system. A public research invitation depends upon accurate information, legitimate rights in the underlying materials, and a truthful presentation of who operates the Commons. Disciplinary research may depend upon a history of earlier methods and upon epistemic validation; historical preservation may depend upon lawful retention and clear authorisation; decision-making may depend upon current participation information, resource constraints, and rules that specify who may approve an activity. The same artefact can support several functions, but the conditions of its legitimate use may differ across them.

Information organisation and communication are particularly easy to confuse. Information infrastructure concerns classification, source identification, access, readability, discovery, permissions, and the practical possibility of reuse. Communication concerns the formation and maintenance of channels through which participants encounter, interpret, question, contest, and develop those materials. A public handbook may be discoverable but written in a form prospective participants cannot understand. A popular advertisement may generate inquiries without disclosing the time requirements or independent status of a project. A technically correct research repository may attract little interdisciplinary use if there is no translation of its questions into other scholarly languages. The design should test these different breakdowns rather than count all visits or messages as evidence of value co-creation.

Coupling also produces adverse pathways. A publicity campaign can exceed a small Commons' ability to answer inquiries or review contributions. A highly successful open-methods project may attract derivative work that overwhelms provenance maintenance. A retention rule intended to improve historical recovery may impose unlawful or disproportionate burdens on participants. A governance procedure may become too elaborate for a small group to operate, leaving formal rights unavailable in practice. Conversely, combining functions without adequate separation can hide conflicts of interest or make the individual steward both accuser and final adjudicator. The design question is thus not how to maximise

the number of connections, but how to maintain connections that are legitimate, intelligible, supportable, and revisable.

Institutional mediation helps explain when these relations can be constructed. A university may provide disciplinary connections, meeting places, communication channels, and potential expert assistance, but those assets enter the Commons only through actual arrangements and permissions. Their presence in a university's organisational chart is not proof of usable mediation. The analysis of Section 4 therefore supplies a conditional hypothesis concerning available relations, while infrastructure design must specify the practices that would make those relations effective and open to criticism.

5.8 Sequential Constitution and the Minimum Functioning Commons

A design methodology should make implementation possible without assuming that all fifteen functions can be built to full maturity at once. The relevant threshold is a minimally adequate *cycle of legitimate inquiry and reuse*, not a prescribed number of departments or a finished web platform. Such a cycle starts with a defensible public or disciplinary problem, identifies responsible stewardship and the applicable limits, makes lawfully usable materials available, supports an independently meaningful inquiry, records the contribution and its source history, and permits a later person to understand, criticise, or reuse the result under the appropriate conditions. It also requires a practicable route for correction, withdrawal where applicable, and restriction of harmful material.

This threshold depends upon the risk and intended activity. An independent, one-person effort using public literature and clearly marked synthetic scheduling data may need a modest but coherent charter, a credible methods environment, versioned source and decision records, explicit licences, a contact point, and the time to maintain them. It need not establish a hospital collaboration, clinical data interface, or permanent committee. If the project expands into human-subject research, the threshold changes; ethics review, research competence, valid permissions, safeguarding, and data protection may become prerequisites. If it expands into actual hospital service coordination, the relevant hospital's operational authority and responsibility enter the configuration. A previously adequate independent research constitution is not transferable without further review.

We can express this as a design requirement for a particular intended action a :

$$\text{Ready}_{I,t}(a) \implies \bigwedge_{f \in \text{Req}_{I,t}(a)} \text{Adequate}_{I,t}(f \mid a), \quad (7)$$

where $\text{Req}_{I,t}(a)$ is the context-dependent set of functions on which that action legitimately depends. Equation (7) gives a necessary-condition schema, not a sufficient-condition theorem or an automated certification. Adequacy is a contestable assessment involving the proper authority, evidence, affected parties, resource burdens, and foreseeable failure modes. There may be multiple acceptable ways to realise a required function, and a function judged adequate for a low-risk synthetic experiment may be wholly inadequate for a patient-facing activity.

A staged programme should therefore include explicit tests. Can an unfamiliar student reconstruct and rerun an open baseline? Can a legal scholar identify which licences cover particular resources and which rights remain uncertain? Can a successor explain why a design decision was made and whether it is still applicable? Can someone publicly criticise an analytical assumption without being compelled to become a service volunteer? Can an inaccurate attribution be corrected, and can a potentially harmful contribution be restricted? Can the maintainer explain the cost of keeping the infrastructure in use? A negative result in one test is information for redesign rather than necessarily a reason to abandon the entire Commons; a negative result involving rights, safety, or authority may instead justify suspension of the affected activity.

5.9 Functional Sufficiency, Substitution, and the Burden of Institutional Design

A design grammar should be capable of recommending *not* constructing a new institutional arrangement. The fifteen functions distinguish questions that may matter to a Commons; they do not imply that every

function requires a separate procedure, an office, or even an additional artefact. Functional sufficiency is relative to a specified activity, the authority and capabilities already available, the affected persons, and the consequences of error. A well-maintained research repository with ordinary disciplinary mentoring may already provide enough epistemic validation, communication, version history, and contributor information for a modest synthetic project. Duplicating those practices in a self-styled ethics committee or elaborate registration system may increase confusion and exclude participants without addressing an unresolved problem. In a patient-facing setting, by contrast, the relevant existing hospital supervision and escalation arrangements may be adequate for an authorised service activity, yet cannot simply be repurposed as review and approval of a separate research study.

The proposed *substitution inquiry* begins with a concrete task and a credible simpler comparator. The investigator identifies a material failure path, a duty or interest whose treatment is contested, and the existing arrangement that might address it. The comparison then asks which required judgments the arrangement actually supports, who may give the necessary decision, how errors can be discovered and corrected, and what resources the arrangement consumes. Substitution need not mean equivalence of every institutional detail. Two configurations can be sufficient for the same bounded research task while differing in legitimate ways concerning how records are stored, which individuals perform review, and which scholarly tradition gives their procedures meaning. The test is task-relevant adequacy, not resemblance to a prescribed organisational chart.

There are at least three reasons why a new interface might nonetheless be warranted. First, an *unrecognised category error* may occur when a research publication is treated as approval to act, a citation is treated as ownership, or a publicly visible dataset is treated as lawfully reusable. Second, an *unsupported handoff* may prevent an otherwise competent existing process from carrying information to the party with the relevant authority. Third, an *obscured temporal dependence* may cause decisions to rely on an obsolete record, an expired role, or a formerly usable resource whose maintainer has departed. These are hypotheses about candidate failure mechanisms, not empirical findings about the prevalence of such failures. Each should be compared with ordinary source checking, role-specific escalation, and versioned documentation before invoking the full Commons vocabulary.

Institutional economy is not reducible to minimising the number of forms. A nominally light arrangement may externalise correction work to junior researchers, volunteers, translators, or successors; a seemingly costly safeguard may protect persons whose interests are otherwise hard to observe. The relevant burden analysis includes attention, time, expertise, data exposure, opportunity cost, exclusion risk, dependence on key individuals, and the distribution of those costs over a project's lifetime. Where baseline safeguarding or legal obligations apply, the comparison concerns ways of satisfying those obligations, not whether a desirable research outcome excuses their absence. Likewise, a permitted activity can still be unwise or ineffective; sufficiency of authority does not establish a positive value claim.

The three reality levels limit the inference. Ontological suspension prevents an institutional diagram from establishing the exhaustive reality of persons, obligations or value. At the relational level, practices and people may become capable of sustaining an activity through historically formed responsibilities and capacities, including practices never named as Commons functions. At the manifestation level, an evaluator observes selective documents, decisions and experiences, with measurement affected by the visibility and safety of reporting. An absence of recorded incidents might indicate adequate practice, inaccessible complaints or missing observation. The comparison therefore requires reasons for treating each available indicator as evidence rather than simply coding an empty register as successful governance.

A proportionate design decision can accordingly preserve a simple arrangement, repair one interface, limit a project, or decline to create a Commons-specific procedure. It should specify an observation that would reverse the choice. If the fifteen-function vocabulary consistently changes neither the decisions nor the quality of their explanation, while increasing participant burdens, that result would count against its institutional adoption for the examined activity. Section 22.7 connects this methodological constraint to inter-functional dependencies, while Section 25.13 develops comparison with rival explanations. The research objective is discriminating judgment, not compulsory institutional elaboration.

5.10 Evaluation, Historical Revision, and the Limits of Designed Generativity

The evaluation of institutional design must avoid equating an infrastructure's existence with its effects. One may observe a correctly organised source register without observing informed use; well-attended presentations without any stable cooperative relation; technically reproducible results without disciplinary significance; or legally attributed contributions without meaningful opportunities for value return. The account developed in Section 3 therefore requires multiple forms of evidence and recognises that descriptions of value depend upon subjects, contexts, reasons, and normative standpoints. Proposed measures should also examine whom they leave out and whether measurement itself changes how participants act.

A defensible review combines prospective and retrospective questions. Prospectively, what is the intended action and which infrastructure functions appear necessary? Which rights, authority conditions, and resource burdens are already known? What evidence would count against the current plan? Retrospectively, did the proposed mechanisms actually become available; who used or declined them; what changed in participants' capacities; whose labour sustained the result; which unintended consequences occurred; and what has been preserved for later reconsideration? The record should preserve versions, rationale, relevant evidence, dissent, correction, and the conditions of any withdrawal or deletion. This is the methodological interface between design inquiry and historical recoverability (Argote, 2013; Star and Ruhleder, 1996).

The design grammar itself faces rival explanations. Increased student participation might follow ordinary mentoring, prior motivation, easier travel, or greater publicity rather than the proposed Commons. Higher reproducibility might follow a discipline's established reporting conventions. More shared outputs could indicate productive collaboration, coercive unpaid work, or superficial multiplication of records. An evaluation should therefore specify beforehand what a narrower alternative would predict, which observations could distinguish it, whose costs may be omitted, and what would warrant abandoning a proposed mechanism. Where institutional design is claimed to support public value, participants' opportunity to reject or criticise the arrangement is itself part of the evidence, not a measure of recruitment failure.

In this respect, institutional engineering remains provisional and reflexive. Its own design principles, classifications, and institutional position can become objects of criticism and revision. The proposed grammar does not deliver an optimal Commons; it provides a disciplined means of asking what must be constructed, how the proposed arrangements acquire legitimate practical force, and what would justify their modification. The next section can therefore investigate the architecture and dependencies of the fifteen functions at the level of a general model, while the subsequent dedicated sections examine their heterogeneous institutional realisations. The final assessment belongs neither to technical performance alone nor to the authority of the original designer, but to a historically situated and contestable inquiry into the actual relationships and possibilities produced.

6 Constitutive Architecture and Infrastructure Dependencies

The previous section described how to investigate infrastructure requirements within a particular institutional context. This section specifies the general architecture needed to compare the fifteen provisional functions without mistaking them for fixed departments or independent causes. Its object is a network of activity-specific responsibilities, permissions, information relationships, and maintenance dependencies. It groups functions for exposition, identifies which interfaces can be shared and which may require institutional separation, and traces a limited independent research cycle. Detailed normative, epistemic, communicative, and operational mechanisms are reserved for the corresponding chapters. The architecture is successful as an analytical device only if it identifies consequential bottlenecks, unsafe couplings, or useful substitutions that are not obvious from a simple task list.

The architecture is developed at three analytical levels. At the level of ontological suspension, it does not purport to identify the ultimate components of an institution or the intrinsic substance of value. At the relational level, it considers the historically conditioned capacities and constraints through which

persons and organisations can actually inquire, decide, communicate, contest, and reproduce knowledge. At the manifestation level, it examines accessible evidence of those relations, such as a source register, a training practice, a valid permission, a working research environment, or a corrected attribution record. An artefact manifesting a function is not evidence that every relation necessary to sustain the function exists. This distinction is important when institutional architecture is represented in diagrams, where the visual completion of a box can be mistaken for actual institutional capability. The proposed account draws upon the recognition of rules in use and action situations in institutional analysis (Ostrom, 2005), the contextual and relational character of infrastructure (Star and Ruhleder, 1996), and the comparative study of knowledge commons (Frischmann et al., 2014a). The particular fifteen-function arrangement and its coupling model remain proposals of the present paper, rather than results established by those literatures.

6.1 The Architectural Object and its Boundaries

A university hospital volunteer commons is a candidate configuration of heterogeneous relations, not a singular organisation assumed to possess all relevant authority. Its research sphere may provide openly accessible literature, lawful datasets, analytical questions, reproducible methods, and contributions by independent scholars or students. Patient-facing voluntary service belongs to arrangements authorised and supervised by the relevant hospital. Research involving persons, protected records, or restricted institutional information may constitute a third sphere requiring its own competent review and permissions. Boundaries among these spheres are part of the architecture because they determine which relations can be constituted at a given time. Proximity to a university, an independently published handbook, or a compelling simulated result does not transfer permission across those boundaries.

The object of design is consequently a set of *conditional action possibilities*. An independent participant may be able to study a publicly documented service question using a synthetic scheduling benchmark, but not to reschedule actual volunteers. A historian may be entitled to interpret a public institutional report, but not to preserve indefinitely a confidential account that was shared for a restricted purpose. A volunteer coordinator may organise an approved activity within an established service, but that operational permission need not include the right to make the activity a human-participant study. The system should preserve these distinctions even if one individual participates in several spheres. Conflating a person's positions would turn relational proximity into an unsupported claim of authority.

The IAD action situation and the knowledge commons research framework provide comparative baselines for the present catalogue: they already ask who participates, which resources and rules are implicated, what institutional conditions constrain action, and which outcomes and costs ensue (Ostrom, 2005; Frischmann et al., 2014a). In contrast, the fifteen-function vocabulary proposes more differentiated questions about interfaces among provenance, epistemic review, external authority, participation, and long-run stewardship. That differentiation is a testable design aid, not evidence that fifteen independent arrangements are preferable to a smaller legitimate set.

The fifteen functions are grouped for analytical convenience into constitutional and normative, epistemic and knowledge, relational and operational, and political-economic and reproductive families. This grouping is not an ontology of four institutional substances or a proposed organisational chart. In a particular research activity, one responsible person and one source record may support several functions, whereas one function may involve independent authorities that must not be consolidated. The classification is useful to the extent that it makes the adequacy and limits of these arrangements examinable. Institutional fit, rather than the number of named components, is the appropriate design object.

6.2 Functional Catalogue, Observable Outputs, and Stewardship

Table 3 specifies the provisional functions in terms of the capability each is meant to support, an inspectable output that might manifest its operation, and the kind of stewardship question it raises. The example outputs are deliberately heterogeneous. Some are records, some practices, some procedures, and some opportunities made available to participants. None is an automatic proof of legitimacy or

positive effect. A named steward means an identifiable person or body responsible for maintaining and answering for an arrangement; the appropriate steward and authority must be determined locally. A steward of a research repository does not thereby become authorised to decide matters reserved to a hospital, university, or participant.

Table 3: Fifteen candidate infrastructure functions. Examples are design probes rather than institutional requirements or evidence of realised benefit.

ID	Constitutive capability	Possible inspectable output	Principal stewardship question
<i>A. Constitutive and normative functions</i>			
F_1	Public problem and value orientation	A problem statement with affected interests, competing interpretations, and its evidentiary status	Who may initiate, challenge, and reformulate the problem?
F_2	Normative, ethical, and jurisprudential interpretation	Versioned norm-source register; differentiated law, licence, ethics, handbook, and permission statuses	Who may interpret, advise, adopt, and authorise each kind of norm?
F_3	Governance and public trustworthiness	Decisions with accountable authorship, reasons, dissent, review and correction procedures	Who holds decision authority and who can contest its exercise?
F_4	Safety and institutional boundary maintenance	Activity classification, access rules, escalation and stop criteria	Who has competence to permit or suspend the particular activity?
<i>B. Epistemic and knowledge functions</i>			
F_5	Historical preservation and recoverability	Contextual archive of sources, decisions, alternatives, losses and legitimate deletions	Who can preserve, interpret, restrict, and correct historical records?
F_6	Information organisation, access, and sharing	Discoverable materials with status, version, accessibility and reuse conditions	Who maintains findability, intelligibility, and authorised access?
F_7	Epistemic validation and research quality	Reproducible methods, reviews, uncertainty statements and correction histories	Which competent standards and reviewers govern particular claims?
F_8	Disciplinary value-creation capacity	Field-specific problems, literature, lawful data, methods and independently testable baselines	Who maintains a genuinely useful research environment and its limits?
F_9	Interdisciplinary mediation and translation	Boundary objects, interpretive notes and records of unresolved conceptual differences	Who can translate, criticise, or reject a common problem formulation?
<i>C. Relational and operational functions</i>			
F_{10}	Communication, public engagement, and independent publication	Accurate public descriptions; inquiry, dialogue and correction channels	Who may speak for the Commons, and with what claimed authority?
F_{11}	Initial participation and voluntary engagement	Informative entry paths, suitable roles, consent processes and exit routes	How are voluntariness, feasibility, and non-participation protected?
F_{12}	Planning, decisions, simulation and coordination	Alternatives, constraints, conditional models, approval records and revisions	Who evaluates options, approves action, and handles contingencies?
<i>D. Political-economic and reproductive functions</i>			

Continued on next page

Table 3 continued

ID	Constitutive capability	Possible inspectable output	Principal stewardship question
F_{13}	Contribution provenance, rights and licensing	Typed contribution records, source lineage, licences and dispute corrections	Who maintains records without manufacturing authorship or ownership?
F_{14}	Generative value circulation and intertemporal return	Lawful reuse pathways, access opportunities, return arrangements and their limits	Who benefits, on what terms, and who bears uncompensated costs?
F_{15}	Resource stewardship, evaluation and reproduction	Maintenance commitments, cost accounts, critical reviews and succession arrangements	Who supplies resources and decides when commitments must change?

This catalogue assigns no intrinsic hierarchy of worth among disciplines or participants. A technical benchmark can be a legitimate manifestation of F_8 without serving as an adequate manifestation of patient benefit. A signed approval may answer part of F_4 without establishing research quality under F_7 . An attractive project announcement may manifest F_{10} but leave the conditions of informed participation under F_{11} unresolved. A citation record may support F_{13} while providing no new opportunity under F_{14} . Such distinctions are not semantic refinements alone. They determine what kinds of evidence would be relevant to an institutional claim of functioning, and where responsibility for a failure should be investigated.

A useful comparison is to trace a single artefact through different questions without awarding a separate institution to each question. A handbook's historical version belongs to recoverability; its current location and accessible format belong to information sharing; the authority of a statement within it belongs to normative interpretation; the competence to adopt a proposal belongs to governance or another authorised body; and public descriptions of its status belong to communication. The physical handbook may be one document, while the five claims require different evidence. Similarly, a simulation may serve disciplinary inquiry, epistemic testing, or operational planning, but its completion proves none of the other functions. This division of questions provides an editorial and empirical *differential test*: remove a proposed function or use a simpler existing arrangement and ask which consequential distinction, if any, becomes unanswerable. If no defensible distinction is lost, the added design burden has not been justified.

The family classification is also contestable. Source registers contribute simultaneously to normative interpretation, information access, historical recoverability, and provenance. Communication can itself be a form of public-problem constitution. Decision records may support governance and later research. The reason for retaining distinguishable analytical functions is to permit examination of situations in which one use of an artefact succeeds while another fails. For instance, a shared register may establish that an attribution is correct while failing to preserve a participant's legitimate request to restrict sensitive historical details. Combining records materially is often efficient; merging their rights and purposes without analysis may not be.

6.3 Institutional Realisations and Distributed Responsibility

An infrastructure function is not identical to the office, file, committee, or person through which it happens to be realised. For a small independent Commons using synthetic examples, the same steward may maintain a public research baseline, record source versions, respond to corrections, and publish an accurate status statement. Whether that is adequate depends on competence, availability, conflicts of interest, and workable escalation or closure procedures. In a hospital partnership, these functions may need separate reviewers and approval paths that cannot be delegated to the Commons steward. The architecture therefore maps responsible functions onto existing arrangements first and proposes new arrangements only when concrete gaps or unacceptable concentrations of authority are identified.

Let $\mathbf{F} = \{F_1, \dots, F_{15}\}$ denote the analytic function set, and let $\mathbf{U}_{I,t}$ denote institutionally situated arrangements, potentially including persons, teams, procedures, documents, technologies, and relevant external institutions at time t . A preliminary realisation relation is

$$\rho_{I,t} \subseteq \mathbf{F} \times \mathbf{U}_{I,t}. \quad (8)$$

Relation (8) is intentionally many-to-many. One arrangement may support several functions; one function may require multiple interdependent arrangements. A pair $(F_i, u) \in \rho_{I,t}$ reports an identified or proposed supporting relation, not that u sufficiently or lawfully performs F_i . Sufficiency depends on a concrete activity and the institutional context. The action-specific readiness condition of Equation (7) therefore cannot be inferred from a full-looking catalogue or from the number of pairs in $\rho_{I,t}$.

A practical architecture record should differentiate at least four roles: the actor who produces or maintains an artefact; the actor empowered to authorise the action associated with it; the actor responsible for independent review or challenge, where such independence is necessary; and the persons affected by its operation. One actor may occupy several roles in a small enterprise, but the consequences of that concentration must be disclosed rather than concealed by generic titles such as “the Commons.” A sole founder may legitimately publish an independent theoretical handbook and correct its errors, yet cannot present a self-appointed review as an independent appeal tribunal. If impartial resolution is needed and no credible alternative is available, the project may need to defer the disputed action, invite genuinely external review, or acknowledge its present incapacity to determine the dispute fairly.

The many-to-many relation also permits reuse of existing infrastructures. A public university library may already provide lawful access to research literature, while an external repository maintains version history and stable artefact identifiers; an independent Commons might need primarily to construct the interface connecting the resources to a defined inquiry. Conversely, reliance on an existing service creates external dependencies: its access conditions may change, funding may disappear, or the service may offer no appropriate remedy for a particular claim. A design should record not merely the name of an external provider but the limits of what it is responsible for providing. Reuse reduces duplication only where the function remains accessible and adequate for the intended activity.

6.4 Typed Dependencies and the Direction of Institutional Coupling

Relationships among functions have different meanings. Normative authority can constrain a proposed experiment; epistemic evidence can inform, but not authorise, its use; information access can enable a participant to inspect a source without ensuring communicative understanding; a contribution record can provide historical credit without transferring future property rights. An undifferentiated network representation obscures these differences and makes it easier to infer permissibility from feasibility or benefit from mere circulation.

For a specified institution and time, let $\mathbf{T}_{\text{arch}}$ denote the following preliminary architectural dependency types: normative authority (n), evidential warrant (e), informational availability (i), communicative interpretation (c), operational feasibility (o), provenance and legal reuse (p), generative opportunity (g), and maintenance (m). The proposed coupling relation is

$$\kappa_{I,t} \subseteq \mathbf{F} \times \mathbf{T}_{\text{arch}} \times \mathbf{F}. \quad (9)$$

A tuple (F_i, τ, F_j) means that, for an identified activity, the performance or legitimacy of F_j may depend in a specified way upon F_i through relation type τ . It does not claim that every instance of F_j depends on F_i , or that F_i is sufficient. Dependencies are directional for particular inquiries but are often reciprocal over historical time. For example, a decision procedure may require available historical evidence, while its new decisions become part of the archive. Further, the same pair of functions can exhibit several dependency types. Equation (9) is a classificatory device rather than an empirically calibrated causal graph. Section 22 introduces a more general, evidentially qualified coupling record $\text{Dep}_{I,t}$, whose type vocabulary Θ can refine or group the categories of $\mathbf{T}_{\text{arch}}$; the two typed relations are not silently identified.

Dependency	Architectural question	Characteristic mistaken inference
Normative (<i>n</i>)	Which actor, norm or permission controls a contemplated use?	A technically possible action is consequently authorised.
Evidential (<i>e</i>)	Which sources, standards and competent reviews support the claim?	A documented procedure establishes validity or effectiveness.
Information (<i>i</i>)	Can appropriate users lawfully find, understand and access the material?	Posting a file makes it meaningfully available to everyone.
Communication (<i>c</i>)	Can subjects ask, interpret, contest and receive a response?	Public visibility constitutes dialogue or participation.
Operational (<i>o</i>)	Which real resources, time, skills and coordination enable implementation?	A simulated feasible plan can be executed as modelled.
Provenance (<i>p</i>)	Which contribution, licence and historical relation governs reuse?	Citation creates ownership of independent derivatives.
Generative (<i>g</i>)	What new legitimate inquiry or capacity becomes possible downstream?	Reuse or recognition necessarily produces a return to originators.
Maintenance (<i>m</i>)	Who sustains the interface, absorbs its costs and revises it?	An arrangement continues working once initially published.

Table 4: Dependency types and invalid transfers of inference. The types are proposed analytical distinctions, not formal legal categories or demonstrated causal pathways.

A useful architecture is therefore a network of *typed questions and responsibilities*. The presence of F_8 and F_{12} can make research-based planning analytically possible, but F_2 , F_3 , and F_4 determine how relevant rules, authority, and safety restrictions are examined. F_5 and F_6 may preserve and distribute the rationale of a decision, but their access conditions can differ. F_{13} can maintain the history of a research contribution while F_{14} asks whether a lawful route for new use or benefit actually exists. The latter is not inferred from the former. In a historical sequence, each use and revision can itself change the requirements placed on the infrastructures that made it possible.

6.5 Analytical Boundaries within Shared Material Systems

Some of the most consequential architectural failures arise where functions are apparently adjacent. The first boundary concerns *normative material and institutional authority*. Ethical principles, applicable laws, relevant jurisprudence, institutional regulations, freely adopted Commons charters, licences, explanatory handbooks, and operational instructions can coexist in one knowledge base. They do not possess identical authority or territorial and professional scope. A handbook that explains possible ethical practices does not become binding merely by being publicly accessible. A Commons governance vote cannot create a hospital's consent to use its facilities. A standard licensing notice may regulate some downstream uses of an original document while leaving the legal status of raw facts, ideas, or independently produced methods distinct. A credible normative architecture records the source and version of each instrument, its asserted scope, contested interpretations, the responsible interpreter, and the procedure, if any, through which it can be adopted or changed.

The second boundary is between *governance and decision support*. Governance concerns who is entitled to set rules, allocate authority, hear objections, and hold decision makers accountable. Planning and decision support concern how competing possible actions can be formulated, compared, simulated, scheduled, monitored, and revised. An optimisation model may minimise travel or scheduling conflicts under its assumptions without having competence to set volunteer policy. An event simulation might reveal that a proposed staffing arrangement is fragile; it cannot decide whose interests should prevail or whether a particular patient-facing activity is permitted. A governance body can likewise possess legitimate authority without sufficient epistemic competence to assess a scientific claim. Responsible design should establish an interface between technical advice, affected-person input, and an identified competent decision maker, preserving disagreement and uncertainty in the record.

Information sharing and communication are adjacent but separable relations. A public resource catalogue may accurately state a file’s existence, version, licence, and access conditions without explaining why a person should care about it. A compelling outreach message may reach many people while failing to supply reliable, lawfully reusable research material. A shared website could serve both purposes, but the adequacy tests differ: can a user identify and access an appropriate resource on justified terms, and can an audience understand, question, or reject the invitation without being misled? An institution may reasonably centralise the interface while keeping these tests and their responsible judgments distinct.

The fourth boundary distinguishes *historical provenance, juridical rights, and value return*. The preservation of an identifiable contribution lineage permits future readers to recognise how methods and artefacts developed. It does not by itself establish legally enforceable authorship, co-ownership, commercial revenue shares, or indefinite access to downstream restricted works. The rights infrastructure should preserve the types of entitlements created by applicable law, licences, and express agreements. A value-return infrastructure investigates additional mechanisms, such as lawful access to later open results, learning from derivatives, reciprocal research opportunities, acknowledgment, or separately negotiated benefits. Some contributors may rationally value anonymity, limited dissemination, or the ability to decline further participation; these choices matter alongside the visibility of credit.

Finally, *epistemic validation and public approval* should not be conflated. A reliable experimental baseline may satisfy important disciplinary criteria yet fail to capture human realities relevant to institutional practice. Public enthusiasm or a favourable service story does not establish methodological reproducibility. Boundary objects can help heterogeneous researchers identify and translate their different questions (Star and Griesemer, 1989; Carlile, 2004), but common terminology cannot eliminate conflicts in normative purposes. An architecture that preserves differences among standards of evidence, authority and experience may be more capable of correction than one that demands a single performance score.

6.6 A Minimal Legitimate Research, Contribution, and Reuse Cycle

The proposed taxonomy becomes practically informative when tested against a complete, modest activity. Consider an independent Commons that publishes an abstract research problem concerning how voluntary availability, uncertain attendance, and limited resources affect hypothetical event scheduling. The problem is relevant to potential public-service settings but uses no actual patient, hospital, or volunteer records. A small research environment provides clearly synthetic instances, a formal problem statement, an accessible classical baseline, methodological references, assumptions, and instructions for reproducing results. Interested persons may use the environment without performing hospital volunteer service or disclosing sensitive experience. The initial contribution of the Commons is not the claim that the method would improve a real hospital; it is the provision of a researchable and criticisable object.

To constitute that activity, public-problem infrastructure (F_1) must explain why the question is worth considering and whose potentially affected interests might be missing. Normative and boundary functions (F_2, F_4) distinguish public materials and synthetic artefacts from restricted materials and specify the status of the independent project. Governance (F_3) identifies who maintains the environment, answers inquiries, and has authority to withdraw incorrect material. Disciplinary infrastructure and validation (F_7, F_8) provide a credible baseline and a route for critical examination. Information infrastructure (F_6) makes the research artefacts findable with usable versions and licence conditions. Communication and participation (F_{10}, F_{11}) offer truthful descriptions and voluntary entry without promises of formal hospital roles. None of these functions requires a newly incorporated hospital programme.

A second participant may then develop an alternative mixed-integer or quantum-inspired model, compare it against the baseline, document limitations, and release a new artefact under a licence the participant is entitled to choose, subject to upstream conditions. Their ability to conduct independent inquiry is one possible manifestation of generative capacity. A contribution record (F_{13}) can distinguish the original dataset and problem specification from the participant’s independently added code, analysis, and expression. Epistemic validation (F_7) asks whether methods and findings are reproducible and whether

comparison criteria are defensible. Historical recoverability (F_5) preserves not just a version identifier but the reasons for changing assumptions or rejecting claims. The Commons should also provide a way for contributors to correct attribution, contest a misleading summary, or restrict material where legally and ethically required. Documentation does not override a valid confidentiality or deletion obligation.

A third researcher may subsequently reuse the earlier work, where permitted, to study fairness constraints, educational translation, or robustness under absence scenarios. The Commons can connect that derivative contribution to its documented antecedents, subject to lawful information disclosure and properly differentiated citation obligations. Value circulation (F_{14}) becomes a research question: did later work expand meaningful opportunities for earlier or later contributors, rather than merely create another accessible file? Such return might involve new methods, critical feedback, reusable tools, or permitted participation in a later study. No automatic royalty, coauthorship, or access to independently restricted derivatives is presumed. Resource reproduction (F_{15}) finally asks who maintains the benchmark, replies to questions, resolves permission ambiguities, and preserves enough context for another person to continue after the first maintainer leaves.

The cycle can be specified as an *examinable sequence of conditions*, not a predetermined outcome: legitimate problem identification; situated rights and risk examination; lawfully usable research entry; independent inquiry and competent criticism; documented contribution and permissible release; later recognition or reuse; and maintenance, correction, and historical revision. At each transition there is a possible stopping point. If a dataset's origin cannot be established, the study need not publish it. If a derived licence is incompatible with an upstream condition, the proposed release must be reconsidered. If a prospective application would require hospital authority, the research cycle can remain independent rather than treating operational access as its natural next stage. An appropriate record should explain not only the steps completed but those rejected or postponed.

We may call the minimal cycle *legitimate* only in a provisional, activity-specific sense: adequate procedures and permissions have been investigated for the actual public/synthetic study. It would be misleading to interpret the word as certification of compliance across jurisdictions or as evidence of superior social outcomes. Equally, a cycle is *complete* for architectural testing when an independent person can examine and, if permitted, critically reuse a contribution through maintained channels. Completion does not require a publication, a new hospital volunteer, revenue, or a measurable patient benefit. Those are distinct possible results and require separate standards of assessment.

6.7 Coupled Failure, Overload, and Negative Feedback

The coupling of infrastructure functions creates opportunities and vulnerabilities. A Commons may invest in public engagement to invite student participation, yet a successful announcement can impose more demands for guidance, supervision, and attribution review than a small maintainer can sustain. The resulting delay can reduce communication quality, discourage contributors, and undermine the trustworthiness of public claims. The observed trajectory is not a simple failure of advertising; it is a coupled mismatch among communication (F_{10}), voluntary entry (F_{11}), governance (F_3), and maintenance (F_{15}). An alternative response could be to limit entry, publish honest capacity constraints, narrow the scope of support, or redesign the study for self-directed use. Which response is justified depends on commitments already made and affected participants' legitimate expectations.

A different failure occurs when the abundance of accessible materials outruns epistemic capacity. Uploading more datasets and methods can create discoverability without adequate documentation, competent review, or contextual constraints. Researchers may interpret synthetic volunteer availability as a valid model of lived human commitments. An apparently efficient schedule could then be cited as evidence for an actual service intervention, despite untested assumptions and missing authority. This trajectory passes through F_6 , F_8 , F_7 , F_{12} , and F_4 . A defensible design must preserve the modelling conditions through which a result was obtained, identify non-transferability, and prohibit treating research outputs as operational decisions without appropriate validation and permission. More sharing is not automatically better sharing.

Historical archives can likewise generate costs and harms. Indefinite retention may increase storage, security, and interpretation burdens while exposing identifiable experience beyond its justified purpose. A policy requiring every meeting to be permanently recorded might deter dissent or create records that later users cannot contextualise. Historical recoverability must therefore be balanced with data minimisation, applicable retention law, privacy, confidentiality, and the legitimate interests of the persons represented. A functioning archive may deliberately preserve some decisions through summaries while declining to retain underlying sensitive material. Its success is not measured solely by volume.

The rights and value-return functions may also diverge sharply. Highly detailed provenance can improve attribution while becoming a means of monitoring labour or imposing perpetual obligations on contributors. Restrictive licences can preserve certain control rights but make collaborative use costly; unrestricted licences may support wider circulation while permitting exploitative appropriation in some institutional settings. Neither licence type guarantees a just distribution of subsequent value. Likewise, a promise that all later commercial value will be redistributed to earlier contributors can be legally ungrounded, administratively infeasible, or unfair to later creators unless specific rights and agreements have been established. The governance problem is to articulate justified and enforceable arrangements where possible, communicate what is not promised, and revisit patterns of benefit and burden over time.

Power asymmetries are particularly consequential where a university's prestige frames participation. A student may feel unable to decline a formally optional research task; an experienced volunteer's tacit knowledge may be extracted into a publication without corresponding recognition; a patient's account may be represented through categories they would contest. Proximity can intensify these pressures rather than diminish them. Architecturally, credible exit, independent criticism, accurate public communication, and the recognition of affected nonparticipants cannot be sacrificed merely because the resulting cooperation produces technically impressive results. A high-output Commons with systematically silenced objections would fail important normative and relational tests of its own generative claim.

These failures motivate feedback arrangements that are proportional to institutional scale. They may involve periodic reassessment of permissions, short contributor surveys that do not demand personal disclosure, clear limits on response time, reproducibility checks, or independent review when practical. Feedback itself consumes labour and can create new surveillance pressures, so the architecture should preserve the possibility of criticism without requiring continuous measurement of every person. Decision records should capture why a design was retained, suspended, or revised, including the limitations of evidence. Organisational learning becomes relevant only when what is recorded can condition subsequent practice and be critically reinterpreted (Argote, 2013).

6.8 Institutional Configurations, Thresholds, and Revision Pathways

The same analytic functions can have different realisations at different stages. In a single-researcher Commons using public and synthetic materials, constitutional conditions may be maintained through a transparent personal statement, source and rights records, an explicit correction channel, and a small reproducible research module. This configuration has a limited but intelligible mandate. It should not claim collective governance where no independent participants exist. Its limitations include the absence of independent appeal, vulnerability to the maintainer's unavailability, and the opportunity cost of sustaining a growing archive. If those limitations become unacceptable for a proposed activity, scope reduction or external collaboration may be more responsible than elaborating a nominal charter that cannot be honoured.

In a multidisciplinary research collective, several members may jointly maintain research environments, deliberate over public problems, and translate disciplinary vocabularies. Such a group may require clearer decisions about contribution roles, speaking authority, moderation, conflict of interest, research-quality standards, and successor stewardship. It can obtain improved review capacity while also experiencing disputes over priorities and recognition. Distribution of work need not imply equal power or equal costs. Rules should be examined in use rather than solely inferred from founding documents (Ostrom, 1990, 2005).

A formal partnership with a hospital introduces a different institutional boundary. The parties may have specific approved roles, contractual commitments, supervisory responsibilities, or lawful data-sharing arrangements. Such a partnership would need arrangements suited to the actual jurisdiction, patients, professionals, institutional processes, and research purposes. The independent Commons' prior repository and methods may contribute useful expertise, but cannot be treated as a substitute for local authorisation or operational competency. In some cases, institutional separation is preferable; a hospital may benefit from public research without transferring any protected records or day-to-day volunteer authority to the Commons.

These configurations are examples for comparison, not a developmental ladder in which larger or more formally affiliated organisations are necessarily better. A well-governed independent research environment may generate greater disciplinary benefit than an overstretched formal partnership. A small public archive can outperform an expansive platform if its sources are intelligible, maintainable, and legally reusable. The relevant threshold is activity-specific: which functions are required to make *this* inquiry or cooperation legitimate, usable, and open to correction? Some deficiencies justify improvement while the activity proceeds; uncertainties concerning consent, lawful data access, safety, or decision authority may require the relevant activity to stop until resolved.

6.9 Architecture as a Researchable Institutional Proposition

The architecture creates a research programme rather than a settled template. Its adequacy can be investigated through traces of participation, documented decision histories, interpretive interviews where authorised, reproducibility studies, analysis of contribution trajectories, and comparative institutional cases. Such evidence should address whether claimed interfaces actually function, whose capacities expand or diminish, what resource burdens arise, and whether recorded histories remain intelligible after personnel change. Testing should distinguish design-specific mechanisms from rival explanations. A second scholar's successful reuse might reflect the intrinsic quality of a method, ordinary disciplinary supervision, the institutional prestige of a university, or a particular Commons interface. Without appropriate comparison, the relative importance of the interface remains uncertain.

The fifteen-function catalogue is a contestable analytical resolution rather than a settled discovery about institutions. Functions may be combined where the same practical mechanism suffices, further subdivided where rights or competences diverge, or omitted from a particular activity's requirements where they add no relevant capability. A proposed architectural distinction should survive comparison with existing institutional routines, a smaller functional vocabulary, and specific failure cases. If it cannot alter a reasonable design or explanatory conclusion, its extra terminology is a maintenance burden rather than an achievement. Such comparative humility also limits the suggestion that an institution becomes generative merely by adopting the model's labels.

The central architectural commitment is thus neither maximal infrastructure nor universal uniformity. It is the constitution of mutually intelligible, normatively differentiated, supportable relations through which legitimate inquiry and potential value generation can occur. What matters is whether the arrangements allow autonomous subjects to recognise problems, act within their rights, create and test knowledge, contest decisions, preserve context, and lawfully participate in further development. The fifteen functions supply a provisional vocabulary for investigating these conditions. Sections 5 and 6 together provide the methodological and architectural basis for the dedicated design chapters that follow, beginning with the institutional constitution of public problems and value orientations. Whether any resulting Commons actually expands generative capacities remains an open empirical and normative question.

7 Public Problem Constitution and Value Orientation

This section examines the first constitutive task of the Commons: deciding how a reported condition becomes a defensible object of shared inquiry. Problem framing selects affected relations, available

evidence, relevant values, and possible methods. Those selections shape who can contribute and which uncertainties remain visible. In a university hospital setting, the perspectives of patients, volunteers, students, clinicians, and administrators may differ without any one perspective exhausting the problem. The section develops a method for documenting and revising research framings, including their authority limits and opportunity costs. The object is the constitution of an *inquiry*, not the authorization of a service intervention.

7.1 Problem Constitution as an Institutional Activity

An institution may possess numerous descriptions of difficulties without possessing a defensible practice for deciding which descriptions should guide its collective attention. A report of inconvenient opening hours, an engineering proposal to improve scheduling, an education student's interest in learning environments, and an administrator's account of unmet demand may refer to the same service setting while constituting different research problems. Each description identifies some entities and relations, leaves others in the background, anticipates a particular kind of evidence, and implies possible action. A Commons that immediately classifies the reports as a single scheduling problem has already made a substantive choice about causation, relevance, and responsibility. Conversely, maintaining every account as equally urgent makes coordinated work difficult and may distribute already scarce attention without a justified purpose.

The distinction between a *condition*, a *problem representation*, and an *authorised intervention* is therefore central. A condition may be described through an observed experience, a reported difficulty, or a documented pattern. A problem representation selects a boundary, actors, relevant variables, a perspective of concern, and a question to investigate. An authorised intervention additionally depends on institutional competence, legitimate permissions, and the obligations of those responsible for its consequences. The first two can sometimes be developed within independent public scholarship; the third cannot be inferred from their quality. This distinction is consistent with Bacchi (2009)'s insistence that policy problems are represented and constituted within practices of problematisation, rather than given in a neutral and self-evident form. The present argument does not reproduce Bacchi's methodology as a GR invention. It extends the inquiry to the practical conditions through which a research Commons can make its own problem-framing activities inspectable, contestable, and historically revisable.

For the present theory, *public problem constitution infrastructure* denotes the situated ensemble of roles, practices, accessible evidence, interpretive resources, communication interfaces, and normative constraints through which candidate concerns become legitimate, bounded, revisable objects of shared inquiry. The definition is functional. It does not require a separate committee or a new software platform. A single researcher may publicly document the problem and its uncertainties. A multidisciplinary collective may maintain a deliberative intake process. A formal partnership may have to work through additional established channels. Their legitimacy cannot be evaluated by comparing administrative size alone, because the authority claimed and the harms risked can differ considerably.

7.2 The Three Reality Levels of Public Problems

The three analytical levels developed in Section 3 provide a discipline against treating the language of a proposal as an unmediated picture of reality. At the level of *ontological reality*, the ultimate status and exhaustive constitution of relevant beings and values remain suspended. Nothing in the Commons' research vocabulary establishes a privileged inventory of everything that exists or matters. This suspension does not negate suffering or erase obligations; it restricts the metaphysical claims that can be inferred from a model.

At the level of *relational reality*, difficulties arise within historically constituted relations among persons, institutions, artefacts, expectations, material arrangements, and capacities. A limited library opening schedule, for instance, may reflect not only volunteer availability but also staffing authority, safety requirements, room use, transportation, educational calendars, patterns of demand, and expectations accumulated across earlier service arrangements. Some of these relations may sustain a valuable

practice even while limiting what can change; others may obstruct participation or direct attention away from less visible persons. A problem statement that isolates one quantity, such as unfilled volunteer shifts, is therefore a selective intervention in the representation of the relational world.

At the level of *manifestation reality*, concerns appear through complaints, documents, measurements, research datasets, meeting statements, published descriptions, or indirect traces. Such manifestations are neither meaningless nor complete. Their form depends on the available channels and the risks of speaking. Persons least able to complain may be omitted from the record, while an institution with sophisticated reporting may seem to have more problems precisely because it can recognise them. Similarly, an attractive numerical simulation may increase the visibility of scheduling constraints without establishing the importance of scheduling relative to other possible public concerns. The engineering task is to preserve the relation between manifestations and the conditions under which they were produced, including absences, possible distortions, and uncertainties. It is not to turn every undocumented concern into an asserted fact.

These levels also clarify how the same object can change status across inquiry. A synthetic dataset may adequately manifest the behaviour of a mathematical scheduling model while telling us almost nothing about actual hospital demand. Its legitimacy as a research object depends on the proposed question: one may responsibly ask which algorithms solve the specified synthetic problem, while remaining unable to infer that the modeled objective would be fair or clinically acceptable in real service. A problem record should preserve that distinction whenever an abstract research formulation is derived from a socially significant domain.

7.3 Affected Subjects, Interpretive Standing, and Unequal Voice

Determining who may formulate, criticise, or authorise a problem requires finer distinctions than simply opening a meeting to “stakeholders.” A subject may possess direct experience of a condition, disciplinary expertise concerning a possible mechanism, delegated authority to allocate resources, a legal right affected by an action, or an interest in future consequences. These positions are not interchangeable. Patients, for example, may be affected by proposed changes to a service without being willing or able to join a research Commons. Volunteers can have relevant operational experience without authority to disclose confidential information. Students may contribute rigorous methods without possessing the authority to redefine a hospital service. University prestige may amplify the claims of academic participants while obscuring the knowledge of less institutionally powerful participants.

Arnstein (1969) drew attention to the distribution of power in purported participation, while Fung (2006) characterised participatory arrangements in part through who participates, how communication and decisions occur, and their connection with public action. These studies offer distinct analytical resources: the first cautions against decorative inclusion, and the second helps compare institutional procedures without assuming one form of participation suits every purpose. The proposed Commons extends these concerns to independent research problem formation. It cannot infer representative authority merely from recruiting several students, accepting open comments, or publicly announcing that its projects concern patients.

Problem intake should distinguish four questions: who is affected, whose experience or expertise is relevant, who may contest the description, and who has competence to authorize any proposed response. Affected persons need not become project members or supply identifiable testimony to make their interests relevant. In particular, public comments, student consultations, and expert interviews should not be presented as representative patient participation without a justified sampling and authorization basis. A minimally adequate record can state which perspectives have not been obtained, the reason for that absence, and the implications for the proposed claims. The Commons may then narrow the inquiry instead of filling the gap with assumed preferences. Governance addresses the allocation of decision power; the present infrastructure is concerned with the defensibility of the problem description that power is asked to consider.

The challenge of *affected nonparticipants* is especially important. They may be affected by the public

presentation of a problem, even when they have not agreed to participate in the Commons or do not know the initiative exists. Their interests should not be inferred from convenient proxy representatives without qualification. This does not imply a duty to contact every potentially affected person before posing any abstract research question. It implies that the framing should disclose whose perspectives remain unknown, refrain from claiming to speak on their behalf, and identify when the stakes of a proposed action require stronger forms of representation or competent external review. An independent Commons can study ethical questions about patient-facing services without collecting patient data, making policy recommendations in patients' names, or claiming clinical access.

7.4 Value Orientations and the Public Character of Inquiry

The “public” in public problem constitution cannot be established solely by attaching a socially desirable label to an academic interest. A mathematical optimization task can be intellectually valuable without yielding a demonstrated improvement in care. A volunteer recruitment campaign can attract many applicants while imposing unsustainable coordination burdens. A public handbook can help disseminate knowledge yet reproduce unverified statements or give the appearance of official rules. These examples suggest that value orientation requires inquiry into beneficiaries, burdens, legitimacy, and the terms under which alleged benefits might materialise.

Moore (1995) associated public management with the creation of public value and the conditions of public legitimacy and operational capacity. The present Commons is not simply a public agency, and an independent research collective does not acquire a governmental mandate by citing this literature. Nonetheless, the separation between valued purposes, supporting legitimacy, and capacities to act is instructive. In the present framework, public-value orientation concerns a situated normative account of who might benefit, who may bear risks or costs, what evidence supports these expectations, and which persons or institutions can legitimately decide about particular actions. Such orientation can include social, epistemic, educational, relational, procedural, and material values. It need not be reducible to a monetary figure or to a single service metric.

A participant's *disciplinary value* should remain visible within this account. An engineering student's new algorithm, a historian's analysis of institutional memory, or a legal scholar's reconstruction of the status of volunteer handbooks may have legitimate scholarly value independently of an immediate operational benefit to a hospital. The relevance of that work to a public domain may supply a reason for pursuing it, but academic merit does not retroactively prove public benefit. Conversely, the absence of an immediate publication does not show that an ethical or educational contribution lacks value. Commons governance should avoid both instrumentalising students as unpaid labour for presumed public goals and representing purely academic gains as already achieved social outcomes.

Value disagreement is therefore an expected property of the problem-constitution process. A volunteer might prioritise reliable service continuity, a student transferable knowledge, a patient personal autonomy, a clinician safety and workload, and an archivist interpretive context across generations. Even where these concerns complement one another, their ordering can change with institutional conditions. The Commons should distinguish norms that exclude an action, such as a missing necessary authorisation, from goals that can be compared or negotiated within lawful options. Recognition of plurality does not require treating every asserted preference as equally justified; it requires an accountable way to state why a concern is relevant, whose position it represents, and what could warrant a different judgment.

7.5 Evidence, Missing Experience, and Problem-Framing Uncertainty

A problem constitution infrastructure requires procedures for relating claims to evidence before prescribing methods. The source of an issue should be recorded separately from the evidence offered for its existence and from the anticipated explanation. For example, “an event may benefit from improved scheduling” is a proposal; “a simulated system exhibits specific conflicts” is a bounded model result; and “actual patients experience longer waiting times because of volunteer schedules” is an empirical and

potentially sensitive causal claim requiring evidence not supplied by the simulation. Conflating these statements would conceal both epistemic uncertainty and a possible shift in institutional responsibility.

The required evidence depends on the problem. A formal impossibility or complexity result might be investigated through mathematical proof, while a hypothesis about volunteer motivations would ordinarily require carefully designed research involving people if it were to be empirically tested. Institutional histories may depend on primary sources and source criticism; normative objections may require legal interpretation and reasoned ethical argument. A public or synthetic Commons can conduct important inquiry within these bounds without possessing restricted records. Where a stronger claim cannot be grounded, the record should identify the absent evidence and maintain a narrower question. The fact that certain information would be useful does not license its collection or reuse.

Problem formation also involves *epistemic silence*. A public report may omit dissent, an archival series may not preserve informal contributions, and a complaint channel may be inaccessible to a person whose language or circumstances make participation difficult. Yet absence of a record is not proof that a specific unreported experience occurred. The appropriate response is to distinguish observed gaps, plausible alternative explanations, and testable hypotheses. Researchers may use sensitivity analysis, source comparisons, explicit assumptions, or a reframed question where available materials do not support a determinate claim. Whenever evidence would require new contact with patients or staff, the project must assess the appropriate permissions, review and risk before proceeding.

These distinctions allocate specific tasks to neighbouring infrastructures. The present section identifies the evidence a question would require and where it is missing; epistemic validation evaluates the warrant for claims actually advanced; information sharing determines whether permitted material is accessible and intelligible; historical preservation retains reasons for earlier framings. None can substitute for the initial justification of why a particular question deserves scarce collective attention.

7.6 Problem Intake, Documentation, and Justificatory Procedure

A concrete infrastructure requires an inspectable procedure through which candidate problems may be proposed, evaluated, adopted for inquiry, revised, declined, or deferred. This need not be bureaucratically elaborate. For a one-person Commons, a dated research note with sources, competing framings, explicit non-authorisations, and an open correction mechanism may suffice for a low-risk public or synthetic study. A collaborative Commons might additionally assign independent reviewers or deliberate over proposed workstreams. The procedure should become more demanding when questions affect people's rights, imply institutional representation, consume substantial collective resources, or move towards intervention.

A candidate framing can be described through a typed problem record:

$$\mathbf{p}_{I,t} = (q, b, S, V, E, \Lambda, \Omega, \sigma)_{I,t}. \quad (10)$$

Here q is a formulated inquiry; b identifies its domain, time horizon, and exclusions; S is an explicitly partial map of concerned or potentially affected subjects and their relation types; V records plural value claims and foreseeable burdens; E records evidence, provenance, missing information, and relevant counterinterpretations; Λ denotes applicable normative or institutional constraints, including those still requiring verification; Ω specifies contemplated actions and the actors whose permission would be necessary for each; and $\sigma = (\sigma^{\text{evid}}, \sigma^{\text{proc}})$ distinguishes the evidentiary standing of the framing (for example, supported, disputed, or not yet assessed) from its internal procedural disposition (proposed, adopted for independent inquiry, deferred, or withdrawn). A procedural adoption is not an external licence, ethics approval, or permission to act upon people. The subscript (I, t) records the situated institutional context and time of the framing. Equation (10) is a *record grammar*, not a quantitative model, legal decision, or claim to possess exhaustive knowledge of the situation. Its fields can be implemented through prose, annotated documents, or more structured records if that becomes useful.

A possible procedure begins with recording a concern in the terms of its proposer without immediately translating it into the Commons' preferred discipline. A second step distinguishes what is already

Table 5: Illustrative components of public-problem constitution. These are inquiry functions rather than compulsory forms or a presumption of institutional authority.

Constitutive task	Inspectable record	Question for revision
Problem admission	Candidate question, boundary and initiating rationale	Who is authorised to name this concern as a collective project?
Affectedness	Positions, possible burdens, absent voices and nonparticipants	Whose experiences or interests remain unknown?
Evidence	Source provenance, uncertainty and rival explanations	Which statements are observed, inferred or merely proposed?
Value orientation	Distinct benefits, costs, conflicts and ethical limits	Which dimensions resist legitimate aggregation?
Action boundary	Independent inquiry, restricted study, operational intervention	Does the proposed activity require permission not possessed by the Commons?
Revision	Challenge, rejection, deferment and dated rationale	What evidence or institutional change would reopen the framing?

supported, what is inferred, and what remains a research question. A third examines affected subjects, likely exclusions, institutional and ethical constraints, and the anticipated public and disciplinary value. A fourth selects a lawful form of engagement: publicly readable research question, synthetic demonstration, restricted inquiry requiring separate approval, or operational proposal requiring a competent institutional decision. A final step records the disposition and the conditions of reconsideration. Some stages may overlap or be repeated; the sequence is an analytical device to protect distinctions, not an assertion that every institution requires five formal committees.

The records should retain alternatives as well as accepted framings. An engineering researcher may frame a limited availability problem in terms of combinatorial scheduling, while a humanities researcher may ask how assumptions about availability and voluntariness arose. Neither question should be erased merely because one is immediately computable. A Commons can maintain related but distinct problems with documented dependencies and common source materials. If it rejects an issue for capacity reasons, rejection should not be represented as a finding that the underlying concern is unimportant. If a proposed question is materially misleading or unsafe, the reason for its refusal should be stated at a suitable level of disclosure.

7.7 Prioritisation, Scarcity, and the Boundaries of Comparison

Limited attention, mentorship, interpretive labour, archive capacity, and administrative time make prioritisation unavoidable, even within an independent Commons. Yet a simple score combining public relevance, expected citations, student interest, operational feasibility, and ethical risk would imply commensurabilities that may be neither established nor legitimate. A defensible process can therefore operate with a *partial*, context-dependent ordering of proposals, justified by explicit reasons rather than a universal scalar measure. Some candidates may be preferable on several relevant dimensions; others may be incomparable until further evidence, consultation, or resource clarification is available. Incomparability can be a reason to preserve a small exploratory portfolio rather than to conceal the conflict through arbitrary weights.

The Commons should first examine exclusionary conditions. An activity requiring unauthorised patient records cannot become acceptable merely because its potential research yield is high. A proposal that falsely presents an independent study as a hospital programme should be corrected before publicity, not traded against anticipated recruitment benefit. Only after considering such constraints does comparison among lawful and supportable inquiries become meaningful. Within this remaining set, practical criteria may include clarity and tractability of the research question, fit with available expertise, opportunities for independent student research, costs of responsible stewardship, potential for knowledge reuse,

and the accessibility of relevant sources. These criteria do not amount to a uniquely correct institutional ordering; they structure the reasons that participants can challenge.

A useful distinction is between *exploratory attention* and *institutional commitment*. A Commons can publish a question, map possible methods, or build a synthetic benchmark without committing to organise a corresponding hospital service. Moving to a more consequential stage should require stronger evidence and more appropriate authority. Even exploratory projects have opportunity costs, however, and should not demand indefinite unpaid maintenance from individuals simply because the research remains publicly accessible. The right to decline a proposed research agenda belongs to contributors as well as institutional partners. Projects can reasonably be paused when they lack a feasible stewardship arrangement.

7.8 Infrastructure Coupling and the Limits of Institutional Mandate

Public problem constitution sits at the intersection of multiple infrastructure functions introduced in Section 6. It receives concerns through communication and voluntary participation, evidence through research and information resources, interpretive categories through disciplinary traditions, and constraints through ethics, law, institutional permissions, and governance. It supplies a framed question to decision-making and simulation, but does not perform those functions. An event-planning model may identify feasible schedules only after someone has justified which goals, burdens, and constraints deserve representation. A well-designed research environment can make the chosen assumptions transparent; it cannot, by computational performance alone, settle the prior normative question of whose time or access ought to be prioritised.

The output of problem constitution is a *candidate inquiry*, not a transferable mandate. The record in Equation (10) can preserve why a question matters, whose positions have been heard, what is missing, and whether the next step is independent analysis or a proposed intervention. Its receiving interfaces are differentiated. Normative analysis in Section 8 examines applicable sources and unresolved duties; governance in Section 9 identifies the person or body competent to decide within the Commons; safety analysis in Section 10 identifies conditions for any transition into another institution's activity. Neither the public character of the question nor a favourable priority assessment supplies those later determinations. A proposal to investigate synthetic schedules may remain independently researchable even after permission to examine real rosters or implement a schedule is declined. This is not a failed problem-constitution process: it is a revision of the permissible activity while retaining a potentially useful scholarly question.

The interfaces are reciprocal. Communication can reveal misrepresentation; historical records can expose an earlier assumption; provenance can identify who originated a useful method; interdisciplinary mediation can reconstruct an issue in a new vocabulary; governance may revise which participants can influence research priorities. These effects can also be adverse. Publicity can turn a modest hypothetical inquiry into a perceived institutional promise; a contributor might receive pressure to conduct unpaid service after a research question becomes popular; over-detailed intake records can become a means of monitoring vulnerable persons. The infrastructure should therefore support corrections, scope limits, appropriate deletion or redaction, and reversibility of proposals where lawful and feasible. A transparent statement of "not yet authorised" may be a constructive output rather than a failure to progress.

7.9 Institutional Variation, Illustrative Contrasts, and Revision Criteria

Consider an independent scholar constructing a public, synthetic volunteer-scheduling research environment. A defensible initial problem might ask how different fairness criteria affect the feasible schedules generated for a stated artificial resource configuration. The research record can include the origin of the hypothetical question, mathematical assumptions, disciplinary motivations, methodological alternatives, and a statement that no real hospital schedule or patient experience has been observed. The Commons can publish the problem and invite independent research without recruiting hospital volunteers or claiming service authority. Should later participants identify that one fairness criterion encodes an unrealistic

assumption about freely available labour, the question should remain open to reformulation rather than defended solely because the benchmark has become popular.

A comparative test should begin before a proposed research programme has acquired participants or funding. Give two investigators the same publicly supportable observation but different opportunities to hear affected perspectives. Ask each to construct a problem record that separates the observed condition, the interests that make it salient, possible rival framings, and the authority actually available to investigate it. The inquiry is whether an explicit problem-constitution practice discloses consequential omissions that an ordinary research brief would miss. If a short disciplinary proposal already preserves these distinctions without excessive consultation costs, an additional committee or intake system has not been justified. Conversely, a detailed register that excludes inconvenient testimony would fail the function even while increasing the volume of records.

Consider next a research collective interested in experiences surrounding a patient library. It may compare educational theories, public descriptions of library services, and independently developed training materials without conducting interviews or visiting wards. A member may propose a claim about actual patients' reading needs, but public descriptions alone may not warrant that conclusion. The collective can narrow the study to conceptual design, identify the need for authorised empirical inquiry, or refer operational proposals to the responsible institution. The underlying public concern may remain meaningful even when the particular evidence pathway is unavailable. This example shows why a well-functioning problem-constitution infrastructure sometimes constrains a project's immediate ambition while preserving its longer-run generative possibilities.

Consider finally a formal multi-institutional partnership, if one is established. Its problem intake might legitimately include a delegated hospital representative, participating researchers, volunteers, and appropriately constituted mechanisms for affected service users. It may need defined confidentiality rules, a process for documenting disagreements, budgetary decisions, and safeguards against sponsor control of published findings. These requirements differ from those of an independent public research Commons because the responsibilities and consequences differ. Even formal participation cannot eliminate conflict or make a participant's presence equivalent to the collective consent of everyone affected. A partnership can learn from independent Commons research without adopting every public problem framing as an institutional priority.

A problem-framing exercise can be evaluated through revision under criticism rather than document volume. Compare an initial statement with an alternative formulated by someone using the same public evidence. Record what differs in the affected subjects, excluded possibilities, value judgments, uncertainty, and requested decision. An improvement occurs when the process makes a consequential omission or unjustified commitment recognizable and permits a reasoned change. If a short annotated research proposal already performs this task, a separate intake body may contribute little. If formal consultation consumes resources without a credible route for incorporating objections, the more elaborate process may be worse. This test concerns the quality and corrigibility of inquiry, not the eventual welfare effects of implementation.

There are also reasons to decline, suspend, or retire a framing. A proposed inquiry may rely on protected information for which permission is unavailable, make claims about people without adequate evidence, require unmanageable safety or stewardship commitments, or reproduce significant harms through misleading public presentation. Other inquiries may simply lack sustained interest or justify no further allocation of scarce resources. Suspension should be differentiated from refutation, and retirement from historical erasure. Where lawful, the Commons should preserve a concise explanation of the disposition so later participants can distinguish an invalid hypothesis, an ethically unacceptable procedure, a deferred question, and an investigation that became unnecessary as conditions changed.

The constitutional importance of this infrastructure is therefore not that the Commons acquires a final inventory of public needs. It is that it develops a historically inspectable and corrigible practice through which proposed problems can be framed, contested, limited, and revisited without appropriating the authority or experience of those affected. This practice gives subsequent normative, epistemic, participatory, and decision infrastructures an accountable object to work upon. The following section

turns to the distinct problem of constructing the normative, ethical, and jurisprudential conditions under which those inquiries and any subsequent activities may legitimately proceed.

8 Normative, Ethical, and Jurisprudential Infrastructure

After a research problem has been formulated, a distinct question arises: which norms apply to each contemplated activity, who can interpret them competently, and what can legitimately be decided on that basis? Applicable law, institutional mandates, professional standards, ethical considerations, licences, contracts, and voluntarily adopted Commons rules have different sources and consequences. The infrastructure designed here connects those sources to actions through documented applicability judgments and revision procedures. It neither offers a uniform legal code for university hospitals nor determines the law of a particular jurisdiction. Its primary output is a scoped normative assessment, including reasons for uncertainty, referral, or restraint; the allocation of collective decision power is treated separately in Section 9.

8.1 Normative Relations and the Constitutive Object

Norms are often represented as rules that constrain an activity already defined independently of them. In practice, some normative relationships help constitute the activity itself. A participant can submit an independent manuscript to an open research Commons because certain authorship, distribution, and platform-use arrangements make submission intelligible. A hospital volunteer's authority to assist with a particular patient-facing activity, by contrast, depends on permissions, role definitions, supervision, and institutional duties that cannot be inferred from public enthusiasm or the activity's apparent helpfulness. These examples display different relations between actors and actions. One concerns the lawful and voluntary circulation of research material; the other concerns action within a service institution that bears responsibilities to patients, workers, and the public.

The design object is therefore broader than a compliance checklist. For present purposes, *normative infrastructure* means the situated ensemble of legitimate sources, interpretive competencies, procedures, records, responsible roles, accessible guidance, and mechanisms for challenge through which a Commons can determine the normative status of its proposed conduct and revise its determinations when reasons or circumstances change. The definition is deliberately functional. The infrastructure might be sustained through an independently maintained source register and a procedure for seeking competent review, or through an institution's formally delegated professional committees and authorised instructions. Neither arrangement can simply borrow the authority of the other. The presence of more documents does not imply that an institution has better normative judgment, and a small Commons' modest structure need not be a defect if its research activities remain appropriately bounded.

A normative infrastructure is also not identical with moral consensus. Participants may accept a research method as mathematically sound while disagreeing over whose interests it serves; they may agree that a contributor deserves recognition while disagreeing over the conditions for co-authorship or reuse. The task is partly to enable defensible disagreement, including the recognition of situations in which no participant has the authority or information required for an actionable conclusion. As discussed in Section 7, the constitution of a public problem does not authorize intervention. The normative infrastructure makes that boundary practically intelligible without foreclosing independent scholarly criticism of existing arrangements.

8.2 Three Reality Levels and the Evidence of Normative Authority

The generative relational analysis of Section 3 helps distinguish what an institutional observer claims to exist from the relationships that may actually condition a decision. At the level of *ontological reality*, the exhaustive grounding of obligation and of the moral status of persons is not asserted to have been established by our model. Ontological suspension should not be mistaken for moral indifference. The

framework must work within applicable rights and serious ethical demands while leaving unresolved metaphysical questions unresolved. Normative design can rely upon publicly defensible reasons and recognised protections without claiming to settle their ultimate philosophical foundations.

At the level of *relational reality*, normative positions are historically and institutionally situated. An actor may possess a contractual entitlement, an institutional duty, a permission to distribute their own expression, a professional responsibility, or a claim arising from the way another actor’s conduct affects them. These relations can constrain or enable one another. For instance, an independently created training document may be legitimately available for open reuse while containing examples whose later publication would violate a separate confidentiality obligation. An institutional affiliation may explain why a researcher can identify a service-related problem but provide no delegated authority to implement a solution. Authority, consent, intellectual-property permissions, and institutional responsibility thus need to be typed as different relations rather than conflated into the category of “being permitted.”

At the level of *manifestation reality*, a normative claim is encountered through particular texts and records: enacted provisions, judicial opinions, institutional regulations, contracts, licence notices, ethical statements, and handbooks. Their visibility does not establish applicability. The relevant inquiry must reconstruct provenance, effective date, geographic and institutional scope, interpretive status, and whether the issuer could bind the actors concerned. A superseded handbook can be valuable historical evidence while being unsuitable as present instruction; an original author can validly licence only rights they control. Keeping these statuses apart is a functional task of normative infrastructure rather than a cosmetic metadata exercise.

8.3 Normative Source Classes, Jurisdiction, and Interpretive Standing

Several source classes should be recognised without treating them as equivalent. Applicable legislation and regulations may impose duties or provide permissions, but their scope must be determined within a governing jurisdiction and legal system. Judicial decisions may clarify, limit, or otherwise affect the interpretation of law, while their precedential significance differs across legal orders, court levels, procedural contexts, and subsequent developments. Contracts, institutional regulations, clinical and professional rules, and individual licences can establish further normative relations within their lawful scope. Ethical declarations, scholarly publishing recommendations, and independently authored research principles may be significant guides without having the force of legislation. The Commons must identify the source, the kind of claim it supports, the persons and activity concerned, and the competent authority before representing it as binding.

Health-related contexts illustrate why these distinctions matter. The World Medical Association’s 2024 *Declaration of Helsinki* articulates ethical principles for medical research involving human participants and certain uses of identifiable human material or data (World Medical Association, 2024). The CIOMS international guidelines, developed in collaboration with the World Health Organization, provide a further account of health-related research ethics in varying social and institutional settings (Council for International Organizations of Medical Sciences, 2016). UNESCO’s *Universal Declaration on Bioethics and Human Rights* places bioethical principles in dialogue with dignity and human rights (UNESCO, 2005). These instruments are not interchangeable with domestic statutes, local ethics-review determinations, or operational hospital permissions. Their relevance depends on the contemplated activity, and their legal or institutional effect cannot be assumed solely from their international prominence. In particular, an independent numerical experiment using genuinely synthetic data does not become a clinical study merely because its motivating question concerns a hospital; conversely, a project involving identifiable human information does not escape review merely because its public description calls it an educational Commons.

The provenance of a normative source can be represented by a context-specific record

$$\mathbf{n} = (s, \tau, j, v, t_{\text{eff}}, \omega, a, \eta), \quad (11)$$

where s identifies the issuing source; τ identifies its type, such as a statute, decision, recommendation, licence, or independent handbook; j records the potentially relevant jurisdiction or institutional order;

Table 6: Distinct normative sources and the questions required before their application. The examples describe source classes, not an asserted universal hierarchy or automatically binding obligations.

Source class	Primary inquiry	Common interpretive risk
Law, regulation, judicial decision	Which jurisdiction, court or regulator, version, facts, and activity are involved?	Applying a foreign, superseded, or fact-specific rule universally
Institutional rule or agreement	Who adopted it, with what competence, for which participants and actions?	Treating draft guidance as an authorised directive
Research or professional ethics	Does the activity fall within the standard’s purpose and review arrangements?	Equating ethical guidance with formal service permission
Licence or contributor agreement	Who controls which rights, in what material, and under what terms?	Licensing rights not held by the contributor
Independent charter or handbook	What is its status, authorship, audience, review history, and explicit limit?	Implying official institutional adoption or expert certification

v denotes version and amendment information; t_{eff} records the effective period when ascertainable; ω describes subject-matter and persons within scope; a records the competent authority or authorised interpreter where established; and η denotes evidence, verification status, and outstanding uncertainty. This is a documentary grammar, not a mathematical test of legal validity. Some source types have no discrete effective date, and a contested rule may lack an agreed authoritative interpretation. The record should display those limitations instead of inserting fabricated values.

Jurisprudential analysis requires more than extracting a convenient quotation from a judgment. The question is what issue the competent tribunal addressed, which facts and procedural posture mattered, what reasoning sustained the holding, and whether the decision has relevant authority in the legal order and period under study. A source record should distinguish the court’s reasoning from the researcher’s comparative interpretation, and a case with superficially similar facts should not automatically be treated as governing a different institution. The Commons can build a public, source-critical corpus of judgments or legal scholarship, but should not label that corpus a substitute for case-specific professional advice. The same methodological requirement applies to competing ethical interpretations: disagreement should be stated rather than dissolved by a generic appeal to public benefit.

8.4 Comparative Authority Domains and Activity-Dependent Effects

A normative register is most useful when it prevents a legitimate conclusion in one domain from being presented as a conclusion in a different domain. International research-ethics texts, public-law instruments, intellectual-property licences, employment or service arrangements, professional review and internal Commons charters are neither a single hierarchy nor independent of one another. Their relation depends upon the legal order, affected activity, nature of the material, institutional role and temporal context. The analyst should begin with these questions, then identify the competent institutional or external decision, rather than starting with a preferred universal policy.

The Helsinki Declaration’s 2024 revision discusses review by a research ethics committee, free and informed consent, participant protection, and conditions for secondary use of identifiable data and material; its ethical prescriptions are not automatically a domestic legal permission to access or process information (World Medical Association, 2024). CIOMS Guideline 10 addresses specified conditions for a competent modification or waiver of research consent; it does not turn a researcher’s practical difficulty in asking for consent into self-granted authority (Council for International Organizations of Medical Sciences, 2016). The OECD Council’s 2016 Recommendation on Health Data Governance is a policy instrument about responsible health-data governance, not a self-executing legal basis for a particular dataset or hospital’s access decision (OECD Council, 2016). These are *source-specific* observations; comparison does not imply an identical implementation or enforceability across states.

Table 7: Comparative normative interfaces for a prospective research Commons. The row entries distinguish questions and potential sources; they do not confer permissions or prescribe the law of any jurisdiction.

Claim domain	Candidate source or competent process	Inference not supplied by the source alone
Human-participant research ethics	Competent research-ethics review; Helsinki 2024; CIOMS 2016, as relevant	Approval of an actual service operation, all data uses or rights over third-party materials
Personal or health information	Applicable jurisdiction-specific data law; legitimate custodian and governance controls; OECD health-data recommendations as policy guidance	A general right to collect, disclose, combine or repurpose identifiable records
Research participation	Informed consent with specified scope, or a duly justified and competent modification or waiver where applicable	Individual agreement to volunteer for hospital service, or permission for new research purposes
Hospital service action	Competent host-institution delegation, professional and safety arrangements, and applicable public or private law	Permission derived from a Commons charter, a simulated result or a university affiliation
Scholarly reuse and authorship	Rights holder's valid licence; specific contract; journal and disciplinary authorship standards	Clinical endorsement, legal title to independent downstream work, or automatic royalties
Commons internal governance	Its legitimately adopted private rules within actual competence	Power to waive external law, independently certify the host hospital, or resolve third-party rights disputes

Consider an artefact legitimately created through independent synthetic research and later offered as an input to a hospital project. A valid licence may facilitate permitted scholarly reuse, while the proposed change in activity raises distinct questions of research ethics, confidentiality, institutional adoption, safety and service responsibility. The relationship is not additive: accumulating five favourable pieces of guidance does not repair the absence of one necessary competent authorisation. Nor does a lack of a common international rule imply that every activity is prohibited. The appropriate inquiry identifies what each authority can actually decide and which unanswered questions justify separation or deferral.

This comparative matrix is deliberately not a compliance checklist. Actual work involving people, protected records or service operations requires a separate legal and institutional determination grounded in the relevant place, time, purpose and competent body. A researcher can make a critical or historical analysis of those norms without thereby acquiring the institutional standing to interpret them conclusively or to perform the activities they regulate. The matrix also preserves space for genuine conflict: a technically permitted disclosure may remain ethically disproportionate, and a desirable scholarly reuse may be legally restricted. Resolving those cases requires reason-giving and competent processes, not merely a more complete metadata entry.

8.5 Ethical Review, Legitimate Exceptions, and the Scope of Consent

International professional guidance can orient the analysis of research obligations without itself resolving whether an independently proposed activity is regulated in a particular jurisdiction. The 2024 *Declaration of Helsinki* addresses medical research involving human participants, including research using

identifiable human material or data. Within its scope, it gives a substantive role to independent ethics committee review of research protocols, specifies protections for voluntary informed consent, and addresses research on identifiable or re-identifiable material and the conditions for secondary use (World Medical Association, 2024). The 2016 CIOMS guidelines address the scientific and social value of health-related research, risk and vulnerability, consent, and the stewardship of health-related material in diverse institutional conditions (Council for International Organizations of Medical Sciences, 2016). Neither source is a universal statutory classification of every educational activity or mathematical model concerning a hospital. Their precise claims should be interpreted in light of their own scope, current version, and the law and competent authorities of the proposed setting.

A decision about a proposed study needs at least four distinct findings. First, the investigator describes the *object and conduct*: whether there is recruitment, intervention, observation, secondary data use, or only public-source or genuinely synthetic inquiry. Second, a competent person determines which *research and institutional regimes* may apply; the researcher's preferred label, such as "service improvement", is evidence of intention rather than a dispositive legal category. Third, the project establishes the relevant *permission pathway*, which may include lawful access to a site or data, institutional sponsorship, prospective ethics review, and a justified form of consent or an authorised exception. Fourth, the design evaluates *ongoing responsibilities*, including changes of purpose, participant safety, withdrawal representations, restricted sharing, amendment review, and the accuracy of public reporting. These findings can diverge: consent to an interview need not grant the interviewer entry to a ward; access to a dataset need not authorise its republication; and approval of a research protocol does not authorise alteration of ordinary clinical service.

The 2024 Helsinki text is especially informative about two distinctions. Its review provisions assign an independent ethics committee an *ex ante* role in medical research within the declaration's scope, and its provisions on stored identifiable or re-identifiable material recognise that secondary use may present new ethical questions rather than inherit permission simply from prior collection (World Medical Association, 2024). The WMA's *Declaration of Taipei*, as revised in 2016, separately addresses governance of identifiable health databases and biobanks for activities beyond individual care; it is not a generic rule for all scholarly archives or synthetic examples (World Medical Association, 2016). A contemplated secondary analysis therefore needs its own purpose-specific and institution-specific assessment. It would be mistaken to read these professional instruments either as declaring that consent alone suffices for release or as granting a Commons power to pronounce an ethical waiver.

Consent, a permissible modification or waiver of research consent, a lawful basis for processing information, access permission from a data custodian, and approval to conduct a service activity must also be analysed as *non-substitutable determinations*. CIOMS Guideline 10 specifies conditions under which a research ethics committee may approve a modification or waiver of informed consent in health-related research, including impracticability, important social value, and no more than minimal risk; an investigator cannot award such a waiver to their own project (Council for International Organizations of Medical Sciences, 2016). The 2024 Helsinki Declaration separately addresses the exceptional secondary use of stored identifiable material or data where consent is impossible or impracticable, in the scope of medical research covered by the declaration (World Medical Association, 2024). The OECD Council's Recommendation on Health Data Governance also expressly calls for clarity about when consent is required and about lawful alternatives and exemptions, with safeguards, for the *processing of personal health data* (OECD Council, 2016). That OECD recommendation is policy guidance to its addressees, not a newly established universal lawful basis or an individual institution's authorisation to process information.

These formulations cannot be collapsed into a single international permission rule. Ethics-review dispensation, the law governing data processing, confidentiality and professional obligations, participant choices, and a custodian's authority to release records may each require a separate determination. A waiver of a research consent process does not itself settle all applicable data-protection requirements. Conversely, a lawful non-consent basis for processing under a particular legal regime does not by itself establish that a proposed human-participant study meets relevant research-ethics standards or has

institutional permission. For independent work restricted to genuinely public and synthetic sources, the appropriate disposition may be to state which questions are inapplicable and why, rather than to fabricate a waiver or an approval document. The historical record should distinguish an application, a competent decision, the scope of the decision, and the analyst's understanding of it.

This distinction also constrains claims about voluntary withdrawal. Declining research participation, ending an unpaid service role, withdrawing permission for a particular future data use, requesting deletion of data, and recalling a previously and validly granted public copyright licence have different subjects and conditions. Ethical promises must be compatible with what can actually be achieved, including the possibility of lawful retention, legally limited erasure, irreversible downstream publication, and overriding obligations to safeguard affected people. The appropriate interface is a versioned record of the participant-facing explanation, the competent determination and its basis, and the steps actually available to an individual. Such a record cannot substitute for the consent process itself.

The framework's three reality levels clarify the modesty of this proposal. Ontological suspension leaves ultimate grounds of moral standing unsettled without suspending concrete protections. At the relational level, dependence on supervisors, care providers, or institutional gatekeepers can impair apparently voluntary choice. At the manifestation level, a checked consent box or a document headed "approved" records a claim made at a particular time; it does not establish comprehension, freedom from pressure, continuing scope, or compliance with a later use. The empirical question is whether competent review and participant-facing procedures reveal and correct these disjunctions more effectively than simpler existing arrangements. For some independent conceptual projects, the proportionate response may be to avoid collecting personal information altogether.

8.6 Ethical Deliberation and the Standing of Affected Subjects

Ethical infrastructure concerns more than whether a proposed activity conforms to a preselected set of virtues. It must help participants identify the persons whose interests may be affected, the asymmetries among them, and the reasons for or against a proposed use of knowledge, labour, time, or institutional trust. Autonomy, confidentiality, fairness, non-extraction, dignity, scholarly integrity, and public benefit may enter a case together without yielding a single uncontested quantitative ranking. A theoretically useful Commons should make these dimensions available for judgment while resisting the claim that an optimisation score can replace ethical deliberation.

The institutionally situated character of ethics is particularly important in hospital-related research. The value of a student gaining methodological experience cannot, by itself, justify converting patients into research inputs or volunteers into sources of uncompensated and undisclosed research labour. Even when an activity is nominally voluntary, pressures arising from course assessment, recommendations, institutional hierarchy, or reputational dependence may affect the freedom with which an individual can decline. Ethical review should therefore consider how the opportunity is communicated, who bears costs and risk, how participants may withdraw, and whether promised scholarly benefits are actually supported by usable research infrastructure. A proposal to publish open scheduling benchmarks can be ethically and methodologically examined without observing real patients, provided its data provenance and representational limits are made explicit.

An ethical consultation procedure requires the distinction among *being affected*, *possessing relevant experience*, *having disciplinary competence*, *holding decision authority*, and *consenting to one's own participation*. A patient may have a strong reason to object to the portrayal of hospital experience without thereby becoming obligated to participate in a study. An engineer may establish that a simulated schedule is computationally feasible while lacking the practical experience to judge whether its labour assumptions are fair. A hospital administrator may possess operational responsibility while needing to hear concerns from volunteers or patients whose situation the original plan does not capture. The aim is not to require every affected person to join the Commons; it is to avoid mistaking restricted, selective, or absent testimony for an authorised representation of all concerned.

The three-level account adds a further safeguard. Normative evaluation cannot proceed only from

manifestations that are easy to count, such as the number of volunteers, formal approvals, or published outputs. The historically conditioned relations through which people experience dignity, dependence, visibility, coercion, or benefit also matter. At the same time, the Commons must not treat hypothetical interpretations of unobserved suffering or motivation as established evidence. Design should preserve uncertainty, provide appropriately protected opportunities for challenge, and recognise that silence may have several explanations. The status of ethical judgments should remain distinguishable from claims that an empirical intervention has improved welfare.

8.7 Handbooks, Institutional Rules, and Operational Translation

A handbook occupies a useful but potentially ambiguous position between ethical argument and practical coordination. Handbooks can explain roles, make complex procedures accessible, record precedents, organise training, or propose a sequence of decisions. They may also conceal the distinction between a writer's suggested practice and an organisation's adopted policy. For a research Commons, this ambiguity is a material design risk, especially when explanatory materials concern a hospital whose name or occupational roles could make the text appear authoritative.

A defensible handbook infrastructure begins with a *document-status classification*. An independently authored research prototype should visibly state its independent status, author, purpose, intended readers, source limitations, version, and non-authorisation for service activities. An internal training guide must identify the competent issuer and conditions of use. An approved operating manual may require formal adoption, review, distribution, training, and confirmation that those expected to act under it possess the necessary instructions and authority. A published legal explanation should identify whether it describes an established rule, a contested interpretation, or a proposed normative principle. The same text can change institutional status over time, but publication alone does not accomplish that transition.

A handbook must connect its asserted norms to actual roles without concealing the source of authority. For each consequential procedure, its author should identify the action, the role expected to perform it, the institutional or legal basis where one exists, any necessary approval, a route for uncertainty, and the document's own status. An independently drafted manual may illustrate how these questions could be answered; only competent institutional adoption can make it an operational instruction for that institution. Conversely, institutional adoption does not make every ethical or empirical assertion in the manual correct. This separation provides an auditable interface to governance and safety without converting the handbook into either a statute or a clinical competence certificate.

A document life cycle may proceed through drafting, source review, consultation as appropriate, designation of its proposed status, responsible adoption if sought, distribution, comprehension checks, incident and feedback review, and revision or retirement. A version history should distinguish corrections to an explanation from actual changes in an institution's binding rule. Where the Commons lacks the resources to keep jurisdiction-dependent operational instructions current, it should cite the responsible official source rather than replicate volatile details. Where a handbook is intended for research only, useful testing may ask whether a new reader can identify the source of each important claim, distinguish an example from a directive, and recognise when to seek authorised guidance.

8.8 Licensing, Authorship, and the Typed Boundaries of Contributor Rights

The value-return ambition of the Commons makes rights analysis indispensable. Nevertheless, the historical presence of a contribution, the legal control of a protected work, scholarly recognition, and a claim on later economic proceeds are different objects. A source dataset may be relevant to a subsequent algorithm without conferring co-authorship over a paper describing the algorithm. A contributor may have a legitimate attribution interest even where a bare idea or mathematical procedure is not protected by copyright. Conversely, a creator may hold copyright in an original explanatory document while lacking permission to republish a confidential case embedded within it.

The World Intellectual Property Organization distinguishes copyright protection of expression from ideas, procedures, methods of operation, and mathematical concepts as such (World Intellectual Property

Organization, 2026a). This distinction has important jurisdiction-specific qualifications, particularly for databases, employment creations, patents, moral rights, and contractual duties. The Commons should therefore not label every intellectual contribution as copyrighted property or treat the provenance of an idea as a universal exclusive right. An open contribution record can recognise historical influence without purporting to grant ownership. The International Committee of Medical Journal Editors (2026) recommendations offer criteria for authorship and acknowledgement in relevant medical-journal contexts; they are not universal rules for every discipline or a substitute for a journal’s own policies.

The Creative Commons Attribution 4.0 International licence permits uses subject to its terms, including attribution obligations within the scope of the licensed rights, but does not convey hospital authorisation, consent to process private data, or third-party rights that the licensor never possessed (Creative Commons, 2013a). The licence text also illustrates why parties should select public licences with care: public permissions generally cannot be withdrawn from compliant recipients at will. Open research may combine papers, code, diagrams, source extracts, synthetic datasets, and software dependencies for which different rights or licensing arrangements are appropriate. A repository-level assertion that “everything is open” is not a substitute for identifying what may lawfully be licensed and what remains third-party or restricted material.

A useful contributor-rights process should therefore collect, for each proposed resource, the creator and source; the nature of the contribution; applicable original rights and other restrictions; the person authorised to grant reuse permission; the selected licence or agreement; attribution and citation expectations; known dependencies; and subsequent corrections. The system should allow an unresolved status that prevents publication or certain reuse. It should also distinguish the contributor’s retained rights from permissions offered to others. An intertemporal revenue-sharing mechanism, if one is proposed, requires its own lawful agreement; it does not arise automatically from open licensing or historical citation. Detailed contribution and value-return design belongs to Sections 19 and 20. The present normative function establishes the conditions under which those later mechanisms can be legitimate.

8.9 Normative Application, Conflict, and Reason-Giving Procedures

The main analytical task is to move from identified normative sources to a *reasoned assessment* of an explicitly specified activity, without silently converting the assessment into an institutional disposition. For example, a reviewer might find that an open licence appears to cover reuse of a figure, while marking unresolved the rights in an embedded photograph; that judgment neither clears other rights nor authorises its use in patient-facing guidance. A proportionate assessment record should identify the proposed act, actors, material, jurisdictional and temporal scope, source versions, relevant interpretations, disputed conditions, and issues reserved for a competent decision maker. It should distinguish a supported interpretation, an adverse finding, a material uncertainty, and a referral rather than present all four as stages on a path to eventual approval. A competent disposition, if subsequently made, has its own issuer, scope, conditions and review history. When none exists, the assessment remains an assessment, including where an independent Commons has reached internal agreement about it.

One can denote a preliminary assessment by

$$\text{Assess}_{I,t}(a) = \text{Review}(a, \mathcal{N}_{I,t}(a), \mathcal{U}_{I,t}(a), \mathcal{V}_{I,t}(a)), \quad (12)$$

where a is a proposed action in institutional context I at time t , $\mathcal{N}_{I,t}(a)$ is the set of potentially relevant, source-traced normative materials, $\mathcal{U}_{I,t}(a)$ contains unresolved questions of scope, interpretation, authority, or evidence, and $\mathcal{V}_{I,t}(a)$ denotes ethically relevant value considerations and affected positions. The symbol *Review* does not represent an automated legal reasoner or a function that necessarily returns a unique answer. It expresses the requirements of an inspectable evaluative practice. The codomain of $\text{Assess}_{I,t}$ is therefore a set of *reasoned assessment records*, potentially containing disagreement or referral, rather than the Boolean set of permissions. Where a competent authority issues a separate disposition, the manuscript represents that decision through the governance and activity-boundary records; it is not produced by substituting a source citation into Equation (12). A legally prohibited action is

Table 8: Illustrative stages of normative review and their institutional limits. The sequence is a proposed research design grammar, not an adopted hospital authorisation procedure.

Stage	Traceable output	Reason for deferral or restriction
Describe proposed action	Purpose, actors, setting, affected resources	Indeterminate activity or concealed dependencies
Identify sources and rights	Source versions, licences, duties, competent issuers	Missing provenance or uncertain jurisdiction
Interpret applicability	Scope analysis, alternative interpretations, unresolved issues	Unqualified interpretation or incompatible obligations
Assess ethics and authority	Affectedness, proportionality, permissions, consultation	Unauthorised service or participant-data use
Decide within competence	Scoped disposition, reasons, owner and review route	No delegated authority or adequate protection
Review and revise	Change history, feedback, corrections and expiry dates	Unmaintainable rule, error, or material contextual change

not legitimised by forecasting valuable research outputs; an institution’s discretionary permission is not established by a Commons vote; and a favourable ethics opinion does not itself resolve all information-rights or operational conditions.

Conflict deserves explicit treatment because disagreement may concern different questions. Two contributors may contest the accuracy of attribution without disputing ownership; an author and an institution may disagree over the publication of an otherwise lawfully held document because confidentiality is at issue; a research team may wish to maintain a publicly available synthetic dataset while a member disputes the fairness of its implied staffing assumptions. Design should first classify the dispute, preserve relevant evidence, and distinguish what the Commons can correct itself from what must be referred to an institution, editor, regulator, professional, mediator, or court. Dispute resolution should not be advertised as impartial if the only adjudicator is the person whose conduct is disputed. A small Commons might provide transparent correction and escalation routes without promising a fully independent tribunal it cannot support.

Normative conflicts do not always admit a single ranking. A source may be inapplicable rather than overridden; duties may apply concurrently; jurisdiction may be contested; ethical permissibility may remain controversial even after the legal question is answered. The design should support a reasoned suspension where material uncertainty cannot presently be resolved. This is especially important for data release, representations of affected persons, or intervention in patient-facing activities. Suspension is not evidence that the Commons has abandoned generativity. It can preserve the legitimate conditions under which future cooperative activity remains possible.

8.10 Institutional Configurations and Infrastructure Dependencies

A small independent Commons built around public literature and genuinely synthetic volunteer-scheduling problems might begin with an accurately scoped charter, an inventory of resource licences, an authorship and contribution policy, a modest complaints contact, an update schedule for source records, and a practice of suspending doubtful releases. Its normative capacity would be limited, and its public claims should say so. Such a configuration can still generate meaningful scholarship. It cannot approve a volunteer’s access to a hospital ward, adopt rules for institutional personnel, or certify that a future clinical collaboration complies with all requirements.

A university-based interdisciplinary collective may need additional arrangements for academic supervision, intellectual property, authorship disputes, student voluntariness, grant administration, accessibility, and research-integrity review. Its members may belong to different schools with different inherited practices. A formal hospital partnership would further require clarity concerning each institution’s decision authority, operational mandates, responsibility for patient protection, institutional review, con-

fidentiality, and the conditions for transferring information. These are possibilities for comparison, not steps that every independent Commons ought to take. Existing institutions may already perform much of the required normative work, and reproducing their functions inside a new Commons could create conflicting instructions rather than improve legitimacy.

The principal interfaces are directional. Problem constitution specifies the contemplated activity and those potentially affected; normative analysis identifies relevant rules, ethical reasons, and uncertainties; governance determines who may make a decision within the resulting scope; safety infrastructure operationalizes a stop, approval, or referral condition. Information systems make the current assessment available to entitled readers, while historical records preserve superseded assessments for limited legitimate purposes. A shared form may serve several functions, but a correct source citation cannot establish collective legitimacy, and a governing vote cannot amend external legal duties.

A further institutional cost is the ongoing burden of interpretation. Small collectives may lack time to check changes in local requirements, verify cross-jurisdictional applicability, or manage the requests created by public release. Maintenance must be proportionate to scope. When the legal and professional demands of a contemplated activity exceed existing competence, narrowing the activity to independent, low-risk scholarly work can be more defensible than constructing an elaborate set of nominal policies. Such narrowing does not imply that every institutional difficulty is solvable by better documentation; some projects require resources, authority, expertise, or trust relationships that a Commons does not yet possess.

8.11 Historical Revision, Evaluation, and Unresolved Normative Questions

A normative infrastructure should be judged by whether it supports justified action, correction, and the protection of affected persons, not by the length of its charter or the number of policy documents produced. An evaluation may ask whether contributors understand the permissions attached to their work, whether readers can distinguish an independent handbook from binding institutional rules, whether uncertain sources are visibly marked, whether complaints reach a competent party, and whether important decisions preserve their underlying reasons. It should also ask whose burdens the infrastructure creates: elaborate licensing forms may deter contributors; intrusive provenance records may compromise privacy; public complaints archives may expose precisely the people the Commons seeks to protect.

An activity-specific normative review can be tested with a disputed reuse of a contributor's handbook. The reviewer should identify the object of reuse, any applicable legal or contractual rules, the actual version and provenance of each source, the identity of the competent decision maker, and the difference between an explanatory recommendation and a binding instruction. A failed result is not merely an incorrect answer: it may be the presentation of a provisional Commons policy as hospital law, or a disclaimer that masks an unresolved legal restriction. If competent existing institutional counsel and an ordinary source register already support an adequate resolution, a new normative board has no demonstrated marginal benefit. Maintenance costs include source updating, translation, access to expertise, and the risk of false confidence.

Historical recoverability adds a temporal dimension to normative engineering. A future participant should be able to understand why an activity was once considered appropriate, which sources and interpretations were then available, what dissent was expressed, and which later changes affected the assessment. Yet preservation is bounded by rights, lawful retention limits, legitimate confidentiality, and the possibility that some information should be redacted or deleted. Versions may document former rules without presenting them as currently effective. An institution may reasonably choose concise public reasons and a protected restricted record rather than an indiscriminately open archive. How much explanation is sufficient depends on institutional competence, the interests at stake, and foreseeable costs of review.

The present account remains a preliminary programme for research, not a completed normative constitution. Determining applicable domestic law, the effect of particular judicial decisions, the rights of specific participants, or the adequacy of institutional approval requires facts and authorised expertise not

provided by an abstract theory. Empirical work would also be needed to test whether a source register and review procedure actually improve understanding, reduce inequitable burdens, and enable meaningful correction. These limitations are substantive: a design that is easily documented but too expensive to maintain, or one that formally invites objection while penalising dissent, may undermine the generative relations it purports to support.

Normative infrastructure is thus a maintained capacity for making defensible, bounded claims about what a proposed activity permits, requires, or leaves unresolved. A compact source and interpretation register may suffice for an independent synthetic research exercise; a materially consequential service project may require competent institutional and professional determinations. The framework can expose missing authority and conflicting reasons, but it cannot supply their resolution by declaration. Governance, examined next, concerns a separate constitutive problem: the allocation, exercise, and review of actual decision power.

9 Institutional Governance and Public Trustworthiness

Normative interpretation identifies relevant reasons, obligations, and permissions, but does not itself allocate the competence to choose among permissible alternatives or hear disputes. The governance problem concerns who controls shared resources, which decisions that control legitimately covers, how affected claims are heard, and what correction remains possible after error. University affiliation may mediate cooperation without delegating authority over an independent Commons or hospital operations. This section develops a context-dependent account of decision roles, contestation, accountability, conflicts of interest, trustworthiness, and succession, using institutional and knowledge-commons scholarship as foundations rather than claiming a universally preferable governance body (Ostrom, 1990, 2005; Frischmann et al., 2014a; Fung, 2006; Bovens, 2007).

The object is neither an optimal constitutional document nor a hypothetical board that every Commons must create. A single investigator maintaining an independent research environment, a student-led collective exchanging open educational materials, and a consortium formally collaborating with a hospital face different demands of authority, coordination, stewardship, and answerability. Their structures need not converge. What must be examined is whether the actual allocation and exercise of decision powers remain justified relative to the actors affected, the resources controlled, the institutional mandates engaged, and the risks of error or capture. Governance is thus related to, but distinct from, management efficiency, the fulfilment of legal minimums, and the favourable public perception of a project. The section proceeds through its constitutive object, the GR reality-level distinction, authority and membership, participatory decision processes, accountability and complaints, power and conflict, trustworthiness and public communication, evolving institutional configurations, and critical evaluation.

9.1 Governance Relations and the Distribution of Institutional Authority

The term *governance* sometimes designates the persons who lead an organization, its stated rules, or the mechanisms through which stakeholders can influence collective action. Each usage captures part of the present problem. A Commons may be governed through policies, custodianship over artifacts, deliberation among contributors, informal conventions of credit, editorial decisions, contracts, and external legal constraints. Some relationships are internal to the Commons; others arise from independent organizations with which it interacts. The distribution of effective power may diverge from the presentation of a nominal governance chart. A person who alone possesses the repository credentials or pays the hosting costs may have practical capacity to delete material even when a collective is said to govern publication. A hospital administrator may have final competence over a volunteer service but no power to require an independent author to adopt the hospital's academic interpretation. Institutional governance must identify such differences instead of treating the word "stakeholder" as a unitary position.

Definition 9.1 (Situated governance infrastructure). A *situated governance infrastructure* is a historically maintained arrangement of decision roles, competence boundaries, access to relevant information,

applicable rules, justificatory practices, challenge mechanisms, and revision procedures through which participants and other competent institutions regulate a delimited set of Commons activities. Its design is adequate only relative to specified purposes, persons, resources, obligations, and foreseeable failures; this definition does not confer legal personality, permission, or authority upon an arrangement.

Three distinctions follow. *Power* is the effective capacity to change another's opportunities, access, or conditions of participation. *Authority* concerns the recognised, justified, or legally delegated competence to make a particular decision within a defined domain. *Legitimacy* concerns the grounds on which that exercise of power or authority may be defended to those whose interests it affects. Their relations are contingent. The capacity to remove a paper does not entail a legitimate entitlement to silence criticism. The moral standing of a patient affected by a proposed research practice does not supply the same institutional role as the authority of a designated clinical officer. A Commons contributor may have a legitimate claim to explanation without possessing unilateral authority over the project's entire research agenda. These are analytically differentiated relational positions, not ranks of human worth.

Informed by Ostrom's work on institutional diversity, the proposed inquiry begins with action situations, rules-in-use, relevant biophysical or technical conditions, communities, and actual patterns of interaction rather than presuming a single form of collective self-government (Ostrom, 2005). The knowledge-commons framework similarly encourages examination of resources, actors, goals, institutions, and outcomes in their particular setting (Frischmann et al., 2014a). The present contribution is to make those concerns explicit within a typed design of an independent, possibly university-mediated volunteer research Commons. An initially individual research initiative can possess governance functions, such as explaining who may reject a contribution and how an error will be corrected, without claiming participatory democracy it cannot yet practice. As people and resources become more interdependent, governance commitments may have to be renegotiated; the later possibility of co-governance should not be represented as an existing fact.

9.2 Three Reality Levels and the Manifestation of Governing Relations

The three-level GR distinction articulated in Section 3 provides a discipline for avoiding the identification of a constitution with an institution. At the level of *ontological reality*, the ultimate status of institutional authority, moral obligation, and human political relations is not settled by a governance model. Ontological suspension does not exempt the project from law or ethical obligations. A researcher may recognise and comply with enforceable duties, and take seriously the claims of people affected by institutional power, without asserting that a relational representation exhausts the philosophical grounds of those duties.

At the level of *relational reality*, governance consists of effective, historically produced relations of decision competence, dependence, representation, sanction, consent, exposure to harm, access to resources, and opportunities for objection. A host university's rules may influence a student's choices through supervision or academic assessment even if the student signs a voluntary participation form. A reviewer can exercise gatekeeping power through editorial decisions that shape which disciplinary approaches are visible. An individual contributor may be legally free to leave while practically unable to recover work stored only in an administrator's private account. These relationships operate through changing material, institutional, and symbolic conditions. Their examination requires more than inspection of declared values.

At the level of *manifestation reality*, governance appears in charters, committee minutes, repository permissions, consent forms, meeting attendance, public reports, appeal messages, and published decisions. Such materials may provide indispensable evidence, but they are partial and may be selective. A unanimous meeting record may conceal that dissenting participants were absent, unfamiliar with the process, or unwilling to risk retaliation. A perfectly accessible public dashboard may show approved projects but omit declined complaints. Conversely, missing documentation does not conclusively establish absence of a governing convention. The epistemic task is to connect available manifestations to

defensible claims about operative relationships, with explicit limits and opportunities for independent criticism.

This distinction is important for evaluation. A written policy of non-retaliation is evidence of a declared commitment, not proof of safe disagreement. A record of many public contributions is evidence of activity, not proof that contributing students retained meaningful academic autonomy. An archive of complaints is evidence of records, not automatically of fair hearing or effective remedy. Evidence may need to combine documentary traceability, voluntary participant accounts, observations of decisions, the distribution of actual decision privileges, and independent checks. Where research on people or restricted institutional information would be required, such evidence gathering itself remains subject to appropriate permissions and safeguards. Abstract governance analysis should not be an excuse to collect identifiable patient, staff, or volunteer data.

9.3 Membership, Standing, and Competence Boundaries

A Commons brings together positions that cannot be represented by one undifferentiated category of membership. Possible participants include original authors, maintainers of shared materials, voluntary researchers, mentors, financial or technical stewards, people whose experience motivates research, and representatives of organizations that may later cooperate with the Commons. Some people may be affected by a project without choosing membership in it, including patients in a hypothetical service setting, future learners, or researchers excluded by language and access barriers. Their interests can create duties of attention and channels for objection without automatically producing the same access, voting, or contractual rights as contributors. Conversely, formal enrollment should not displace protections owed to nonmembers. Section 7 distinguishes affectedness, interpretive standing, expertise, and authorization; governance translates these distinctions into institutional procedures.

Membership rules should answer distinct questions about entry, access to artifacts, proposal rights, decision competence, and review standing. An author may control an original manuscript without governing a research collective's entire agenda; a repository maintainer may have technical deletion privileges without legitimately deciding a scientific dispute; an authorized hospital officer may manage a volunteer shift without editing an independent paper. A concise mandate should assign each decision type to a responsible role, specify review and recusal conditions, and disclose where the Commons cannot offer an independent appellate process. Where no one holds competence over an external matter, the correct governance disposition is referral or non-action, not an internal vote purporting to create permission.

For purposes of accountable design, one may represent a *claim* concerning decision competence using a typed record. We reserve AuthRec for this documentary object, distinct from the role-screening conditions in Section 17 and from any actual grant of competence:

$$\text{AuthRec}_{I,t}(d) = (a, s, \rho, n, b, \delta, \tau, \epsilon), \quad (13)$$

where d denotes a contemplated decision, a the actor claiming competence, s the decision's substantive scope, ρ the institution or role supplying that competence, n the relevant normative sources, b the persons or interests potentially affected, δ the required deliberation or consultation process, τ the time or version at which the competence is asserted, and ϵ the uncertainty or evidence status. The record in Eq. (13) is an *analytical representation of a claimed and checkable relation*, not an algorithm that proves lawful authority. Determining actual competence still requires verified sources, local context, and sometimes expert or institutional review. The schema is deliberately relational: a person may be competent to decide publication formatting but not patient recruitment, financial commitments, or a change to a hospital's safeguarding requirements.

Membership arrangements should anticipate ambiguity and change. Students may graduate; maintainers may become unavailable; research groups may change their priorities; financial supporters may acquire influence over infrastructure. A reasonable arrangement may therefore use time-limited responsibilities, visible transfer protocols, and procedures for revising membership criteria. But extensive administrative procedures impose real costs. An independent Commons with two active contributors may

need a clear record of custodial rights and an accessible route for objections rather than the administrative machinery of a large institution. A hospital-linked consortium may require formal approval routes, external contacts, and documented non-delegable duties. The theoretical requirement is clarification of standing and competence, not institutional uniformity.

9.4 Decision Procedures and the Justification of Collective Choices

Governance is tested most clearly where available resources, values, and interpretations do not converge. A research group might face competing proposals to invest its limited maintenance effort in a scheduling benchmark, a volunteer learning module, or an ethics source register. Contributors may disagree over whether a research artifact is adequately documented for publication. A partner organization may contest the accuracy of a public description. None of these matters necessarily has a single numerical objective, and majorities may not be authoritative across every domain. Some decisions concern preferences among permissible alternatives, others concern rights that should not be overridden by preference aggregation, and others require specialist judgment about technical validity or institutional authorization.

Fung's institutional design analysis distinguishes who participates, how communication and decisions proceed, and how their outcomes are linked to public action (Fung, 2006). We use these dimensions as a source-informed starting point rather than as a ready-made constitutional recipe. A proposed Commons procedure should make visible the opportunity to propose alternatives, access relevant information, explain competing reasons, examine conflicts of interest, record dissent, and obtain a decision from an actor with appropriate competence. In some settings a delegated maintainer's documented decision will be legitimate and efficient; in others a participatory assembly or external independent review may be warranted. The selection depends on the type of decision, its reversibility, its impact, the affected actors, and the resources available for hearing objections.

The selection of a procedure should follow the object and jurisdiction of the decision, its reversibility, the rights at stake, and the credible means of contestation. Governance *receives* reasons from normative review but does not promote an interpretive assessment into external authority. A delegated maintainer may decide the release date of a Commons-authored synthetic benchmark under an established internal remit; a disputed third-party licence may require an actual rights-holder or competent adjudicator; a proposed change to hospital services remains with the relevant institution. Likewise, an internal decision to invite comments may be valid within the Commons without creating permission to recruit patients for research. The resulting decision record should link the specific assessed act to an identifiable issuer, competence source, conditions, dissent or referral, review date, and affected activity sphere. A missing competence source warrants suspension or a narrower independent activity, not an invented committee. A compact decision note can satisfy this function where a larger governance apparatus adds no justified value.

Even carefully structured deliberation can create exclusion. Meetings held during standard working hours may favor some participants; legalistic language may deter nonexperts; technical presentations may privilege one discipline's evidentiary style; public disagreement may be risky for junior researchers. Design may therefore require asynchronous written input, accessible explanatory materials, multiple languages where feasible, a confidential channel for sensitive concerns, and different means of expressing objection. These are contextual possibilities, not claims that any particular interface is sufficient. Participation quality is better evaluated through effective opportunities to influence an appropriate decision than through attendance or message counts alone.

9.5 Accountability, Complaints, and Corrective Review

Governance without answerability risks turning shared purposes into discretionary rule by those who control resources. Bovens' conceptual framework usefully treats accountability as a relationship between an actor and a forum in which conduct is explained and justified, questions and judgments may follow, and consequences may arise (Bovens, 2007). This is a more demanding notion than simply publishing an annual report. The present framework adopts the relational emphasis while leaving open which

Table 9: Proposed governance-decision grammar. Categories are illustrative design questions, not a certification of competence or a mandatory organisational procedure.

Decision object	Relevant standing and competence	Possible procedure and failure check
Open research publication	Authors, repository steward, reviewers, affected rights-holders	Evidentiary review; correct misleading affiliation; route disputed rights before release
Shared research priorities	Contributors, maintainers, affected publics where appropriate	Reasons and alternative proposals; document allocation burden and excluded options
Contributor credit and licence disagreement	Original rights-holders, affected contributors, qualified reviewer when necessary	Preserve versions; separate citation norms, legal rights, and contracts; permit challenge
Complaints about conduct	Complainant, impartial recipient, appropriate competent body	Confidential intake; protect against retaliation; clarify limits and escalation
Hospital-facing service activity	Competent hospital authority and appropriate professional roles	Seek independent operational approval; Commons votes and simulations do not authorize action

fora possess relevant competence and what consequences are lawful or institutionally permissible. Accountability may involve contributors, funders, institutional supervisors, rights-holders, the public, or designated external regulators; their roles are not interchangeable.

An accountable Commons requires a practicable route from concern to response. Consider a participant who discovers that a public research report incorrectly credits an earlier dataset, or a student who feels pressured to deliver unpaid work beyond an agreed educational collaboration. The first matter may require a provenance correction and renewed rights review; the second may require confidential discussion, suspension of demands, and, in some circumstances, external institutional support. Both illustrate the inadequacy of one generic complaint mailbox that accepts messages but has no identified responder or duty to act. A proposed complaint pathway should distinguish receipt and acknowledgement, competence assessment, evidence preservation with privacy safeguards, interim risk reduction where justified, reasoned disposition, and review or referral. The scale and degree of formality should be proportionate to the stakes.

The existence of such a pathway does not mean the Commons can operate a tribunal or adjudicate employment law, institutional misconduct, or medical negligence. It should not promise legally binding appeals without the required legal basis and competence. Some disputes may be resolved through negotiated corrections or an impartial community reviewer; others exceed the Commons' capacity and should be referred to competent institutions or legal mechanisms. When a complaint involves potential immediate safety risks, applicable safeguarding duties may demand a different response from a routine editorial dispute. A record should distinguish a final internal decision, provisional opinion, external referral, and unresolved allegation; conflating them may expose participants to reputational harm.

An illustrative *decision and review record* can be represented by:

$$\text{Dec}_t(d) = (q, \text{AuthRec}_{I,t}(d), E, V, J, C, O, R), \quad (14)$$

where q is the framed question; E the available evidence and its limitations; V the competing values and identified affected positions; J the reasons for the disposition; C any conflicts of interest and safeguards; O the decision or justified deferral; and R the channels and conditions of review. Eq. (14) describes information a defensible process may need; it should not be read as a universal sufficient condition for fairness. Different kinds of decisions require different records, disclosure rules, and competent decision makers. A published summary may legitimately omit personal evidence available only to an authorized reviewer, and removal of identifying information may be necessary before historical preservation.

9.6 Conflicts of Interest, Institutional Power, and the Risk of Capture

Commons participants occupy unequal positions. A founder may own the domain and research infrastructure, possess the most technical expertise, and make the initial choices about publication. A senior scholar may control recommendation letters or disciplinary recognition; a funding organization may influence priorities; a hospital or university may possess the symbols of credibility to which volunteers orient their choices. These dependencies can improve coordination but may also narrow who can safely dissent. The framework should therefore inspect both formal declarations of interest and the less visible conditions under which participants depend on powerful actors for access, credit, opportunity, or continued involvement.

Conflict of interest is not equivalent to misconduct. It identifies circumstances in which a secondary interest, personal relationship, material stake, or institutional dependence may reasonably affect judgment. Disclosure may be necessary, but it is rarely sufficient. Appropriate responses may include recusal from an editorial or contribution dispute, independent review of a financial arrangement, separation of repository privileges from rights adjudication, multiple custodians for critical records, or a clear public note about funding and institutional affiliations. These measures entail costs and may fail if nominally independent reviewers share the same dependencies. Governance evaluation should test actual decision conditions rather than equate formal disclosure with impartiality.

An especially salient failure mechanism is *benevolent capture*: an actor sincerely committed to public service assumes broad discretion over research direction, volunteer labour, or participant narratives because the underlying mission appears morally important. Benevolent intention does not resolve whose burdens are imposed or who may contest the framing. For example, a Commons might advertise that engineering students will both learn advanced methods and help patients. Yet the technical work may not be academically adequate, and authorized hospital roles may not be available. If students enter through the public promise but find themselves doing uncompensated maintenance tasks unrelated to their aims, the claim of “mutual benefit” becomes subject to criticism. Actual choice, research quality, and legitimate withdrawal matter more than the institution’s generous rhetoric.

Related problems arise through gatekeeping and unequal recognition. A transparent licence repository may protect a contributor’s original documentation while doing little for a novice’s standing to challenge the prevailing research agenda. A repository maintainer may unintentionally prioritize familiar mathematical techniques over competing qualitative inquiries. Communication staff may curate only favourable results, weakening future error discovery. The design response is not necessarily universal participation in every decision, which can become administratively paralyzing; it is a more discriminating allocation of standing, reasons, editorial alternatives, independent channels for challenge, and visible limits of authority. Where actual inequalities remain, they should be treated as empirical and normative questions rather than declared solved by an open membership policy.

9.7 Public Trustworthiness, Communication, and Institutional Claims

Public trust can be desirable for volunteer cooperation, but its magnitude is not a sufficient measure of institutional worth. Confidence may rise because of university symbolism, compelling design, or publicity before an institution has established accountable practice. It may also decline for reasons unrelated to actual competence. The focus of governance design should therefore be on characteristics for which trust may be warranted: reliable performance within a declared scope, truthful representation of limitations, respect for the interests of affected persons, opportunities for correction, and a defensible separation between claimed authority and demonstrated capacity. The present section treats *trustworthiness* as an evaluative concern distinct from publicity success or a numerical trust score; it does not claim an experimentally validated measure.

Hirschman’s distinction between exit and voice offers a useful account of responses to institutional decline, while not resolving every difficulty of dissent in dependent relationships (Hirschman, 1970). A nominal right to exit may be costly when a student loses access to a needed method, when shared work lacks portable attribution records, or when a person fears damage to future recommendations. Voice

may similarly be ineffective when complaints are acknowledged but ignored. In the Commons setting, a stronger design can preserve the lawful portability of one's original contributions, a means to obtain reasons, clear withdrawal conditions, and continuing access to genuinely open resources independent of one's willingness to undertake particular volunteer activities. It should also distinguish withdrawal of future participation from the separate, licence-dependent question of retracting material already lawfully shared.

Trustworthiness is implicated directly by public representation. A website may describe an independently maintained Commons inspired by university-hospital service and disclose its draft governance rules; it should not use a hospital logo or imply approval without permission. A scholarly handbook can be responsibly published as an independent interpretation while stating that it is neither operative hospital procedure nor a grant of clinical authority. Public reports should distinguish proposed activities, prototypes tested with synthetic materials, externally confirmed findings, and completed authorized collaborations. Advertising should avoid promises of academic authorship, institutional credit, employment, patient contact, or research access that the Commons cannot guarantee. The communication infrastructure discussed in future Section 16 should operationalize these distinctions rather than substitute publicity for accountability.

Transparency itself has boundaries. Disclosure of voting records or editorial reasons may facilitate public criticism, but blanket publication of identifiable complaints, internal correspondence, patient narratives, or junior contributors' vulnerabilities may be unjustified. A proportionate arrangement can make decision categories, competence sources, summary reasons, and correction histories public while restricting sensitive personal evidence. The principle is *justified visibility*, not maximum disclosure. Critics may legitimately question whether a confidentiality claim conceals avoidable error; competent stewards must be able to explain the basis and scope of withholding information without revealing what must remain protected. The design challenge is a relation between reason-giving and protective discretion, not a simple choice between openness and secrecy.

9.8 Institutional Configurations, Succession, and Infrastructure Coupling

The preceding mechanisms can be constituted through several institutional configurations. An independent scholar maintaining public research materials may act as initial editor, steward, and complaints recipient, while publishing the resulting concentration of power and offering an identifiable route for correction. The arrangement has modest coordination costs but weak independence of review and substantial succession risk. A student or multidisciplinary research collective may allocate editorial, technical, and financial roles among members, use rotating conveners, and define which decisions require broader consultation. This can enrich expertise and improve continuity but may also create free-riding, confusion over ownership, and burdensome meetings. A formally constituted consortium may support more robust oversight and resources while introducing contractual obligations, approval bottlenecks, and conflicts among participating organizations. These examples are comparative possibilities, not observations of actual Commons operating under this framework.

A governance infrastructure cannot remain reliable if critical roles disappear without replacement. Succession design may include a record of rights to shared infrastructure, exportable archives where legally permissible, documented maintenance duties, a method of appointing a substitute custodian, and a plan for responsibly closing activities that lack adequate stewardship. Continuity may be preferable to permanent institutional survival: when a Commons cannot maintain safety, accuracy, or fair treatment of contributors, an orderly closure and lawful preservation of reusable public results may better support generativity than preserving its name. Such questions should be revisited as the participant population, external relationships, financial commitments, and legal setting change.

Governance interfaces are clearest at disputed decisions. Normative infrastructure identifies candidate constraints but cannot choose the decision maker; epistemic review judges the research claim but does not allocate ownership; information sharing supplies permitted evidence for challenge; communication represents the resulting decision to an audience; rights infrastructure constrains what may be

Table 10: Illustrative governance configurations and possible failure pressures. These are counterfactual design comparisons, not descriptions of existing hospital or university policies.

Configuration	Practicable constitutive arrangement	Salient failure pressure
Independent scholarly Commons	Named custodian, public scope, contribution rules, correction contact, versioned reasons	Concentrated authority, review dependence, disappearance of maintainer
Peer research collective	Delegated editorial and resource roles, negotiated membership, recorded disputes	Role ambiguity, status hierarchy, coordination burden
Multi-institutional research consortium	Joint mandate, agreed decisions, explicit authority interfaces, designated complaints routes	Institutional capture, contractual asymmetries, slow revision
Authorized hospital-related collaboration	Separately competent service officers, applicable safeguarding and research oversight, restricted-data boundaries	Mistaken substitution of internal Commons consent for operational or research approval

redistributed; and historical preservation records why a rule changed. For a contested event plan, simulation provides alternatives and their assumptions, while governance identifies who can approve the choice and to whom that decision must answer. Interdependence does not imply a mandate for a single integrated committee.

9.9 Failure Cases, Evaluation, and Historical Revision of Governance

Three counterfactual contrasts clarify the proposed research obligations. First, suppose a small Commons publishes a mathematical benchmark and invites student contributions. Its founder preserves detailed contribution records but alone controls which results are shown. The Commons may achieve technical reproducibility while failing to provide defensible opportunities for participants to contest suppression of negative results. Second, imagine that a collective votes to deploy its scheduling model in an actual hospital. Even if its internal procedures were inclusive and technically sophisticated, the decision cannot replace the competence of hospital authorities or the necessary safeguarding assessments. Third, imagine an institution advertises itself as transparent and open, while confidential complaints about credit or coercive tasks routinely receive no response. Its publication record is not reliable evidence of governance trustworthiness. Each case suggests a different failure mechanism: concentrated editorial power, a boundary violation, and the gap between declared and operative accountability.

A discriminating governance case occurs when a founder rejects a technically sound contribution, invoking an unpublished editorial preference. The relevant questions are not whether a comprehensive ethics code exists, but who has authority over acceptance, whether that authority was announced, whether the contributor receives a reason, and how an objection can be heard without retaliation. A small Commons may publish a limited editorial mandate and refer irreconcilable disputes externally; it need not imitate a university senate. Its governance arrangement nevertheless fails where the reviewer and the person complained against are treated as independent by mere relabelling. This test distinguishes allocation and contestation of decision power from the validity of the scientific contribution itself.

A discriminating evaluation should observe whether authority is recognizable, whether a person can contest a decision without disproportionate cost, whether explanations address the objection, whether corrective action occurs where warranted, and whether the procedure can be maintained. These dimensions should be investigated separately; adding them into a trust score would obscure important asymmetries. A low complaint count can indicate satisfaction or deterred voice. A more demanding test follows a contested editorial decision from initial notice through reason-giving and appeal, including who bears the cost and whether the decision maker changes course when presented with evidence of error. Existing credible editorial practice is the relevant comparator, not an institution with no rules at all.

Historical recoverability matters because governance changes the very relationships by which later

generations interpret the Commons. A dispute over authorship may prompt an amendment to citation procedures; departure of a maintainer may require changed archival access; a new institutional partner may require revised disclosure practices. Future participants need to recover why a rule was enacted, which problem it addressed, what alternatives were considered, who was excluded from the decision, which objections remain unresolved, and how the rule's scope has changed. Yet open historical preservation cannot justify indefinite publication of sensitive accusations or personal data. A proportionate record may contain an accessible public rationale, a restricted evidentiary record retained only when justified, and a legally and ethically sound process for correction or deletion. The aim is critical institutional memory, not the indiscriminate permanence of every interpersonal conflict.

The governance programme remains theoretical. No evidence offered here establishes that these arrangements improve participation, public trust, research output, or patient welfare in an actual setting. Constitutional choices are neither neutral nor costless, and apparently well-designed safeguards may produce exclusion or fatigue when implemented. Moreover, standards of legitimacy differ across legal settings, institutional forms, and types of decision. The proper contribution of the section is thus a set of discriminating design requirements and questions: whose power is constituted; by what authority; toward which persons and resources; with which means of explanation, objection, and correction; under what confidentiality boundaries; and at what historical and maintenance costs. A generative Commons is more defensibly governed when these questions remain examinable and revisable than when procedural language simply asserts that all contributors have been empowered.

The next infrastructure inquiry concerns safety and institutional boundaries. Governance may allocate responsibility for research artifacts and voluntary collaboration, but it cannot by internal decision alone acquire clinical competence, authorize access to protected data, or override the external duties of a hospital. The separation of these powers is an integral condition for attempting cooperation that respects both public service and participants' independent generative capacities.

10 Safety and Institutional Boundary Infrastructure

Governance allocates decisions within a Commons, but many contemplated acts depend on responsibilities held elsewhere. Safety and institutional-boundary infrastructure concerns the practical interfaces that prevent a research artifact, invitation, dataset, or participant role from being misapplied to protected persons or authorized service activity. The key question is not whether the Commons values safety in the abstract; it is how an activity is classified, who must authorize it, when it must stop or be referred, and how defects are corrected. The analysis remains internationally scoped and makes no claim to certify local clinical practice or data processing.

The analysis is an institutional design exercise rather than a hospital-specific operational protocol. It draws upon the World Health Organization's patient-safety programme and incident-reporting guidance, the ethical principles of the World Medical Association and CIOMS, and applicable data-protection and research-oversight questions (World Health Organization, 2021, 2020; World Medical Association, 2024; Council for International Organizations of Medical Sciences, 2016). Their authority is not uniform: international guidance expresses principles and recommended practices, while enforceable obligations, review pathways, and service permissions depend on relevant jurisdictions, competent organizations, and activity types. The aim is to identify general problems that any proposed configuration needs to address, leaving the content of locally binding procedures to competent institutions. The section proceeds through the constitutive object, the three GR reality levels, activity and authority boundaries, information stewardship, safeguarding and competence, simulation and decision support, incident management, institutional interfaces, comparative configurations, and evaluation.

10.1 The Constitutive Object of Safety and Institutional Boundaries

Safety is not identical to the absence of recorded incidents. A volunteer may report no incident because a potentially harmful situation was appropriately interrupted; another may encounter an apparently un-

eventful activity while participants bear burdens not visible to the activity organizer. In a Commons that links independent research with possible hospital service, safety concerns extend beyond immediate physical harm to dignity, confidentiality, psychological burden, misrepresentation, misuse of authority, and the displacement of professionally responsible judgment. These concerns differ in magnitude and provenance. Some may be addressed through research design and editorial controls. Others require competent clinical, administrative, legal, safeguarding, or research-ethics processes. An arrangement that calls everything “safe” because a contributor signed a form would fail to distinguish procedural manifestation from its actual protective conditions.

Definition 10.1 (Situated safety and boundary infrastructure). *A situated safety and institutional boundary infrastructure* is a historically maintained configuration of role-specific permissions, protected interests, risk-recognition capacities, information-handling practices, competent escalation paths, decision-review procedures, and revision mechanisms that governs defined Commons activities and their potential interfaces with separately constituted institutions. Its adequacy is a contextual research question, not a quality automatically conferred by the existence of this definition or any proposed Commons document.

The design object is simultaneously protective and constitutive. Safeguards may prohibit inappropriate access, but they also establish the conditions under which legitimate participation becomes possible. A participant who knows that a scheduling exercise uses independent synthetic data can explore mathematical alternatives without uncertain claims about handling real volunteer records. A volunteer who understands a defined nonclinical role can direct a question involving symptoms or treatment to appropriate hospital personnel instead of improvising clinical advice. A researcher who learns where an institutional permission boundary lies can redesign the project to study a different object or request review rather than assume tacit consent. These are distinct ways in which a boundary can preserve generative capacity rather than merely inhibit action.

A proposed Commons may maintain its own records and govern its original research artifacts, but authority over those artifacts is not the same as authority over other people’s health information or a hospital’s operations. In particular, *permission to discuss a public problem*, *competence to assess a proposed method*, *permission to use particular information*, and *authority to intervene in a service* are separate relational predicates. Neither agreement among collaborators nor the plausibility of a public-value claim collapses them. Section 8 addresses the normative provenance of such claims, while the present inquiry asks how their distinctions are recognised and maintained in the actual activities, technologies, conversations, and institutional interfaces of a Commons.

10.2 Reality Levels, Risk Knowledge, and the Partial Manifestation of Safety

At the first GR analytical level, the ultimate ontological status of persons, institutions, causal mechanisms, and harm is not settled by the theoretical vocabulary used here. Ontological suspension does not suspend practical obligations to protect persons or prevent foreseeable damage. It instead blocks a convenient inference: describing a mathematical variable as “patient wellbeing” neither captures the fullness of an individual’s experience nor transforms the variable into an ethically sufficient decision criterion. Human vulnerability is encountered through historically and relationally situated knowledge and responsibility, including uncertainties that cannot be erased by naming an indicator.

At the second level, safety conditions exist in historically constituted relations. These include a patient’s position in a clinical and social environment, a student’s unequal access to institutional knowledge, an authorised staff member’s professional responsibilities, the capacity of a volunteer coordinator to supervise tasks, the ability to withdraw, and the institutional dependencies that determine whether a concerning observation can reach an appropriate responder. Information may be distributed among people who possess different permissions and different knowledge. A Commons’s safety relation thus depends partly on actors outside its own governance. The same outwardly similar activity may involve different hazards, entitlements, and competencies in a publicly accessible educational setting and a restricted clinical area.

At the third level, safety is manifested through schedules, consent records, restricted-access classifications, incident reports, training materials, handbooks, protocol approvals, logs, simulations, and published assurances. Such artifacts can make some aspects of protective arrangements inspectable while concealing others. An apparently complete checklist does not establish that an individual understood the role; a low incident count may reflect competent prevention or inadequate reporting; and a classification label can be stale or incorrect. WHO's incident-reporting guidance emphasizes both the value and the limitations of information derived from reports, and the importance of linking reporting to learning (World Health Organization, 2020). Accordingly, this paper treats safety representations as evidence requiring interpretation, not as direct proof that the corresponding relational conditions have been satisfied.

These levels imply a continuing epistemic obligation. The Commons should not claim to have certified a proposed hospital activity as safe solely because it constructed a model, read a handbook, or obtained a reassuring numerical result. It should identify uncertainty about hazards, relevant authority, data lineage, and implementation context; determine what can be examined independently; and defer decisions outside its competence. Epistemic humility is here a practical feature of an infrastructure, not merely a disclaimer added to its final reports.

10.3 Three Activity Spheres and the Structure of Authorised Interfaces

For each proposed activity, the independent research sphere, hospital-authorized service sphere, and separately authorized human-participant or restricted-information research sphere must remain distinguishable. The critical design object is a transition between them. An open mathematical benchmark does not require a hospital to approve its equations; using its output to assign actual volunteers would engage the competent service institution; collecting participant-level experience or protected records may involve additional independent review and legal obligations. A change in data source, audience, intended use, or affected persons can alter the activity's status even when the underlying software is unchanged.

A person may occupy roles in more than one sphere, yet rights and obligations attached to one role do not automatically pass to another. A university student's presence in a hospital does not make them a clinical investigator. A volunteer who encounters confidential information during assistance does not thereby acquire an entitlement to enter it into an open research dataset. A formally enrolled investigator may still lack permission to publish a sensitive operational note. Nor does Commons membership make the holder an institutional representative. Each crossing requires attention to the particular action, data, purpose, actors, legal basis, organisational authorisation, safeguards, and conditions of continued use.

A boundary should therefore be understood as an *interface with conditions*, not invariably a wall between entirely separate social worlds. University mediation may help participants discover appropriate contacts and legitimate collaboration procedures, but mediation itself grants no competence. For instance, an independently published model of book-cart scheduling may prompt a hospital officer to consider whether it could be adapted. The model can remain open as independent research while the institution separately evaluates service feasibility, accessibility, training, cost, and risks. If validation requires real operational records, a new information-use and, as appropriate, research-oversight inquiry begins. Failure to obtain that authorisation does not invalidate the original mathematical research; it limits what may legitimately be inferred or deployed in the particular service setting.

An infrastructure that performs this differentiation must also cope with hybrid activities. A service-improvement project may modify institutional operations while also seeking to produce generalisable knowledge. Research classification cannot responsibly be decided by calling an activity "quality improvement" or merely by planning to publish its findings. Jurisdictions differ in the criteria and competent review pathways used to distinguish improvement from human-participant research. An example of the need for contextual interpretation is the nonbinding guidance of the United States Office for Human Research Protections, which cautions that improvement and research purposes can overlap (U.S. Department of Health and Human Services, Office for Human Research Protections, n.d.). Its criteria are not global criteria. A university or hospital operating elsewhere may use another legal framework, and organizations may impose additional internal safeguards. The same caution applies to student in-

Table 11: Analytical separation of Commons activity spheres and representative interface questions. The table is a conceptual design aid, not an institution-specific permission matrix.

Activity sphere	Illustrative permissible research object, subject to ordinary rights	Distinct boundary questions before institutional interaction
Independent public or synthetic inquiry	Literature, lawfully usable public records, original conceptual models, independently generated synthetic instances	Material provenance; licences; no implied operational approval; risk of realistic synthetic examples disclosing protected details
Authorised hospital service	Nonclinical tasks within a hospital-defined role, with relevant training and supervision	Who grants and supervises permission; safeguarding; role restrictions; escalation; no automatic onward use of experience or records
Separately authorised people-related or restricted-data research	Approved interaction, observation, or use of data with relevant permissions and safeguards	Research classification; competent ethics review; lawful data basis; consent or valid alternative where applicable; continuing oversight

interviews, research on volunteer motivations, patient-experience recordings, and ostensibly anonymous institutional observation.

10.4 Material Transitions, Renewed Authority, and Operational Restraint

A static category attached to a project at its creation can obscure the moments at which its obligations change. The principal transition is not necessarily a move from “research” to “practice”. An apparently minor change in input data, participant recruitment, intended audience, implementation site, or resulting recommendations can alter the person exposed to risk and the authority required. The proposed boundary mechanism therefore records a *material transition* whenever one of those features changes in a way relevant to rights, safety, evidence, or competence. It neither assumes that every edit triggers a new committee review nor leaves the significance of a change to the applicant’s unilateral assertion.

Consider four stages of a volunteer-routing inquiry. At the first stage, original fictional floor plans and independently generated arrival patterns support an open optimisation comparison. At the second, a researcher proposes to incorporate actual staff schedules or observations obtained during service, requiring a fresh provenance and purpose-of-use determination before importation. At the third, a volunteer coordinator asks whether the model could generate suggested shifts: that proposal requires the institution responsible for operations to examine workforce effects, accessibility, fallback procedures, and training, even if the inputs are permissible. At the fourth, a scholarly team proposes to evaluate how identifiable volunteers or patients respond to the changed practice. Any applicable human-participant research classification, review, consent, data-use and safety responsibilities must then be determined by competent processes. A favourable result at an earlier stage supplies neither automatic authority nor evidentiary validity at the next.

An *activity-transition record* should compare the old and proposed acts, identify changes in people, data, location, purposes, outputs and recipients, and state which earlier permissions are still demonstrably within scope. It should specify the competent pathway for matters that the Commons cannot decide. The record’s immediate research output is a classification and a reason for *continue within established scope*, *stop or narrow the Commons activity*, or *seek external determination*; it is not itself an operational approval. For instance, replacing synthetic arrival times with real service logs changes the evidentiary and information-rights questions even if the mathematical objective function is unchanged. Conversely, removing the operational input and returning to wholly synthetic experiments may support a narrower independent project, subject to the provenance and continuing-use conditions of materials already obtained. Documenting the transition does not retrospectively legitimise an earlier unauthorised acquisition or the continuing retention of restricted information.

This mechanism must also support correction in the reverse direction. When an institution ends a service pilot or withdraws permission to receive new restricted inputs, independently owned prior theory may remain discussable, subject to any continuing confidentiality and intellectual-property obligations. Historical preservation should register the time and scope of the terminated permission without publishing protected traces. The WHO’s global patient-safety strategy and guidance on incident-reporting systems can inform attention to competent escalation and learning, but they cannot certify this proposed transition workflow or provide a local operational mandate (World Health Organization, 2021, 2020). A negative case would be a competent institution whose existing change-control procedure already detects the relevant transition at lower burden. In that case, the Commons should link to that procedure rather than manufacture a parallel approval structure.

10.5 Information Classification, Provenance, and Stewardship

Information is not made shareable by being relevant to a public problem. An institution needs to distinguish information categories by their applicable legal status, identifiable content, sensitivity, provenance, licensed permissions, purposes of use, retention requirements, and risks to affected people. The Commons can develop an independent classification schema for its own materials, but that schema must not purport to reclassify hospital-controlled data without competent authority. The same artifact may also acquire different risks when combined with other information. A collection of descriptions that individually appear innocuous may reveal an identifiable pattern when linked by time, location, rare event, or professional role.

A provisional Commons research schema might differentiate (i) openly licensable original Commons resources, (ii) third-party public resources with independently applicable terms, (iii) internal collaborative material shared under specific agreements, and (iv) material that must not be solicited, imported, or retained without an adequate legal and institutional basis. These categories describe a possible procedure for the Commons’s own repositories, not authoritative legal classifications. Where institutional material is at issue, a data steward or other competent representative needs to determine its actual status, authorised purpose, persons permitted to access it, conditions on onward sharing, and required withdrawal or disposal. Consent, where applicable, is important but may be neither the sole legal basis nor sufficient to override duties of confidentiality or institutional restrictions.

$$\text{BRec}_t(x, a, p) = (\text{src}(x), \text{steward}(x), \text{scope}_t(a, p, x), \text{basis}_t(a, p, x), \text{guards}_t(a, p, x), \text{review}_t(x)), \quad (15)$$

where x denotes an information artifact or activity, a a contemplated actor and p an intended purpose. The *proposed boundary record* in Eq. (15) documents declared source, stewardship, scope, justification, safeguards and review status at time t . The symbols deliberately have no automatic truth semantics: a completed record does not establish the validity of its stated basis, nor that the person recording it is authorised to decide. A missing competent determination is an unresolved condition, not permission by default. The record can support questions and escalation without manufacturing a legal certification by notation. Its declared basis must be traced, when relevant, to the normative-source record of Equation (11) and the competent-decision inquiry of Equation (13). A public research artefact’s successful internal classification is not a determination about a hospital-controlled source. Conversely, a refusal to import restricted inputs need not prevent an independently generated synthetic study. The safety record thereby documents a boundary between activities rather than assigning a permanent legal identity to a file.

Data transformations require similarly situated scrutiny. Removing names does not necessarily prevent re-identification through small groups or distinctive sequences. Pseudonymisation and anonymisation are not interchangeable; their legal definitions and operational safeguards vary. The FAIR principles support the usability and stewardship of research artifacts but do not require unrestricted access to protected data (Wilkinson et al., 2016). A synthetic dataset created independently from fictional assumptions generally presents a different access problem from patient-derived information transformed to look synthetic. An apparently artificial schedule reconstructed from a real confidential roster might still disclose

specific individuals' work patterns. Conversely, an original fictional example need not inherit real patient records merely because it concerns hospital-related tasks.

Data governance across jurisdictions illustrates the need for versioned, context-specific determination rather than blanket claims. The OECD's review of health-data governance identifies a continuing tension between the potential benefits of legitimate health-data uses, interoperability, privacy, and security (Organisation for Economic Co-operation and Development, 2022b). The relevant domestic and cross-border rules may differ according to the data, institutions, actors, purposes, and date of the proposed processing. Accordingly, the Commons should not declare a dataset legally anonymous, consent-exempt, or releasable through a self-produced classification. Its records instead specify the competent determination required before information beyond independently created and appropriately licensable resources is used.

10.6 Competence, Safeguarding, and the Limits of Delegation

Institutional boundaries also concern what actors can responsibly do, not only what documents they may read. Competence is relational and task-specific. A student with advanced expertise in optimization may be well qualified to formulate mathematical constraints yet unfamiliar with safe movement assistance in a clinical corridor. An experienced volunteer may know how to guide visitors through a building yet lack authority to advise on diagnosis, treatment, or clinical urgency. A person who is simultaneously a Commons contributor and an authorized hospital volunteer occupies distinguishable roles. Their competence and permissions require evaluation in relation to the activity undertaken at the relevant moment. The existence of broad academic ability, good intentions, or previous cooperation is not an adequate substitute for such evaluation.

A role-boundary check should identify the proposed task, the people and resources exposed, the competent local decision maker, any required training or supervision, and a stop or referral trigger. When these facts are unknown, the Commons should not classify its own contributor as operationally qualified. It may continue an independently lawful conceptual or synthetic inquiry while withholding service-facing instructions. This check is a practical safety function, distinct from the normative section's analysis of source authority and the governance section's assignment of internal decisions.

Safeguarding requires attention to asymmetry and dependency. Patients may be fatigued, distressed, or unable to refuse a request comfortably; students may be reluctant to challenge supervisors; and volunteers may feel indebted to an organization that provided learning opportunities. These dependencies affect whether consent, complaint, and withdrawal are meaningful in practice. A person who declines an optional interview, research task, or public photograph should not thereby lose access to an otherwise independently available service. Consent cannot be inferred from a favourable interaction, a visitor's presence in a shared space, or a volunteer's willingness to perform their authorized role. A research project on participants' motivations requires its own consideration of recruitment authority and the possibility of undue influence, even when its questions appear benign.

A possible competence register may document the kind of proposed activity, the sources of the claimed competence, relevant authorized role, supervision arrangements, contact to be consulted when uncertainty arises, and review date. However, the act of filling out a Commons register does not grant a professional qualification. Its legitimate role is to make limitations discoverable and to direct unresolved questions to persons who actually hold responsibility. A handbook is similarly an interface between articulated knowledge and situated action, not a source of powers that the issuing institution never conferred. Section 8 provides the source-authority distinction that underlies this conclusion.

10.7 Simulation, Scheduling, and the Boundaries of Decision Support

The proposed Commons may create valuable research infrastructures for simulation, optimization, scheduling, and decision analysis. Such environments invite a particularly subtle kind of boundary error: the conflation of a valid result within a formal model with a legitimate decision in the world the model describes. A schedule may satisfy its coded constraints while omitting accessibility, unanticipated

care needs, local supervision, unmeasured fatigue, or a participant's right to decline an assignment. A simulated evacuation route may have desirable computed properties and nevertheless be unsuitable for an actual clinical environment whose layout, restrictions, or staff responsibilities differ from the model's assumptions. An optimization result is evidence about a chosen representation under chosen assumptions, not certification of hospital safety.

The distinction can be expressed as a conceptual separation among feasibility, evidential adequacy, and legitimate authorization:

$$\text{Feas}_{M,t}(d), \quad \text{Evid}_{I,t}(M, d), \quad \text{Auth}_{I,t}(a, d), \quad (16)$$

where d is a contemplated decision, M the computational model, I the relevant institution, a the proposed decision maker, and t the historical time. The first relation indicates whether d satisfies constraints represented in M ; the second records the situated evidential warrant for using the model in institution I ; and the third represents the competent determination of authority to make the decision. Equation (16) does not assert that the second and third relations can be settled by calculation, nor that satisfying any one relation implies the others. A record of claimed authorization is not authorization itself.

A synthetic simulation should carry its scope at the point of use: assumptions, invented parameter provenance, excluded constraints, uncertainty, and the absence of demonstrated operational validity. The computational inquiry may compare algorithms or test sensitivity without accessing clinical records. If a partner later considers the model for actual scheduling, it must establish local fit and obtain appropriate competent decisions separately. The analytical task here is the *safe transition or non-transition* between contexts; Section 18 examines model-supported choice among alternatives more generally.

Model outputs also affect behavior through their presentation. A research dashboard displaying a schedule as *recommended* may be mistaken for an instruction. Labels, legends, disclaimers, and access controls do not always prevent this effect. A context-sensitive design asks who is likely to encounter an output, whether the presentation could reasonably imply operational approval, and whether critical missing assumptions are visible where the result is displayed. A synthetic demonstration should state its hypothetical status in the artifact itself rather than relying on a disclaimer on a separate website. This connects the safety function directly to information-sharing and communication infrastructures, which can otherwise amplify the consequences of an inaccurate representation.

10.8 Incident Recognition, Escalation, and Corrective Learning

Even carefully constituted arrangements may fail. The design question is how persons can recognize a potentially harmful event, determine whose competence is implicated, communicate within appropriate boundaries, and support corrective learning without accumulating unnecessary sensitive information. The World Health Organization's patient-safety incident-reporting guidance describes the interpretive strengths and limitations of reports and the importance of learning from them (World Health Organization, 2020). A Commons should not appropriate clinical incident reporting as an independent channel outside the responsible health-care organization's governance. It can, however, maintain appropriately limited mechanisms for defects arising in its own research materials, such as the accidental publication of sensitive information, an erroneous safety representation, an incompatible software licence, or a false statement of institutional affiliation.

An incident route must distinguish defects the Commons can correct from events it cannot investigate competently. Mislabeled licensing, an erroneous public safety claim, or an accidental disclosure from its own repository may call for access restriction, preservation of minimal essential evidence, a responsible contact, and an auditable correction. A real patient's urgent welfare concern must instead reach the relevant institution's established service or emergency process. An independent Commons must not advertise itself as a clinical incident reporting or liability-adjudication body. Response time, notification duties, and retained evidence remain context- and jurisdiction-dependent.

For Commons-controlled materials, an incident-and-correction record could include the affected artifact, discovery context, immediate protective action within the Commons's actual control, competent

contact or referral, documented uncertainty, decisions and reasons, version history, communication decisions, and a review of whether preventive measures are appropriate. The record should be minimized, and access controls should be matched to its sensitivity. It should distinguish allegations, observations, preliminary interpretations, and established findings. A retained account of an error can support historical learning, but indefinite retention of personal narratives may itself generate risks. The historical preservation infrastructure therefore needs erasure, restricted retention, or redaction pathways as well as procedures for preserving justified institutional reasons.

There is an asymmetry between the pressures to publicize positive Commons contributions and to discuss mistakes. If unfavorable experiences disappear from its archives, a Commons may systematically overestimate its protective capacities. Yet public release of detailed incidents may expose identifiable individuals or breach duties of confidence. We therefore distinguish *internal discoverability of an issue by competent stewards*, *accountable review*, and *appropriately bounded public explanation*. Accountability may require an intelligible explanation of what was corrected without requiring unrestricted disclosure of every underlying record. The design should enable criticism of a procedure without treating a patient or student as an involuntary public example.

10.9 Institutional Interfaces, Multijurisdictional Contexts, and Responsibilities

University hospital Commons can form in many jurisdictions and organizational configurations. Their relevant obligations may depend on the location of the hospital, status of the participating university, identity and location of the data controller or steward, applicable employment and volunteering arrangements, conditions of research funding, permissions of research participants, and the cross-border transfer of information. Different systems also define clinical governance, data protection, human-participant research, and institutional approval through different legal and administrative categories. Consequently, an international theoretical framework cannot resolve actual authorization simply by naming a globally familiar ethical principle or by adopting the procedure of one country.

International instruments and organizations nonetheless provide important common reference points. The WHO Global Patient Safety Action Plan 2021–2030 outlines a strategic international orientation toward reducing avoidable harm, while the Declaration of Helsinki and CIOMS guidelines articulate ethical guidance for relevant medical and health-related research (World Health Organization, 2021; World Medical Association, 2024; Council for International Organizations of Medical Sciences, 2016). The OECD’s work on health-data governance highlights the need to enable legitimate use alongside privacy, security, and cross-border interoperability (Organisation for Economic Co-operation and Development, 2022b). These instruments differ in origin, intended audience, domain, and normative force. They do not constitute a global substitute for domestic law or an institution’s authorization. The theoretical task is to clarify which questions should be examined across configurations, not to declare those questions already decided.

Two configurations can satisfy similar protective purposes through substantially different mechanisms. One institution might require a designated committee to approve certain activities, while another uses a different authorized structure for determining responsibility. The Commons need not require the same committee or identical forms in every setting. It should instead identify the accountable decision, the reasons for making it, the party empowered to make it, whether affected persons have a meaningful avenue for concern, and how compliance or error can be examined. A cross-border partnership may need additional arrangements to reconcile distinct legal duties rather than presume that a permissive licence settles confidentiality or data-export requirements. The existence of a publicly accessible document likewise does not establish unrestricted authorization to extract, republish, or recombine its contents.

The most restrained initial configuration avoids contested institutional interfaces. Independently sourced literature, genuinely fictional scenarios, original mathematical constructions, and appropriately licensed public materials permit a substantial research programme to proceed without obtaining patient records or suggesting hospital representation. These independent achievements may later be shown to competent institutions as possible objects of consideration. Such an approach neither promises future

Table 12: Comparative design variables for institutional interfaces. Examples are questions for local determination, not universal legal requirements or reported empirical findings.

Context dimension	Potentially variable institutional condition	Required analytical distinction
Independent scholarly collective	Source rights, local entity status, publication and archival arrangements	Governance of its own materials versus jurisdictional or third-party rights
University research partnership	Research sponsorship, supervisory responsibility, ethics classification, intellectual-property arrangements	Academic participation versus formal research authorization
Hospital-associated service	Volunteer role, training, site access, professional supervision, safeguarding and incident pathways	Commons proposal versus competent operational permission
Cross-border knowledge or data exchange	Data-transfer conditions, access restrictions, contractual commitments, regional privacy rules	Publication of an abstract model versus transfer of restricted records
Multi-organization governance	Shared responsibilities, conflict resolution, authority for changes and withdrawals	Collaboration agreement versus authority over each participant's regulated activities

partnership nor makes formal endorsement a condition of productive independent scholarship. It limits the reach of the Commons's claims to the sphere in which its members actually possess authority.

10.10 Design Trade-offs, Failure Mechanisms, and Historical Revision

Safety and institutional boundary infrastructure requires resources and can itself create burdens. Reviewing every minor revision through an elaborate committee may inhibit academic exploration; treating all outputs as freely reusable may expose affected individuals or institutions; and placing every uncertainty in a public log may make people less willing to report honest mistakes. The relevant objective cannot be represented adequately by maximizing an abstract scalar called "safety." Protective arrangements should instead be evaluated against identifiable harms, participant standing, feasible alternatives, competence, legal and ethical duties, organizational resources, and the effects of safeguards on independent generative activity.

The minimum credible boundary test follows a proposed activity as its status changes. A synthetic scheduling exercise can usually remain independent research; a request to insert real volunteer rosters changes the data question; a proposal to deploy the resulting schedule changes operational competence; a plan to interview identifiable patients raises another set of permissions. At each transition an identified steward should be able to stop work, state the missing authorisation or safeguard, and refer the decision to an appropriate institution without asserting competence the Commons lacks. A general webpage disclaimer is insufficient if researchers continue an activity in practice. The cost of this function should be compared against using an existing competent institutional review channel rather than constructing a parallel safety authority.

Four hypothetical contrasts clarify the evaluation problem. First, an open mathematical scheduling benchmark constructed from independent synthetic instances can be studied, criticized, and modified without access to a hospital's actual roster. Requiring institutional operational approval for the publication of every such benchmark would confuse independent inquiry with authorized service. Second, a student volunteering in a hospital may be motivated to use observations as research data, but the student's service role does not supply an independent legal or ethical basis for that use. Third, a Commons that advertises a simulated event plan as "hospital-tested" despite having performed no institutional trial creates a misleading manifestation even if its computational model is internally correct. Fourth, a multi-institutional project may secure one participant's permission to reuse a derived dataset while lacking the authorizations necessary for other participants' restricted information embedded within it. These con-

trasts show why the interface, not the appearance of a single approved document, is the proper object of inquiry.

An evaluation of the infrastructure would examine whether participants can distinguish their roles, whether a proposed material has an intelligible provenance and authorized use, whether errors can be recognized and corrected without undue burden, whether protective procedures suppress legitimate criticism, and whether changes in institutional circumstances invalidate older assumptions. Useful evidence may include structured review of research artifacts, simulations of hypothetical disclosure scenarios, audit of source and licence metadata, and confidential, appropriately authorized inquiry into participant experience. These observations remain partial manifestations of historically contingent relations and do not prove that harmful outcomes have been eliminated.

The normative obligation to protect persons should not be transformed into an assurance of perfect institutional foresight. Under the proposed generative relational framework, the infrastructure is provisionally adequate insofar as it makes responsibilities, uncertainties, and competent interfaces more intelligible and supports justified revision when evidence or contexts change. Its history should preserve which claims were examined, which permissions were actually established, and where authority was withheld. Such bounded historical recoverability can enlarge future capacities for safer research and cooperation without converting the Commons into a fictional authority over hospitals or research participants.

11 Historical Preservation and Epistemic Recoverability

The preceding infrastructures identify problems, assess norms, allocate authority, and distinguish safe research from authorized service. Historical preservation asks a different question: what can a later legitimate inquirer reconstruct about why an artifact, rule, decision, or relationship took its particular form? A preserved file may lose its interpretive context; a well-understood past decision may be inappropriate to reproduce; and a new research opportunity may arise from a reasoned rejection of earlier practice. This section treats preservation, recoverability, and later generative use as distinct historically situated capacities, rather than stages guaranteed by storage.

Three claims must remain separate. A surviving trace does not necessarily permit a responsible reconstruction of the circumstances of its creation. An intelligible reconstruction does not establish authority to reuse the trace or the original practice. Even a legitimately reused historical result does not demonstrate that generative capacity has increased. The infrastructure should make these distinctions investigable across institutions with different histories, laws, technologies, resources, and vulnerable populations. It should not prescribe one universal archive, retention schedule, or organizational custodian. Although university hospitals provide an especially informative setting because service, education, research, and administrative histories intersect, the mechanisms considered here are not restricted to any national health system or named institution.

11.1 Historical Traces, Organizational Memory, and the Constitutive Object

An institution has a history not only because it possesses old documents but because past relationships continue to condition present capacities, expectations, material arrangements, and available interpretations. A volunteer-supported learning activity may depend on accumulated ways of welcoming newcomers, coordinating a room, interpreting a visitor's uncertainty, or knowing when to refer a question to competent personnel. Research contributors may inherit an established model, an ambiguous dataset, an archived discussion, and the convention by which one result is credited to another. A person joining later confronts consequences of those earlier relations even when the persons who produced them are no longer present. Such persistence is a potential source of institutional knowledge, but also of unquestioned habits, exclusions, or error.

Walsh and Ungson (1991) analyse organizational memory through acquisition, retention, and retrieval, and warn that memory may be used or misused. Argote (2013) examines organizational learning

and the retention and transfer of knowledge. These contributions support the study of remembered practices without making memory a unitary mind or equating formal documentation with actual collective competence. Archival preservation theory addresses a different but related problem: what information, representation context, stewardship, and access arrangements are needed to preserve intelligible objects over changing technical and social conditions. The OAIS reference model, for example, treats preservation as an organizational responsibility that includes information and policy-based processes, not only hardware or files; its notion of openness does not imply unrestricted access (International Organization for Standardization, 2025). Our proposed extension concerns the historical relations among people, norms, artifacts, interpretations, and future opportunities in an independently constituted Commons.

For this analysis, a *historical trace* may be a document, decision record, piece of software, source citation, research protocol, licensed dataset, version history, training artifact, oral account, or authorized aggregate description of experience. The term does not imply that every experience should become a record. Some knowledge is better transmitted through supervised practice; other information should not be collected or should be deleted. The task of the infrastructure is to identify which historical dependencies matter for a specified inquiry and what proportionate means of preservation and interpretation are legitimate. It must also specify the limits of an institution's actual custodial authority. An independent Commons does not acquire rights over a hospital's service history merely because that history would be intellectually useful.

Definition 11.1 (Historical preservation and epistemic recoverability). For a specified community of legitimate inquirers and a historically situated object of inquiry, *historical preservation* denotes the continued availability, subject to valid restrictions, of selected traces and their relevant integrity and provenance information. *Epistemic recoverability* denotes a situated capacity to reconstruct an explicitly qualified account of the object's origin, context, assumptions, transformations, and reasons using accessible and warranted evidence. *Generative reactivation* denotes a distinct subsequent event in which an interpretation contributes, under the relevant normative and practical conditions, to a new capability, inquiry, practice, or artifact. None of the three implies either of the others without further conditions.

A partial history may be adequate for one question and inadequate for another. Reconstructing the provenance of a synthetic benchmark may require software versions, random seeds, instance-generation rules, baseline methods, and permission statements. Understanding a change to a volunteer induction practice may instead require the applicable institutional responsibilities, pedagogical reasoning, accessible documents, and appropriately bounded accounts of experience. A historian investigating power asymmetry may need records that a technical reproducer would ordinarily ignore. Recoverability must therefore be assessed relative to an explicit historical question and a justified community of interpretation, rather than through an undifferentiated completeness score.

11.2 Three Reality Levels and the Limits of Historical Representation

The three GR analytical levels introduced in Section 3 clarify what an archive can and cannot establish. At the level of *ontological suspension*, the full past existence of a person, experience, or institution is not identified with its documentary remainder. An interview, case note, or authored artifact can carry evidence about a life or practice without exhausting the being of the subject concerned. This modest commitment matters in ethically charged contexts: a volunteer's motives, a patient's vulnerability, and an organization's character cannot be read transparently from records that were created for particular purposes under unequal relations.

At the level of *relational reality*, historical actors, roles, permissions, dependencies, tacit competences, and power distributions have developed through particular processes. Some of these structures may outlast the people or media that sustained them; others disappear when a coordinating person leaves, a regulation changes, or a useful practice loses its material conditions. The historical object is thus an evolving network of situated relations rather than an inert sequence of artifacts. A handbook can influence conduct long after its author departs, yet the persistence of a handbook does not establish that its

guidance remains competent, ethically defensible, or institutionally authoritative. Conversely, an apprenticeship may maintain skills through interaction even when little explicit documentation survives. The relevant question is which historically constituted capacities still operate, under whose authority and for whom.

At the level of *manifestation reality*, archives, meeting notes, timestamps, citations, stories, schedules, photographs, version histories, and usage records provide selective presentations of relations. A record may be accurate for the limited purpose for which it was created but misleading when treated as a complete account. A volunteer attendance sheet manifests registered presence, not necessarily quality of support, willingness, safety, or the absence of exclusion. A published research report may present successful experiments while leaving unsuccessful paths and assumptions invisible. A declaration that a handbook was “adopted” may be a claim in a document, whereas actual authority requires examination of the competent actor, adopted scope, effective period, and subsequent practice.

These differences have an epistemic consequence. Archival description itself is an intervention: choosing what to preserve, how to classify it, which vocabulary to use, and whose account is authoritative can alter what future persons regard as institutionally real. The responsible infrastructure should identify, wherever proportionate, the standpoint of record creation, the historical purposes of classification, relevant excluded accounts, and the limits of available evidence. It should preserve the possibility of revising a historical interpretation rather than assigning an immutable institutional truth to a single record. This is not a demand that every disagreement be resolved. It is a demand to distinguish warranted claims, conflicting interpretations, and historical uncertainties.

11.3 The Differentiated Histories of Problems, Decisions, Artifacts, and Relations

The relevant history is plural. A *problem history* records how the object of inquiry and its affected interests were represented. A *decision history* records considered alternatives, competence, reasons, dissent, and revision. An *artifact history* records versions, dependencies, rights, and conditions of reproduction. A *relational-capability history* records how skills, trust, obligations, and access conditions changed, when they can be evidenced without unjustified surveillance. A chronological list of uploads may document only the third of these. The aim is not total memory but an accountable selection of traces relative to plausible future questions.

These histories interact but should not be collapsed. A schedule optimization model may have a well-preserved code history while the reasons for a changed fairness criterion remain unknown. A legal handbook may have a clear issuing authority and version history but rest on an unexamined problem framing. A contributed dataset may preserve provenance but omit the circumstances of participants’ consent or the permission under which the material was obtained. The fact that one relation is documented does not justify inferring the others. In particular, the rights of a contributor and the grounds of lawful collection may require different records; later publication under a reuse licence cannot retroactively authorize an impermissible original acquisition.

The *historical provenance graph* is consequently a useful analytical image, provided the relationships are typed. One node may represent a research artifact and another a methodological revision; edges can represent “derived from”, “criticises”, “supersedes”, “licensed under”, “decided by”, “affected by”, or “reviewed on”. A citation is not equivalent to a legal permission; a derivation relation is not equivalent to coauthorship; and a previous decision does not necessarily bind the present institution. The structure should permit absent, uncertain, or disputed relations rather than silently treating missing metadata as proof of continuity.

Recording histories does not entitle a Commons to collect a continuous personal biography of volunteers, patients, or researchers. An aggregate account of an operational problem may suffice to preserve its institutional reasoning. A person’s request to withdraw participation may call for a bounded record of a governance response while the person’s private narrative remains confidential or is deleted under applicable rules. The proper unit of historical inquiry is chosen in relation to purpose, evidential necessity, affected rights, and future interpretive needs.

Table 13: Distinct histories for a prospective Commons. Entries describe design questions, not a compulsory classification standard or empirical findings.

Historical object	Questions for reconstruction	Characteristic risk if misrepresented
Problem framing	Which needs, evidence, affected standpoints, and alternatives informed the original question?	Treating a provisional framing as an enduring public mandate
Decision and authority	Who had competence to decide, what reasons were given, and what conditions applied?	Converting a draft or past exception into continuing authority
Research artifact	Which version, methods, sources, dependencies, and licences were operative?	Irreproducible comparison or unlawful downstream reuse
Participation and capability	Which practices, training conditions, and relational dependencies supported action?	Inferring competence or motivation from attendance alone
Error and contestation	Which claims were questioned, corrected, withdrawn, or left unresolved?	Institutional self-celebration that suppresses negative evidence

11.4 Provenance, Reasons, and Representation Information

Preserving a record’s content is often insufficient to preserve its meaning. A saved output from a scheduling simulation could become unintelligible if its units, feasible-set constraints, software assumptions, synthetic-data specification, optimization objective, and definition of “fairness” are lost. Likewise, a normative document may be misread if its adoption status, applicable jurisdiction, issuer, historical version, or superseding amendments are not identifiable. The question is not merely whether an artifact can be opened, but whether an appropriate reader can determine what the artifact purports to represent, why it was produced, and which interpretations remain defensible.

The OAIS reference model addresses the problem of information preservation for a designated community whose knowledge base may change with time, and it includes the preservation of information needed to understand retained digital objects (International Organization for Standardization, 2025). The FAIR principles similarly emphasize findability, accessibility, interoperability, and reusability of scholarly data, including descriptive metadata and provenance (Wilkinson et al., 2016). Neither establishes that all materials should be made public or retained perpetually. FAIR availability can involve authentication and authorization; preservation for a designated group differs from unqualified public distribution. A historical Commons infrastructure should draw these lessons without claiming compliance with a formal archival standard merely because it adopts a few related concepts.

A proportionate historical record identifies the object and its source, its version, relevant historical context, the decision or hypothesis it embodies, known dependencies, interpretive limitations, and the rights governing retention and access. Additional detail is warranted only insofar as it supports a legitimate reconstruction question. An account of why a fairness constraint was rejected may require contemporaneous mathematical and ethical reasons but no identifiable patient narratives; a software dependency history may require runtime versions rather than organizational deliberation minutes. Selection and appraisal should state what was not preserved and why. A preserved absence must not be mistaken for proof that the underlying event never occurred.

A formal representation can make the epistemic distinction visible without substituting for actual archival analysis. Let $\text{Tr}_{I,t}$ denote a set of retained, legitimately stewarded historical traces in the bounded institutional setting I at reference time t . Unlike the set of historical positions $\mathbb{T}_I$ in Section 23, its elements are *records or other traces*, not times. For each $h \in \text{Tr}_{I,t}$, the proposed *history description* is a partially specified, typed record

$$\text{HistRec}_{I,t}(h) = (\text{Src}, \text{Ctx}, \text{Ver}, \text{Why}, \text{Unc}, \text{Perm}, \text{Stew}, \text{Review})(h). \quad (17)$$

Here **Src** denotes known sources and provenance; **Ctx** the relevant historical and institutional context; **Ver** a version and transformation description; **Why** reported reasons and alternatives, when applicable;

Unc acknowledged uncertainty or contested interpretation; Perm access and use conditions; Stew an accountable custodian or explicitly unassigned responsibility; and Review retention, correction, or reappraisal conditions. The tuple is a proposed analytical checklist, not a claim that these fields are available for all past artifacts or that documentation generates a legal entitlement. The history record is one source of claims represented in H_t of Equation (44); it is not identical to the relational history that H_t incompletely describes. A missing or restricted field should remain distinguishable from a field whose content is known to be empty.

The representation should also preserve a history of its own corrections. If a researcher identifies a false attribution or an outdated legal description, an intelligible correction normally requires recording the change, its evidential basis, and its effect on dependent artifacts, subject to rights and security constraints. Quietly replacing an old version can conceal a consequential history; indiscriminately publishing every earlier version can expose data that should no longer be accessible. Proper version policy requires an explicit distinction among a preserved internal audit trail, a public changelog, a restricted source object, and a revised outward-facing account.

11.5 Epistemic Recoverability as a Situated Capacity

A history does not become recoverable merely because its data are stored in a durable format. Its interpretation depends on available persons, language, disciplinary understanding, research methods, reference materials, and the ability to judge whether records were valid for the relevant historical setting. A compiler may be able to execute an old mathematical model while lacking the social context needed to assess what its objective function meant. A lawyer may identify an obsolete rule’s text without understanding the institutional practice that surrounded it. Conversely, an experienced mentor might explain a lost procedure but be unable to verify when it changed or why. Recoverability is therefore a relational capacity distributed among records, readers, tools, institutions, and permissions.

For a specified legitimate inquiry q , eligible inquirer a , and time t , we propose a qualitative recoverability assessment

$$\text{Rec}_{I,t}(a, h, q) \in \{\text{supported, partial, unsupported, undetermined}\}, \quad h \in \text{Tr}_{I,t}, \quad (18)$$

where the assessment is relative to accessible evidence, interpretive competence, acknowledged uncertainty, and valid permission. *Unsupported* records a reconstruction that has been examined and found inadequate for the specified question; *undetermined* records a question that cannot presently be examined or resolved, including because necessary material is lawfully withheld. Neither outcome warrants inferring that the putative historical event did not occur. It evaluates the adequacy of a *particular reconstruction for a particular question*, not the permanent quality of a record or the ontological status of the past. Where an assessment is possible, “unsupported” means that the available permissible material fails to sustain the proposed reconstruction; missing authority, unexamined records, and withholding can instead justify an “undetermined” disposition. The four labels are deliberately coarse and require justification, not mechanical scoring. An archive may warrant a partial reconstruction of a decision while being insufficient to reconstruct its effects on particular people.

Epistemic recovery therefore requires *critical recontextualisation*, not the mechanical retrieval of a stored assertion. An archived decision may be authentic as a record yet incomplete about dissent, outside the competence of its issuer, or inapplicable after a material change of time or scope. A recoverability exercise should ask whether a specified legitimate inquirer can identify which event is alleged, which trace is available, when and why that trace was made, and which competing reconstructions remain possible. This output differs from finding the record through the information infrastructure (Section 12), from accepting a substantive scientific claim (Section 13), and from treating an old approval as present authority (Section 9). The differences can be tested: two reviewers may retrieve the same archived licence note but reasonably disagree about its application to a later composite artifact because the underlying rights or intended uses are not sufficiently recoverable. A richer archive is warranted only if it improves such historically bounded inquiry enough to justify the retention and interpretation burdens, including privacy risks.

The research infrastructure can test its recoverability through exercises involving people who did not create the original material. A new scholar might attempt to reconstruct a benchmark's assumptions and rerun a baseline; another might trace why a handbook paragraph was revised; an independent reviewer might identify the reasons and authority for suspending a proposed service event. Evaluators should record not just whether a task was completed but the missing context, external expertise, permission barriers, and interpretation disputes encountered. A successful reconstruction with an insider's undocumented explanations reveals a different infrastructure than one that is understandable independently. Neither configuration is automatically preferable: some safety-sensitive practices appropriately require supervised interpretation, while other knowledge should remain publicly and independently inspectable.

11.6 Tacit Knowledge, Experience, and Historical Plurality

Documents are particularly weak at capturing bodily habits, social sensitivity, and the situated knowledge through which people recognize circumstances. The practical judgment required to welcome an anxious visitor, communicate across languages, or notice when an attempted assistance exceeds one's competence may resist complete translation into rules. In an interdisciplinary Commons, similar difficulties arise when mathematicians, legal scholars, educators, and practitioners use the same terms to mean different things. A published method can preserve formal steps while losing the context that made an experimental choice reasonable. Historical continuity may therefore require mentoring, reflective training, dialogue, oral explanation, and opportunities for newcomers to ask why a convention exists.

Such practices are not uncomplicated substitutes for records. A mentor may transmit established competence, but also transmit prejudice, informal gatekeeping, or an outdated interpretation of authority. An oral account may illuminate a missing decision history but be selective or contested. An institutional archive may privilege the language of administrators and recognized researchers while neglecting people who experienced the consequences of their decisions. A design attentive to plurality should permit attributed, appropriately consented, or responsibly anonymized perspectives to coexist with formal explanations. Where people disagree about historical events, the infrastructure may need to preserve the disagreement and the basis of each claim rather than force a premature synthesis.

The inclusion of experience remains subject to permissions and ethical constraints. A Commons should not solicit or publish patient stories as automatically available raw material for organizational learning. Even apparently anonymized narratives can expose people when a rare event, location, or combination of details makes identification possible. A volunteer may reasonably decline to have a personal reflection kept for future researchers; an educational exercise can often retain general methods and agreed learning points without preserving the speaker's identifiable account. Where a real institutional incident creates a duty of reporting or a need for investigation, the competent organization rather than the independent Commons must determine the proper retention and access pathway. Historical depth cannot justify transferring restricted service material into an open research repository.

The design also requires attention to succession and knowledge concentration. If only one founder knows how research materials relate, the archive may remain technically accessible but practically unreadable after the founder leaves. If only one experienced volunteer can interpret a handbook, the organization's apparent continuity may mask fragile dependence on that person's availability. Conversely, demanding that every participant document every interaction may replace cooperative learning with administrative work. Proportionate arrangements could combine short decision rationales, versioned research artifacts, peer explanation, newcomer reconstruction exercises, and identifiable stewardship responsibilities. The appropriate mix depends on the kinds of history that matter, not on a universal preference for written records.

11.7 Normative Retention, Restricted Access, and Justified Forgetting

Historical preservation is an ethical and legal activity as well as an epistemic one. The same trace that facilitates scholarly understanding may reveal a vulnerable person's identity, disclose an internal deliberation, expose confidential research, or preserve an accusation that was never substantiated. Retention

Table 14: Context-dependent preservation choices and illustrative tensions. The table specifies questions for local determination, not universal legal retention periods.

Trace category	Potential purpose	Required question or safeguard
Original public research artifact	Critical replication and lawful reuse	Verify rights, source conditions, version context, and continued stewardship
Commons decision rationale	Accountable interpretation and revision	Identify competence, confidentiality, contested claims, and review dates
Personal reflection or participation account	Pedagogical learning, if appropriate	Examine voluntary consent, minimization, later withdrawal, and alternative aggregate records
Safety or complaint record	Competent review and justified correction	Limit access, separate allegations from findings, and defer to applicable institutional processes
Externally controlled hospital material	Authorized operational or research purpose only	Identify actual custodian and permissions; do not appropriate it into the independent Commons

also has opportunity costs, and institutional enthusiasm for keeping everything may discourage candid communication. The proper aim cannot be permanent memory as an unconditional good. A defensible design must identify legitimate purposes, applicable authority, permitted uses, foreseeable harms, temporal limits, and means of correction or withdrawal. Relevant duties vary by jurisdiction, institutional role, data type, and the relationship in which material was obtained.

The International Council on Archives articulates principles for access alongside legitimate restrictions arising from law, ethics, and other applicable authority (International Council on Archives, 2012). This is useful as archival guidance, not a claim that all Commons materials are public archives or that a single global rule settles erasure and confidentiality. Research-data discoverability does not grant unrestricted access to protected underlying information. Nor does an academic licence necessarily overcome privacy rights, professional confidentiality, a consent condition, or institutional ownership. As Sections 8 and 10 emphasize, a record's intellectual value and the authority to retain or disclose it must be considered separately.

Retention should be governed by the kind of information, its lawful purpose, relevant obligations, reasonably foreseeable reuse, and the harms of persistence. Open original research artifacts, restricted decision records, identifiable participant narratives, and materials disclosed under limited permission should not inherit a common default of indefinite public storage. An archival description may retain a lawful, sufficiently general account of a decision after sensitive source records have been removed or access restricted. This possibility has limits: anonymized summaries can still expose individuals in small communities, and neither a Commons licence nor the ideal of organizational memory overrides applicable deletion or confidentiality requirements.

A Commons can sometimes preserve *the fact and reasons for a decision* while lawfully removing or withholding *the personal information through which an issue came to notice*. For instance, a public note might explain that a proposed illustration was withdrawn because its source rights could not be substantiated, without disclosing a complainant's identity. A revised handbook may preserve the general reasoning for changing an unsafe instruction without publishing a detailed underlying incident. This separation can protect critical institutional learning, although de-identification and redaction should not be represented as infallible. Where deletion or restricted access is required, the infrastructure should not quietly reconstruct the deleted information from linked indexes or retained backups in ways that defeat the relevant obligation. Implementation details depend on actual systems and law.

11.8 Infrastructure Interfaces, Configurations, and Stewardship Costs

Historical infrastructure preserves the context of the other functions without taking over their current duties. It records why a public problem was framed, how a norm was interpreted, who exercised decision competence, which safety boundary was applied, and what evidence supported a claim. It does not thereby reauthorize an expired procedure, certify a historical interpretation as true, or grant renewed access to its underlying information. The practical interface is a typed, versioned reference from current work to the historical trace and its permitted interpretive uses.

The practical constitution of historical infrastructure need not begin with a dedicated repository or permanent staff. An independent researcher may initially maintain version-controlled papers, source registers, bounded decision logs, contribution metadata, and periodic audits of whether the records remain intelligible to a newcomer. A university-based collective might distribute stewardship among researchers or archivists, develop shared descriptive practices, and specify succession when students graduate. A formally authorized multi-institutional arrangement might negotiate different preservation responsibilities across organizations, including restrictions on the transfer of confidential material. In no case does participation in an open Commons alone entitle members to retrieve hospital records, preserve real service logs, or create a shadow archive of sensitive operational history.

These configurations face coupled costs. Detailed metadata can improve interpretability yet discourage contribution if the work required is excessive. Cheap storage can invite uncritical retention, while expensive curation can privilege the history of well-funded projects. Public preservation can help criticism and attribution but may endanger confidentiality or make past provisional mistakes persist without context. Short retention can protect individuals while leaving institutions unable to explain consequential decisions. A viable design should evaluate these tensions with affected parties rather than presume that the largest archive is the best one. The OAIS model's emphasis on organizational responsibility and changing designated communities is instructive precisely because technical longevity alone is inadequate (International Organization for Standardization, 2025).

A minimal arrangement should make three practical obligations inspectable: who is responsible for a retained record, what a future legitimate reader could reasonably learn from it, and when its necessity or permissions should be reconsidered. This is compatible with multiple formats and governance structures. Some decisions may only require a brief public explanation and link to source materials; others require a restricted review record under accountable custody. Methods may differ, but the questions of purpose, interpretation, rights, and maintenance recur. The proposed *historical recoverability test* should therefore be an exercise in warranted reconstruction, not simply a count of stored documents or available search results.

11.9 Failure Mechanisms, Recoverability Tests, and Generative Reproduction

Several counterexamples illuminate the difference between archival success and institutional learning. First, imagine a synthetic volunteer-scheduling benchmark stored with all input files but without the origin of its constraints. Later scholars may execute the code successfully yet be unable to judge whether it models a legitimate scheduling problem. Second, imagine a handbook carefully archived across versions, while its historical adoption status remains ambiguous. A reader may incorrectly present a private proposal as an authorized hospital rule. Third, imagine a Commons publicly retaining named complaints to demonstrate its commitment to transparency. The preserved record may impose foreseeable harm on complainants and discourage future reporting; increased visibility would not establish improved accountability. Fourth, imagine an oral mentoring tradition that transmits competent practice but loses its critical historical reasons after a generation of turnover. A newcomer may reproduce the procedure without knowing when it has become unsafe or unjustified.

One practical recoverability experiment should be defined around an explicit historical question rather than the number of retained files. A new researcher might be asked to reconstruct why a synthetic scheduling constraint was rejected three versions earlier, identify the evidence and dissent available at the time, and state which assumptions can no longer be evaluated. The records are sufficient for that

question only when the researcher can give a justified account of both what is recoverable and what remains unknown. A version-control log alone may fail because the contemporaneous reasoning is absent; a lengthy narrative archive may also fail when the decisive source cannot be located. Restricted records, justified deletion, and maintenance costs remain part of the test rather than exceptions to be hidden.

A fifth counterexample concerns power and the archive itself. An institution may preserve extensive accounts of successful projects and prominent contributors while recording unsuccessful research, volunteers' objections, and abandoned ideas only sporadically. Its archives then reproduce the perspective of actors who controlled publicity. Later analysis could find apparently strong evidence of continuous success, but that appearance partly results from selective historical retention. The correction need not be universal publication of every dissenting remark. More credible approaches include documenting selection criteria, recording whether negative results were considered, allowing relevant corrections and qualified counter-accounts, and assessing whose historical contributions are absent. The archive is thereby an object of institutional criticism as well as a resource for it.

The infrastructure's adequacy can be examined through bounded tests. Can a later researcher reproduce a published baseline and explain its original assumptions? Can a newcomer identify the authority, version, and historical reason for a handbook provision without confusing it with current law? Can a contributor trace lawful reuse of their artifact while distinguishing attribution from automatic downstream ownership? Can a reviewer find whether a previous error was corrected and whether an earlier interpretation remains contested? Can a person obtain an intelligible explanation of what information about them is retained and what correction, access, or deletion processes apply? Are restricted records actually kept from audiences lacking authority, while legitimate criticism of decisions remains possible? Answers may differ according to task, permissions, community expertise, and archival costs.

This section proposes no universal recoverability threshold or deterministic sequence from storage to social improvement. The importance of a trace depends on whose future questions are being considered, what they may legitimately access, how much context is available, and which practices are still feasible. The appropriate finding may be "partial" or "unsupported" rather than an apparently precise score. Nor does the preservation of a historical injustice make its practice worth reproducing. Generative reactivation may require discontinuing an old rule, recognising neglected contributors, rejecting an obsolete objective, or changing how future records are made. A Commons should be capable of learning *against* its own institutional history as well as learning from it.

The proposed historical infrastructure therefore combines selective, lawful retention with question-relative intelligibility and contestable reconstruction. Its adequacy is not measured by storage volume or the automatic repetition of inherited procedures. It is measured, provisionally, by whether a later authorized reader can recover the material assumptions and disagreements relevant to a specific inquiry, identify what remains unknowable, and develop a justified response to changed conditions. This completes the first cluster of infrastructure functions; the next section examines present information discovery, access, and sharing as a different institutional task.

12 Information Organization, Access, and Sharing

Historical preservation, examined in Section 11, concerns what can remain available for warranted reconstruction when a Commons changes over time. The corresponding present problem is different. An interested student may know that an independent scheduling benchmark exists without being able to locate its assumptions; a researcher may locate a handbook while remaining unable to determine whether it is an author's proposal or an adopted operational instruction; and a community participant may receive a document that is technically readable but written in an inaccessible disciplinary language. These are neither exclusively archival problems nor failures of public publicity. They concern the situated conditions under which information is *organized, discovered, understood, legitimately obtained, transferred, and used* in ongoing institutional relationships. This section develops those conditions as a distinct infrastructure function of the proposed university hospital volunteer Commons.

The inquiry builds on the FAIR principles for research-data stewardship, established metadata and

provenance models, accessibility guidance, and the problem of heterogeneous access to knowledge. FAIR explicitly distinguishes findability, accessibility, interoperability, and reusability; its accessibility principle can accommodate authentication and authorization rather than imposing unrestricted disclosure (Wilkinson et al., 2016; GO FAIR Foundation, n.d.). The W3C Data Catalog Vocabulary (DCAT) provides a vocabulary for describing datasets, distributions, and data services in interoperable catalogues, whereas the PROV framework represents provenance relationships among entities, activities, and agents (World Wide Web Consortium, 2024a, 2013a). Neither standard, by itself, establishes the truth, licence, ethical acceptability, or institutional authority of a resource. The proposed extension concerns how these partial technical capacities must be coupled to normative judgement, educational translation, human participation, and the historical reproduction of a heterogeneous Commons.

The proposed design is institution-independent and internationally applicable. An independent Commons may initially need only a maintained index, durable resource identifiers, explicit artifact status, and links to public or genuinely synthetic materials. A different configuration may require authenticated access, a mediated request process, or no disclosure beyond a public description. The infrastructure does not receive permission to release a hospital's restricted information by organizing it well. This section therefore concentrates on the *information-use pathway*: a specified person identifies the appropriate resource, understands its status, obtains it through a legitimate route, and determines what uses are permitted. Whether its claims are well supported belongs to Section 13; disciplinary translation and audience-facing outreach have separate constitutive objects. Its comparative question is whether the chosen arrangement enables that pathway at a proportionate maintenance and exclusion cost.

12.1 The Constitutive Object and the Differentiation of Information Functions

Information does not become a shared institutional resource solely because it is stored or publicly announced. A usable resource depends on relations among the object, its provenance, a situated seeker, a meaningful question, an appropriate interpretive capacity, a permitted means of access, and a maintained route for correction. Consider a publicly downloadable scheduling example that lacks a description of whether its constraints are invented or taken from a specific institution. The files may be technically available and legally reusable, yet a novice can reasonably misunderstand their empirical status. By contrast, a restricted research dataset may have excellent documentation and be genuinely useful to authorized investigators while properly remaining unavailable to the public. Sharing therefore cannot be defined exclusively by the quantity of files released.

Definition 12.1 (Situated information infrastructure). *A situated information organization, access, and sharing infrastructure* is a maintained configuration of information resources, descriptive practices, interpretive interfaces, normative access conditions, responsible stewards, exchange procedures, and correction capacities through which specified participants can discover, assess, obtain where authorized, and communicate information needed for legitimate Commons activities. The definition identifies functions to investigate; it does not certify that an actual system is accurate, accessible, secure, or fairly governed.

At least six questions are analytically separable. *Existence* asks whether an artifact or knowledge resource has been constituted. *Discovery* asks whether a person can learn that it exists and identify the correct version. *Intelligibility* asks whether the person can understand its relevant meaning and limits. *Access* asks both whether a usable channel exists and whether that person may legitimately use it for a given purpose. *Transfer* asks whether the artifact or knowledge can be exchanged without corrupting context, creating prohibited disclosure, or misleading the recipient. *Reuse* asks whether permitted use is supported by adequate legal, methodological, and relational conditions. A system may satisfy one question while failing the next. Indeed, a published catalogue entry can support responsible discovery precisely by stating that the underlying material is restricted.

The information function has a limited object: enabling specified audiences to discover a resource, distinguish its versions and status, interpret the description for a defined task, and reach the appropriate access route or a reasoned refusal. Discovery does not establish lawful reuse, and a documented access

disposition does not by itself verify the correctness of the underlying research. Historical recoverability in Section 11 concerns whether earlier circumstances can be responsibly reconstructed; epistemic validation in Section 13 concerns what a claim's evidence warrants; public communication in Section 16 concerns the claims made to an audience. A well-maintained index may serve all these tasks as a shared artifact, but its steward does not thereby acquire each function's decision competence. For example, adding a "verified" catalogue tag without identifying whether it refers to a checksum, rights review, or scientific replication would obscure rather than resolve the status of a synthetic research resource.

12.2 Three Reality Levels and Information as a Relational Condition

At the first GR reality level, the ultimate ontological status of the world represented in information is not established by classifying or coding its records. A service interaction represented as a row in a dataset is not exhausted by that row; a legal rule represented by a keyword is not thereby reduced to the keyword's meaning. Ontological suspension does not make factual claims arbitrary. It limits the inference from a representation to the totality of the represented object, and requires attention to how evidence, interpretation, and context are constituted. A research Commons can employ information systems without presuming that their ontologies capture every dimension of a subject's situation.

At the relational level, information operates through historical relations among people, institutions, conventions, tools, and purposes. Access to a methods paper may be routine for a researcher familiar with its vocabulary but considerably more difficult for a volunteer without formal disciplinary training. A student may be physically close to a university hospital but epistemically distant from its organizational practices. An artifact does not acquire an identical institutional role for every recipient merely by moving through a shared repository. The conditions of intelligibility depend on translation, prior learning, available time, trusted mediation, and the possibility of asking an informed question. These relations can themselves change when introductory resources, cross-disciplinary glossaries, or guided pathways are created.

At the manifestation level, information relations appear through catalogues, search results, metadata, download links, access-denial notices, handbooks, language versions, dashboards, repository permissions, meeting notes, and documented releases. Such manifestations are necessary objects of examination, yet they provide partial evidence. High page-view counts do not demonstrate understanding; a search result that advertises a file does not show that the file's use is lawful; a successful download does not demonstrate comprehension or disciplinary value. The same apparently accessible document may function differently for readers using assistive technology, for multilingual contributors, and for persons unable to understand its provenance. Accordingly, an evaluation of information infrastructure must connect observable interface performance to the actual tasks, entitlements, and interpretive conditions of specified users.

This three-level treatment also prevents an overly technological conception of sharing. A carefully moderated discussion, a supervised workshop, a translated concept map, or an authorised account of a difficult past decision may transmit information in ways not captured by web traffic. Conversely, a technically interoperable interface may intensify institutional asymmetry if it transfers interpretive burden to people with fewer resources. The infrastructure is therefore partly social and normative, even when realized through digital tools.

12.3 Information Classes, Audiences, and Representation Boundaries

The proposed Commons involves information with markedly different functions and permissions. Public academic articles, original synthetic research data, independently authored handbooks, operational announcements, contributor agreements, historical criticism, and restricted materials are not variants of one undifferentiated pool. An architecture designed around only the binary distinction between "open" and "closed" would obscure questions of provenance, audience, lawful use, sensitivity, and interpretive risk. A more defensible classification is multidimensional and revision-sensitive. Table 15 illustrates the analytical differences without prescribing universal local policy labels.

Table 15: Illustrative information classes and their distinct review questions. The listed conditions are research-design considerations, not permission determinations for any institution.

Resource class	Principal use	Relevant boundary question
Open literature and public law	Disciplinary and normative orientation	Is this source current, correctly attributed, and relevant to the applicable context?
Original synthetic dataset and code	Independent experimentation and methodological comparison	Are the generating assumptions and licences explicit, and is the claim of synthetic origin supportable?
Independent handbook or proposal	Interpretive guidance and possible future discussion	Is its status clearly distinguished from institutionally adopted instructions?
Project, role, or schedule notice	Present coordination of an activity	Who has authority to issue or amend the notice, and when does it become stale?
Contribution and decision records	Provenance, reasons, and critical review	Which personal details are necessary, and what disclosure is justified?
Sensitive or externally controlled material	Potential authorised service or research work	Who controls access, for which purposes, under which review and safeguards?

A resource can carry multiple classifications that should not be collapsed. An openly readable policy statement may be protected by copyright; a licensed dataset may nevertheless involve confidentiality duties; a synthetic dataset may reveal assumptions that mimic a restricted setting even if no patient records were used. The act of attaching an attractive open licence is not proof that the publisher actually holds every right necessary to grant it. Nor does a general research-ethics declaration determine a particular institution’s disclosure competence. The normative and safety infrastructure functions discussed in Sections 8 and 10 remain controlling contextual inquiries.

A further distinction concerns *public metadata* and *public underlying content*. A catalogue may legitimately expose a generic description, citation, custodian, and lawful access procedure while withholding the full data. But metadata itself can be identifying or inferentially sensitive. Naming a rare clinical event, a small cohort, a precise location, or an otherwise concealed collaboration might disclose information that the access rule was meant to protect. Publication of a metadata record therefore requires its own disclosure review. Even a seemingly harmless derived statistical summary should be examined for re-identification, contextual stigma, and inferential exposure where these concerns are plausible. A restricted catalogue that protects participants may sometimes be preferable to a public index.

Information stewards must also decide whose information needs are recognized. Patients and family members, volunteers, hospital coordinators, students, disciplinary specialists, public readers, and contributors may differ in language, disability accommodations, technical competence, available time, and legitimate permissions. They should not be described as identical “users.” A design that is highly usable for a research software developer may leave a person seeking a plain-language role description unable to locate the required guidance. The Commons must investigate audiences without claiming to represent persons from whom it has received no legitimate testimony.

12.4 Discovery, Metadata, and Cross-Disciplinary Interoperability

Findability requires enough descriptive structure for a participant to distinguish a relevant resource from similarly named or obsolete ones. A minimal identifier and file title are often insufficient. Responsible metadata may include a resource type, originator or custodian, dated version, relevant question, disciplinary vocabulary, known limitations, language, accessibility features, relation to other objects, rights statement, sensitivity designation, and an avenue for correction. Which fields matter depends on the risk and intended use. High-risk or ambiguous records may require more context; a simple public glossary need not carry the full administrative burden of a controlled-data archive.

FAIR provides a bounded point of comparison for machine-actionable and human reuse of digital research objects, including persistent identifiers, metadata, authentication-capable access, interoperable vocabularies, qualified references, licensing information, and provenance (Wilkinson et al., 2016; GO FAIR Foundation, n.d.). Its accessibility principles expressly allow authentication and authorization where necessary; a restricted dataset can therefore be more responsibly FAIR-aligned than an improperly exposed dataset. DCAT 3 can describe catalogues, datasets, distributions, and data services (World Wide Web Consortium, 2024a), while W3C PROV can represent relations among activities, entities, and agents (World Wide Web Consortium, 2013a). These standards do not determine who may authorize disclosure, whether a legal interpretation is sound, or whether a derivative research claim is warranted. For a modest Commons, a manually maintained register could meet the specific information task without implementing all of these vocabularies. The comparative test concerns the adequacy and upkeep of descriptive relations, not nominal standards adoption.

A preliminary information record can be typed without assigning numerical weights to incomparable interests:

$$l_t(x) = \langle \text{id}(x), \text{kind}(x), \text{source}(x), \\ \text{version}_t(x), \text{context}_t(x), \text{rights}_t(x), \\ \text{access}_t(x), \text{limits}_t(x), \text{steward}_t(x) \rangle. \quad (19)$$

Here x is a proposed information resource or description and t the record's reference time. The fields are *typed descriptive positions*: $\text{rights}_t(x)$ records a documented rights claim or governing source rather than certified ownership; $\text{access}_t(x)$ records stated access conditions rather than an authorization token; $\text{context}_t(x)$ includes the intended task or interpretive setting; and $\text{limits}_t(x)$ may include uncertainty, incompleteness, or missing authority. Equation (19) is a proposed research schema for comparing implementations, not a mandatory database structure. For sensitive resources, even its existence and fields may require protected handling.

Cross-disciplinary retrieval poses an additional problem: different communities may describe the same activity through different ontologies. A scheduling researcher may search for constraint feasibility, an educator for experiential learning, a governance scholar for decision accountability, and a patient-support practitioner for role coverage or service continuity. A single classification based on the founder's discipline can systematically suppress other descriptions. One response is a plural description strategy: retain source-specific terminology, document carefully justified conceptual mappings, and allow several audience pathways to the same resource. Mappings should preserve their provenance and uncertainty. A translation from an operational term into a mathematical variable can enable analysis while losing aspects of lived experience, normative authority, or professional practice.

This suggests a distinction between *shared reference* and *shared interpretation*. Participants can refer to one artifact without agreeing on its meaning, priority, or validity. Their disagreement can be documented productively as competing interpretations, provided the information architecture does not erase provenance or present a speculative mapping as settled institutional fact. The interdisciplinary mediation section will examine the cooperative consequences in greater detail. The information infrastructure here supplies the retrievable and contestable descriptions on which such mediation depends.

12.5 Technical Access, Legitimate Authorization, and Responsible Disclosure

Information can be technically accessible and impermissible to use, legally available and technologically inaccessible, or available only after legitimate review. These cases must remain separate. FAIR's accessibility principle explicitly accommodates authentication and authorization where necessary (GO FAIR Foundation, n.d.). The existence of a download button, a shared password, an institutional email address, or a publicly forwarded file does not determine the lawful purposes for which its content may be processed. Conversely, a legitimate right of access is of little practical value when a participant cannot find or use an accessible format, receive a necessary explanation, or obtain a decision within a meaningful time.

The proposed infrastructure therefore distinguishes a resource from a disclosure decision. Let a be an actor, x an information resource, p the stated purpose, c the proposed recipient and institutional context, and t the relevant time. The notation

$$\text{AccessDisp}_{I,t}(a, x, p, c \mid e) \in \{\text{allow, deny, review, undetermined}\} \quad (20)$$

represents a *claimed and documented administrative disposition* under a specified competent process, not the truth of legal entitlement. Here I fixes institutional scope and e denotes the evidence of the issuing actor, decision, version, and relevant competence. The distinctive symbol **AccessDisp** avoids confusing an access disposition with the decision-situation record $D(d)$ of Equation (30). The possibility of *review* is important where a request might be permitted subject to further safeguards or external approvals. *Undetermined* means the Commons lacks sufficient competence or evidence to treat the request as decided. A local decision record needs to identify the relevant steward, normative basis, permitted purpose and limitations; it should not imply that a Commons coordinator may substitute personal judgement for a hospital's information-governance office or an applicable research-ethics process. Equation (20) should never be implemented as an unrestricted formula that turns a researcher's self-declared purpose into access rights.

Controlled sharing may be organized through public access, a restricted group, mediated requests, an approved research environment, a non-disclosive summary, or non-release. Which arrangement is legitimate varies with the data, participants, jurisdiction, contracts, research purpose, and available safeguards. The general principle is to disclose no more than can be justified while enabling legitimate, intelligible access where feasible. A data-sharing request might be declined, yet the Commons could still publish a synthetic benchmark with documented assumptions or a literature-based problem formulation. Such substitution is not a claim that synthetic material reproduces real patients or hospital operations; it is a different, independent research object.

The rights of source creators and subsequent users also require distinction. Public-domain source material, copyrighted writing, software under an open-source licence, licensed research data, third-party figures, and undisclosed institutional records have different use conditions. Academic citation, authorship, licensing, permission to download, consent for a particular research purpose, and authority to republish are not interchangeable. A Commons policy should identify these differences and refer contested issues to competent interpretation. At the information interface, the practical responsibility is to avoid stripping away licence and attribution information or silently altering the conditions attached to a resource during exchange. The later contribution-rights section will analyse allocation of rights and value return as separate objects.

12.6 Intelligibility, Accessibility, and Situated Interpretive Support

A central purpose of the Commons is to enable people without an established shared research history to recognize a meaningful opportunity. That possibility depends on more than transferring the same PDF to every participant. Material must be interpretable within different prior knowledge, languages, abilities, available time, and social positions. For an engineering student, a scheduling repository might need formal notation, data-generation procedures, reproducible baselines, and well-scoped open questions. For a volunteer considering a nonclinical role, a short and clear account of the activity, its real authority, expected time, and right to decline may be more important. Neither representation necessarily supersedes the other; they answer different situated questions.

Accessible format is one element of this relation. The W3C Web Content Accessibility Guidelines, version 2.2, offer testable recommendations for accessible web content, including needs associated with visual, physical, cognitive, and other disabilities (World Wide Web Consortium, 2024b). Their scope is web content, and conformity does not guarantee that every person's needs are met. A Commons operating through print material, guided workshops, accessible structured documents, captioned audio, or assisted conversations may need other practices as well. Technical standards can guide a portion of institutional design, but do not replace consultation with affected persons, actual user testing, and legitimate accommodations.

Language mediation should preserve differences in the status and meaning of terms. A research document might be translated into a second language while its normative status remains a proposal, not an official instruction. A handbook can define technical terms yet conceal an unresolved conflict in the underlying doctrine. A glossary that equates “participation,” “service,” and “research” for ease of reading would be especially dangerous in this setting because those activities have distinct permission and consent structures. A more responsible system provides a plain-language account, links to original source documents, identifies the authority and limitations of translations, and offers a channel for correction.

The provision of “easy” information can also become paternalistic if it removes uncertainties or dissenting explanations. Intelligibility need not mean forcing every issue into one authoritative summary. When a research problem is genuinely contested, a properly layered interface can distinguish a short orientation, sources, disciplinary elaboration, and competing interpretations. A reader should be able to discover what is known, what has been inferred, what remains contested, and which decision requires another institution’s authority. Such layering respects diverse informational needs without constructing separate factual realities for different audiences.

Interpretive support entails maintenance costs. Creating and revising translations, checking links, preparing accessible figures, moderating requests, and updating introductory notes require time and expertise. An under-resourced Commons may legitimately narrow its coverage instead of declaring universal accessibility it cannot maintain. What matters analytically is whether known exclusions are recognized, the limits of current provision are stated, and improvement choices are justified in relation to available resources and participants’ interests.

12.7 Sharing Procedures, Versioning, and the Status of Institutional Messages

Sharing is an institutional process as well as a file transfer. A scholarly result can move from an author’s private draft to a reviewable working paper and then to a published version; an independently written procedure can remain a research proposal even when widely circulated; and a practical schedule can change after a responsible coordinator has issued it. Recipients need to know which state they are seeing. Confusing a historical draft with a current operational instruction can produce harms that no increase in download speed would repair.

A release decision should begin by identifying the artifact and its intended recipient, then determining the rights and disclosure conditions applicable to that concrete exchange. Only after that determination can a steward select a version, status label, format, audience explanation, channel, and appropriate correction route. A public glossary ordinarily needs different review from a confidential collaborator record; the relevant difference is the consequence of erroneous disclosure or interpretation, not a preference for elaborate checklists. If the Commons does not control the information, it can index permitted public descriptions or seek competent authorization, but not acquire access by documenting its own approval. A practical minimum is a status-and-rights check linked to an accountable maintainer; a more elaborate workflow is justified only if it demonstrably catches consequential failures the simple check misses.

Status metadata deserve particular attention. A resource may be a draft, unverified explanatory note, independently released research document, superseded version, or formally adopted instruction within a named authority’s scope. The system should expose this difference at the point of use, not merely in a remote legal notice. For public announcements, recipients also need effective date, responsible contact, update interval, and a correction route. For research datasets, recipients need source and version relations sufficient to reproduce the intended analysis. Versioning metadata may be assisted by standards such as DCAT 3, but a well-maintained document register can perform the same underlying function in a small Commons (World Wide Web Consortium, 2024a).

The boundary with communication arises when a resource becomes a message addressed to a particular public. Information stewardship supplies a versioned, permission-qualified artifact and explains what it contains; communication stewardship selects a claim, frame, language, channel, and invitation to respond. A researcher may correctly index a provisional project description while a promotional flyer misrepresents it as an adopted hospital programme. Conversely, a clear invitation may lead to unusable

Table 16: Context-dependent design questions for the information infrastructure. Answers vary with institutional authority, disciplinary context, resource constraints and intended recipients.

Design dimension	Question to establish	Possible evidence of adequacy
Discovery and status	Can specified users identify relevant and current resources?	Task-based retrieval and version recognition tests
Rights and authorization	Is the requested use within the steward's competence and applicable conditions?	Traceable source, purpose, review, and disposition
Intelligibility and inclusion	Can different audiences understand relevant scope and limits?	Situated comprehension and accessibility tests
Cross-disciplinary translation	Can competing disciplinary meanings remain recoverable?	Linked source terms, qualified mappings, correction history
Stewardship and revision	Who maintains links, translations, rights notes, and access conditions?	Dated responsibility and documented revisions
Risk and proportionality	Does the information benefit justify disclosure and maintenance costs?	Risk review, alternative releases, reasoned limits

material because the linked benchmark is obsolete. These failures require different remedies: resource repair in the first information pathway, message correction in the second. Neither function independently establishes epistemic validity or informed volunteer commitment. A shared person may perform both tasks, but the handoff from resource status to communicative claim should be explicit.

The receiving actor may also contribute new information: an error report, correction, alternative interpretation, translation, or new source. Governance should clarify how these reports are acknowledged, evaluated, credited, and incorporated. Not every suggestion is automatically accepted, and not every submitted detail may be retained publicly. A transparent correction mechanism can preserve reasons for adoption, rejection, or deferment without treating disagreement as a platform defect. Historical records of substantive revisions then support the recoverability function in Section 11.

12.8 Institutional Configurations, Stewardship, and Infrastructure Coupling

The same information functions can be constituted in different material and social arrangements. A sole independent researcher might use a versioned repository with a readable index, licence notices, a source register, and a contact address for corrections. An interdisciplinary association may combine a research catalogue with multiple editors, translation roles, and an explicit decision procedure for sensitive submissions. A formally authorised inter-institutional collaboration may need additional agreements, restricted environments, designated information custodians, audit mechanisms, or carefully separated publication channels. These configurations differ in scale and competence; they are not successive grades on a universal path to maturity. An independently useful research Commons need not progress toward clinical-data integration.

A design decision should consider at least the characteristics in Table 16. It should identify a responsible person or body without presuming that one steward has authority over all resource classes. An editor can correct an independently authored article; the same editor may lack authority to correct an institutional schedule or release personal information. Likewise, local information security cannot be deduced from how professional a website appears. Organizational accountability and technological configuration are different but coupled parts of a situated arrangement.

Coupling among infrastructures is both necessary and potentially adverse. Publishing a well-organized information catalogue may improve disciplinary entry and participation. It may also increase demand for unpaid mentoring, expose the identities of vulnerable contributors, distribute material beyond its intended interpretive context, or lead outsiders to misread a provisional handbook as official hospital guidance. Metadata and provenance can facilitate legitimate research credit while becoming tools of unwanted surveillance. A resource library that requires extensive curation can consume the

time otherwise available for original inquiry. These are not reasons to reject organized information; they are reasons to treat maintenance burdens, information asymmetry, public claims, and the legitimacy of sharing as first-order design questions.

The Commons may also require an information-dependency register for assets that are important to several functions. A mathematical benchmark may depend on a licence record, a methodological explanation, a cited public problem, and a synthetic-data generator. If the generator is updated, the benchmark must indicate which versions remain mutually compatible. If a source article is retracted or a legal rule changes, dependent resources require review rather than mechanical deletion. The infrastructure can preserve qualified links and update notices without pretending to resolve all related epistemic or normative questions centrally. Its role is to make the dependencies sufficiently visible for competent participants to reconsider them.

12.9 Failure Mechanisms, Situated Tests, and Historical Revision

Information infrastructure should be evaluated through meaningful tasks, not file counts alone. A new student may be asked to find a public synthetic scheduling benchmark, determine its scientific limitations, identify a reproducible baseline, and state what permissions apply to reuse. An independent handbook reader may be asked to distinguish an illustrative proposal from a hospital's actual instruction. A researcher examining an archived dataset may need to discover why one version is withdrawn and whether its metadata may legitimately remain visible. A participant using a screen reader or a different working language may test whether essential warnings and links are perceivable and intelligible. Such exercises generate observations about the actual relation between available resources and situated capabilities; they are not general certifications of accessibility, safety, or legal compliance.

A discriminating information test can give a newcomer a bounded request: identify the current synthetic benchmark, distinguish it from a superseded version, access it through a legitimate route, discover any material restrictions, and locate the assumptions required to begin use. Separately test a denied-access case: the participant should be able to discover that an item exists and understand why further access is unavailable without receiving the restricted content. Record points of failure and whether a maintained index, a clearer rights note, or one accessible glossary resolves them. Success does not establish the benchmark's scientific quality or the participant's eventual research capacity; those are tested in Sections 13 and 14. An expensive catalogue that performs no better than a short reliable register has not justified its added stewardship burden.

Several failure modes warrant specific attention. *False discovery* occurs when an index suggests that a resource exists or is current when it does not. *Interpretive loss* occurs when format conversion, translation, or summarization removes decisive caveats. *Authority confusion* occurs when the author or publisher of information is mistaken for the institution empowered to adopt it. *Unjustified disclosure* occurs when the resource or its metadata expose protected interests. *Permission opacity* makes a resource visible but leaves users uncertain whether reuse is allowed. *Maintenance exhaustion* leaves attractive catalogues with broken links, superseded guidance, or unanswered correction requests. *Information capture* permits a powerful participant or single discipline to define the entire catalogue's vocabulary and ranking. Each failure can occur without the others, and each requires a different response.

A responsible assessment should therefore examine retrieval correctness, status and version recognition, lawful-access handling, user comprehension, correction responsiveness, cross-disciplinary interpretation, and stewardship cost. Reported success rates should specify the task, population, test setting, and reference conditions rather than being presented as universal measures of information quality. Low complaint numbers may reflect satisfaction, ignorance of reporting channels, or exclusion of those least able to complain. Equally, a failed access request is not always an infrastructural deficiency: refusal may be required by legitimate confidentiality, privacy, or institutional conditions. Evaluation should distinguish unjustified barriers from justified non-disclosure.

The design is historically revisable. A classification scheme may no longer describe new scholarly objects; a translation may become misleading; licensing policies and laws may change; a formerly ac-

ceptable information exposure may create new risks when combined with other publicly available data. An information steward must be able to document what changed, how the revision was justified, who was affected, and which prior versions remain appropriate to preserve. That historical account returns to Section 11, but its present purpose is to maintain the reliability of ongoing information relations. It also creates usable conditions for the next infrastructure inquiry: a field of documents becomes a research environment only when claims and methods can be examined under appropriate standards of *epistemic validation*, the subject of the following section.

13 Epistemic Validation and Research Quality

The information infrastructure can enable a person to locate a resource and identify its legitimate uses without answering whether a particular claim is justified. This section addresses that unanswered question: which evidence, reasoning, countertests, and competent criticism warrant an assertion for a specified purpose and time? A synthetic optimisation result, a legal interpretation, a historical reconstruction, and a proposed ethical principle may coexist in one Commons, but their standards of warrant and permissible inferences differ. Epistemic validation is the institutional capacity to make that difference examinable, to challenge an argument on its own terms, and to correct its published status. The objective is neither a universal certificate of truth nor an authority to approve a hospital intervention; it is the maintenance of claim-specific, revisable assessment relationships.

The section brings several established traditions into relation without merging their disciplinary standards. The National Academies distinguish computational *reproducibility*, understood as consistent computational results with the same data and analytical procedures, from *replicability*, which concerns consistency across studies with their own data; neither definition automatically settles interpretive validity or transfer to another institutional context (National Academies of Sciences, Engineering, and Medicine, 2019). The National Academies' account of research integrity places honesty, objectivity, openness, fairness, accountability, and stewardship within the organizational conditions of inquiry (National Academies of Sciences, Engineering, and Medicine, 2017b). Transparency and Openness Promotion guidelines articulate selectable transparency standards rather than one unvarying disciplinary checklist (Nosek et al., 2015). In historical scholarship, professional standards connect the integrity of evidence to reasoned interpretation and the willingness to confront contrary sources (American Historical Association, 2023). Publication-ethics guidance treats correction and retraction as means of protecting the integrity of the literature, rather than as automatic proof of an author's moral culpability (COPE Council, 2025). These sources supply different reference points. The proposed extension is a relational account of how a heterogeneous Commons may maintain the *conditions for warranted disagreement and justified revision* without either reducing quality to a single metric or claiming the authority of an accredited research institution.

The discussion distinguishes the object and three reality levels of validation, typed claims and appropriate evidential standards, reproducibility and situated replication, the procedural constitution of review, criticism and power, adverse and inconclusive findings, correction, infrastructure coupling, and tests of institutional quality. The setting remains an internationally general university-hospital research Commons, whose independently developed public or synthetic resources must be distinguished from authorized clinical research and hospital operations. Scholarly validation cannot itself confer clinical approval, legal permission, or authority to change a service.

13.1 The Constitutive Object of Epistemic Validation

A claim is not merely a string of words to which an external seal of approval can be attached. It arises through a relation between a question, a relevant object or process, an inferential method, available evidence, its author's commitments, a disciplinary community, and a purpose for which it might be used. Its epistemic status can change when the evidence changes, a hidden assumption becomes visible, an analytical error is found, or a different community poses a question the initial method was not designed to

answer. In a volunteer Commons, this historical responsiveness matters because research may be reused outside the context in which it was first produced. A scheduling benchmark developed to compare algorithms, for instance, can circulate into a proposed real allocation procedure. The original performance claim does not warrant that change of use.

Definition 13.1 (Situated epistemic validation infrastructure). A *situated epistemic validation infrastructure* is an accountable and revisable configuration of claim descriptions, source and method records, disciplinary review practices, access to competent criticism, correction procedures, and responsible stewards through which the warrant and limitations of specified knowledge claims can be examined for stated questions and uses. It constitutes conditions for review; it does not guarantee truth, certify researchers, confer regulatory approval, or replace the judgement of competent disciplinary and institutional authorities.

A proportionate validation process differentiates *claim registration* from *methodological examination*, *review disposition*, and *revision*. Registration preserves exactly what is claimed, about which object, on what assumptions, with which evidence, and for what intended use. Examination asks which counterexample, independent calculation, rival reading, or source criticism would be probative. Disposition reports the limits of the reviewer's competence and records disagreement; it cannot silently transform a method check into authorization for operational action. Revision changes the standing of the claim while retaining an appropriate correction link. These functions may be served through code review, peer discussion, an annotated legal analysis, or more formal domain examination. A separate institutional certificate is warranted only if it improves the reliability of the actual judgment.

We should resist treating validation as a binary property that a resource permanently acquires. A model may satisfy an internal mathematical proof obligation but have no empirical support for its behavioural assumptions. A description of a particular volunteer experience may be faithfully transcribed but incapable of justifying a population-level conclusion. A legally sophisticated argument may be coherent without correctly stating the law applicable in another jurisdiction. Conversely, an unsuccessful attempt to reproduce a numerical result can disclose an implementation defect, an undocumented boundary condition, or a genuinely informative discrepancy. Each outcome bears on a different dimension of warrant. A quality infrastructure must permit such distinctions to be recorded rather than compel one undifferentiated verdict.

13.2 Three Reality Levels and the Limits of Epistemic Representation

At the first GR reality level, the ultimate ontological status of the researched object remains suspended. Neither a research metric nor the accumulation of favourable reviews establishes that an institutional relation has been exhaustively represented. A patient-facing interaction may contain experiences and asymmetries inaccessible to the variables of a scheduling model; a legal analysis may depend on social and institutional meanings not reducible to article numbers; a historical reconstruction may remain contingent on missing traces. Ontological suspension does not excuse poor evidence or imply that contradictory assertions are equally credible. It limits the inference that an instrument designed for a particular epistemic purpose has disclosed the entirety of the object.

At the level of relational reality, knowledge is constituted and tested through historically developing relations among evidence, questions, practices, instruments, reviewers, disciplinary conventions, organizations, and affected subjects. The methodological capacity of a research group is not independent of its personnel, prior training, available data, time, and ability to invite criticism. An engineer's simulation, a historian's source evaluation, and an ethicist's normative argument can address connected institutional circumstances while warranting different kinds of claims. Their standards may be mutually relevant without becoming interchangeable. A programme that insists on a single proof technique risks invalidating legitimate approaches; one that permits every assertion without scrutiny loses the ability to distinguish inquiry from advocacy.

At the manifestation level, validation appears in peer-review comments, laboratory notebooks, test logs, mathematical proofs, data dictionaries, uncertainty intervals, annotated legal sources, reproducibil-

Table 17: Illustrative claim types and context-sensitive examination criteria. Categories can overlap. The table neither exhausts epistemology nor establishes a universal ranking of disciplines.

Claim type	Illustrative object	Relevant examination questions
Formal or computational	Feasibility theorem, scheduling algorithm, synthetic benchmark	Does the proof follow? Are data, code, implementation, baseline, and assumptions inspectable?
Empirical and causal	Effect of an intervention, observed service experience	Is the design suitable for the claim? What uncertainty, confounding, sampling, and transfer limits remain?
Historical and interpretive	Explanation of a past programme or institutional decision	Is source provenance sound? Are context, absences, alternatives, and contradictory evidence examined?
Legal and normative	Interpretation of a permission, responsibility, or ethical obligation	Which jurisdiction, source, authority, interpretive method, affected interests, and rival reasons apply?
Design and prospective	Proposed handbook, governance mechanism, or event plan	Are aims, constraints, scenarios, failure modes, and review arrangements explicit? Has real-world effectiveness been demonstrated or merely conjectured?

ity reports, retracted publications, revised handbooks, and public correction notices. These traces are indispensable, but they are partial signs of underlying practices. A passed automated test can coexist with a mistaken specification. An acceptance letter is not a theorem of truth; citation counts do not establish the validity of a proposition. The San Francisco Declaration on Research Assessment explicitly cautions against using journal-level metrics as substitutes for judging individual research quality (San Francisco Declaration on Research Assessment, 2013). A Commons should therefore examine what a validation indicator actually measures, which decisions it supports, and whether participants can investigate the supporting reasons.

These levels also specify the relation between epistemic and normative authority. A Commons may record a well-supported finding that a hypothetical coordination arrangement would reduce conflicts under given assumptions. Whether such an arrangement should be implemented, whose interests it should prioritize, and which organization may authorize it remain separate questions. Likewise, a review board’s authorization to conduct a study does not make the study’s resulting claims scientifically sound. The integrity of the system requires interfaces between epistemic validation, norm interpretation, governance, decision-making, and safety, rather than a conflation of their competences.

13.3 Typed Claims and Context-Appropriate Standards of Warrant

A practical Commons may create an explicit *claim record* before seeking review. The record should specify the type of claim, its object, scale, conditions, source, methods, uncertainty, intended use, and possible tests or counterarguments. We propose the following descriptive tuple, without assuming that epistemic adequacy can be calculated from it:

$$\text{Claim}_t(c) = (\tau_c, q_c, o_c, e_c, m_c, a_c, u_c, \ell_c, s_{c,t}). \quad (21)$$

Here c identifies a claim at time t ; τ_c specifies its epistemic type; q_c the question; o_c its scope and object; e_c available evidence and provenance; m_c method of inference; a_c assumptions; u_c uncertainty and known objections; ℓ_c the limits of intended application; and $s_{c,t}$ its dated review status. The elements may be structured records, statements, or links, not necessarily numeric values. The tuple is a proposal for responsible documentation, rather than an empirically calibrated or juridically binding model.

The types in Table 17 should remain open to interdisciplinary combinations. An algorithmic proposal may raise empirical questions about whether human volunteers accept a schedule, ethical questions

about unequal burdens, and legal questions about authorized data collection. In such cases, a positive assessment of one component must not silently validate the others. The reviewer should record both the achievement and the boundary of that achievement. In particular, a clean run of a quantum optimization demonstration on synthetic examples may support a narrow computational observation, not the conclusion that a hospital would benefit from deploying the model.

An institution may need different degrees of review for exploratory notebook results, public educational materials, working papers, decisions to invite collaboration, and proposals concerning vulnerable persons. Greater potential harm raises the need for stronger scrutiny and competent authorization, but a Commons should not pretend that one checklist can eliminate risk. We distinguish a proposed *review depth* from a claim of verified reliability: it is a decision about what questions need checking, by whom, and before which uses. The relevance of a particular evidential test is determined by the claim and its intended inferential use, not by the prestige of the contributor.

13.4 Reproducibility, Replicability, and Disciplinary Plurality

For computational claims, the National Academies distinguishes *reproducibility*, obtaining consistent results from the same data and computational conditions, from *replicability*, comparing independent studies addressing the same question using newly obtained data (National Academies of Sciences, Engineering, and Medicine, 2019). A synthetic scheduling benchmark may support computational reproduction but not empirical replication of actual volunteer behavior. This is not a defect to be repaired by simulating another dataset and calling it an independent hospital study. A useful review therefore records the claim that was reproduced, the software and data versions, the perturbations examined, and the inferential boundary between model behavior and institutional practice. When an implementation fails to reproduce, the reviewer should first distinguish missing materials or environmental drift from a mathematical or scientific defect. The broader validity of an operational claim requires a different evidentiary inquiry and competent authority.

A hypothetical scheduling repository illustrates the distinction. Reproducing an experiment may require the actual instance generator, documented constraints, objective functions, seed, solver settings, computing environment, and criteria for calculating performance. Replicating a substantive claim that a scheduling policy improves volunteer welfare would require an independently justified design capable of observing relevant experiences, rights, and organizational effects, not merely another solver run. If those experiences involve human participants, access and ethical review depend on the relevant institutional and legal conditions. The synthetic benchmark can be excellent for methodological comparison without licensing an inference about clinical outcomes or real volunteers.

Research forms based on qualitative interpretation, philosophy, legal reasoning, and history require an explicit account of what responsible reconstruction means for those disciplines. A historian may make primary evidence and interpretive reasoning examinable, acknowledge competing explanations, and permit later correction without promising identical conclusions from independent readers. The American Historical Association’s professional standards connect rigorous scholarship to evidential integrity, acknowledgement of bias, and consideration of counterevidence (American Historical Association, 2023). A legal argument requires verification of legal sources, applicable periods and jurisdictions, and interpretive choices; an ethically serious argument must engage possible objections and the affected subjects’ standing. Computational replication of a narrative is neither possible nor an appropriate universal criterion. Nonetheless, each type of inquiry can be criticized with reasons, can identify its evidence, and can make the limits of its claims accountable.

The Transparency and Openness Promotion framework provides a useful example of standards whose required depth and components can vary, although its journal-oriented standards are not a general law for Commons participation (Nosek et al., 2015). Openness has further conditions: confidential sources may need restricted examination, a participant’s consent may be limited, and public release of a small dataset might indirectly identify people. A rigorous review process might legitimately verify that protected materials were examined by authorized researchers without reproducing them publicly. Such safeguards

Table 18: Illustrative phases in a claim-specific review process. The responsible reviewer and thresholds are institution- and purpose-dependent; the sequence grants no external permissions.

Phase	Main question	Record or possible response
Intake and classification	What has been asserted, for which audience and use?	Typed claim, version, provenance, intended use
Source and permission check	Are the materials genuine, sufficiently identified, and legitimately held?	Traceable sources, access constraints, unresolved issues
Substantive examination	Are relevant methods, evidence, assumptions, and objections addressed?	Reasons, tests, discrepancies, competing interpretations
Disposition and communication	What may responsibly be asserted about this version?	Dated status, reviewer competence, limits, requested changes
Post-release review	What happens when errors, new evidence, or changed contexts arise?	Linked correction, qualification, supersession, or withdrawal

do not eliminate the need to state what was and was not independently checked.

13.5 Validation Procedures, Review Competence, and Institutional Standing

A small Commons can conduct claim-focused review without recreating a journal office. At submission, the author states the claim’s type, object, evidence, assumptions, uncertainty, and intended audience. A procedural check verifies source identity, lawful use of materials, and whether the publication label accurately describes the work. A competent disciplinary reviewer then examines only the inferences within their expertise. A proposal that would direct a real service requires a separate institutional decision even if its technical derivation survives review. The resulting record should distinguish *examined method*, *unresolved substantive issue*, *correction required*, and *out-of-scope use*. It should not use one generic “approved” status to conflate methodological quality, ethical defensibility, and permission to implement.

Different roles should remain identifiable. A contributor constructs an argument or artifact; a methodological reviewer examines the merits of particular claims; an editor or steward may decide whether and how an artifact is distributed; a governing body may set review procedures; and an external competent institution determines authorizations beyond the Commons’ mandate. These roles can be combined in a small project, but the conflicts and limitations of such combinations should remain visible. A solo founder’s self-review can be a useful development step, not independent peer review. A public comment invitation can expose an argument to criticism, but silence or favourable comments do not establish that a qualified review occurred.

A practicable review record may distinguish *unexamined*, *under review*, *examined with limitations*, *contested*, *revised*, and *withdrawn or superseded* states. They describe what has happened procedurally rather than certify the truth of a claim. This status vocabulary should not be mistaken for a numerical epistemic ranking: a contested claim may be valuable because competing interpretations disclose a significant unresolved question, while a heavily reviewed technical artifact may remain unsuitable for a particular social use. Where a review finds that a claim falls outside the available competence, recording that limitation is more responsible than endorsing it provisionally without explanation.

The proposed validation mechanism has a deliberately restricted interface with other functions. A finding’s evidentiary warrant can be revised without altering the validity of a previously issued institutional permission, while the withdrawal of an applicable permission can forbid a new use without rendering a mathematical theorem false. The analyst should record separately (i) the source and methods that support a knowledge claim, (ii) the population and setting to which it is proposed to transfer, (iii) rights and approvals for the specific use, and (iv) an appropriately competent action decision. These four inquiries may condition one another in practice, but cannot be reduced to a single review status. The typed inferential limits are formalised in Section 23.6.

The institutional configuration should be scaled to capacity. A small independent project may use versioned public discussions and invited expert examination; a larger interdisciplinary Commons may ap-

point discipline-specific reviewers and independent conflict-resolution processes. Neither form justifies implying that an external university or hospital has certified the contribution. Public disclosure of review methods should be balanced against legitimate privacy and confidentiality, and reviewers should be enabled to state potential conflicts of interest. The cost of review must also be acknowledged: repetitive forms, inaccessible demands, and unremunerated expert work can create new exclusion and extraction.

13.6 Evidence Transport, Claim Dependencies, and Evaluative Modesty

The formal correctness of a result and its suitability for a subsequent decision are distinct judgments. One can reconstruct the computational steps of a simulation, confirm its internal consistency, and still lack justified grounds to infer an effect on real service users. In the terminology adopted by the US National Academies' methodological report, computational reproducibility concerns results obtained from the same data and computational conditions, whereas replicability concerns independent studies with separately obtained data directed to a common scientific question (National Academies of Sciences, Engineering, and Medicine, 2019). Neither label by itself establishes external validity, permission to use the observed data, or authority to change services. A Commons should preserve the *transport conditions* under which a claim is offered to an audience beyond the one for which its evidence was generated.

An example is the proposition that a scheduler improves volunteer fairness. A solver run might establish, under given synthetic constraints, that its objective was optimised. An evidence-based assertion about experienced fairness requires an additional account of why those constraints represent relevant interests, how burdens are distributed, whether affected participants can question the representation, and which observations support the proposed effect. Even a well-designed observational study may remain unable to distinguish a scheduling benefit from training, management changes, self-selection, or a contemporaneous institutional reform. The intended transport from technical result to practical recommendation must display the missing links. Where those links cannot be established lawfully, the proper conclusion is a bounded research result, not an implied practical endorsement.

A proportionate *claim-dependency record* should identify a proposition, its actual evidentiary object, the inference applied, the domain and population in which that inference has support, material alternatives and counterarguments, and the intended downstream use. A reproducible computation may support a theorem check or a benchmark result under stipulated inputs; it does not, by itself, demonstrate experienced fairness or predict improved hospital service. Other records can link an interpretation to its originating discipline, locate a resource, or establish the existence of a competent operational disposition. Those records are necessary for some uses but do not change the epistemic warrant of the original proposition simply by being linked. If an experiment tests participants' responses to the benchmark, its evidence must be assessed under a separate design with the relevant permissions. The epistemic handoff to action should therefore disclose exactly which claim was validated, which transport inference remains untested, and who, if anyone, is competent to evaluate a proposed intervention. A claim can be methodologically strong and still remain wholly within independent research.

The theory's three reality levels remain consequential. Suspension of ultimate ontology prevents the model from treating its own categories as exhaustive entities; relational reality concerns causally effective constraints and historically changed capabilities; manifestations are the limited measurements, statements, computed outputs and documents by which observers attempt to apprehend those relations. The record is a device for disciplined inference between manifestations and proposed relations, not a direct window onto unobserved experience. In testing its value, researchers should compare it against ordinary disciplinary review, versioned documentation, and competent institutional assessment. Its distinctive hypothesis is narrower than a general superiority claim: explicit dependency tracking may reduce specific instances of *evidence transport without warrant*, particularly at the research-service interface. If it merely repeats reviewers' existing reasons while imposing an appreciable new burden, the additional procedure should be reduced or abandoned.

One implication of the event distinction in Section 23.5 is that increased documentary visibility is not necessarily increased occurrence. A safer complaint channel, more careful version control, or broader

reviewer participation may generate more recorded errors even when the underlying rate of mistakes has remained stable or declined. Conversely, a clean record may express missing detection, legitimate restricted access, or unobserved harm. Claim validation should therefore report, where feasible and lawful, relevant changes in discovery procedures and the population able to supply evidence, rather than interpreting the count of entries as a direct measure of institutional trustworthiness.

13.7 Claim Scope in Public-Service and Research-Return Evidence

The evidentiary distinction is especially consequential when a manuscript invokes public-service value or generative return. The ecosystem framework of Osborne et al. (2022) differentiates institutional, service, individual and belief levels and includes forms of value arising through the experience of participation in service production. It does not establish that a particular research Commons has generated those values, that a benefit has returned to an identified earlier contributor, or that documented return opportunities produce durable capacity. Those latter propositions belong to this paper's proposed historical-relational extension and must be examined through separate evidence of actual access, use, experience and alternative explanations.

An apparently favourable indicator can also hide a changing observation process. A new complaints mechanism can increase the number of recorded problems while improving people's ability to express concerns. A more complete rights ledger can increase the number of unresolved permission entries because it no longer conceals uncertainty behind a generic "open" label. The analyst should not infer deterioration or improvement solely from those changing record counts. Conversely, a zero count of complaints or licence disputes can be compatible with effective governance, lack of reporting channels or exclusions from voice. Accordingly, an empirical claim should name its target event or relation, the process making evidence visible, the status of missing or withheld records, and a plausible competing interpretation before it is used to appraise the Commons.

13.8 Criticism, Power, and the Distribution of Epistemic Voice

Validation operates within social relationships, and the ability to challenge a claim is unequally distributed. Academic credentials, institutional affiliation, language proficiency, access to methodological training, and familiarity with editorial conventions may affect whose objections are heard. Conversely, direct experience may disclose a problem that formal modelling has overlooked. Neither professional expertise nor situated experience should automatically substitute for the other. Their epistemic relevance is tied to the claim under examination. A patient or volunteer may be particularly well placed to contest a model's representation of a lived situation, while a mathematical reviewer may be needed to determine whether an optimization theorem is valid.

The Commons should preserve a practical route for objections that do not arrive in polished disciplinary form. For example, a volunteer might report that an otherwise efficient schedule regularly creates inaccessible travel conditions. That objection need not demonstrate an error in the solver. It may disclose that the original objective failed to represent a materially relevant burden. Translating this report into a new research question should neither silence the person who raised it nor automatically attach that person to later scholarly authorship. The normative and provenance infrastructure must address recognition and responsibility through their own criteria.

An independent research contributor might also challenge a published handbook written by the Commons founder. A trustworthy arrangement should permit criticism without a presumption that the founder's interpretive authority is decisive. Practical measures include preserving alternative arguments, enabling review by someone without a direct stake in the outcome where feasible, allowing explicit dissent, and documenting the reasons for the eventual editorial decision. Acknowledging unequal epistemic power does not require the Commons to treat contradictory empirical claims as equally well supported. It requires a defensible procedure for deciding which kinds of evidence and experience bear on each question.

Review can become extractive when the demand for free expert commentary far exceeds the community's capacities or when prestigious participants monopolize the power to define quality. It can also become performative if participants accumulate approvals mainly to advertise the Commons. In both cases, review practices modify the generative conditions they are supposed to safeguard. The institutional design should therefore permit selective review depth, transparent recognition of reviewers' contributions, limits on unnecessary procedural work, and periodic examination of who can initiate, complete, and contest validation. The aim is not maximal review volume but a viable capacity for criticism and learning.

13.9 Negative Results, Ambiguity, and the Correction of Claims

A generative research environment should have a place for unsuccessful attempts, null findings, disconfirming evidence, and well-documented uncertainty. If publication and recognition are reserved for favourable results, participants may have incentives to select flattering benchmarks, hide failed configurations, or overstate the promise of an intervention. The integrity literature documents detrimental research practices extending beyond narrowly defined misconduct, and it treats supportive institutional environments as part of research quality (National Academies of Sciences, Engineering, and Medicine, 2017b). A responsible Commons need not preserve every exploratory computation indefinitely, but its appraisal rules should avoid systematically erasing the failures that future participants may need to understand a method.

Suppose a study compares classical integer programming, a heuristic, and an experimental quantum approach on synthetic volunteer scheduling instances. If the experimental approach is inferior under well-documented conditions, the result can still contribute to the field by clarifying resource limits, sensitivity to modelling choices, or benchmark design. An adverse result can also reveal that the selected problem representation has little practical correspondence to volunteer needs. In the latter case, the critical advance concerns problem constitution rather than algorithmic performance. The judgment should explain which interpretation the evidence supports and what remains unresolved. This protects against retroactively converting every failure into a vague assertion of success.

The mechanisms for correcting published claims should distinguish minor errors, substantial uncertainty, supersession, and results that should no longer be relied upon. A corrected computation can sometimes retain the original substantive conclusion with narrower scope. In other situations, the failure undermines the central result and requires a prominent withdrawal or retraction notice linked to the original object. COPE's updated retraction guidelines emphasize correcting the literature and alerting readers to unreliable findings, while distinguishing that task from punishing authors (COPE Council, 2025). These editorial recommendations do not automatically govern independently released Commons working papers, but they provide a reference for designing a locally explicit and proportionate correction process.

Revision should be historically recoverable. Erasing an error without preserving an appropriate correction trace can leave downstream readers unaware that earlier material changed. Conversely, unrestricted permanent retention may conflict with privacy, confidentiality, or legitimate deletion obligations discussed in Section 11. A suitable solution may preserve a public correction notice while lawfully restricting the erroneous underlying material. What matters for epistemic accountability is that legitimate users can understand the status of the claim and avoid relying on an invalid version, to the degree permitted and feasible. A Commons should not promise that a correction will reach every downstream user, particularly when artifacts have been copied under independently exercisable licences.

13.10 Infrastructure Coupling and Institution-Specific Research Quality

Epistemic validation depends on other constitutive infrastructures and is, in turn, capable of transforming them. The problem-constitution function supplies the question to which an evidential answer is relevant. Normative and safety infrastructures bound acquisition and examination of sensitive materials. Historical infrastructure preserves traces that later reviewers need for reconstruction, while information-sharing

infrastructure supplies discoverability and intelligible access. Disciplinary infrastructure enables methods and experiments; interdisciplinary mediation determines whether a result can be translated without losing its conditions of warrant. Communication, participation, and governance affect how criticism is invited and heard. Provenance, licensing, and value circulation influence how corrected outputs can be reused. Resource stewardship determines whether review remains sustainable.

These interdependencies do not imply that one central review committee should exercise jurisdiction over every function. A Commons might publish its own openly inspectable benchmark while preserving an explicit label that the system has not been clinically or operationally tested. A university-affiliated research group might conduct an independently approved empirical study and provide a reviewed scholarly result to the Commons under an appropriate licence. A hospital might choose not to adopt the result despite scholarly support because of separate safety, resource, or authority considerations. None of these decisions makes the other institution's judgement redundant.

One useful contextual design test asks whether review responsibilities are proportional to the expected use and consequences of a claim. A tutorial demonstration may need correct explanations and executable examples. A document presenting itself as legal guidance may require up-to-date and jurisdiction-identified legal review. A proposal to redesign a live hospital process may need additional institutional, safeguarding, and operational examination regardless of the research quality of its model. The Commons can make these interfaces visible by attaching permitted-use statements, named reviewing functions, unresolved limitations, and triggers for additional scrutiny. Such statements should be genuinely informative, not merely disclaimers inserted to avoid responsibility.

The project should also retain the possibility that validation criteria themselves are historically inadequate. A method adopted because it is familiar may suppress more suitable approaches; a reliance on numerical performance can obscure rights and qualitative experience; a highly technical review standard may unnecessarily exclude competent contributors without formal training. Periodic methodological review should ask which claims the current procedures fail to examine, which communities bear disproportionate review burdens, and which errors repeatedly escape detection. The institution's capacity to revise its criteria is part of its epistemic infrastructure, rather than an admission that validation has failed.

13.11 Evaluation, Failure Cases, and Historical Revision of Research Quality

Evaluation of an epistemic validation infrastructure should begin with *claim-specific reconstruction tasks*, not counts of review badges. Can a qualified participant identify which version was evaluated, why a result was accepted or contested, and which assumptions remain open? Can an independent analyst rerun a computational benchmark with the documented artifacts? Can a reader follow the basis of an ethical or legal argument and determine where it ceases to apply? Can a critic raise a material objection without losing access to unrelated Commons research resources? Can a previously corrected claim be distinguished from an earlier unreliable version? These questions can be investigated through proportionate audits or structured exercises without inventing confidential test populations.

To test whether the infrastructure adds epistemic capacity, present reviewers with three deliberately different objects: an executable algorithm containing a hidden infeasibility, a mathematically correct analysis based on an unsupported claim about real volunteers, and a legal or historical argument whose cited source does not warrant the proposed inference. The first calls for computational testing, the second for scope correction, and the third for source-context analysis. Compare ordinary domain review with the proposed typed claim procedure, recording which specific errors each identifies and whether errors are corrected in downstream publications. If existing competent peer review performs the task at lower cost, there is no justification for a duplicate Commons accreditation layer. Reviewer agreement alone is not proof of truth; the relevant observation is the detection, explanation, and correction of consequential inferential errors.

Several failure patterns deserve explicit attention. *Validation by association* occurs when proximity to a university or hospital is presented as substantive endorsement of a result. *Methodological laundering* occurs when a formally correct computation is used to justify an empirically unsupported intervention.

Procedural inflation occurs when review forms multiply without increasing the quality of criticism. *Prestige substitution* occurs when a contributor's status replaces examination of evidence. *Corrective opacity* occurs when failed results disappear without adequate warning to downstream users. The effects of these failures depend on context, yet each indicates a mismatch between the represented status of knowledge and the practices that support it.

A Commons can respond by identifying the original claim, the source of the error or uncertainty, who was entitled to review it, whether linked outputs were affected, and what disposition was justified. Records of disagreement should preserve sufficient context for later reappraisal while respecting lawful limits on disclosure. An epistemically responsible release may explicitly state that some verification steps were impossible because of unavailable data, limited review capacity, or unresolved methodological disagreement. The limit should constrain the associated claims rather than prevent all useful inquiry. Independent knowledge production becomes more credible when a community can say precisely what it has not established.

The proposed infrastructure's distinctive contribution is a maintained route for competent, reason-giving, historically traceable criticism of a specified claim. Computational reproducibility, argumentative transparency, consensus, and editorial review can contribute to this purpose in different ways, but none serves as a universal proxy. Equally important, a reviewer's verdict must travel with its defined scope: a tested algorithm is not thereby an empirically verified volunteer policy, and a well-sourced ethical analysis is not a license to act on patient information. Section 14 addresses whether someone can create new research; the present section asks whether the resulting claims receive justified appraisal. This distinction allows unsuccessful studies and qualified negative findings to contribute to knowledge without inflating the status of their conclusions.

14 Disciplinary Value-Creation Infrastructure

A claim-review procedure can reject or qualify unsound research while providing almost none of the conditions through which someone develops a genuinely new inquiry. This section concerns those enabling conditions. A repository containing excellent papers and validated methods may remain unusable for original work because the research question is unformed, the benchmark cannot run, the necessary mentorship is missing, or critical alternatives are discouraged. Conversely, independent inquiry can occur outside a formally organised Commons, although participants may bear substantial private costs. The disciplinary value-creation infrastructure is therefore the configuration of researchable problems, warranted foundations, lawful materials, methodological choices, feedback and room for independent criticism through which a participant can attempt an original contribution. It is neither a course completion system nor a requirement to undertake hospital volunteering.

This function is distinctive in a university-hospital context. University affiliation may provide access to academic traditions, methodological communities, educational resources, and researchers capable of recognising problems that arise in public-service environments. These potential mediations do not make hospital participation a research requirement. An independent Commons can build scholarly environments around licensed public materials, openly documented methods, formal models, and genuinely synthetic scenarios without representing itself as a hospital programme. Research involving people, protected records, or actual service decisions enters a different sphere of permissions and responsibilities. The section therefore distinguishes the research conditions that can be independently constituted from the institution-specific authority that cannot be acquired merely by producing a good research design.

The argument draws selectively on several established contributions. The UNESCO Recommendation on Open Science links open scientific practice with human-capacity development, training, infrastructure, and diversity of knowledge systems (UNESCO, 2021). The Design-Based Research Collective treats the design and study of learning environments as mutually related processes, while attending to the contexts in which they are enacted (The Design-Based Research Collective, 2003). The National Academies' account of graduate STEM education identifies mentoring, learner development, and institutional support as relevant to research preparation (National Academies of Sciences, Engineering, and

Medicine, 2018). FAIR principles extend research stewardship beyond datasets to associated algorithms, tools, and workflows (Wilkinson et al., 2016). Artifact-evaluation practices in computing provide a concrete, though discipline-specific, example of distinguishing availability from functionality and reusability (ACM SIGSIM PADS 2024, 2024). None of these sources establishes that the proposed Commons will produce scientific results, and they should not be understood as a single unified disciplinary standard. The proposed extension is a relational account of the conditions that allow research capacities, questions, and contributions to arise and be reproduced across different academic communities.

14.1 Research Capacity as the Constitutive Object

For present purposes, *research capacity* denotes more than prior mastery of a technique. It includes the ability to recognise a researchable question, locate and criticise relevant sources, select and justify methods, work within applicable permissions, interpret uncertain findings, communicate limitations, and revise an inquiry in response to criticism. These capacities are situated rather than interchangeable: a mathematical proof, a legal argument, an archival reconstruction, an educational intervention, and a qualitative field study each require forms of competence that may overlap without becoming identical. A Commons that supplies open datasets but lacks appropriate contextual knowledge can make computation possible while leaving the scientific question obscure. A Commons that offers carefully written lectures but no opportunities to vary assumptions or challenge existing explanations may support learning without yet supporting research.

Definition 14.1 (Disciplinary value-creation infrastructure). A *disciplinary value-creation infrastructure* is a historically maintainable configuration of justified research questions, relevant knowledge and materials, method-bearing practices, situated guidance, legitimate access relations, and opportunities for independent critical contribution, through which participants may acquire or exercise the capacity to generate warranted and revisable disciplinary knowledge. Its institutional form and degree of formality depend on the subjects, discipline, available resources, applicable norms, and research purposes concerned.

The infrastructure's constitutive unit is a research opportunity rather than a platform, dataset, syllabus, or named mentor. Those artifacts matter only through the relations that make a worthwhile inquiry possible. A module can enable criticism that invalidates its own assumptions; that outcome may be intellectually generative even without a publishable novelty claim. Conversely, a person may complete tutorials and reproduce every baseline without possessing the time, support, or methodological freedom to formulate an independent question. We should distinguish *available capacity*, *actual research practice*, and *demonstrated results*. Their value is situated and may include a well-specified failure, a reusable negative result, or a revised problem description. Institutional design should support such outcomes without advertising them in advance as assured scholarly benefits.

The same definition allows different configurations. A small independent Commons may provide a literature map, open problem statements, synthetic datasets, annotated models, and modest community discussion. A mature academic consortium may add laboratory equipment, multiple supervisors, secure research environments, and formal educational recognition. These differences are significant for what participants can reasonably attempt, but the former need not pretend to be the latter. Institutional claims should communicate the actual available capacities, not an aspirational equivalence with an accredited research programme.

14.2 Three Reality Levels and Situated Disciplinary Possibilities

At the level of *ontological reality*, the proposed generative relational framework suspends claims concerning the ultimate status of knowledge, persons, social value, and scientific possibility. The fact that a scholarly environment is useful to a participant does not settle a metaphysical theory of scientific truth or individual creativity. The infrastructure design does not need such settlement to specify its activities, but neither may its documents be used to resolve these questions by administrative fiat.

At the level of *relational reality*, research capacities exist through histories of training, interpretive traditions, artifacts, instruments, mentorship, disagreements, permissions, and material resources. A mathematically defined optimization problem becomes investigable because particular representational conventions, algorithms, software, and communities of criticism are available. A legal argument becomes investigable because primary authorities, jurisprudential traditions, and interpretive competencies are connected. The same person may possess advanced methods in one field but lack the standing, language, or background needed in another. University mediation can sometimes shorten these distances, but formal membership or geographical nearness does not establish the requisite relations.

At the level of *manifestation reality*, a curriculum, bibliography, benchmark score, publication, contributor dashboard, or research completion certificate is a partial indication of those underlying relations. Downloads are not learning; runnable code is not a novel scientific contribution; a legal case collection is not competence in jurisprudence; a paper count is not a sufficient representation of the capacities that produced it. A Commons must use such records for legitimate coordination and critical evaluation while preventing them from becoming proxies for the whole subject or a predetermined measure of value. The distinction also changes what can reasonably be promised in an invitation: access to research materials may be offered; scholarly excellence, future publications, employability, and public-service impact cannot be guaranteed.

14.3 The Design of Researchable Environments

A disciplinary environment requires at least a defensible relation among a problem, its sources, the available methods, the permissions attached to those materials, and opportunities for the participant to vary or challenge the initial account. For design purposes, the Commons may record a proposed research module as the typed, time-indexed tuple

$$\mathfrak{D}_{d,t} = (\mathbf{P}, \mathbf{B}, \mathbf{E}, \mathbf{M}, \mathbf{I}, \mathbf{L}, \mathbf{U}, \mathbf{S}, \mathbf{H})_{d,t}, \quad (22)$$

where d identifies the disciplinary setting and t the recorded version; $\mathbf{P}$ is the question and its scope; $\mathbf{B}$ the relevant background and prior work; $\mathbf{E}$ the admissible evidential or experimental materials; $\mathbf{M}$ the methods and comparison standards; $\mathbf{I}$ the modes of inquiry and variation; $\mathbf{L}$ the legal, ethical, and institutional conditions of access and use; $\mathbf{U}$ the participant's feasible autonomy and contribution opportunities; $\mathbf{S}$ the available stewardship, guidance, and review relations; and $\mathbf{H}$ the historical provenance, versions, and revision reasons. Equation (22) is a descriptive checklist, not an optimization objective or a proof that the module is educationally effective. The position of each element is conceptually typed; it does not imply that all fields can be reduced to a common scalar metric.

Several dependencies are consequential. An accessible source may be legally unusable for a planned study; a permitted synthetic dataset may be too simple to distinguish competing algorithms; a technically sophisticated model may have no carefully justified connection to public-service conditions; an open research question may be so underspecified that only experienced specialists can work productively with it. Conversely, overdetermined tasks can leave a participant with no meaningful methodological discretion. A researchable environment therefore needs both *scaffolding* and *room for independent problem reformulation*. Guidance supports participants in acquiring competence, while open alternatives allow them to develop different questions and, where warranted, reject the framing furnished by the Commons.

A practical module review begins with a bounded task. Can a participant with the advertised prerequisites reconstruct the problem, lawfully obtain or generate its material, and conduct at least one credible baseline? Next, can that participant identify a nontrivial uncertainty whose answer has not been embedded in a tutorial solution, select an alternative method, and receive appropriately competent criticism? Finally, can a substantive failure or counterexample be preserved and reused by others without obliging the participant to donate additional labour? These questions isolate the opportunity to inquire from the later warrant of a particular conclusion. An elaborate curriculum is not a substitute for open research questions, and an expensive experimental stack may be unnecessary if a reproducible baseline and explicit uncertainty already permit meaningful inquiry.

14.4 Learning, Mentorship, and Independent Research Agency

Disciplinary learning and original research are related but separable activities. Participants often need orientation to the relevant theory and methods before they can productively criticise them. The National Academies' discussion of graduate preparation stresses the importance of research mentoring and attention to students' developmental needs (National Academies of Sciences, Engineering, and Medicine, 2018); this guidance is relevant as a design reference rather than evidence that every volunteer Commons should replicate the organisation of a graduate programme. In educational research, design-based approaches foreground the reciprocal testing of theory and situated learning arrangements (The Design-Based Research Collective, 2003). A Commons may adapt these insights by supporting modular pathways that allow participants with different backgrounds to enter without imposing a single age, academic status, or degree requirement.

Reading, reproduction, original investigation, and documented contribution are distinct possible engagements, not a compulsory ladder toward publication. Participants can enter through a methodological objection, pursue structured learning without claiming novelty, develop an unforeseen question, or withdraw after discovering that the opportunity is unsuitable. A Commons can make these options legible by recording prerequisites, available feedback, resource costs, known open problems, and the scope of contributors' rights. It should not advertise speculative coauthorship, institutional credentials, or guaranteed career gains as inducements to remain. The success of a pathway is judged against the opportunity it actually offers, not whether each entrant reaches the same endpoint.

Mentorship creates additional problems of power and distribution. An expert may legitimately assess mathematical correctness but not possess the authority to allocate clinical work or determine coauthorship unilaterally. A supervisor's availability may be scarce, and an ostensibly open environment can become inaccessible when real progress depends on informal contact with a small inner circle. For that reason, the module should indicate what guidance can actually be offered, which competencies its maintainers possess, how disagreements may be raised, and what a participant can do autonomously when mentorship is unavailable. The institution should also permit appropriate withdrawal, nonpublication, and independent continuation subject to the applicable rights in shared materials. Access to openly licensed research environments should not depend upon completion of hospital volunteer hours or other unpaid institutional service.

14.5 Engineering Research Through a Synthetic Scheduling Environment

Engineering provides a concrete illustration because the same general service-coordination question can support mathematical modelling, algorithmic research, experimental analysis, and normative criticism without access to actual hospital records. Consider a wholly synthetic collection of available volunteer agents V , candidate activity slots S , hypothetical activity types K , and resources R . A data generator produces explicitly fictitious availability, required competences, task coverage, location and time-compatibility constraints, and a range of disruption scenarios. Nothing in these symbols identifies an actual patient, hospital volunteer, or institutional timetable. The initial research object is to construct and compare candidate coordination procedures under declared conditions, not to select a schedule for a real hospital.

Let $x_{vs} \in \{0, 1\}$ indicate whether synthetic agent $v \in V$ is assigned to hypothetical slot $s \in S$. The module could introduce elementary coverage, eligibility, and workload constraints such as

$$\begin{aligned} \sum_{v \in V} x_{vs} &\geq d_s && (s \in S), \\ 0 \leq x_{vs} &\leq a_{vs} && (v \in V, s \in S), \\ \sum_{s \in S} h_s x_{vs} &\leq H_v && (v \in V), \end{aligned} \tag{23}$$

where d_s denotes a stated minimum synthetic coverage demand, $a_{vs} \in \{0, 1\}$ encodes declared availability and eligibility, h_s is the duration or workload of a slot, and H_v is a hypothetical workload bound.

Feasible coverage is not guaranteed, and the constraints are deliberately incomplete: simultaneous-slot conflicts, qualifications, rest conditions, site accessibility, task dependencies, and fairness require additional specification. The equation is an illustrative starting point, not an operational staffing policy. In particular, it does not support a claim that a volunteer's competence, safety, or consent can be inferred from a synthetic binary parameter.

The research value arises when the module explains its assumptions and offers meaningful alternative specifications. One investigator might study the relationship between mixed-integer programming and constraint programming under varying sparsity and disruption patterns. Another might examine a QUBO encoding, penalty calibration, feasibility restoration, and the scaling limitations of a chosen heuristic or quantum-inspired procedure. A third might study robust or stochastic optimization, comparing performance under specified uncertainty sets while making the hypothetical nature of those uncertainty distributions explicit. A fourth might challenge the framing itself: does aggregate coverage obscure voluntariness, burnout risk, unequal access to attractive assignments, or the interests of people who are not represented in the model? These research directions are connected by a shared object but cannot be collapsed into one performance leaderboard.

A minimally useful computational research environment would require at least a documented instance generator and its distributions, an elementary feasible example, an explicit infeasible example, one reproducible classical baseline, evaluable objectives and constraints, and a protocol for recording versions, hardware, software and random seeds. It should also explain which modelling choices were inherited from source literature, which were proposed by the Commons, which are contested, and which results remain unverified. These are prospective requirements, not a claim that the present paper supplies or has benchmarked such a software package. Research-artifact guidance distinguishes the availability of materials from their technical functionality and readiness for reuse (ACM SIGSIM PADS 2024, 2024); the Commons may draw on that distinction without claiming accreditation by the Association for Computing Machinery.

The separation from hospital activity remains exact. A scheduling problem based on synthetic data may provide original academic work while being unsuitable for actual service allocation. Operational feasibility would require different information and safeguards: competent activity definitions, authorised volunteers, real availability and consent, applicable organisational obligations, human review, safeguards for unforeseen events, and appropriate approval. A computation performed outside such a process gives no right to modify hospital schedules. The engineering module can nevertheless generate legitimate disciplinary value by identifying mathematical properties, error cases, complexity trade-offs, and alternative modelling approaches that later investigators may criticise or develop.

14.6 Jurisprudential, Historical, and Philosophical Research Environments

A legal research environment requires a different constitution. It may organise public primary authorities, judgments, institutional norms, interpretive disputes, and reliable scholarly commentary into a corpus where provenance, jurisdiction, date, and the relation between legal sources are recoverable. Students might investigate the contractual status of Commons contributions, the permissible reach of open licences, standards of institutional responsibility, or the interaction between organisational policies and professional duties. A corpus that mixes binding legal sources, academic interpretation, international recommendations, and draft Commons guidance without labeling their distinct authority is not an adequate infrastructure. The legal researcher must be able to verify source text, identify the competent legal order and temporal applicability, reconstruct competing arguments, and remain free to reach conclusions inconsistent with an initial Commons policy. The Commons's role is to provide the conditions for defensible inquiry, not to represent a provisional interpretation as legal advice or binding law.

A historical research environment would instead orient the participant toward primary records, archival provenance, institutional context, alternative reconstructions, and the consequences of preservation choices. An older handbook, for example, might support research into changing ideas of public service, but its survival does not show that the handbook was formally adopted, consistently practised,

or beneficial to participants. Source criticism and conflicting testimonies may be more significant than document volume. Professional historical standards explicitly treat reasoned interpretation and evidential integrity as essential to historical practice (American Historical Association, 2023). This does not establish one mandatory method for every regional or disciplinary tradition; it illustrates why historical inquiry cannot be measured solely by computational reproducibility or automated search accuracy.

In philosophy and ethics, infrastructure might consist of a carefully sourced conceptual genealogy, explicit competing positions, well-characterised cases, argumentative reconstruction, formal counter-models where appropriate, and forums for reasoned objection. The question of whether a contributor's participation is non-extractive, for example, cannot be settled by the number of downstream citations. It requires examining autonomy, rights, institutional power, expected benefits, responsibilities, and contestable normative premises. The Commons must distinguish the original authors' arguments from its own generative relational interpretations and must preserve dissenting lines of reasoning. A philosophical module is genuine when it makes stronger criticism and conceptual revision possible, not when it recruits participants to affirm the Commons's preselected values.

In all three environments, legitimate use of publicly accessible documents still depends on their actual rights and contexts. Publication of a legal judgment, an interview excerpt, or an institutional record does not erase all privacy, ethical, licensing, or downstream-use considerations. Appropriate research capacity includes knowing when an otherwise interesting question cannot be pursued with the materials currently available.

14.7 Educational and Social-Scientific Research Configurations

Educational research may examine how people encounter, learn, adapt, and contest the Commons's own research materials. A possible independent module could invite participants to compare versions of an open methodological tutorial, document their reasoning processes with voluntary participation, and consider whether the materials support independent problem formulation rather than rote performance. However, actual research involving human participants requires the relevant ethical, legal, and institutional analysis before recruitment or data collection. In the absence of such permissions, the Commons can still work on theoretical models, openly licensed instructional artifacts, synthetic responses identified as synthetic, and transparent design conjectures. Design-based research supplies one methodological reference for iterative relations among learning theory, designed environments, and practice; it does not license a claim of effectiveness before an appropriate study has been conducted (The Design-Based Research Collective, 2003).

Social-scientific inquiry may begin with public policy documents, open aggregate data, or theoretical accounts of governance and collective action. Modules could compare alternative assumptions about participation costs, institutional mediation, or the distribution of recognition. The Commons should identify what counts as causal evidence, descriptive evidence, normative appraisal, or purely illustrative modelling. A questionnaire devised by an independent researcher is not yet evidence of any volunteer's motives. A simulated population is not an empirical sample. An elegant network model does not demonstrate the historical formation of a real institution. The research environment must therefore support critical examination of its own representational and sampling limits as well as opportunities to generate new hypotheses.

These environments can offer independent research opportunities without producing commensurable results or a shared authority to act. The infrastructure's output is a *researchable opportunity* with feasible access to methods, critique and lawful materials, not a guarantee that participants will generate original knowledge. A mathematics module may yield a rigorous negative result; a jurisprudential module may identify an unresolved jurisdictional disagreement; a historical module may expose a gap that cannot justifiably be filled. Such outcomes can each be meaningful within the relevant disciplinary standards. The distinct mediation task in Section 15 begins only when one inquiry's claim, terminology or artifact is proposed for use in another. At that point the receiving discipline must identify a purpose and independent conditions of warrant; the fact that an opportunity was well-designed in the originating discipline does

Table 19: Illustrative disciplinary research environments and non-equivalent conditions of adequacy. These are design questions, not completed programme descriptions or validated criteria.

Inquiry setting	Candidate infrastructure	Necessary critical distinction
Engineering	Formal tasks, synthetic generators, models, baselines, experiments	Reproducible computation versus authorised service use
Education	Learning theory, adaptable materials, questions about learning	Pedagogical design versus demonstrated effect on participants
Law	Versioned authorities, case relationships, competing interpretations	Source accessibility versus legal validity or advice
History	Archival provenance, context, alternative reconstructions	Document survival versus warranted historical understanding
Philosophy and ethics	Conceptual arguments, objections, cases, normative premises	Internal coherence versus settled practical legitimacy
Social science	Explicit constructs, public data, research designs, uncertainties	Hypothetical models versus empirical or causal inference

not supply those conditions.

14.8 Constitution, Stewardship, and the Distribution of Research Opportunity

The infrastructure must be constituted and maintained. Research environments require sustained work in literature assessment, rights verification, source updating, problem specification, methodological testing, accessibility, criticism, and the retirement of defective materials. The UNESCO open-science recommendation explicitly recognises capacity building, training, and open-science competencies alongside research infrastructures (UNESCO, 2021). Yet those functions have real costs, and the recommendation by itself does not provide funding or determine how responsibilities should be allocated in a particular Commons. Software maintenance, expert mentoring, legal source revision, multilingual editing, and historical curation can consume substantial resources even when the outward-facing materials are freely accessible.

These costs raise political-economic questions. An open repository may depend upon a single unpaid steward who cannot respond to new users, or upon junior contributors who maintain public infrastructure without appropriate recognition. A sophisticated computational environment may favour people with powerful hardware or prior technical training. An ostensibly cross-disciplinary resource may privilege the concepts and publication practices of its founding discipline. The Commons should document prerequisites, actual guidance capacity, contributor roles, accessible lower-cost alternatives, known exclusions, and the rights under which material can be independently reused or forked. Contribution credit must be traceable, but acknowledgement does not itself resolve the fair distribution of workload, opportunities, or economic benefit.

Infrastructure coupling clarifies additional boundaries. Public-problem constitution justifies the research question and affected interests; normative and safety functions determine permissible activities; information-sharing and historical functions make materials identifiable and reconstructible; epistemic validation examines particular claims; communication and participation functions allow people to encounter opportunities without coercion; decision-making functions may compare alternatives; provenance and value-return mechanisms govern recognised contributions and lawful downstream opportunities. The disciplinary environment coordinates these capacities for inquiry, but it cannot substitute for any one of them. Its independence is especially important: a Commons may legitimately support an academic project even where no hospital wishes to cooperate, and it should not imply that subsequent institutional participation is the price of having learned from public resources.

Different institutions may constitute these functions through different arrangements. An independent researcher may maintain one carefully specified open problem and a small source archive. A student association may organise peer review, mentorship by invitation, and periodic maintenance. A formal

university group may support advanced equipment and institutional research procedures. What matters for comparative analysis is whether participants can identify the actual available opportunities, exercise justified autonomy, obtain competent criticism appropriate to the claims at issue, and retain appropriate rights. Institutional form changes the feasible scope and oversight; it does not make any particular configuration a universal template.

14.9 Failure Conditions, Evaluation, and Historical Reproduction

A research-capacity test should compare participants attempting a bounded original question with otherwise similar learners who receive only the conventional reading list and baseline tutorial. Observe whether each can formulate a defensible alternative, obtain necessary lawful inputs, test against relevant counterexamples, understand substantive critique, and preserve a usable contribution or a well-documented failure. Distinguish new opportunity from prior technical ability, external mentoring, selection effects, and the extra time supplied by the intervention. One successful student does not establish that the infrastructure generated the ability; evidence is stronger where the specific missing condition is identified and the revised arrangement helps resolve it at acceptable cost. A simpler existing laboratory, seminar, or repository may already perform the function adequately.

The distinctive test is whether a participant can move beyond consumption of a prepared lesson. For a synthetic scheduling module, a newcomer should be able to identify the original research assumptions, reproduce an appropriate baseline, propose an alternative fairness or robustness question, and justify a method for evaluating it. The module need not guarantee a publishable finding, nor require hospital volunteering as an entry condition. A collection of tutorials may meet a pedagogical aim without constituting a research environment; conversely, an intricate benchmark may be unsuitable if only its maintainer can execute it. Maintenance responsibilities therefore include keeping methodological prerequisites, low-cost baselines, unresolved problems, and permissions intelligible as the research field changes.

The most revealing failures are functional rather than cosmetic. A perfectly documented module may offer only predetermined exercises; a technically sophisticated module may depend on unavailable computing capacity; a legally reusable corpus may lack the context required to formulate an intellectually serious question; and an apparently open mentoring environment may be sustained by unrecognized junior labour. A hospital-related benchmark may be excellent mathematics yet misleadingly promoted as an operationally validated system. A response should match the failure: introduce real open alternatives, lower execution costs, improve methodological support, correct public claims, or stop a module whose stewardship burden exceeds its actual opportunities. The goal is to preserve participants' capacity to ask new questions, including questions that challenge whether the module should continue.

The historical object is therefore not merely a sequence of successful student projects. It includes records of why a problem was framed in a certain way, which methods were available, how failures were interpreted, what contributors could legitimately use, which forms of guidance existed, and what capacities later participants were able to develop. The precise effect of such an infrastructure on learning, research originality, or public value remains an empirical question, and the present manuscript does not supply those outcomes. Its theoretical proposal is narrower and more useful: a Commons becomes a potential site of disciplinary value creation when the institutional conditions for *autonomous, informed, criticisable, and historically reusable inquiry* are made available and responsibly maintained. The following section examines a related but distinct task: the mediation and translation required when those disciplinary environments encounter one another.

15 Interdisciplinary Mediation and Knowledge Translation

A disciplinary research environment can support rigorous work while remaining difficult to connect to another field's questions. The present section develops the distinct institutional capacity to establish *qualified relations between non-equivalent research claims and practices*. A synthetic scheduling objec-

tive may be mathematically specified, a historian may question the category of availability, and a jurist may ask whether the proposed activity has lawful authority. None of these contributions automatically validates, supersedes, or translates the others. Interdisciplinary mediation concerns the explicit interfaces through which their objects, assumptions, inferential uses, and disagreements can be made mutually intelligible without compelling participants to accept one vocabulary or one standard of value. It does not supply the disciplinary tools themselves or certify the claims that travel through the interface.

This argument builds on established scholarship rather than treating mediation as a discovery of the proposed generative relational framework. Star and Griesemer's historical analysis of a natural-history museum describes cooperation among heterogeneous social worlds through standardised methods and *boundary objects* that remain adaptable to local uses while retaining sufficient common identity (Star and Griesemer, 1989). Star subsequently cautioned against treating any flexible shared item as a boundary object without studying its work arrangements and the relation between relatively ill-structured common uses and more specialised local uses (Star, 2010). Carlile distinguishes syntactic, semantic, and pragmatic knowledge boundaries, relating them to transfer, translation, and transformation of knowledge in innovation settings (Carlile, 2004). Akkerman and Bakker's review identifies identification, coordination, reflection, and transformation as potential learning mechanisms associated with boundary crossing (Akkerman and Bakker, 2011). Galison's account of trading zones in experimental physics illustrates forms of historically situated local coordination across different technical traditions (Galison, 1997). These contributions provide differentiated theoretical resources; they are not interchangeable classifications, nor do they establish that any particular hospital-related research network already possesses a successful mediation practice.

The proposed extension is an institutional design account of how such encounters may be constituted and maintained while preserving the distinction among conceptual translation, the validity of a claim, the rights attached to an artifact, and the authority to apply a result. The aim is a conditional design grammar, not a universal interdisciplinary protocol. It must be possible for a proposed connection to remain partial, controversial, costly, or inappropriate.

15.1 Heterogeneous Research Relations as the Constitutive Object

An interdisciplinary relationship is not established merely because individuals from two fields attend the same meeting or access a common document. At minimum, the participants must be able to recognise what is being exchanged, what remains field-specific, which questions a proposed exchange can help answer, and how differences that matter to the inquiry will be handled. Research in mathematical optimisation may regard the feasibility of an explicitly defined model as its immediate concern. Research in jurisprudence may ask whether an action, permission, or assignment has a valid normative basis in an identified legal order. An historian may investigate why an institution came to classify a service in a particular way. An educational researcher may examine how people learn to recognise and perform the activity. These questions can be connected by a shared practical situation without receiving a common answer.

Definition 15.1 (Interdisciplinary mediation infrastructure). An *interdisciplinary mediation infrastructure* is a historically maintained configuration of participants, interpretive resources, translation practices, contestable interfaces, and situated responsibilities through which differently constituted research communities may establish qualified relationships among their questions, artifacts, claims, and practices, without presuming their epistemic, normative, or institutional equivalence. The relevant design may include shared records or artifacts, but its effectiveness depends on actual interpretive and cooperative relations rather than the existence of those artifacts alone.

The qualifier *qualified* is essential. A synthetic scheduling model might be usable as a formal illustration within a sociology seminar, yet unsuitable as evidence about real volunteer preferences. An ethical analysis might disclose a previously unrecognised constraint on a proposed algorithm without specifying its computational implementation. A historical account can expose a change in institutional vocabulary

while leaving its causes contested. Mediation is sometimes productive precisely because a contribution from one field prevents an overly confident inference in another. Its value cannot therefore be measured by the number of occasions on which all participants agree, nor by the speed with which questions are converted into code.

In a small independent Commons, a mediation function may be enacted by an annotated research note, a discussion between two qualified participants, and a record of unresolved terms. In a larger collaboration, it may require domain reviewers, translators of specialist concepts, jointly governed working groups, and arrangements for allocating maintenance burdens. The design should be proportionate to the risks, resources, and actual knowledge boundaries. It should neither demand the costly machinery of a mature consortium from a single researcher nor represent a loosely associated discussion forum as an institutionally endorsed interdisciplinary laboratory.

15.2 Three Reality Levels and the Limits of Shared Representations

The three analytical reality levels of the proposed generative relational approach clarify what a mediation infrastructure can claim. At the level of *ontological reality*, the analysis suspends ultimate claims about whether a discipline's concepts exhaust the nature of persons, values, institutional relations, or knowledge. Neither a legal category, a mathematical state variable, a sociological narrative, nor an archival label should be taken as a final account of the being it addresses. This suspension does not abolish standards of inquiry. Rather, it prevents the common representation chosen for collaboration from being mistaken for a complete metaphysical description.

At the level of *relational reality*, disciplines and their objects have historically constituted relations: practices of training, instruments, source conventions, languages of justification, authorised offices, rights, professional responsibilities, and communities capable of criticism. Some participants can use a model as an experimental artifact while others relate to its proposed application through duties of care or interpretive responsibilities. Such relations are real in the provisional explanatory sense adopted by the paper because they condition what participants can know and do. They also evolve. A translation that worked in one historical setting may cease to work when an institutional rule, disciplinary method, or affected population changes.

At the level of *manifestation reality*, a bilingual glossary, shared diagram, dataset schema, dashboard, model card, joint workshop, or public paper is a partial presentation of these relationships. The existence of a common label does not demonstrate common interpretation. A diagram with arrows between disciplines does not establish that contributions can legitimately circulate along them. The publication of a joint statement need not disclose suppressed disagreement or unequal authority. Conversely, a recorded dispute can be a useful manifestation of a functioning mediation process when it preserves incompatible yet well-grounded reasons. The three levels therefore direct attention to the incompleteness and historical conditions of the artifacts through which cooperation becomes visible.

This distinction has a practical consequence for Commons evaluation. Counts of interdisciplinary meetings, joint authorships, shared repositories, or vocabulary alignments may indicate activity, but they cannot by themselves establish understanding, ethical legitimacy, or the reproduction of independent disciplinary capacities. A stronger test asks whether a participant can reconstruct a neighbouring discipline's claim in terms acceptable to a competent representative of that discipline, identify its limitations, and specify what further work would be required before it could influence another inquiry.

15.3 Knowledge Boundaries, Translation Tasks, and Non-Equivalence

Carlile's syntactic, semantic, and pragmatic distinctions provide one useful point of departure (Carlile, 2004). When parties share relevant meanings and interests, exchanging a well-formed representation may be sufficient for a narrow task. When meanings differ, interpretation and negotiation become necessary. When forms of knowledge are implicated in different interests or established practices, collaboration may require the parties to transform their respective arrangements rather than merely exchange or

Table 20: Illustrative interdisciplinary boundaries and bounded mediation tasks. The entries describe design questions, not empirically validated workflows or transferable permissions.

Boundary object of inquiry	Possible mediation task	Inference that remains unwarranted
A shared technical term	Record local definitions, units, provenance, and differences	Identical language entails identical concepts or evidential standards
A scheduling model	Map variables to a stated hypothetical activity, its omissions, and alternatives	Formal feasibility demonstrates operational suitability or consent
A public normative document	Identify source type, competent jurisdiction, temporal scope, and rival readings	A published source or ethical ideal is universally binding
A historical case	Reconstruct context, source selection, missing voices, and competing interpretations	Similar past arrangements imply present legitimacy
A learning or participation measure	Clarify population, constructs, instrument, uncertainties, and context	Recorded engagement measures welfare, autonomy, or service quality

translate information. The order is an analytic aid for diagnosing some boundaries, not a claim that all interdisciplinary relations proceed through three fixed phases.

A qualified interface can address four different translation tasks. Terminological mapping identifies reference objects, units, historical usage, and meanings that do not match. Inferential mapping states which argument or result can be used for which target question, with what conditions and exclusions. Practical coordination identifies where field-specific findings affect a shared design without transferring decision authority. Normative boundary review indicates when a proposed joint use requires permissions or expertise not possessed by the participating researchers. These tasks may be recorded in a jointly annotated artifact rather than a permanent committee. Agreement on a shared noun is weak evidence of inferential compatibility, while explicitly recording a non-equivalence can prevent a consequential category error.

Table 20 sets out illustrative distinctions. The table does not specify a ranking of disciplines or a standard sequence of collaboration. It helps identify which question is being negotiated at a particular interface.

The same research question may generate multiple interfaces rather than one settled interdisciplinary synthesis. A scheduling model may need mathematical refinement, historical examination of its task categories, inquiry into participants' preferences, and review of permissible use. Each line of inquiry can remain autonomous. A sound interface makes the conditions under which one line informs another explicit, including cases in which no inference should be drawn. Incommensurability need not be treated as permanent hostility; it can signal that a provisional interface is limited or that a different cooperative object is needed.

15.4 Boundary Objects and the Design of Interpretive Interfaces

The concept of a boundary object is attractive for an interdisciplinary Commons because shared artifacts are relatively inexpensive to distribute and may invite multiple disciplinary interpretations. Yet the historical literature cautions against equating distribution with successful translation. Star and Griesemer identified repositories, ideal types, coincident boundaries, and standardised forms in their study of heterogeneous cooperative work (Star and Griesemer, 1989). Star's later reflection insists that interpretive flexibility must be understood together with the particular information and work-process arrangements involved (Star, 2010). A synthetic dataset, protocol, problem record, or diagram is therefore at most a *candidate* boundary object until one examines whether it actually mediates different local practices while preserving a workable common identity.

A shared problem record can function as a boundary object when its referents remain sufficiently stable for coordinated work while its disciplinary annotations stay distinct. An optimization researcher may treat a proposed demand variable as a modeling choice; an education researcher may investigate its implications for training; and a legal scholar may examine the authority needed to measure or act on the variable. The record should identify the originating claim, the status of each annotation, and any subsequent transformation of the question. It must not silently convert an ethical concern into a numeric coefficient, or a legal question into a statement that a hospital has granted permission. A short annotated record can be adequate where a more elaborate shared ontology would impose false uniformity and substantial upkeep.

An overly standardised form can produce the opposite effect. Requiring every concern to be translated into a numerical optimisation objective may suppress arguments about dignity, non-coercion, and legitimate authority. Requiring all technical evidence to be reduced to a narrative statement may prevent competent review of model assumptions or computational error. In both cases, the supposed boundary object becomes a one-way instrument of assimilation. A more adequate design may preserve parallel field-specific representations and a deliberately limited mapping between them. The absence of a mapping can itself be recorded as a research problem rather than concealed as a missing database field.

Galison's historically situated *trading zones* suggest another model of local coordination among participants who do not adopt a single disciplinary culture (Galison, 1997). Such local interfaces may be sufficient for a specific joint task; they need not become universal ontologies. The Commons should accordingly distinguish reusable translation resources from temporary negotiated agreements. Both require historical care, but their validity, participants, and maintenance commitments may differ substantially.

15.5 A Provisional Grammar of Qualified Translation

The preceding distinctions motivate a design instrument rather than a formal claim that disciplinary meanings can be perfectly translated. Let d and e denote two situated disciplinary practices at time t , let q_d identify a question as formulated in d , and let a_d be an artifact or claim with its original source, scope, and review status. We propose recording a *qualified translation attempt* as

$$\mathfrak{T}_{d \rightsquigarrow e, t} = (q_d, a_d, \mu_{d,e}, \omega_{d,e}, \lambda_{d,e}, \pi_{d,e}, \rho_{d,e}, \sigma_t), \quad (24)$$

where $\mu_{d,e}$ describes the proposed conceptual or methodological mapping, $\omega_{d,e}$ its evidential warrant and known omissions, $\lambda_{d,e}$ the limitations and rival interpretations, $\pi_{d,e}$ the permissions and institutional authority boundaries, $\rho_{d,e}$ the responsible participants and avenues for criticism, and σ_t its recorded historical state. These components are *typed descriptions* established by situated inquiry, not numerical variables whose presence validates the translation. The symbol $\rightsquigarrow$ denotes an attempted directional relationship, not a logical implication or claim of reversible equivalence.

A useful mediation record should also distinguish its *intended inferential use*. Translating an accessibility concern into a provisional constraint for a purely synthetic scheduling experiment is a different task from using that model to recommend a change to an authorised service. The first may proceed within an independent scholarly environment if the materials and rights permit it. The second depends on evidence concerning actual operations, applicable norms, the views of affected participants where appropriate, and authorisation by competent bodies. The Commons may record that an operational question exists; it cannot certify its own right to implement an answer.

The asymmetric and potentially incomplete nature of translation is important. Let $\mathcal{Q}_{d \rightarrow e, t}(a_d)$ denote the set of uses of a_d that have been *specifically justified* for an inquiry in discipline e by the competent participants, given the evidence and permissions presently available. Then the design principle is

$$\mathcal{Q}_{d \rightarrow e, t}(a_d) \subseteq \mathcal{U}_{e, t}(a_d), \quad \mathcal{Q}_{d \rightarrow e, t}(a_d) = \emptyset \text{ is permitted}, \quad (25)$$

where $\mathcal{U}_{e, t}(a_d)$ is the set of uses conceivable within the target inquiry, not necessarily lawful or warranted. The subset relation records only that justified uses are selected from conceivable uses in the receiving inquiry; such a set may remain empty when evidence, resources, or permissions do not support

any transfer. No reverse relationship is presumed. The codomain of a possible translation back into the originating discipline would differ and any partial map would require a separate argument. Equation (25) is a bookkeeping discipline, not a theorem establishing valid translation, and even membership in a proposed justified-use record remains subject to review. In particular, $Q_{d \rightarrow e,t}(a_d)$ is *purpose- and evidence-indexed*: a translation justified for independent model criticism cannot be silently re-used as an instruction to change service practice. Translation warrant, artefact licence, competent operational delegation, and affected-person assent are distinct claim types. The formal subset does not create a closed set of legally usable actions.

A proposed translation can be retained with the versions of both source and receiving questions, exposed to criticism, restricted to one use, or explicitly retired. The record allows a later scholar to ask what was preserved, which assumptions changed, and why a mapping was accepted or declined. In particular, *semantic intelligibility*, *epistemic warrant*, *rights to reuse*, and *authority to implement* are separately reviewable. A translated accessibility concern may be intelligible as a scheduling constraint without being adequately supported as a measure of lived burden; a sound constraint analysis may be published without authorising a coordinator to use it. The receiving inquiry should identify a revised claim with its own evidence status rather than inherit the status of the source statement. The source and target may remain linked even when no action is warranted. This disciplined partial transfer preserves the possibility of original interdisciplinary scholarship while allowing a simpler explanatory note to prevail when a formal mapping adds no reliable inference.

15.6 Mediating Roles, Standing, and Disciplinary Power

A Commons cannot solve interdisciplinary mediation merely by appointing a generalist who is presumed competent in every field. A mediator's contribution may lie in identifying a mismatch, asking for an appropriate expert, constructing an accessible explanation, preserving disagreement, or coordinating revision. Each action has different competence requirements. A mathematically trained convenor may recognise that a qualitative description cannot support a stochastic parameter estimate, yet lack the expertise or authority to decide which qualitative study would be adequate. A lawyer may clarify the distinction between a licence and an institutional approval without thereby validating a computational experiment. Participants retain responsibility for the claims they are competent to make, and the Commons must not treat central administrative access as a substitute for field-specific expertise.

The proposed design should distinguish an *originating contributor*, who defines a claim within one research setting; a *receiving investigator*, who states how that claim would be used elsewhere; a *mediator*, who documents the proposed relation and its limits; and a *domain reviewer*, who examines particular interpretations within an appropriate competence. A person may perform more than one role, especially in a small project, but role combination should be disclosed where it reduces critical independence. A Commons steward may decide which records it publishes while lacking authority to decide whether the recorded scientific or legal claim is correct.

An interface also redistributes epistemic visibility. The field controlling a model, meeting agenda, translation language, publication venue, or funding may make its categories appear naturally shared. A volunteer's account of an unrecognized burden may be flattened into a scheduling penalty; a mathematical feasibility result may acquire unjustified normative force; an administrator may purport to represent patient interests without a basis for doing so. The mediation record should disclose who proposed each mapping, whose interpretation is absent, what evidence would permit revision, and who bears the continuing translation work. These controls do not require universal access to restricted information or identical authority for every participant. They require that the limits and asymmetries of the claimed collaboration remain open to criticism.

A useful governance practice is to record which viewpoints have been directly expressed, which have been inferred, which have been excluded by legitimate restrictions, and who has standing to challenge those representations. This does not confer rights of access or representation that the Commons does not possess. Where a real institutional decision may affect vulnerable persons, the appropriate external

authority and safeguards remain indispensable. For independent scholarly inquiry, the ability to publish reasoned dissent, withdraw one's contribution within applicable terms, decline a collaborative role, or pursue a separate research question is likewise central. Voluntary cooperation is not demonstrated by agreement obtained through prestige, dependency, or the promise of future scholarly credit.

15.7 A Synthetic Scheduling Problem Across Research Traditions

A wholly synthetic volunteer-scheduling example illustrates the design without pretending to describe an actual hospital. Suppose an engineering module defines hypothetical agents, activity slots, eligibility indicators, and coverage constraints, as in Equation (23). Within mathematical optimisation, a legitimate first inquiry might compare the feasibility properties of a mixed-integer formulation and a constraint-programming formulation. The relevant objects are synthetic instances and precisely stated constraints. Their existence does not establish that the represented activities would be desirable, safe, or compatible with real volunteers' preferences.

A legal researcher may ask what an institution would need to establish before collecting availability data, assigning responsibilities, or adopting a recommendation. The inquiry must specify the applicable jurisdiction, institutional form, kind of relationship, and relevant primary authorities. It may identify uncertainties without producing an immediate definitive legal answer. An ethicist may ask whether the modelling objective treats the contributor as a freely choosing person or merely as an allocable unit, while distinguishing moral critique from positive legal obligation. A social scientist may investigate the conceptual difference between formally recorded availability and a person's experienced ability to accept an assignment. Without a separately justified empirical design, that question cannot be answered by filling missing synthetic variables with invented survey findings.

A historian might investigate the emergence of assignment categories in publicly documented forms of volunteer work, paying attention to records, institutional periods, absences, and changes in terminology. An education researcher may develop a hypothetical training study concerning how novices learn to recognise role boundaries or read a model's assumptions. In each case, the participant can use the common problem to form a discipline-specific inquiry while maintaining independent standards for what a warranted conclusion would be. The disciplines are related by a situated problem and a record of translations, not by a claim that their explanatory objects are identical.

Suppose the historical inquiry reveals that an older term for "available" referred to a social obligation rather than an unconstrained personal choice. That discovery might lead a modeller to reconsider the interpretation of availability data; it would not automatically supply a numerical coefficient. A legal inquiry might identify that a proposed data-sharing arrangement requires prior authorisation under the relevant circumstances; this may require the research design to change or stop, rather than merely add a penalty term to an optimisation function. A social-scientific criticism might disclose that apparent optimisation gains conceal unequal burdens for some hypothetical participants; the engineer can explore alternative synthetic fairness definitions while explicitly marking the absence of evidence for real-world welfare effects.

A candidate interdisciplinary artifact may consequently consist of a problem record, separate field-specific analyses, a controlled vocabulary of disputed terms, and qualified links between claims. The Commons should record which claims were amended, which objections remain unresolved, and which proposed inferences were rejected. Such a result may be more valuable than a unified score claiming to rank fairness, efficiency, legality, and dignity on one scale. Importantly, nothing in this example uses a hospital's real schedule, patient records, staff information, or volunteer identities. Any subsequent practical project would require a fresh institutional and evidential examination rather than inheriting permission from the illustrative research.

15.8 Institutional Constitution, Maintenance Burdens, and Interfaces

The design of mediation infrastructure should begin with actual problems of interpretation rather than require permanent cross-disciplinary machinery in advance. An independent project may identify a pair

of related research modules, state the disagreement that motivates translation, invite appropriate review, and maintain a small number of traceable records. A university research group may provide seminar forums and trained interlocutors. A multi-institutional partnership may require explicit arrangements for authorship, document access, translation labour, dispute handling, financial responsibilities, and the status of statements issued jointly. The same function can thus be realised through different procedures, institutions, and material supports.

Mediation carries costs that are easily rendered invisible. Producing a bilingual disciplinary glossary, explaining research methods to newcomers, rechecking an outdated legal classification, responding to repeated category errors, and maintaining shared artifacts all require time and competence. A Commons that expects students or unpaid volunteers to carry these burdens indefinitely can become extractive despite generous licences or a persuasive rhetoric of collaboration. Responsibilities should be scaled to available resources, attributable where appropriate, and made open to negotiation. A project may reasonably limit its interdisciplinary scope when it cannot provide competent interpretation or maintenance. This restraint may protect future generative capacity better than a larger catalogue of nominal connections.

Several interfaces require distinct stewardship. The information-sharing infrastructure manages visibility, versions, and authorised access to resources; mediation addresses meaning across disciplinary contexts. Epistemic validation examines whether particular claims are warranted; mediation cannot substitute a generic joint endorsement for field-specific scrutiny. Normative and governance infrastructures address rights, institutional responsibilities, and legitimate collective decisions; a translation meeting cannot confer external research approval. Historical preservation records the origins and later interpretation of mediating relations, while contributor-provenance infrastructure identifies authorship and derivative dependence. Communication infrastructure may publicise an interdisciplinary project, but it must not present exploratory synthesis as demonstrated impact. These interfaces are connected but should preserve their respective functions.

Collaboration agreements can document intended purposes, scope, responsibilities, allocation of shared work, publication expectations, and routes for revising arrangements. Their status depends on applicable law and competent adoption; an independent Commons cannot assume that a draft agreement binds a university, hospital, research ethics body, or absent contributor. Shared knowledge production may be possible through deliberately narrow arrangements that preserve independent branches of inquiry. Likewise, the refusal to combine two modules may reflect appropriate methodological or normative judgment, rather than organisational failure.

15.9 Evaluation, Failure Conditions, and Historical Revision

The evaluation of interdisciplinary mediation should test particular epistemic and institutional functions rather than presume that more disciplines or more interaction produce better outcomes. A prospective reconstruction exercise could ask a new participant to read a qualified translation record, identify the originating claim and evidence, reconstruct the proposed receiving use, state two limitations, and locate the required permission or review boundary. A domain reviewer could examine whether the record materially misrepresents the source field. Participants from different fields could each explain where the shared object supports their inquiry and where it ceases to do so. Such exercises would provide situated evidence of specific interpretive capacities, not a general measure of interdisciplinary success.

A concrete mediation trial can follow the word “fairness” through a scheduling model, a volunteer’s account of burden, an ethical argument, and a jurisdiction-specific legal analysis. Ask each participant to identify the proposition available in their own domain, an intended downstream use, and at least one inference the translation cannot support. Then compare the original and translated statements for preservation of uncertainty, scope, and disagreement. An interface fails when mathematical equity is announced as a legal verdict or an affected person’s concern disappears from the joint document. A short, jointly annotated meeting record can outperform a permanent interdisciplinary office if it prevents these errors at lower cost. This outcome does not validate every constituent claim; it validates the adequacy

of a particular interpretive interface for a specified purpose.

The relevant failures can be distinguished by where the relationship breaks. *False equivalence* silently identifies different concepts; *epistemic laundering* treats translated claims as better evidenced than they were; *authority laundering* substitutes multidisciplinary approval for the competent institution's permission; *translation capture* privileges the vocabulary of the most powerful group; and *maintenance asymmetry* leaves less visible contributors responsible for repeated interpretive repair. These are analytic possibilities, not observed prevalence estimates. Appropriate responses include explicitly marking an untranslatable inference, reopening an affected interpretation, separating independent modules, or cancelling a joint claim. Successful mediation need not culminate in consensus or a new collective product.

An adequate revision practice would preserve the original disciplinary claims, versioned translation attempts, relevant objections, decisions about publication or implementation, and the reasons for accepting, narrowing, rejecting, or retiring an interface. Where public preservation would infringe confidentiality, privacy, or legitimate withdrawal expectations, historical recoverability must be pursued through narrower lawful records or accepted as limited. Preservation is not an entitlement to disclose. Equally, the ability to retire a failed interface should be understood as a feature of a critically revisable Commons. Some disagreements may remain open across multiple institutional generations and later become productive in new settings.

The infrastructure's proposed generative contribution is therefore conditional. It can make new questions visible, prevent unjustified transfers of authority, help participants retain distinct research identities, and sustain interpretable pathways for subsequent collaborative work. It may also introduce complexity, unequal burdens, or conflicts that undermine participation. Whether the resulting arrangement produces actual value for participants or public service cannot be inferred from its design alone. The relevant task of institutional engineering is to establish the conditions for justified encounters among heterogeneous disciplines, preserve the reasons and limits of those encounters, and provide legitimate means by which later participants can criticise, transform, or discontinue them. This account prepares the subsequent analysis of public communication, which concerns how proposed research and opportunities become responsibly visible beyond their immediate disciplinary communities rather than how their meanings are negotiated within them.

16 Communication, Public Engagement, and Independent Publication

The previous chapters distinguish resource discoverability, claim-specific warrant, disciplinary inquiry, and qualified translation. None determines whether a person outside the Commons encounters an intelligible and accurately scoped public message or can respond to it. The communication infrastructure concerns those relations: identifying a public, selecting a purpose and channel, representing provisional research and institutional standing without distortion, hearing criticism, and distributing corrections where feasible. A technically sound project page may fail to reach the people whose questions it could serve; an attractive invitation may reach them while obscuring effort, permissions, or uncertainty. The outcome sought is *informed public encounter and answerable expression*, not maximal attention, automatic trust, institutional endorsement, or volunteer enrolment.

The proposed approach is informed by established communication and participation scholarship. The National Academies' research agenda describes science communication as a situated activity whose purposes, participants, messages, media, and sociopolitical environments influence what can be understood or achieved (National Academies of Sciences, Engineering, and Medicine, 2017a). The UNESCO Recommendation on Open Science includes science communication, open engagement of societal actors, and dialogue with other knowledge systems among its pillars, while identifying inclusive multilingual access as an aspiration of open science (UNESCO, 2021). The OECD's guidelines for citizen participation distinguish informing people about a process, creating genuine opportunities for input, explaining the treatment of that input, and evaluating participation (Organisation for Economic Co-operation and Development, 2022a). These sources do not establish a universal communication technique or demonstrate

the effectiveness of the particular Commons proposed here. They instead help specify design questions that cannot be answered by choosing a website, a publicity channel, or a visual identity alone.

The analysis is intentionally international and institution-independent. A Commons may be constituted by an independent researcher, a voluntary association, a research collaboration, or another lawful arrangement. Its public identity, legal capacities, and relationships with universities or hospitals depend on its actual constitution. In particular, a statement about a university-hospital research problem is not, solely by virtue of its subject, an official hospital announcement. Communication must preserve the boundary among independent theoretical or synthetic research, independently authorised hospital volunteer service, and separately authorised human-participant or restricted-data research. The section therefore examines communicative agency, public-facing claim status, independent publication, project presentation, accessibility, engagement, ethical persuasion, maintenance, and historically revisable evaluation.

16.1 Communicative Relations and Their Constitutive Object

Communication infrastructure is not identical to an inventory of messages or a publicity office. It consists in the historically maintained conditions through which persons and organisations may create, encounter, interpret, question, and respond to situated expressions. These conditions include languages, communicative practices, persons with responsibilities, publication channels, rules of attribution, methods of checking claims, opportunities for feedback, and the material resources needed to sustain the relationships. A public project page may contribute to such infrastructure when readers can identify what the project is, who speaks for it, what claims are warranted, and how concerns can be raised. A page that names an ambitious future programme but obscures the absence of authorised activities may undermine the same relations it purports to establish.

Definition 16.1 (Communication and public-engagement infrastructure). An *institutional communication and public-engagement infrastructure* is a context-dependent configuration of communicative agents, representational artifacts, channels, interpretive supports, answerability procedures, and stewardship relations that permits relevant publics to encounter, interpret, contest, and, where appropriate, participate in the development of an institution's stated questions, activities, and knowledge. Its operation is qualified by the speakers' actual authority, the status of the claims communicated, the rights of affected subjects, and the availability of meaningful responses.

This definition does not require permanent public debate, unrestricted disclosure, or the formation of a new legal corporation. It identifies functions that can be realised in very different organisational forms. A small independent project may operate through a versioned research note, a clearly identified contact channel, a modest public description, and periodic replies. A multi-institutional collaboration may need delegated spokespeople, language review, consultation procedures, media coordination, and documented approval paths. Neither arrangement should be assessed by its apparent professionalism alone. The relevant question is whether those affected can determine what is being asserted, which relations are being requested of them, and where the limits of the assertion lie.

The infrastructure also has an intrinsic asymmetry: producing a message is usually easier than establishing what it has meant to heterogeneous audiences. A speaker knows, at least partially, the purpose of an announcement; a prospective participant encounters it through different institutional knowledge, time constraints, disciplinary interests, linguistic capabilities, and expectations. Communicative competence therefore includes the capacity to learn from misinterpretation and silence. Not receiving a response need not mean that a message was clear or that no objection existed. An institution which treats public communication solely as the outward projection of a settled identity forecloses an important source of knowledge about how its own relations are formed.

16.2 Three Analytical Reality Levels of Public Expression

At the level of *ontological reality*, the present account suspends a final identification of persons, institutions, values, and experiences with the language in which they appear. A patient-related concern is not exhausted by a publicity narrative about it; the reality of a person's volunteering is not reducible to their testimonial; and the existence of a Commons need not be metaphysically defined by its published mission. This suspension does not imply that claims are unanswerable to reality. It marks the limits of treating communicative representations as full accounts of the beings and relationships they address.

At the level of *relational reality*, communicative acts occur within historically constituted networks of speaking opportunities, institutional expectations, credibility relations, resource inequalities, and possible sanctions. Students may have access to university notices that members of surrounding communities lack. A professional title may carry persuasive force independent of the accuracy of a claim. Some affected people may be unwilling or unable to speak openly, especially where care, employment, immigration, disability, academic evaluation, or other dependencies shape the consequences of public participation. Language choice and the location of a notice can alter who is practically able to encounter an invitation. These conditions may change through institutional learning, exclusion, withdrawal, and new collaborations.

At the level of *manifestation reality*, a flyer, website, working paper, translated summary, public lecture, media interview, or social-media post provides a particular presentation of an institution or research question. Such objects may carry useful evidence of communication, but cannot fully establish the meaning attributed to them by readers. Counts of impressions, downloads, followers, or quotations indicate certain observable occurrences; they do not certify understanding, trustworthiness, voluntary motivation, or beneficial service outcomes. A highly circulated diagram can generate a false appearance of technical maturity, just as an attractive project identity can create an impression of institutional endorsement. The distinction among the three levels requires the Commons to ask what each public artifact manifests, which claims it excludes, and what relationships sustain or contradict it.

A practical implication concerns the treatment of the author's own concepts. The label "generative" may invite readers to assume that the Commons has already demonstrated value creation or equitable returns. The proposed framework supplies reasons to investigate such effects, not evidence that they have occurred. A communicative infrastructure should make this epistemic position visible rather than concealing it behind an aspirational name. Likewise, references to established scholarship should disclose the authorship of the underlying concepts. This is essential where ambitious theoretical claims encounter people who have neither the time nor the specialist background to audit every scholarly citation.

16.3 Communicative Purposes, Publics, and the Status of Claims

Communicative tasks differ according to their immediate institutional purposes. A notice describing an independently accessible research resource seeks to inform potential users. A methodological summary invites epistemic criticism. A project invitation asks whether a person wishes to explore a future cooperative relation. A consultation seeks perspectives on a problem that remains open. An announcement about a completed study reports a result with an appropriate statement of its warrant. An operational instruction issued by competent authorities may establish expectations for an activity within their mandate. These tasks cannot be merged into a single goal of maximising public attention. The design must identify what communication is attempting to do, what response could legitimately follow, and what remains outside the speaker's competence.

A proposed record of communicative responsibility can be written as

$$\text{Msg}_t = (\text{id, speaker, standing, purpose,} \\ \text{public, claim, status, source,} \\ \text{channel, rights, feedback, version})_t. \quad (26)$$

The symbol Msg_t refers to a versioned public-expression record, not the situated manifestation $\text{M}_{o,q,t}$ in Equation (1) or the maintenance practices examined in Section 21. Here *id* identifies the expression;

Table 21: Illustrative public-expression types and characteristic checks. Types may overlap in a particular project, and none grants authority over a separate institution.

Expression type	Principal purpose	Checks before and after communication
Research prospectus	State an open question and invite scholarly engagement	Distinguish proposal from findings; identify responsible authors and limits
Research output	Report a method, result, argument, or limitation	Identify version, evidence, review status, rights, corrections
Project invitation	Explain a prospective cooperative activity	Disclose conditions, costs, role, voluntary character and contact pathway
Public consultation	Receive affected or relevant perspectives	Clarify the scope of influence, privacy protections and feedback process
Institutional notice	Report an authorised organisational position	Establish the speaker's mandate, currentness and approval scope
Publicity or campaign	Increase appropriate awareness or reach	Review accuracy, burden, pressure, selectivity and misinterpretation risk

speaker and standing distinguish identity from authority; **purpose** is its stated communicative aim; **public** and **channel** record intended audiences and means of access; **claim**, **status**, and **source** identify the assertions, their epistemic and institutional character, and grounds; **rights** concerns disclosure and reuse conditions; **feedback** specifies a possible response path; and **version** preserves temporal identity. Equation (26) describes a documentation grammar, not a mathematical proof that the claims are true or that their circulation is lawful. The status of the communicative act is also not the status of every proposition it contains: a published invitation may be authentic yet falsely imply hospital sponsorship, and a correct mathematical description may be distributed without appropriate rights to its underlying material. When a prospective project crosses from a public inquiry invitation into recruitment for an institutionally controlled activity, the activity-transition analysis in Section 10.4 becomes relevant. Mere audience interest, positive feedback or a public correction never retroactively supplies the missing authority.

The categories in Table 21 are not fixed legal classifications. They clarify how an identical channel may host objects with different normative consequences. A university bulletin could carry an independently authored research invitation, an approved volunteer recruitment notice, and an educational announcement, each requiring different statements of institutional origin and authority. An independent researcher who posts a draft handbook should state whether it is an interpretation or proposal, not an adopted hospital operating procedure. A public request for ideas should disclose whether the convenor merely intends to read suggestions or is empowered to incorporate them into an institutional decision. Transparency about restricted decision authority is particularly important when participants are encouraged to share time, expertise, or personally significant experience.

16.4 Independent Publication and the Historical Status of Research Outputs

Independent publication permits the Commons to make research inspectable before an established university or hospital accepts a partnership. Working papers, preprints, methodological notes, educational resources, public project statements, and reproducible artifacts may each warrant publication, with different expectations of review. The right to publish one's own research does not grant rights over another institution's protected information, marks, personnel, or operating procedures. Nor should proximity to a university be styled as an endorsement. The design task is to make the source, authorial responsibility, provisional status, rights, and opportunities for criticism of each publication legible. Scholarly validation remains a separate function; a published item can be both useful for discussion and insufficiently warranted for implementation.

Scholarly self-publication has different functions from scholarly validation. A manuscript can be made publicly available without having undergone external peer review. An openly distributed computational notebook can provide an auditable method without proving a result's applicability to real-world

service. A handbook may offer structured professional reasoning without becoming a binding institutional manual. These statements of status are substantive parts of the publication infrastructure, not small-print disclaimers. The UNESCO open-science recommendation supports broader access and participation in knowledge processes (UNESCO, 2021); it does not erase ethical, legal, and epistemic limits. Crossref’s guidance on posted content likewise illustrates the importance of identifying posted works by type, relating preprints to later versions, and maintaining meaningful metadata when materials are updated or withdrawn (Crossref, 2025). Crossref’s particular metadata conventions are technical practices for participating publishers, not requirements that every independent Commons possess a DOI registration service.

A proportionate independent-press arrangement may publish the responsible author, date, version, review status, provenance, intended scope, use conditions, material limitations, and a functioning correction channel. Material revisions should be linked to the earlier claim so that readers can recognize changes without being told that a corrected document was always accurate. But historical accountability does not require unlawful or harmful indefinite availability of withdrawn personal material: a scoped notice may remain where underlying content must be restricted. The publication task is thus to communicate what the issuer can currently defend, in a form that later readers can verify. Where a maintained page and archived versions suffice, a branded periodical or complex editorial bureaucracy has no presumptive advantage.

Self-presentation also deserves care. An independent Commons may describe its mission, founders, research capacities, and aspirations. Yet a visually sophisticated presentation or portfolio can resemble an organisational credential even where the operating structure is provisional. A practical publication design should distinguish ongoing research from completed studies, intended future collaboration from agreed partnership, open invitation from confirmed membership, and illustrative scenarios from tested systems. The purpose is not to suppress ambition. It is to make ambition intelligible without converting it into an unearned claim of institutional standing. The same discipline applies to scholarly credit: public presentations should identify whose work provided the concepts, resources, and contributions being presented, rather than allowing the platform’s identity to absorb distributed intellectual labour.

16.5 Project Presentation, Publicity, and Situated Channels of Encounter

The proposed university-hospital setting is significant because some audiences may be relationally close without already participating. Students may routinely encounter communications through academic departments, interdisciplinary seminars, physical noticeboards, faculty newsletters, research societies, or networks connecting them to public-service questions. Nearby residents, patient organisations, service users, and community researchers may encounter entirely different channels. A choice of place, time, medium, and language therefore shapes the feasible audience of an invitation. As analysed in Section 4, geographical and organisational proximity may be enabling under some conditions, but should not be assumed to produce either attention or legitimate commitment.

A proposed project description should begin from a real, inspectable activity rather than from a general exhortation to “generate value”. Consider an independent synthetic volunteer-scheduling research module. Its public presentation can explain the scientific question, the synthetic status of the data, the relevant mathematical prerequisites, available materials, avenues for independent critical work, costs of participation, and contribution/licensing arrangements. It should also state that the module is not a hospital scheduling service and does not entail access to any real hospital or volunteer data. A person may find the topic useful for mathematical inquiry while declining any hospital-related activities. Communications concerning an independently authorised hospital volunteer opportunity, if one exists, must instead be issued or approved within the competent institution’s actual procedures. The Commons cannot borrow that authority by proximity.

The design of a communication campaign should identify its expected resource burden and failure conditions. An invitation distributed widely may produce more questions than a small Commons can responsibly answer. A single ambitious project page may appeal to engineering students but exclude

readers whose disciplines use different problem descriptions. Messages that promise future publication or professional opportunities without specifying uncertainty can distort autonomous choice. Conversely, excessively defensive disclaimers may obscure a genuinely accessible research opportunity. A useful design goal is *proportionate intelligibility*: readers should understand the substantive opportunity and its boundaries with effort reasonable for their circumstances.

An outreach process can be organized around a concrete claim chain: a verified research opportunity, an identified audience, an appropriate medium, an explanation of prerequisites and uncertainty, a clearly distinguished participation option, and a reachable response or correction route. The steward should test comprehension before rewarding click-through counts. An interested student may adopt a public research question, criticize a methodological claim, or decide not to participate; each outcome can be consistent with legitimate communication. Conversely, a persuasive campaign that conceals its independent status or overstates academic rewards has failed the information-for-choice function even if it increases applications. The relevant comparison is between understandable, bounded outreach and more costly publicity that might impose additional response, translation, or reputational burdens.

16.6 Accessibility, Multilingual Interpretation, and Unequal Communicative Burdens

Communication infrastructures operate across linguistic, cognitive, sensory, temporal, and socio-economic differences. Providing an English-language technical manuscript may make a research programme legible to some academic communities while leaving prospective local participants without a practical understanding of it. Translating an introduction can help, yet literal lexical equivalence may not preserve normative distinctions about liability, permission, evidence, or voluntary activity. Where an expression carries legal or operational significance, translators should identify the jurisdiction, audience, source status, and qualified meaning. The interdisciplinary translation concerns described in Section 15 therefore recur in public-facing communication, but the task is different: a public reader cannot reasonably be expected to reconstruct specialised disciplinary qualifications independently.

Accessible design can include understandable prose, descriptive headings, meaningful alternatives for diagrams, readable and navigable publications, captions or transcripts where appropriate, and multiple routes to ask questions. The W3C Web Content Accessibility Guidelines provide developed technical criteria for web accessibility (World Wide Web Consortium, 2024b); they are a useful design reference, not a substitute for assessing the accessibility of a particular institutional context. International guidance toward multilingual open science similarly indicates a public-interest rationale for reducing language barriers, without implying that full translation into every language is feasible (UNESCO, 2021). Accessibility should be examined as a situated opportunity that may require testing with intended users rather than a declaration that a PDF or website is universally usable.

There are trade-offs. A small research Commons may not have the resources to maintain accurate translations of a changing legal explanation in several languages. Publishing a stale translation can be worse than identifying a limitation and offering a clear route to request clarification. A participant may prefer not to appear publicly in a photograph, testimony, or success story, even where their contribution was valuable. A concern about confidentiality may require anonymised summaries, mediated discussion, or no public disclosure. These restrictions are not failures of openness. They are part of the normative conditions through which the potential benefits of communication are balanced against the agency and safety of particular persons.

Unequal burden also appears in who is asked to interpret. Bilingual students, junior scholars, or volunteers may become informal translation services without recognition, compensation, or authority to correct underlying content. An infrastructure designed to reduce barriers must therefore document stewardship, review responsibilities, and rights to decline additional work. It should periodically ask whose understanding is being privileged and who bears the cost of making the Commons publicly intelligible. Measures of reach are insufficient when the people most affected lack an accessible response channel or a realistic way to influence the message that describes them.

16.7 Public Dialogue, Criticism, and the Return of Communicative Value

Dialogue becomes a distinct communicative achievement when the audience has a credible route to ask questions, contest a representation, or identify an omitted perspective, and when its input receives an intelligible response. The OECD’s participation guidance emphasizes matching the stated purpose of engagement to the influence participants can actually exercise and explaining how contributions were treated (Organisation for Economic Co-operation and Development, 2022a). In the Commons, an invitation to comment must not be advertised as a promise of shared governing authority. A critic may change the wording of a problem, correct a public source, or expose a harmful example without joining the organization. The response route should therefore preserve non-member standing to submit relevant criticism while leaving actual governance and operational decisions with the appropriate competent actors.

Public communication therefore needs a response cycle. A criticism might concern an incorrect bibliographic claim, a misleading implication of partnership, inaccessible documentation, an overly narrow definition of service value, or an illustration that appears to describe real patients when it uses synthetic cases. The steward should be able to acknowledge receipt where feasible, classify the issue by relevant competence and rights, decide whether further review is needed, communicate the outcome with appropriate reasons, and preserve a proportionate historical record. Some issues must be referred to competent external authorities; others require no more than correcting a typographical error. A procedure should not imply that every public correspondent becomes a member of the Commons or acquires a vote over its research conclusions.

For analytic purposes, a publicly accountable exchange may be represented by the conditional relation

$$R_t^{\text{comm}} \subseteq \text{Public}_t \times \text{Message}_t \times \text{Response}_t \times \text{Disposition}_t \times \text{Reason}_t, \quad (27)$$

where a tuple registers, when legitimately recordable, the originating public or representative, the message received, the institution’s response or reasoned non-response, its disposition, and relevant reasons. Equation (27) is intentionally a *partial* relation. Anonymous feedback, unsafe disclosures, protected information, abusive correspondence, and requests beyond the Commons’ mandate may not permit public traceability. Nor does a recorded response prove that the correspondent accepts it. The model highlights responsibilities of classification and explanation rather than prescribing constant dialogue or a universal response time.

Communication can contribute to value return when publicly raised concerns are credited appropriately, when a critic can see what changed, or when a published correction allows others to avoid repeating an error. Yet the gain to the institution must not automatically be called a return to the person whose unpaid feedback enabled it. Attribution may need to be withheld for safety; acknowledgement does not guarantee recognition by a professional field; and learning from public critique does not justify unrestricted appropriation of private material. The separate value-return infrastructure developed later in the manuscript should be integrated with explicit rights and contribution practices rather than inferred from the mere existence of a feedback channel.

16.8 Ethical Persuasion, Institutional Reputation, and Boundaries of Authority

Publicity and persuasion are not intrinsically incompatible with voluntary participation. Communicating an opportunity is often necessary for someone to exercise an informed choice. But techniques aimed at maximising engagement can distort the relation between a message and the freedom of its recipient. Scarcity claims, urgency, selective success stories, ambiguous affiliations, emotional depictions of vulnerability, unverified performance comparisons, or promises of future career gains can create pressures that exceed what the Commons can justify. The National Academies report makes clear that the effects of science communication depend on its purposes, audiences, framing, and context (National Academies of Sciences, Engineering, and Medicine, 2017a); the present framework adds a normative requirement to examine how those choices interact with actual authority and relational dependence.

The use of hospital imagery, institutional names, logos, photographs, or patient narratives poses distinctive issues. A researcher may legitimately discuss a class of institutions without holding a position

Table 22: Illustrative communication risks and context-dependent safeguards. The safeguards are design questions, not certifications of legal compliance or institutional endorsement.

Risk relation	Possible consequence	Candidate safeguard and evaluation question
Unspecified affiliation	Misread institutional authorisation	Explicit speaker identity and provenance; can readers distinguish an independent Commons?
Aspirational results described as established	Undue confidence or inappropriate reuse	Label the claim's evidential status; can readers identify its limitations?
One-way solicitation of feedback	Unrecognised unpaid input and distrust	Defined response and credit procedures; do contributors know what follows?
Image or testimony exposure	Loss of privacy or autonomy	Appropriate permissions, restrictions and withdrawal processes; who can refuse?
High-volume recruitment publicity	Maintenance overload or pressure to join	Proportionate release and capacity review; are responses being handled responsibly?
Inaccessible or stale translations	Exclusion or misinterpretation	Accessible alternatives, dating and qualified review; who is unable to understand?

in any particular one. A Commons should not use design cues that could reasonably imply partnership, recruitment authorization, clinical endorsement, access to patients, or sponsorship when such relations have not been established. A public case study based solely on public documentation must say so, and factual statements should remain limited by the available evidence. The power of an attractive institutional image to generate credibility is not equivalent to legitimate authorization. Where an actual formal collaboration exists in the future, the scope of what may be announced, and by whom, remains a question for the relevant authorities and agreements.

In health-related communication, the WHO emphasises transparency about methods, uncertainties, and mistakes, and also recognises the importance of listening to communities (World Health Organization, 2026). WHO's risk-communication and community-engagement guidance is especially shaped by public-health threats; it provides useful considerations about reciprocal communication but does not itself govern ordinary volunteer-research publicity (World Health Organization, 2024). A prospective Commons should be especially cautious about generalising findings from synthetic models to patient safety, service effectiveness, or volunteer well-being. Where direct evidence is absent, the scientifically accurate message may be a statement of an open question rather than an apparent recommendation.

The normative criterion proposed here is not a ban on persuasion, but proportionality between a communicative claim and the reasons, permissions, and capacities supporting it. A project may reasonably invite students to examine a mathematical problem. It may not imply guaranteed publication, special admission, clinical access, or institutional preference absent grounds. A public message should be capable of surviving scrutiny by an informed reader who is free to decline participation. That possibility is one condition of trustworthiness; positive sentiment alone is not.

16.9 Stewardship, Infrastructure Interfaces, and Institutional Configurations

The communication infrastructure depends upon other constitutive functions and can also reshape them. Public problem constitution supplies the questions a project claims to address; normative infrastructure identifies the limits of its promises; epistemic validation qualifies knowledge statements; information infrastructure maintains actual resources and rights; historical preservation records versions and corrections; interdisciplinary mediation supports accurate cross-field interpretation; governance allocates speaking and approval responsibilities. Public communication then provides an occasion for new concerns to enter those other relations. The relationship is recursive: better information may support more

accurate publicity, while a public objection may expose an underlying classification or governance error that requires substantial institutional change.

This coupling creates practical design problems. Should a project announcement be published immediately upon drafting or after source and affiliation checks? Who can correct a publicly quoted error? Who maintains an outdated project page after its original author has left? How can a public concern be routed to an appropriate research or governance procedure without overdisclosing personal information? How will a proposed Commons prevent university students from being treated as a free publicity workforce? The answers depend on organisational capacity and risk, not on the completeness of a platform's software features.

Three configurations illustrate the variation. An independently constituted one-person Commons may rely on a modest website, openly posted manuscripts, short notices of status, and a published correction email address. Its claims of accountability should match its limited human capacity: it may not be able to promise immediate responses or community representation. A student-led association may develop rotating editorial responsibilities and peer checks while documenting succession and the risks of turnover. A formally authorised university–hospital collaboration may have multiple responsible communication offices and approval channels, but should also consider whether those arrangements suppress independent academic criticism. Each case realises some of the same communicative functions while distributing responsibility, resource burden, and public authority differently.

Communicative labour must therefore be budgeted as labour. Editing, accessible formatting, translation, moderation, answering questions, obtaining licences, archiving revisions, and explaining disagreements consume time and competence. A publicity strategy that depends on uncompensated junior contributors, or produces obligations its organisers cannot meet, may erode the very generative capacities the Commons aims to support. The resource-stewardship infrastructure should examine whether the scale of communication remains proportionate to the actual research and administrative work that sustains it.

16.10 Communicative Failure, Situated Evaluation, and Historical Revision

The empirical evaluation of communication should be tied to its stated purpose rather than to a single metric of reach. A notice intended to clarify a research programme can be tested through readers' ability to identify the research question, publication status, and institutional independence. An invitation to scholarly criticism can be examined through the quality and diversity of objections received, how they are handled, and whether errors are actually corrected. A multilingual public resource can be examined through situated comprehension tasks, accessibility testing, and the continuing validity of translated statements. A dialogue process can be examined through the intelligibility of its decisions and the experience of persons whose suggestions were declined. In none of these cases does a favourable metric by itself justify a claim of generative value.

A discriminating communication test presents readers with a public invitation and asks them to distinguish the *existence* of an independent research opportunity, the *status* of any promised collaboration, the actual costs and permissions of participation, and whether a university or hospital has endorsed the project. A separate test introduces a material correction and checks whether it reaches the earlier audience instead of being deposited only in an obscure archive. These tasks measure situated message comprehension and correction reach, not a reader's voluntary commitment. In particular, correctly interpreting an invitation does not amount to accepting a role, agreeing to data collection, or becoming eligible for hospital service; those are distinct relations examined in Section 17. Compare a short accurate notice, a notice accompanied by clear linked detail, and an elaborate communication system under equal factual conditions. If the simplest option performs as well with lower maintenance burden, a more complex platform has not earned priority merely through wider reach. Excessive simplification may nevertheless fail if crucial institutional boundaries disappear in translation or inaccessible formatting.

A failure case may be informative. Suppose an appealing public description of an optimisation module attracts many requests from prospective volunteers, despite the module being only an independent research environment. Such a result would reveal that the distinction between research and service was

not effectively communicated. A correction might require changed wording, more visible qualifications, a different channel, or separation of research and service pages. If the Commons had also implied that a university endorsed the project, the problem could require public correction and reconsideration of branding. If the requests contained sensitive personal information, the response would additionally involve information-governance limits. The lesson is not that more disclaimers always solve confusion, but that communication must be tested against its actual relational effects.

Another failure may be less visible: no people from a relevant affected community respond to an invitation. The absence of feedback could reflect lack of interest, restricted time, inaccessible media, concern about consequences, incompatible terminology, or an unrecognised power asymmetry. Treating silence as approval would import a claim that the evidence does not support. Historical evaluation should retain alternative explanations and enable a future researcher to reconstruct the channels used, sources cited, complaints received, changes made, and uncertainties remaining. In this sense communication has a history of reasons, not merely a history of campaigns.

The proposed infrastructure is successful only in a qualified, context-dependent sense if its practices allow people to encounter accurate statements, understand relevant limits, raise criticism where feasible, and receive responses proportionate to the institution's real capacities and responsibilities. It remains possible that a project communicates clearly and nevertheless attracts few collaborators. That outcome does not refute its epistemic or normative quality. Conversely, a popular campaign may harm trustworthiness by obscuring uncertainty or authority. The task of constitutive engineering is to establish responsible conditions of public expression and dialogic correction, not to guarantee attention, trust, volunteer recruitment, or beneficial hospital outcomes. The subsequent section therefore considers voluntary entry as a further and distinct institutional relationship, one which can occur only after potential participants have encountered an opportunity but cannot be inferred from that encounter.

17 Initial Participation and Voluntary Engagement

A public invitation can be understood without being accepted, and acceptance can be intelligible without constituting authority to perform a particular activity. A person who reads a research note, a student who offers a correction to a synthetic benchmark, and a prospective volunteer who seeks an orientation may each establish a different relation with the same Commons. The design object of this section is the capacity to make those relations available for informed choice, differentiated commitment, continuing support, and legitimate exit. Recruitment conversion is not its objective: an informed refusal can be an entirely successful outcome of an entry process. Nor does access to an open research environment create a requirement to offer hospital service. The question is how previously unconnected subjects can encounter a feasible opportunity, understand its conditions, and retain practical as well as formal freedom over their involvement.

This section examines participation as a historically situated and normatively qualified institutional relation. The established literature offers important but partial explanations. Clary and colleagues' functional approach identifies different motivations that volunteering may serve and presents evidence concerning the fit between motives and opportunities (Clary et al., 1998). Omoto and Snyder analyse motivations, organisational experiences, and the duration of volunteer service in a particular empirical setting; their results caution against simply inferring long-term commitment from prosocial dispositions (Omoto and Snyder, 1995). Wilson's sociological review connects voluntary activity to social ties, human capital, institutional participation, and different social conditions (Wilson, 2000). Hustinx, Cnaan, and Handy show why accounts of volunteering cannot be reduced to one explanatory model across disciplines and institutional forms (Hustinx et al., 2010). These contributions should be understood on their own terms. The proposed generative-relational reconstruction concerns the institutional conditions connecting heterogeneous motivations, accessible entry, legitimate role formation, experience, value circulation, and the preservation of future possibilities; it is not presented as the origin of volunteering research.

The design remains international and institution-independent. Throughout, three distinct activities are maintained: participation in independently accessible research based on public or synthetic resources;

participation in hospital-authorised volunteer service; and human-participant or restricted-data research requiring its own competent permissions and safeguards. Admission into one sphere neither entitles a person to enter another nor creates rights to disclose patient information. The section specifies an adaptable participation grammar, the corresponding resource burdens and constraints, and situated tests of whether participation is in fact informed, voluntary, and capable of generating value without producing avoidable dependency or exclusion.

17.1 Voluntary Relations as a Constitutive Institutional Object

The existence of a participation form or a roster does not establish an operative relationship. Participation requires at least some meaningful connection between a person's considered disposition to engage, a recognisable activity, a set of reciprocal expectations, and the capacities and authorisations appropriate to that activity. The relevant arrangement may be brief and self-contained: a researcher contributes a correction to a public model, a student attends a methodological discussion, or a community member answers a consultation. More enduring activity, such as assisting in a supervised hospital setting, involves additional histories of preparation, role assignment, care-related boundaries, reliability, and review. The two forms should not be treated as interchangeable because both are labelled "participation".

Definition 17.1 (Situated voluntary participation infrastructure). A *situated voluntary participation infrastructure* is a context-dependent configuration of accessible opportunities, intelligible role descriptions, informed-choice practices, competent authorisations, preparation and support relations, arrangements for recognising and challenging commitments, and procedures for revision or exit through which persons may form, decline, maintain, or end institutionally differentiated relations without an unjustified transfer of rights, risks, or burdens. Its adequacy depends on the participants' circumstances, the affected subjects' interests, the nature of the activity, and the historical conditions of the responsible institutions.

The function can be implemented without a recruitment office or a new membership platform. For an independent synthetic-research Commons, a credible public description, a way to ask questions, a bounded contribution agreement, and an accessible route to decline may suffice. The distinct responsibilities of a supervised hospital volunteer programme can require screening, training, identity verification, supervision, safety escalation, and a competent authority's acceptance of the role. A research group's ability to administer a mailing list establishes none of those service permissions. A differential design test asks whether a proposed additional intake mechanism changes the participant's understanding or freedom to choose, or catches a material safeguarding problem that the simpler arrangement misses; otherwise its administrative burden requires justification.

An institution should also avoid defining participation solely through observable output. A person who raises a serious objection, identifies a privacy risk, requests an accessible format, or declines a proposed role may contribute information relevant to the institutional design without consenting to become a volunteer or research subject. Although an organisation has limited resources and cannot give every request priority, treating consent and refusal as mere obstacles to a target recruitment rate mistakes an institutional indicator for the relationship it purports to assess.

17.2 Three Analytical Reality Levels of Participatory Relations

At the level of *ontological reality*, the present account suspends a final metaphysical reduction of persons to preference vectors, volunteer identities, or productivity capacities. A declared motivation is not an exhaustive account of the person's life or of the value of their action. A refusal is not proof that the institutional purpose lacks value; continued service is not proof that the participant freely endorses each condition attached to it. This suspension also discourages the treatment of a registration record as the being it describes.

At the level of *relational reality*, opportunities and commitments are historically constituted through information channels, educational expectations, financial pressures, personal relationships, confidence in institutions, language access, disability accommodations, time budgets, and prior experiences of care

or organisational authority. A university-affiliated student may possess advantageous geographical or disciplinary proximity yet face examination periods, insecure income, commuting constraints, unequal supervision, or pressure to accumulate credentials. A community volunteer may have extensive practical experience but weak access to academic communication channels. The same advertised opportunity is therefore embedded in different feasible worlds of action. Relational proximity is not a scalar guarantee of willingness; it is a partly enabling and partly constraining configuration.

At the level of *manifestation reality*, sign-up numbers, declared motivations, completed orientation sessions, logged hours, retention rates, testimonials, and research contributions present selected aspects of participation. Each indicator can be useful for a specific question, but may conceal unequal opportunity costs, dissatisfaction, invisible care work, or external pressure. Apparent retention can coexist with disengagement. High conversion from outreach to registration can reflect clear communication, aggressive persuasion, or strategic credential seeking; it cannot alone discriminate among these explanations. A project's evidence system should therefore specify which manifestations it records, whose accounts are missing, and what uncertainty remains about the underlying relations.

The three levels matter directly for infrastructure engineering. A form can record a person's self-described availability, a coordinator can negotiate a tentative role, and a later schedule can show attendance. These are different evidential objects. The first does not imply a binding commitment, the second does not automatically create a right to provide hospital services, and the third does not establish the participant's motivation or an unqualified benefit to a patient. Treating them as distinct makes it easier to correct unrealistic assumptions and respond to changing circumstances.

17.3 Plural Motivations, Autonomous Choice, and Institutional Incentives

The familiar opposition between altruism and self-interest is too narrow to explain voluntary engagement. In the volunteer functions inventory, Clary and colleagues examine values, understanding, social, career, protective, and enhancement functions of volunteering, while recognising that motives can coexist (Clary et al., 1998). These are research categories and should not be transformed into a universally exhaustive typology or a screening test for personal worth. A participant may wish to help others, test a research technique, understand institutional life, build social relationships, or develop professional competence. A changing mixture of these reasons does not by itself invalidate voluntary activity. Similarly, the public character of a Commons does not depend on each participant having a wholly disinterested personal motivation.

Self-determination theory distinguishes the regulation and quality of motivation and examines autonomy, competence, and relatedness as psychological needs (Deci and Ryan, 2000). This work provides a conceptual reference for examining how opportunities are framed and experienced; it does not establish that any specific Commons will satisfy these needs. For institutional design, the salient questions include whether activities are adequately explained, whether participants can exercise meaningful choice, whether learning opportunities are real, and whether obligations and expectations can be questioned. The absence of wages does not alone establish autonomy. Academic dependency, reputational pressure, precarious funding, social expectations, or a misleading promise of career advancement can compromise meaningful choice even if consent appears formally voluntary.

An independent Commons should make a genuine disciplinary opportunity usable before soliciting substantial unpaid contributions. For example, a synthetic scheduling benchmark can support independent work on constraint programming or robustness while remaining available to someone who never undertakes hospital service. An invitation should distinguish access to existing licensed materials, optional research contribution, mentorship capacity, and any responsibilities associated with coauthoring or maintaining a shared artifact. It should not offer publication credit or future employment as if those outcomes were guaranteed. Where preparation, moderation, or software upkeep creates continuing work, the responsible institution should specify its expected duration, possible remuneration, authority limits, and right to renegotiate commitments. Academic benefit may coexist with exploitation; its mere possibility is not evidence of valid consent.

The same sensitivity applies to incentives for hospital volunteering. Orientation, skills learning, social recognition, reasonable expense support, and credible information about the work may facilitate participation in some settings. Yet a reward framed as a prerequisite for admission, academic credit under strong evaluative pressure, or a prestigious association represented ambiguously can create undue influence. The design challenge is not to eliminate motives but to preserve the conditions under which people can understand their meaning, identify incompatibilities with other responsibilities, and refuse an unsuitable invitation. Jurisdiction-specific definitions of volunteers, employment, reimbursements, insurance, and student placements require their own legal examination; a theoretical description cannot settle them universally. International statistical guidance on volunteer work, for example, serves a purpose distinct from prescribing the legal classification of a particular relationship (International Labour Organization, 2011).

17.4 Initial Encounter, Relational Proximity, and Unequal Feasibility

Initial participation is of particular interest when the prospective participant and the organisation have no common practical history. Public communication may create a first encounter, but institutional engagement begins only when the individual can relate that encounter to a plausible activity, credible expectations, and a feasible role. The university may provide several possible mediating channels: disciplinary seminars, research communities, student organisations, library collections, neighbouring public spaces, or institutional contacts. These channels vary greatly across universities, national contexts, academic calendars, and the local distribution of resources. The mere physical presence of students near a teaching hospital does not demonstrate their availability or consent to volunteer.

Wilson's account of social resources and institutional ties is relevant because participation opportunities may be unequally distributed even among persons with similar professed motives (Wilson, 2000). The United Nations Volunteers' international report also emphasises differences in participation and representation, including the possibility that marginalised volunteers contribute without equal opportunities to shape collective decisions (United Nations Volunteers, 2022). Such findings do not specify the optimal recruitment channel for a university hospital Commons, but they support investigating who encounters an opportunity and who is left outside its effective reach. Scholarship cannot infer local access patterns merely from the prestige or geographical setting of a university.

Proximity should be examined multidimensionally. Geographical proximity may reduce travel time; temporal proximity may make a project compatible with study or employment; cognitive proximity may make a research question intelligible; organisational proximity may create legitimate channels of communication; social proximity may facilitate trusted introduction; institutional proximity may clarify or, conversely, obscure authority boundaries. As developed in Section 4, these dimensions may substitute for or frustrate one another. Close organisational relations can also induce conformity or deter criticism. In that sense, a highly proximate academic setting may be less welcoming to a person who fears an adverse evaluation from a senior colleague.

A responsible participation infrastructure should examine the *cost of the first step*. An invitation requiring an interview during working hours, prior mastery of disciplinary jargon, or an expensive trip may exclude persons for reasons unrelated to their capacity to contribute. Alternatives might include a short public orientation, asynchronous questions, clearly scoped trial tasks using non-sensitive materials, transparent language about eligibility, or access to a trained mediator. These are possible design options rather than obligations that every setting can fund. Their effects depend on the activity and must be tested against the resources and safeguarding requirements of the actual institution.

17.5 Informed Entry, Competent Authority, and Role Differentiation

Entry is better understood through *distinct, revisable relationships* rather than a single membership event. Encountering a notice is evidence of a communication event; requesting information may permit a bounded reply but is not consent to continuing solicitation; expressing interest does not create a duty; accepting the terms of one open research contribution does not automatically include consent to

Table 23: Illustrative boundaries among participation spheres. Requirements and available routes are institution- and jurisdiction-dependent; these examples do not establish approval.

Activity sphere	Potential entry arrangements	Limit of entry
Independent public/synthetic research	Open documentation, project-scoped contribution terms, voluntary discussion and review	Does not grant access to patients, hospital records, or hospital operations
Hospital-authorized volunteer service	Institution-specific eligibility, role definition, orientation, preparation, screening, supervision and permission	Service permission is bounded by assigned role and competent authority
Human-participant or restricted-data research	Study-specific oversight, lawful data basis, approved protocol and safeguards as applicable	Commons membership and service credentials are not research approval

be a research participant; and an agreed Commons role gives no hospital-service authority. Each subsequent transition requires a specified activity, accessible explanation, an appropriately free and informed decision by the person, and, where relevant, an independent disposition by the competent organisation or research oversight pathway. A refusal, a request for clarification, or an inability to meet a proposed schedule is not a defective state awaiting conversion into “accepted.” For analysis, these events should be time-indexed and recorded minimally; sensitive explanations for withdrawal need not become part of a permanent shared archive. This distinction also prevents an apparent communication success from being mistaken for an outcome in recruitment, safe service, or sustained participation.

For comparative design purposes, the following record describes the types of information that may matter in a legitimate entry process. It is descriptive, does not prescribe what must be collected, and should be minimised according to the actual purpose and applicable norms:

$$E_{a,r,t} = (\text{purpose, sphere, role, scope, expectations, authority, permissions, support, review, exit})_{a,r,t}. \quad (28)$$

Here a denotes a prospective participating person, r a proposed activity role, and t the historically situated decision moment. The fields record conditions relevant to an offer; they do not constitute a mathematical criterion for freely given consent, a determination of legal status, or a proxy for a person’s motivation. The specific personal information necessary to document an actual acceptance varies by function. Anonymous use of public research resources may require no identity record at all. Protected service contexts can require additional competent procedures that an independent Commons cannot invent or waive.

Within authorised service, role design should reflect activities and risks rather than a generic wish to help. Information assistance, event logistics, publicly available library tasks, and direct interaction in care settings may involve different preparation and boundaries. The existence of a useful mathematical schedule does not determine whether an individual is prepared, available, or authorised for a service task. The institution responsible for the service must determine relevant requirements, supported by appropriate professional and operational expertise. Conversely, an independent researcher may construct a synthetic operational scenario and analyse it without making any claims that a real institution ought to adopt the output.

The Commons should specify who may explain, recommend, accept, supervise, and revise a role. These powers can be dispersed across distinct persons and organisations. A project founder can invite participation in an independently governed research repository but cannot, on that basis, certify hospital-service readiness. A university researcher may advise on experimental methods but cannot assume approval over clinical conduct. These competence boundaries are not merely restrictions. They can protect participants from inconsistent expectations and preserve opportunities for legitimate collaboration where authority has actually been established.

17.6 Preparation, Matching, Supervision, and Relational Learning

Preparation is an infrastructure for making role expectations intelligible and feasible, not a ritual for manufacturing conformity. Orientation can explain the institution's purposes, the role's practical boundaries, anticipated costs, the forms of help available, and the participant's freedom to report uncertainty or decline. Preparation for public research can focus on methods, repositories, contribution licensing, epistemic criticism, and permission boundaries. Preparation for hospital service may require supervised practical learning, confidential communication, safety-related limits, and reliable escalation channels. The amount and form of preparation should be proportionate to the role, not inferred from an institution's university affiliation.

Matching a person to an activity likewise involves heterogeneous attributes. A coordinator may consider declared interests, existing skills, desired learning, temporal availability, accessibility needs, confidentiality, service requirements, and the institution's ability to provide responsible support. Such considerations cannot be reduced to maximising volunteer hours or filling vacant positions. A participant who enjoys public research may reasonably decline face-to-face service; someone with extensive experience in service may have no interest in publishing research. A matching process that equates the two can produce frustration, reputational harm, or inappropriate work allocation.

For a particular candidate role, the following limited feasibility description may help organise inquiry:

$$\mathcal{F}_{a,I,t}^{\text{screen}}(e) = \{r \in \mathcal{R}_{I,t}^{\text{offered}} : \text{Stat}_{I,t}^k(a, r \mid e) = \text{supported for each } k \in \mathcal{K}_{\text{role}}\}, \quad (29)$$

$$\mathcal{K}_{\text{role}} = \{\text{competence, preparation, availability, support}\}.$$

Here a is a prospective participant, r an offered role, I an identified institutional setting, and e the currently admissible evidence for this assessment. The candidate-screening status $\text{Stat}_{I,t}^k$ takes values in $\{\text{supported, excluded, unresolved, contested}\}$; it is not the governance competence record $\text{AuthRec}_{I,t}(d)$ of Equation (13). In particular, an unknown training status is not silently counted as either demonstrated preparation or a failed participant. The label *competence* here includes the relevant role-specific institutional determination, not the researcher's certification of another organisation's authority.

Equation (29) describes candidates for a *further* participation decision. Even a role in $\mathcal{F}_{a,I,t}^{\text{screen}}(e)$ requires an independently voluntary, appropriately informed choice by a and any final admission by a competent institution. Neither assent nor final admission is inferred from a positive screening record. Where screening evidence is insufficient, referral, clarification or a different independently lawful research activity may be preferable to extra data collection. The formula is not a complete model of safety, justice, motivation or accessibility. A small public scholarly project may require only the permissions necessary for a particular contribution, whereas a hospital-facing service role is governed by a distinct, locally authorised assessment.

Mentoring and supervision introduce further relationships. A student may depend on a researcher for technical explanation, a volunteer on a coordinator for safe service guidance, and the coordinator on experienced volunteers for situated knowledge. These relations can distribute capabilities, but may also reproduce power asymmetry. Requests to volunteer can feel less optional when issued by a person who evaluates academic work or controls future opportunities. A designed mentoring system should therefore distinguish educational guidance from compulsory labour and provide appropriate channels to question roles without direct dependence on the person whose decision is contested.

17.7 Continuing Participation, Recognition, and the Quality of Commitment

Initial entry and continuing engagement have different explanatory conditions. In their longitudinal study of AIDS volunteers, Omoto and Snyder distinguish antecedent dispositions and motivations from organisational experiences such as satisfaction and integration, and examine their relationship to duration of service (Omoto and Snyder, 1995). Their empirical findings belong to that historical and organisational context; they cannot be directly imported as retention coefficients for university hospitals. The more general design implication is methodological: an invitation should not be evaluated only through regis-

tration because relationships may develop, deteriorate, or become incompatible with participants' lives after the first encounter.

Continuing participation may depend on accessible supervision, compatible time commitments, a manageable workload, intelligible institutional changes, appropriately handled interpersonal disagreements, and genuine recognition of contributions. Recognition can take many forms: a considered response to a research criticism, correct citation of a technical contribution, inclusion in a discussion appropriate to one's role, feedback about a service concern, or an opportunity to use material within a legitimate licence. None of these entails an automatic entitlement to authorship, institutional credentials, preferred assignments, financial returns, or confidential information. The distinct normative infrastructure for contributor rights should specify appropriate forms of credit without promising rights beyond its authority.

Institutional commitment should not be treated as a one-way transfer of reliability from the participant to the Commons. An institution that advertises opportunities undertakes corresponding practical burdens of explanation, support, conflict response, and proportionate maintenance. Excessive reliance on an enthusiastic few can shift the costs of organisational continuity to persons who lack bargaining power or formal compensation. High retention, in that situation, may represent solidarity but could also conceal obligation or the absence of acceptable exit arrangements. Evaluation should examine experienced voluntariness and distribution of costs, not just whether a service schedule remains filled.

Participation can also change the institution's understanding of its own problem. A volunteer who identifies a mismatch between an advertised role and actual service needs, or a researcher who challenges the relevance of a benchmark, contributes critical information even if they do not generate the result originally sought. A Commons concerned with generativity should provide a path through which these observations can be considered, documented, and, where warranted, lead to modification of available opportunities. Otherwise, it preserves the outward form of participation while constraining participants to reproduce settled institutional assumptions.

17.8 Refusal, Withdrawal, and Non-Extractive Participation Boundaries

Voluntary engagement requires a feasible refusal or exit route, not merely a clause announcing that participation is optional. A researcher can ordinarily stop using open materials without notice, whereas a volunteer scheduled for an authorized service shift may reasonably be asked to communicate an absence so that the competent institution can arrange continuity. A research collaborator may remain bound by valid confidentiality obligations or the licensing terms already granted even after ceasing further work. Design should therefore distinguish the capacity to stop performing work from the consequences of earlier lawful actions. An exit test asks whether a participant with limited time, financial resources, or institutional standing can actually exercise the stated route without disproportionate retaliation, public embarrassment, or loss of independently available research access.

The Commons should make the distinctions among *ending activity*, *withdrawing a contribution*, *revoking a permission*, and *removing information* explicit. A contributor may discontinue future work while a previously granted valid licence continues to permit certain lawful reuse. The confidentiality of a participant's personal correspondence can justify restriction without necessarily requiring erasure of an independently created public method. Conversely, valid requests for deletion or restricted access under applicable legal and ethical conditions may require alteration of records that would otherwise be historically valuable. A universal "right to delete everything" or "permanent right to keep every trace" would obscure these different legal and normative relations.

An adverse experience is not necessarily evidence that a participant has failed to embrace the public mission. It may reveal unrealistic schedules, an unaddressed safety issue, inadequate mentorship, conflicting social obligations, disability exclusion, or disagreement about institutional values. A robust infrastructure should allow criticism without requiring personal disclosure to the very actors who may be implicated. Access to mediation or complaints procedures is therefore a condition of trustworthy participation; the Commons need not guarantee the preferred outcome of every complaint, but it should

Table 24: Failure configurations in voluntary engagement and associated design questions. These are analytical cases, not observed outcomes of the proposed Commons.

Configuration	Possible failure	Design response to examine
Recruitment by an academic supervisor	Students infer that refusal may affect evaluation	Independent invitation and assessment channels; explicit non-retaliation practice
Open research tied to service shifts	Unpaid work becomes a de facto condition for research access	Separate access rules and role-specific contribution agreements
Attendance-centred retention metrics	Overload, silent dissatisfaction, or unequal care obligations disappear from view	Confidential feedback, workload review, permitted exit and handover
Ambiguous role or approval language	Participants assume clinical/service authority from Commons affiliation	Clear status statements and competent permission verification
Excessive documentation of motives	Sensitive personal information is collected without necessity	Data minimisation, role-specific records, limited retention and access

preserve reasons and correct demonstrable mistakes within its competence.

The possibility of exit also relates to the non-extractive purposes discussed elsewhere in the manuscript. If a participant contributes research tools or documentation, the Commons should avoid designing dependence in which the institution gains indefinitely while the contributor loses lawful access to their own work, credit, or opportunities to develop it. Equally, a contributor's legitimate credit does not give them authority over a subsequent researcher's independent output. The practical response is to establish contribution provenance, licences, role limits, and review arrangements before reliance develops, rather than appealing retrospectively to general ideals of fairness.

17.9 Institutional Configurations, Participation Evaluation, and Historical Revision

Different organisational settings can satisfy the same participation functions through distinct arrangements. An independent research Commons might rely on publicly described research problems, non-sensitive demonstration resources, discussion forums with moderation, and transparent contributor terms. An authorised hospital volunteer organisation may integrate eligibility and orientation with its existing professional and patient-safety practices. A university-based educational collaboration may distinguish curricular work, voluntary extracurricular engagement, and research activities subject to separate ethical review. Across these settings, formal membership need not be the principal form of participation. A public contribution, a critical review, or a small bounded project can have value without long-term enrolment.

The strongest test of an entry infrastructure arises before commitment and after a costly change of circumstance. Before entry, a newcomer should be able to compare research-only participation, separately authorized service, a smaller task, and informed refusal without an implied penalty. After entry, an unexpected examination period, a changed employment situation, or a failed supervision relation should prompt renegotiation rather than automatic moral blame. A documented refusal may indicate that the invitation was intelligible and the exit meaningful. The relevant evidence is not a high rate of enrolment but whether the person could accurately describe the scope, support, burdens, and available alternatives, and whether those conditions remained credible during participation. A basic orientation and a responsive coordinator might meet this test better than a sophisticated recruitment funnel.

The design should compare alternatives against both their generative possibilities and the material conditions required to maintain them. Accessible orientation needs trained staff or reusable explanatory material; genuine mentoring consumes time; fair complaint handling requires competence, confidentiality and independence appropriate to the stakes. Broad inclusion may be undermined if the project lacks translation, accessibility, transport, childcare, or schedule flexibility, but the availability of each support is contingent on resources. A Commons that advertises every possible accommodation while delivering

none may be less trustworthy than one that communicates a narrower but reliable capacity and plans explicit expansion. In such cases, the design of reasonable participation opportunities is a question of resource justice as well as organisational efficiency.

Evaluation should preserve variation in participants' purposes and perspectives. Counts of initial inquiries, role acceptances, active participants, completed service hours, and published contributions can describe selected manifestations, but should be supplemented, where lawful and appropriate, by participant understandings of role clarity, experienced autonomy, barriers, support quality, unwanted pressure, and reasons for leaving. Evaluation should also consider affected publics, supervisory burden, missed safety escalations, contested attribution, and institutional responsiveness. Anonymous or aggregated feedback is often preferable where detailed personal records are unnecessary. No single composite "engagement score" can determine whether relations are just, productive, or voluntary across heterogeneous contexts.

Two comparative tests illustrate the importance of causal caution. First, a university-adjacent project may exhibit high student enrolment because it recruits only from a course whose students have unusually strong academic incentives, rather than because spatial proximity independently enables participation. Second, a small non-university service organisation may achieve stable voluntary engagement through long-standing community relations despite limited academic channels. Both cases challenge an unconditional claim of university superiority. Comparisons would need to examine baseline motivations, selection into invitations, socioeconomic burdens, role types, authority structures, and longitudinal experiences. Where research on participants involves personal data or systematic human-subject inquiry, competent approval and safeguards must be addressed separately.

The historical record should retain more than successful recruitment campaigns. It should preserve, in lawful and proportionate forms, changes to eligibility, information given at entry, role design assumptions, documented reasons for significant decisions, institutional corrections, and evidence that advertised opportunities could not be supported. Individual motivations should not be archived indefinitely merely for theoretical curiosity. A later researcher ought to be able to understand how participation conditions changed, without requiring the indefinite preservation or publication of personal histories. In this sense, the capacity to revise recruitment, supervision, and exit relations forms part of the historical reproduction of the Commons, while the meaning and effects of that revision remain open to justified inquiry.

The section's central design claim is conditional. Participation infrastructure can make new voluntary relations more intelligible, feasible, and normatively accountable, but it cannot guarantee willingness, persistent motivation, service quality, or equitable value generation. Its success is best examined through the practical opportunities it provides for considered entry, critical participation, adequately supported contribution, and justified refusal or exit. These relations connect directly to Section 16, which concerns public expression preceding engagement, and to the subsequent analysis of planning and decision-making, where bounded roles and actual resources become conditions of feasible collective action.

18 Planning, Decision-Making, Simulation, and Coordination

The formation of a legitimate practical decision is a different institutional achievement from identifying a research problem, recruiting participants, or producing a computational answer. For a candidate activity, at least five questions must remain distinct: which options are expressible, which are feasible under stated model assumptions, which are supported by adequate evidence, which are normatively defensible, and who is competent to authorize and coordinate any resulting action. The constitutive object here is the revisable relation among alternatives, responsible decision makers, supporting reasons, and execution conditions. For an independent Commons, that relation may end with a publishable hypothetical model. An actual hospital event requires separate institutional authority and safeguards. A technical recommendation cannot promote itself into an operational order by being internally consistent.

This section develops a context-dependent institutional design grammar for such a capacity. Simon's analysis of administrative decision processes and bounded rationality provides an established explanation

of why institutional choice cannot ordinarily presuppose exhaustive knowledge or unbounded calculation (Simon, 1997). Keeney's value-focused decision analysis makes objectives and the creation of alternatives themselves subjects of inquiry rather than fixed inputs to a later comparison (Keeney, 1992). Rittel and Webber's account of problems in social planning warns against treating plural and contested public problems as if they admitted an uncontested technical optimum (Rittel and Webber, 1973). Systems modelling and the methodological criticism of policy models further motivate attention to feedback, omitted mechanisms, opacity, and uncertainty (Sterman, 2000; Saltelli et al., 2020). These are distinct intellectual contributions. The proposed generative-relational argument addresses how conditions for warranted institutional choices may be constituted, connected to other Commons infrastructures, and preserved for subsequent criticism. It does not offer a single decision theory that supersedes those contributions.

The analysis remains applicable across university hospital settings and other service-related Commons, without attributing operative authority to the Commons itself. Research on a hypothetical event or synthetic volunteer schedule may proceed independently with appropriately licensed information. An actual hospital event, service roster, patient-facing intervention, or study involving people or restricted data requires separate and competent institutional permissions. Decisions in one sphere cannot be silently transferred to another. The section treats institution-specific procedures as matters to be investigated and designed under their applicable conditions, not as universal rules.

18.1 Decision Situations and the Constitution of Practical Alternatives

A decision situation emerges when some actor or institution recognises that more than one course of action, including postponement or non-intervention, may be relevant to a defined problem. It does not follow that the relevant choices are known. A hospital-affiliated group may initially ask how to allocate volunteers among several activities, but investigation may show that a task should be redesigned, a role should be separated, additional preparation is necessary, or the proposed activity should not take place. The formation of alternatives is part of decision-making itself. A model trained only to allocate fixed volunteer hours may systematically exclude the possibility that service expectations are inappropriate or that an institutional burden should be reduced rather than redistributed.

The section on public problem constitution (Section 7) concerns which problems deserve attention and how their framing can be contested. The present section examines the subsequent but revisable constitution of practical alternatives. The problem record supplies a provisional purpose, affected interests, evidence, and unanswered questions. Decision analysis then considers which actions can meaningfully address that purpose, what conditions their consequences depend upon, and who is entitled to select among them. A planning cycle can return to the problem record when alternatives expose a previously unrecognised conflict. Such feedback is not an irregularity in responsible planning; it can be evidence that the original formulation was insufficient.

Definition 18.1 (Situated decision infrastructure). A *situated decision infrastructure* is a context-dependent arrangement of problem and alternative formulation, evidence appraisal, normative and authority review, resource and scenario analysis, deliberation, accountable selection, coordination, exception handling, and historical revision, through which institutionally differentiated subjects can examine, authorise where competent, conduct, or decline courses of action. Its adequacy depends on the affected subjects, applicable norms, practical resources, available evidence, and conditions under which decisions are made and subsequently reconsidered.

Decision infrastructure is a function rather than an obligatory committee, optimization platform, or workflow application. An independent research group might adequately compare alternatives using a one-page decision record, a spreadsheet, and a documented discussion of uncertainties. A service institution may need formal delegation, competent approvals, duty rosters, contingency instructions, and incident routes commensurate with the consequences of error. The relevant comparison is not paper against software but an arrangement that exposes consequential assumptions and designates a responsible decision maker against one that cannot. A technically sophisticated ranking with concealed criteria can be less useful than an accessible meeting record documenting a justified decision to postpone.

18.2 Three Reality Levels and the Limits of Decision Representations

At the level of *ontological reality*, a decision model does not settle the ultimate status of persons, their purposes, or the meanings of care and public value. Persons represented in scheduling variables are not thereby constituted as interchangeable units of productive time. An optimisation objective remains a constructed description of a particular purpose, not a complete definition of the interests and lives of the people it affects. Ontological suspension is pertinent because a model's representational conveniences can otherwise be mistaken for the kinds of beings and obligations that the institution actually encounters.

At the level of *relational reality*, a decision depends upon historically differentiated capacities and institutional relations. Roles, supervision, permission to communicate with patients, knowledge of a task, volunteer time constraints, institutional habits, material resources, and responsibility for responding to incidents may all shape a feasible choice. These relations are not necessarily stable across departments or periods. A volunteer's expressed preference for a recurring time slot can change after new academic obligations arise; the service value of a particular event may change when its intended participants or institutional priorities change. The decision situation is therefore not fully captured by an isolated vector of preferences and constraints at one moment.

At the level of *manifestation reality*, meeting minutes, project proposals, simulation traces, numerical risk categories, staffing tables, approval letters, and actual attendance logs present partial and differently authorised aspects of decision processes. A recorded approval is evidence of an approval under stated conditions, not proof that the decision was ethically justified or that implementation matched the approved design. A simulation's prediction is a manifestation of assumptions and calculations, not a direct observation of future practice. Its evidential standing depends on model construction, data quality, critical testing, and transferability to the situation at issue.

These distinctions require a disciplined separation of at least five predicates: an alternative may be *computationally feasible* within a specified model, *epistemically supported* by available evidence, *normatively defensible* under applicable and contestable considerations, *authorised* by a competent institution, and *implemented* as a historical event. Evidence for one does not itself establish the others. The corresponding procedures can cooperate, but should not be treated as a single binary "approved" property.

18.3 Decision Objectives, Plural Values, and Institutional Standing

Planning requires articulating what is at stake before treating measures as evaluative objectives. Keeney's value-focused approach identifies the elicitation and structuring of objectives as a way to develop alternatives instead of merely scoring a pre-selected list (Keeney, 1992). Within a volunteer Commons, relevant considerations might include accessibility of an activity, patient experience, participant autonomy, predictable workloads, scheduling reliability, educational opportunities, equitable distribution of burdens, long-term capacity, and cost. Their relevance and relative importance depend on the particular institution and the perspectives of affected persons. No fixed weighting of these values is justified by the mere existence of a Commons.

A distinction must also be maintained between an objective, a measurement, and a legitimate standing to decide. A proposed schedule might reduce the number of uncovered slots while making it difficult for a volunteer with caregiving responsibilities to participate. A model can display both effects if the requisite information is available; it cannot, by computation alone, resolve the normative dispute between aggregate coverage and distributive burdens. Similarly, a patient-oriented programme may have important interests that are not adequately represented by either volunteers or technical planners. Consultation, delegated decision power, consent, and rights of complaint should be differentiated rather than being presented as interchangeable kinds of "stakeholder involvement."

Governance infrastructure (Section 9) is concerned with the constitution and accountability of decision powers. Decision infrastructure examines how persons exercising those powers obtain, scrutinise, and use reasons and alternatives. The governance body may determine who can approve a certain class of activity, while subject-matter reviewers assess the information available to the decision maker. Both

Table 25: Distinct claims and competences in an illustrative institutional decision. The columns identify questions to be established, not an automatically applicable approval sequence.

Claim type	Question and appropriate evidence	Limitation of the claim
Problem relevance	Who has reason to regard the activity as worth considering, and on what basis?	Recognition does not license intervention.
Model feasibility	Can an alternative satisfy the formal constraints given the stated inputs?	Formal feasibility is conditional on the model.
Epistemic warrant	Which tests, comparisons, and uncertainties support expected consequences?	Evidential support may not transport across settings.
Normative defensibility	Which rights, burdens, duties, and objections have been considered?	A favourable technical score does not settle justice.
Competent authorisation	Which actor can legitimately approve the particular activity and conditions?	Commons membership does not create hospital authority.
Practical execution	What happened, under which changes, and with whose responsibilities?	Performance records do not validate all prior reasons.

may need channels for those affected to express disagreement. A participant’s capacity to formulate a technically good plan does not make them an authorised hospital coordinator; a coordinator’s delegated authority does not imply competence in every analytic method used to support a choice.

18.4 Decision Records, Constraints, and Qualified Admissibility

A minimal institutional design can connect the problem, alternatives, reasons, authority, and historical revision through a typed record. For a candidate decision event d , consider

$$D(d) = (p, \mathcal{X}, S, E, N, U, R, I, V)_d, \quad (30)$$

where p identifies the version of the problem under consideration; $\mathcal{X}$ is the set of documented alternatives, including where appropriate a deferral or non-intervention option; S describes affected subjects and their differentiated standing; E identifies evidence, assumptions, and uncertainties; N identifies relevant normative sources and interpretive questions; U identifies the competent authorising roles and limits of their jurisdiction; R records resource, timing, and coordination conditions; I records the actual implementation status and exceptions; and V identifies review arrangements, historical provenance, and superseding versions. This is a *proposed descriptive schema*, not a proof that each field can be filled conclusively or that completion establishes legitimacy.

The decision record should preserve consequential uncertainty instead of completing every field with unwarranted precision. Unknown availability should remain unknown; contested accessibility constraints should identify the person or process capable of further review; and restricted information should remain with its competent steward rather than be copied into a public log. The record can make clear that a simulation is conditional, that a required authorization is pending, or that no safe alternative has yet been identified. It should also distinguish an informal suggestion, a preliminary recommendation, an approved institutional decision, and an instruction to act. These are different statuses with different consequences. More complete documentation is useful only where its evidential and accountability gains exceed the time, privacy, and interpretive burdens imposed.

In a particular decision setting c , a conditional notion of admissibility can be represented as

$$\text{Adm}_c(x) = \text{Scope}_c(x) \wedge \text{Rights}_c(x) \wedge \text{Authority}_c(x) \wedge \text{Safety}_c(x), \quad x \in \mathcal{X}_c. \quad (31)$$

Equation (31) specifies a *conditional normative conjunction*, not a procedure for converting unavailable information into Boolean truth values. Its component predicates express requirements as they would be interpreted by a competent decision process in context c . The analyst must separately record whether

each condition has been established for the proposed use, established to fail, remains unresolved, or is contested. In particular, a blank authorisation field is not evidence of refusal, and it is not a grant. The expression does not select the best alternative or confer institutional competence; even a proposal satisfying its stated necessary conditions may require further deliberation. Model-feasible alternatives may fail those conditions, and authorised alternatives can still have uncertain consequences requiring monitoring.

Institutional rules may change during a project, and a planning record must distinguish the source version applicable at a particular time from a later revision. A handbook can offer helpful guidance without possessing the force of an authorised order. A provisional Commons protocol cannot waive applicable privacy requirements or allocate rights over third-party resources. The normative source register and the decision record should therefore be connected by versioned references, not silently merged into a generic compliance check.

18.5 Evidence-Qualified Admissibility and the Exercise of Decision Authority

An admissibility claim has two objects: the status of a particular proposed action under the conditions that govern it, and an observer’s warranted knowledge of that status. The latter is limited by source access, institutional competence, temporal scope, and disagreement about the applicable rules. For a proposed use x , context c , observer o , and review time t , define a non-certifying assessment label

$$\widehat{\text{Adm}}_{c,t}^o(x) \in \{\text{supported, excluded, unresolved, contested}\}. \quad (32)$$

The terms in Equation (32) are reportable statuses of an assessment, not legally effective dispositions. “Supported” means that the scoped conditions have been examined with stated evidence and competent inputs; it is not a universal certification. “Excluded” records an identified disqualifying condition, with its source and applicability. “Unresolved” preserves absent or insufficient evidence, while “contested” preserves a material dispute over an identified ground. Mixed statuses may be retained at the component level rather than forced into a single aggregate classification. A later correction changes what is supportable at the review time without automatically rewriting the legal or historical conditions at the time of the original action.

The passage from assessment to institutional action requires a further, independently constituted relation. A proposal may be substantively defensible but outside the author’s delegated remit; an authorised person may make a procedurally valid decision whose expected benefits remain uncertain. Denote by $\text{ActWarrant}_{I,t}(r, x)$ an analyst’s claim that a person in role r has a warranted institutional basis to implement proposal x . At a minimum, such a claim entails separately examined decision, delegation and current-condition questions:

$$\text{ActWarrant}_{I,t}(r, x) \implies \text{Decision}_{I,t}(r, x) \wedge \text{Delegated}_{I,t}(r, x) \wedge \text{Conditions}_{I,t}(x). \quad (33)$$

These are necessary analytical questions, not sufficient legal conditions or a complete procedural code. Their interpretation and any additional requirements belong to the relevant competent authority. In independent public research, a valid outcome may be a bounded publication or the deliberate decision not to seek an operational interface. In a service setting, the decision may additionally require changes in role preparation, supervision, resources or safeguards. The relational model gains explanatory content only if distinguishing these transitions changes a specific review or prevents a demonstrable error beyond what an ordinary decision memorandum would achieve.

The analytical status of Equation (32) should not be confused with the historical status of a decision. An observer may classify an authorisation claim as supported while the institutional decision maker has not yet exercised the relevant power; an apparently complete record may also prove that an institution decided to decline an activity. A legitimate decision to defer should be described as a decision with its own reasons and effective scope, not as a data-quality failure to be converted into a positive recommendation. Correspondingly, an observed activity can occur without warranted permission. The historical occurrence of an action therefore does not retrospectively satisfy the antecedents in Equation (33).

Consider a fictional research group whose synthetic roster simulation yields a feasible allocation and whose independent publication proposal is approved by its own editorial team. A second proposed action is to distribute that roster as a hospital service instruction. The first decision supplies neither a delegated hospital role nor permission for the second use. Even if a reviewer later discovers that some schedule was circulated, circulation is an observed event rather than proof of competent approval. The smallest sufficient analytic record for this case may consist of two identified proposed uses, one dated editorial decision, a clearly identified missing service authority, and the status of any subsequent distribution. Adding one comprehensive approval dashboard would risk collapsing the different kinds of evidence without improving the judgment.

This distinction also limits the claim of the proposed model. Where a short existing decision memorandum already identifies the actor, specific scope, authoritative source, conditions, and disposition, an additional typed decision layer has no presumed benefit. Its proposed contribution is testable only when the comparison shows that certain consequential confusions are less likely under equal evidence, or are corrected more efficiently without shifting unreasonable costs to reviewers or participants.

One further qualification follows when a decision has several downstream objects. An observed publication, an operative decision within the research group, an exercise of externally delegated service authority, and a documented effect of an implemented service are not successive grades of one approval. They are distinct events or claims whose relevant decision makers and evidentiary bases may differ. For instance, an editorial decision at t_1 can be reliably recovered at t_3 without retrospectively creating a service authorisation at t_2 ; a service instruction may have been acted upon without having been validly issued. When joining a decision record to an artefact-rights review, the proposed *act* must match: permission to distribute a source code file and a decision to deploy the code in a staffed service do not address the same act. The scoped comparison formalised in Equation (50) consequently preserves both records but supplies neither missing approval nor an inference about resulting welfare.

For an analyst, an adverse or incomplete disposition is not always a failed decision. Deliberate deferral may preserve the ability to obtain expertise, decline a disclosure, or withdraw a proposed role. Research should examine whether a review recognises those alternatives *without* increasing false refusals of straightforward and legitimate independent scholarship. The contrast is testable with the matched-dossier protocol in Section 25.10, not by counting how many fields in Equation (30) were populated.

18.6 Simulation, Scenario Testing, and Epistemic Boundaries

Simulation is useful when it exposes how plausible changes in assumptions affect available choices. A synthetic volunteer-scheduling example might compare a baseline plan with alternative availability distributions, accessible shift arrangements, or a sudden absence. Its output is a statement about those modeled conditions, not a forecast of actual people or an approval to deploy a roster. To evaluate the simulation, investigators should record assumptions that are controllable, uncertain, or absent, and test whether a decision is robust to reasonable changes in each. Sterman's discussion of simulation in organizational learning informs the distinction between model-based exploration and warranted inference (Sterman, 2000). For a genuinely high-stakes application, modeling cannot substitute for competent field judgment, relevant evidence, and authorized safeguards. Conversely, low-stakes research may be better served by a transparent sensitivity table than by expensive agent-based machinery whose behavioral assumptions cannot be validated.

Model development should distinguish the intended purpose of a simulation from any claim of external validity. A synthetic simulation may be appropriate for comparing algorithmic approaches under stated artificial distributions. It can establish computational behavior under those conditions, including sensitivity to changes in the input. It does not thereby establish that real volunteer availability follows those distributions, that the represented outcomes capture lived burden, or that an intervention would be safe. Saltelli and colleagues' discussion of models in high-stakes policy contexts supports explicit scrutiny of model assumptions, uncertainty, and the social consequences of modelling choices (Saltelli et al., 2020). The present framework extends those concerns as design questions for Commons gover-

nance without treating their article as empirical evidence of any Commons programme.

Useful scenario families may address ordinary variation, bottlenecks, rare but consequential disruptions, and adversarially selected model failures. The selection should follow the stated research question and justified uncertainty, not an arbitrary universal scenario budget. Sensitivity analysis can reveal which assumptions strongly influence a result; independent model criticism can identify mechanisms absent from the representation. For an event, this may include missing accessibility requirements, participant fatigue, noise, misunderstandings about roles, inadequate evacuation provisions, or the unavailability of a responsible supervisor. Some conditions are not ethically or practically suitable for experimental manipulation in actual care environments. In such cases, desk-based reviews, synthetic scenarios, expert examination under proper authority, and institutionally approved nonintrusive observations may have different roles.

The distinction between *prediction*, *stress testing*, and *deliberative illustration* is consequential. An event storyboard may help volunteers understand alternative procedures without providing a statistical probability of success. A discrete-event model may estimate queues under a hypothetical arrival process, but estimates can change if the assumed population is inaccurate. A historical incident analysis may suggest particular precautions, yet its transfer to another department can be limited by different responsibilities and equipment. A responsible infrastructure reports what kind of epistemic claim a simulation supports, which alternatives it compares, and which practical decisions remain beyond its authority.

18.7 Scheduling, Role Allocation, and Conditional Optimisation

Volunteer scheduling illustrates the intersection of time, competence, fairness, and authority. A research team may construct a synthetic benchmark with indexed volunteers $i \in I$, time blocks $t \in T$, and service roles $r \in R$. A binary variable x_{itr} may represent whether a synthetic participant is assigned to a role and block. The model may constrain assignments by declared availability, role compatibility, preparation, maximum hours, or assumed coverage targets. It may compare alternative objectives such as uncovered time, distribution of assigned shifts, preference satisfaction, or stability across replanning. These assumptions should be defined and made available for critique rather than presented as direct observations of real people.

Even the meaning of “availability” is institutionally conditioned. A volunteer can declare possible times without agreeing to every assignment. A person may require accommodations, may withdraw from a task, or may be unsuitable for a particular role without that fact being public. Reliability can be influenced by institutional support, travel burden, and predictable scheduling rather than simply by individual dispositions. Accordingly, the research representation should permit qualified commitments, contingencies, exceptions, and protected information boundaries. It should not infer a moral obligation from a solver’s use of an availability matrix.

Multi-objective optimisation can reveal genuine trade-offs, but should not be used to hide them. Suppose an allocation minimises the number of unfilled slots while repeatedly assigning inconvenient times to participants with limited ability to refuse. A nominally optimal result may be undesirable once unequal burdens and role relationships are examined. Lexicographic constraints, Pareto comparisons, robust optimisation, participatory discussion, or explicit review of distributional consequences may each be useful under particular circumstances. The paper does not select one as universally correct. Equally, a quantum optimisation method may be a legitimate subject of independent engineering research but has no privileged entitlement to operational deployment; its performance claims would require appropriate baselines and domain-specific validation.

Scheduling may also be an inappropriate response to the original problem. If coverage expectations exceed available voluntary capacity, a better institutional decision might be to narrow an activity, improve preparation, procure resources, ask authorised personnel to undertake required work, or refrain from offering the activity. A coordination infrastructure that treats “assign all duties” as an unquestionable objective can conceal a resource shortage and shift burdens onto volunteers. The capacity to reconsider the task structure is therefore as important as the capacity to compute an assignment.

18.8 Event Planning, Authorised Coordination, and Exception Handling

Consider a hypothetical educational event intended to make a nonclinical hospital-related library resource more accessible. Its planning may involve programme objectives, intended audiences, suitable spaces, accessible communication, supervision, role boundaries, equipment, participant consent where needed, time windows, and a way to suspend activity if an important condition changes. An independent Commons could research alternative event schedules, compare illustrative staffing configurations, draft a publicly available handbook, or analyse historical accounts. It could not thereby book institutional space, direct hospital volunteers, publish a patient's account, or represent the event as endorsed. Actual activities require competent institutional decisions, potentially including requirements that the independent Commons cannot itself satisfy.

A hypothetical plan may be documented in stages: an exploratory problem statement, alternative activity designs, review of available knowledge, explicit constraints and scenarios, communication of a tentative proposal, institutional decision where authorised, and an implementation record if implementation occurs. This order is not assumed to be universal. The practical sequence may differ across jurisdictions, organisational arrangements, or the urgency of the situation. In all settings, a change in material assumptions should have a recognised path back to reconsideration. The purpose of planning is not to protect the initial plan from modification, but to maintain a responsible connection among purpose, affected interests, authority, and action.

Coordination is itself a relational practice. Even where an authorising official makes a final decision, execution may depend upon several agents who interpret instructions under different local conditions. Role descriptions, contact routes, timing agreements, capacity to ask for clarification, and escalation responsibilities can reduce avoidable ambiguity, but they impose communication and maintenance costs. A research protocol may specify who maintains a simulation; an authorised service protocol may specify who supervises an activity or responds to an incident. These need not be the same person or organisation. An effective arrangement should allow a frontline participant to report a material problem without having to prove that the original planner was mistaken.

Exception handling is a decision function in its own right because authorized activity can become inadmissible as its conditions change. A volunteer absence, newly identified privacy risk, inaccessible venue, or loss of required supervision may create a decision point not represented in the original schedule. Before action, an institution should identify which deviations may be adjusted within delegated competence, which require new authorization, and which call for stopping and referral. In a research-only example these are modeling questions; in service practice they belong to the responsible institution. Reversibility helps distinguish response options: postponing an event can preserve future choices, whereas publication of protected personal information may be impossible to undo fully. The best-designed escalation rule is one a situated participant can understand and use, not merely a rule that appears complete in a handbook.

18.9 Decision Interfaces, Power, and Resource Stewardship

Planning and coordination make visible the coupling among the Commons' infrastructure functions. Public-problem constitution supplies a revisable purpose. Normative and safety infrastructures define questions of permissibility and protection. Governance distinguishes the persons who can deliberate or approve from persons who can advise. The information and epistemic infrastructures determine whether relevant evidence can be discovered, legitimately accessed, and adequately scrutinised. Disciplinary research environments may provide models and alternative methods; interdisciplinary mediation translates their outputs without treating technical and legal claims as identical. Communication carries proposals and decisions to affected publics, while voluntary-participation infrastructure protects the autonomy and preparedness of contributors. Historical preservation records the evolution of reasons and failed plans, and contributor-rights infrastructure addresses the ownership and reuse of research artefacts produced along the way.

These relations create resource burdens. A simulation can require extensive assumptions and spe-

Table 26: Illustrative weaknesses of proposed decision infrastructures and possible forms of examination. These are design tests, not reports of observed hospital outcomes.

Failure mechanism	Relational or institutional consequence	Possible examination
A solver defines the available choices	Declining or redesigning a task becomes invisible.	Ask whether non-intervention and alternative problem framings were considered.
Synthetic assumptions become operational facts	A model is used beyond its warranted domain.	Trace the data source, sensitivity analyses, validation limits, and transfer conditions.
Approval status is ambiguous	Technical advice is mistaken for permission to act.	Identify the competent authoriser, the decision scope, and outstanding conditions.
Aggregate metrics conceal unequal burdens	Persons with weaker bargaining positions absorb more costs.	Review distributions, objections, accessible exit, and qualitative accounts.
Exceptions have no responsible owner	Frontline uncertainty produces unmanaged risk or silent improvisation.	Reconstruct escalation channels, delegation, and stopping conditions.
Decision records preserve only successful plans	Later participants lose evidence needed for critical revision.	Examine whether rejected options, uncertainty, reasons, and justified redactions remain recoverable.

cialist maintenance; a participatory review can demand time from people whose labour is already scarce; repeated consultation may generate fatigue without affecting the eventual decision. The appropriate depth of analysis depends in part on consequences, reversibility, institutional scale, and available competence. A simple low-impact decision should not automatically require an elaborate model. Conversely, a high-stakes change should not be justified by a superficial optimisation or an unreviewed template. The costs of responsible deliberation are real, but procedural economising that systematically silences affected persons may create larger downstream costs and harms.

Power can shape each step of a decision. A modeller may select assumptions that favour measurable efficiency; an administrator may frame objections as impractical; a volunteer may feel unable to contradict an established institution; a donor may influence which projects become available for consideration. Transparent reasons and complaint procedures can improve the examinability of such relationships, but not erase differences in standing and material dependence. The relevant governance design should preserve opportunities to challenge a model's purpose, not only its computational accuracy. It should also distinguish a request for consultation from an obligation to contribute uncompensated analytical work.

18.10 Situated Evaluation, Historical Learning, and Design Revision

A decision infrastructure can be evaluated by its capacity to improve the justification and revisability of institutional action, not simply by counting plans produced or objectives optimised. Examination may address the clarity of alternatives, quality of evidential support, treatment of disagreement, identification of competent authority, adequacy of contingency arrangements, distribution of burdens, and ability to reconstruct subsequent changes. The relevant indicators are question-dependent. A more elaborate review record may improve recoverability yet become so burdensome that it displaces essential service preparation. An event may be cancelled for appropriate safety reasons; this should not automatically be counted as a planning failure. Conversely, smooth execution does not prove that all persons affected were adequately heard.

A discriminating test should hold a synthetic event problem constant and compare an ordinary worksheet with an added simulation or decision protocol. Introduce an absent volunteer, a competing accessibility need, and a venue constraint whose status is uncertain. Ask which alternative each arrangement recommends, whether it exposes the decisive assumption, whether postponement is a permissible output,

and whether the observer can identify the person who would have authority in a real setting. A faster schedule is not automatically preferable when it achieves speed by excluding a participant or concealing uncertainty. A protocol that produces richer records without improving the decision or the capacity to challenge it may be an unnecessary burden. Because no real service outcomes are observed in this test, its result concerns the adequacy of the proposed decision procedure, not hospital effectiveness.

The historical record of a decision should make a later question intelligible: given what the participants were entitled to know and do at the time, what alternatives were considered, what reasons justified selection or refusal, what actually changed, and how have subsequent circumstances affected the relevance of that decision? A complete reconstruction may be impossible because memories fade, sensitive information cannot be retained, and the participants' experiences were never fully represented. The archive should therefore identify unresolved uncertainty and lawful limitations on disclosure rather than claim comprehensive institutional memory. Failed simulations, rejected plans, reports of burdens, and justifiable non-interventions can themselves become valuable objects of future research.

Institutional reproduction is more demanding than repeating a successful schedule. It entails the capacity to recognise when historical assumptions cease to hold, when new participants have different constraints, or when formerly legitimate permissions expire. A Commons might preserve the scientific lineage of a scheduling method while independently examining whether its application would now be unfair or unauthorised. Decisions can also improve the infrastructure that produced them: discovering an absent accessibility consideration may revise project-intake practices; repeated unanticipated absences may motivate more realistic contingency planning rather than stricter penalties; a misleading simulation can motivate new validation procedures. These are potential mechanisms for generative institutional learning, not empirically established effects of the proposed framework.

The design consequence is a disciplined but revisable separation among the construction of choices, the examination of their evidence, the justification of their consequences, the authority to act, and the historical practices through which their effects become knowable. Such separation permits a research Commons to develop sophisticated planning and simulation infrastructure without presenting research models as hospital policy. It also provides the conceptual interface to the following section on contributor provenance and rights: models, decision records, simulation scripts, interpretations, and reusable handbooks may generate new scholarly and practical value, but their authorship, permitted use, and downstream claims require independent examination.

19 Contributor Provenance, Rights, and Licensing

The contribution of a dataset, handbook, software implementation, translation, research method, or critical comment can become part of a longer historical process whose eventual uses were not anticipated when the contribution was made. A university hospital volunteer Commons concerned with generative relations therefore faces a practical institutional question: how can it preserve intelligible histories of contributions, recognise the people and organisations involved, and enable lawful reuse without converting provenance into an unsupported claim of ownership over future work? This section develops a context-dependent infrastructure for contribution provenance, rights identification, licensing, and conflict review. It addresses the status of contributions and permissible transactions, rather than the distinct question of whether subsequent benefits actually return to contributors. That latter question concerns generative value circulation and is reserved for the following section; here it is considered only to mark an institutional interface.

The infrastructure connects established but analytically different domains. The World Intellectual Property Organization distinguishes protected expression from ideas and methods as such, while explaining that the scope of authors' economic and moral rights depends on applicable legal rules (World Intellectual Property Organization, 2026a,b). The CRediT taxonomy describes contributor roles but is not an authorship test (National Information Standards Organization, 2022). The International Committee of Medical Journal Editors articulates authorship criteria for scholarly publications within the scope of its recommendations (International Committee of Medical Journal Editors, 2026). Creative Commons

provides standardised permissions for specified rights in licensed material (Creative Commons, 2013b). DataCite metadata and SPDX licence identifiers supply techniques for identifying research objects, related versions and licensing expressions without adjudicating legal title (DataCite Metadata Working Group, 2026; SPDX Project, 2026). Our proposed framework brings these resources into a situated design grammar; it does not claim to originate those standards or to replace specialist legal judgment.

The analysis remains independent of any named hospital or national legal system. A contribution to an independently maintained collection of genuinely synthetic data can be governed by its own legitimate permissions. A contribution involving institutional employment, third-party documents, human-participant research, clinical images, identifiable volunteer records, confidential organisational information, or hospital infrastructure can be subject to additional obligations and approvals. Neither membership in a Commons nor publication of a contribution record changes these boundaries.

19.1 Contributions, Entitlements, and the Constitutive Object

A contribution is an historically situated activity or result that affects the conditions of a research or cooperative undertaking. It can consist in formulating a problem, preparing evidence, implementing software, correcting an error, establishing an explanatory relationship, reviewing a method, designing a learning environment, mediating between disciplines, or sustaining the infrastructure through maintenance. These activities have distinct epistemic, social, economic, and normative characteristics. The fact that a contribution matters to the Commons does not by itself settle the legal classification of its products, the contributor's scholarly authorship, or the scope of subsequent claims.

Three distinctions are especially important. First, evidence of participation is not proof of an exclusive right. A repository history may show that a person supplied a useful idea, while copyright rules may not confer exclusivity over the idea as such. Second, the existence of legal rights does not necessarily establish who presently holds them. Employment arrangements, joint creation, assignments, contractual licences, applicable exceptions, or other legal relations may affect that question. Third, recognition of a contributor is neither equivalent to a contractual promise of future payment nor sufficient evidence that value has returned. These distinctions guard against two symmetrical errors: allowing the Commons to appropriate contributions merely because they are shared, and allowing contributors to appropriate the independent works of others merely because their earlier contributions influenced later activity.

Definition 19.1 (Situated contribution-rights infrastructure). *A situated contribution-rights infrastructure* is a revisable configuration of contribution identification, provenance evidence, role attribution, rights and authority examination, licence and agreement documentation, permitted-use communication, dispute review, and historical preservation through which a Commons can examine and administer legitimate relations concerning particular contributions. Its records describe claimed, evidenced, and verified statuses separately; they do not create rights or authorise institutional uses merely by being recorded.

The definition does not assume that every contribution is protected intellectual property, that a credited participant is an author, or that tracing dependence produces a claim to future proceeds. A factual correction, original research code, a protected illustration, an uncopyrightable idea, and confidential participant testimony can have different legal and ethical conditions. A narrow Commons might keep a contribution history and artifact-specific permission notice without maintaining an elaborate registry of purported ownership. Its adequacy should be tested on disputes that matter: who was responsible for a revision, which version may be reused, and which legal or contractual question remains unsettled. Recording a contributor's name is insufficient where the right type or legitimate use is unknown.

19.2 Three Reality Levels and the Partial Manifestation of Rights

At the level of *ontological reality*, identifying a contributor as an “author”, “owner”, or “volunteer” does not settle the ultimate nature of creative agency, personhood, property, or value. The present framework suspends claims of ontological finality. In particular, a convenient database identifier is not a complete

account of a person, and an automatically generated contribution label cannot settle difficult questions of individual and collective creation.

At the level of *relational reality*, contributions emerge under historically specific conditions: opportunities for training, access to tools, previous research, mentoring, organisational power, labour contracts, interpersonal collaboration, and permitted access to resources. An early software implementer and a later experimental critic may both contribute significantly to a scientific result in different ways. Their claims and responsibilities are conditioned by the actual relations through which the work was done. Intellectual property and institutional rights are themselves legally and socially constituted relations, rather than material qualities inherent in an isolated file.

At the level of *manifestation reality*, an acknowledgment, version-control commit, signed agreement, licence notice, citation, persistent identifier, accepted paper, or contributor-role statement presents partial evidence. A commit may identify an account rather than the legally relevant author. A signed contribution agreement may grant a permission without establishing that its signatory possessed the rights purportedly granted. A citation may acknowledge intellectual influence while omitting maintenance, care, or informal translation work. A publicly displayed attribution may even be unwanted when pseudonymity or safety matters. Consequently, the infrastructure requires source criticism, contextual investigation, and differentiated evidentiary confidence; it cannot substitute a record's completeness for the fairness or legality of underlying relations.

This three-level analysis is especially pertinent to cross-disciplinary research. A formula, a source edition, a pedagogical design, and a software library may share a project context while possessing different legal and scholarly statuses. One uniform "contribution score" would erase precisely those differences that the Commons ought to preserve.

19.3 Contribution Roles, Scholarly Credit, and Authorship Decisions

A contribution record should distinguish a person's activity from the scholarly credit conventions associated with a particular output. The CRediT taxonomy usefully identifies roles such as conceptualisation, data curation, formal analysis, software, investigation, writing, and supervision. Its own documentation explains that the taxonomy does not determine scholarly authorship (National Information Standards Organization, 2022). Such a taxonomy can make otherwise obscure work visible, provided its categories are not treated as exhaustive or as an automatic ranking of individual importance. Translation, participant assistance, institutional repair, safeguarding, and knowledge stewardship may require additional context-specific descriptions.

Authorship requires a separate decision under the standards applicable to a journal, discipline, collaborative agreement, and the actual work. In its relevant publication context, the ICMJE recommends substantive intellectual contribution, participation in drafting or critical revision, approval of the version, and accountability for the work (International Committee of Medical Journal Editors, 2026). Other fields and publication venues may adopt different conventions. A Commons should not assert that contributing data, being a supervisor, providing funding, or authoring an earlier paper automatically establishes coauthorship of a later article. Nor should it use the absence of paper authorship as a reason to erase a documented contribution.

Different records can be kept together while retaining distinct fields: the *contribution history* states what a participant did and when; a *scholarly credit statement* records the output-specific attribution decision; and a *rights and permissions record* identifies only those legal or contractual relations for which a responsible interpretation is available. The same person may appear differently across the three, and no one field should be treated as a substitute for another. When authorship is disputed, a repository administrator can correct an inaccurate activity log without claiming competence to settle the journal's authorship requirements. A contested legal entitlement should be referred to an appropriately competent process, with the record's limits made explicit to users.

Contribution credit may also involve a decision not to disclose a name. A participant might reasonably request identification through a pseudonym, institutional collective attribution, restricted prove-

Table 27: Different contribution-related statuses and the questions they require. The entries are design distinctions, not determinations of applicable law.

Status	Question for the Commons	Common mistaken inference
Historical contribution	What activity occurred, under which conditions, and with which evidence?	Contribution implies exclusive ownership.
Scholarly credit	Which citation, acknowledgment, or authorship standard applies?	A role tag automatically makes someone an author.
Legal entitlement	Who holds which relevant rights under applicable law and agreements?	Repository access establishes a licence.
Permission to reuse	Which specific acts are permitted by the rights holder, law, or agreement?	A licence conveys all third-party rights.
Institutional authority	Who can authorise service, data access, or publication in a particular organisation?	Open publication authorises hospital activities.
Future economic return	Has a specific enforceable allocation arrangement been made?	Attribution creates an automatic royalty.

nance available only to responsible reviewers, or removal of a public acknowledgement. The scope of such requests depends on applicable duties to retain evidence, public licence terms, research integrity and privacy obligations. A credible Commons cannot promise complete erasure from every lawful downstream copy, but it can establish procedures for future disclosure restriction, corrected attribution, and removal where feasible and required.

19.4 Rights Classes, Jurisdiction, and Permission Boundaries

A Commons artifact may be associated with several nonidentical legal and normative relations. Copyright may protect original expression, while underlying ideas, mathematical concepts, procedures, or methods of operation are generally not protected by copyright as such in WIPO’s comparative account (World Intellectual Property Organization, 2026a). That observation does not settle the application of patents, trade secrets, database rights, confidential-information duties, or contractual restrictions. The scope of copyright protection, moral rights, licences, employment-related ownership, research data rights, and legal exceptions requires relevant jurisdictional examination (World Intellectual Property Organization, 2026b). Institutional rules and research-ethics commitments constitute additional questions rather than simply additional forms of copyright.

Rights identification should begin with the particular artifact, the claimed use, the people or institutions whose interests may be affected, and the source of each asserted restriction or permission. “Owned”, “open”, and “research use” are too coarse to settle whether an adaptation may be distributed, a person’s image disclosed, or a protected database accessed. Copyright may protect the expression of a handbook without covering its underlying ideas, while privacy, contractual obligations, and the rights of third parties can independently constrain particular activities. For each material use, the infrastructure should record the applicable scope and uncertainty, rather than issue a globally valid freedom certificate. If an existing project already maintains accurate attribution and licence metadata, the Commons need not duplicate it unless an identifiable failure remains unresolved.

An appropriately scoped normative-source register should record the relevant jurisdiction, the provenance and version of a statute, contractual clause, institutional rule or licence, the claimed authority of the interpreting party, and unresolved uncertainty. When a material question is contested, review by a competent person may be necessary. Theoretical records should mark “not established” instead of forcing unknown legal status into a binary permitted/prohibited field. Such caution is part of institutional capacity: an incorrectly asserted right can be a barrier to lawful collaboration just as an unrecognised right can be a source of extraction.

19.5 Artifact-Specific Licensing and the Limits of Openness

Licensing is a mechanism for communicating certain permissions, not a universal solution to every normative or operational problem. Different artifact classes often call for distinct decisions. Scholarly prose, educational materials, software, original graphics, synthetic datasets, structured databases, and mixed-source reproductions may involve different copyright, licensing, attribution and confidentiality considerations. An independent Commons may elect to make some original artifacts openly reusable while preserving others under limited disclosure or withholding release until rights are established. Openness should be a reasoned configuration, not a condition imposed on all contributors as a prerequisite for legitimate participation.

The Creative Commons Attribution 4.0 International legal code illustrates both the power and the limits of a standardised licence. Within the scope of its grant, it permits reproduction, sharing, and adaptations, including commercial uses, subject to conditions such as attribution; it grants a nonexclusive, generally irrevocable permission as specified in the legal code. It does not license patent or trademark rights, obtain privacy permissions, or convey rights not held by the licensor. It also disclaims any permission to suggest institutional sponsorship or endorsement (Creative Commons, 2013b). A licensing decision cannot be treated as reversible simply because a contributor later becomes dissatisfied with a permissible downstream use. Conversely, it cannot eliminate statutory or contractual rights beyond its lawful scope.

Open-source software licences follow their own conditions. The SPDX License List supplies identifiers and expressions useful for documenting licences consistently, but an identifier is not a finding that dependencies have compatible terms or that a contributor holds the relevant rights (SPDX Project, 2026). Similarly, recording a dataset’s licence in a DataCite-style metadata field improves discovery and contextual traceability but does not establish that the dataset was lawfully obtained or that data protection obligations have been fulfilled (DataCite Metadata Working Group, 2026). Where an artifact contains several components, licences may have to be recorded separately at the component level. An overall “CC BY” label cannot supersede another person’s incompatible copyright notice, a private agreement, or an institutional disclosure restriction.

Rights retention should be designed before contributors are asked to make a transfer or broad licence grant. A creator may wish to continue using their own contribution in teaching, publication, or later research while allowing the Commons specified nonexclusive uses. What can be retained depends on existing obligations and rights; an institution should not promise that every participant can licence material owned by an employer or jointly controlled with another contributor. Equally, access to another researcher’s downstream work depends on that work’s applicable licence or agreement, not on an earlier participant’s place in the historical lineage. A concise rights notice and a competent review route may therefore be more defensible than a contractual promise of perpetual unrestricted access that no party has authority to make.

19.6 Provenance, Versioning, and Downstream Contribution Relations

A research object does not have a single immutable identity simply because its filename remains the same. Its contents may be corrected, translated, transformed into a teaching example, combined with new material, or reused as a component of another project. Rights-relevant provenance therefore needs to distinguish *identity*, *version*, *source relation*, *contribution*, and *authorisation*. DataCite’s metadata model offers related identifiers and relationship types that can assist in representing dependencies, versions, derivation, and other research-object relations (DataCite Metadata Working Group, 2026). Those representations remain evidence and metadata, not declarations of legal ownership.

We propose a provisional typed record of the form

$$\mathcal{P}(a, t) = (\text{id}(a), \text{ver}_t(a), \text{prov}_t(a), \text{roles}_t(a), \text{claims}_t(a), \text{lic}_t(a), \text{restr}_t(a), \text{review}_t(a)). \quad (34)$$

Here a denotes a particular artifact or identifiable research object, t its relevant recorded time, and the components denote respectively its identifier, version, provenance, documented contributor roles, unad-

judicated or established rights claims with their evidentiary status, applicable licence assertions, known restrictions, and review history. The record explicitly allows uncertainty, disagreement, and separate assertions for different components. Equation (34) specifies proposed fields; it neither recognises a new legal property right nor guarantees the accuracy of each entry.

For a declared downstream relation $a \rightsquigarrow b$, the infrastructure should record *how* b relates to a : reproducing protected expression, altering a work, citing an idea, deriving a dataset, implementing a method independently, or merely addressing the same problem. These are different historical and legal relations. The existence of an intellectual lineage does not establish a legally relevant derivative work; conversely, copyright-relevant adaptations may demand permissions even when scholarly credit is inadequately recorded. A qualified record should preserve evidence of both factual dependence and the status of any claimed permission.

Consider a synthetic scheduling dataset published by contributor A with properly specified reuse permissions. Researcher B uses the dataset to compare classical and quantum-inspired heuristics and publishes original source code and an article. Researcher C later critiques B’s fairness assumptions and produces an educational simulation. A’s historical contribution may appropriately be cited in B’s and C’s work when relevant, and A retains those rights A has not lawfully transferred. B does not necessarily owe A coauthorship or an ownership share in the algorithm, and C does not automatically acquire permission to copy B’s protected code. Any lawful downstream openness is determined by the relevant licences and agreements, not by an imagined expanding ownership right generated by citation ancestry. This hypothetical scenario illustrates an infrastructure design problem; it makes no claim about real contributors or empirical outcomes.

19.7 Use-Specific Permission Claims and the Non-Inheritance of Entitlements

The rights record of Equation (34) is artifact-centred, whereas an actual reuse question is also person-, action-, component-, time-, and jurisdiction-dependent. To keep these levels separate, let s be a proposed user, a an identified artifact or component, u a specific contemplated use, j the relevant jurisdictional context, and v the applicable version. A reviewable claim can be written

$$\text{PermClaim}_{o,t}(s, a, u ; j, v, e, \sigma), \quad \sigma \in \{\text{supported, excluded, unresolved, contested}\}, \quad (35)$$

where e identifies the relied-upon licence, agreement, applicable rule and evidence, o is the observer or reviewer, and t is the assessment date. Equation (35) describes a claim about permission; it does not establish an actual licence grant. A lawful technical copy, public quotation, republication of a modified component, and access to nonpublic records are different proposed uses even when they relate to one research object. An open licence granted by an authorised rights holder may address some uses, but it neither certifies the provenance of every embedded third-party component nor supplies a separate basis for disclosing personal information.

Three relations must not be made transitive by a common language of “contribution.” First, the fact that a helped an investigator develop b does not imply that b is legally derivative of a . Second, legitimate reuse of a does not prove an entitlement to every subsequent output or its proceeds. Third, a proposal to return material or financial benefits does not prove that a transfer is owed, funded, or in the control of the proposed steward. These are distinguishable questions of provenance, legal entitlement, contractual or governance choice, and practical capacity. A Commons may advocate prospective non-extractive distribution while reporting accurately the absence of a presently enforceable downstream payment obligation.

For example, a synthetic dataset may be permissively released and later used in an independently authored algorithm. The original contributor may benefit from a new publicly shared method, but cannot infer ownership of the algorithm from the dataset’s position in the research history. If the later author voluntarily offers mentoring or releases code under a licence that permits the original contributor’s intended use, those are additional social or legal relations with their own conditions. Conversely, the original dataset’s creator may continue to hold rights in the original components while being unable to publish

restricted third-party material incorporated into a later study. The appropriate analytical record identifies the specific component, use, claimed authority, factual uncertainty and qualified reviewer, not a single unqualified “rights cleared” state.

A composite research artefact presents a particularly discriminating test of the permission-claim signature in Equation (35). Suppose a fictional package contains original scheduling code, a separately contributed table, and a figure obtained from an external source. The package maintainer publishes one permissive licence notice, but the evidence establishes authority to license only the code. In that situation, a review may support a specified use of the code while leaving the table’s permissions unresolved and identifying an exclusion for a particular reuse of the figure. The package is neither uniformly permitted nor uniformly prohibited under the stipulated facts; an applicable exception or limitation may require a separate analysis. This component-sensitive reading accords with the scope and third-party-rights cautions in the CC BY 4.0 legal code (Creative Commons, 2013b). A claim about the bundle should retain the component identity, the contemplated operation, the applicable source and version, and any exclusion or uncertainty, rather than letting a top-level licence field certify an entire lineage.

The argument distinguishes the actual normative position from the reviewer’s report about it. In Equation (35), v denotes the version of the relevant artefact or component; if the scope depends on a versioned licence or agreement, that version is identified separately in the evidence field e . A status of *supported* is not itself an operative licence, and an unresolved status is not proof of infringement. If an applicable rule or competent institution does determine a permission, its authority arises from that source and not from the Commons’s classification. The same separation applies to a historical correction: discovering a missing third-party component can warrant revising the current account and prospective distribution without pretending the earlier release never happened or that every prior licence was automatically rescinded.

For ordinary public scholarship this analysis may be performed in a concise manifest and human-readable notes. A component-level table becomes useful where a reviewer would otherwise infer rights from a publisher’s access statement, a persistent identifier, or the provenance of a different component. Where no consequential ambiguity exists, multiplying entries beyond the actual question can impair rather than enhance responsible reuse.

The temporal scope of a permission inquiry adds a further problem. A public licence may have been validly offered for a particular component and version before a later reviewer notices a disputed attribution or embedded third-party item. The later discovery may alter the current account of what was licensed, what needs correction, and what can responsibly be distributed next. It does not by itself determine whether earlier recipient permissions have terminated. Such consequences require attention to the actual licence text, relevant law, facts and competent interpretation; the CC BY 4.0 legal code, for example, describes an irrevocable grant within the rights its licensor can grant and expressly excludes any implication of endorsement (Creative Commons, 2013b). The status history of a reviewer claim in Equation (35) must not be confused with the legal history of the grant or with an institution’s separate authority to make use of the material.

A suitable comparison asks whether a later maintenance or governance decision relied on the *same component, operation and applicable version* as the permission claim, and whether the reviewer was competent to assess that question. Where a simple licence manifest already enables the distinction, an added linked-rights database would provide no demonstrated benefit. Where the manifest contains an ambiguous image or the requested use changes materially, an explicit unresolved status is informative without constituting a provisional prohibition or permission.

19.8 Rights-Preserving Deposit, Metadata Exposure, and Long-Term Traceability

Scholarly persistence does not require identical treatment of a public citation, a deposited object, a restricted research record, and a withdrawn artefact. A persistent identifier and a discoverable metadata entry can make an object findable across versions; neither element certifies ownership, informed consent, nor permission to disclose the underlying contents. DataCite’s metadata schema supplies fields for identifiers, creators, rights information, versions and related objects, which can be used to describe

research relations while preserving a separate record of the legal and ethical basis for release (DataCite Metadata Working Group, 2026). The FAIR principles likewise permit authentication and authorisation in the access pathway and explicitly contemplate metadata that remain available when underlying data are unavailable (Wilkinson et al., 2016; GO FAIR Foundation, n.d.). This makes *carefully bounded discoverability* a serious alternative to unrestricted public deposit.

The proposed Commons should assess at least three exposure surfaces before registration or publication. The first is the artefact itself, including embedded examples, code comments, images, schedules, and machine-readable metadata. The second is the descriptive record, which may disclose participant identities, affiliations, vulnerable population characteristics, dates, or cross-links even when access to the artefact is restricted. The third is the historically linked graph of versions and contributors, whose aggregation may permit inferences not apparent from an individual record. An identifier may remain valid while some descriptive fields are minimised, delayed, aggregated, pseudonymised where lawful, or withheld. Such a decision requires real provenance and access review; a “metadata only” label does not demonstrate harmlessness.

In the special case of identifiable health databases or biobanks, the WMA’s *Declaration of Taipei* discusses governance of access, sharing, documentation and security for uses beyond individual patient care, complementing rather than replacing the 2024 Helsinki guidance on medical research (World Medical Association, 2016, 2024). The Commons cannot convert those ethical statements into a right to establish a database, just as a CC BY licence for a manuscript cannot convey patent, privacy or other third-party rights outside its scope (Creative Commons, 2013b). A valid copyright licence may persist for compliant recipients while a public website ceases distribution or restricts an associated personal-data record. These outcomes are legally and operationally distinguishable; promises to contributors should name the operations to which withdrawal or correction could realistically apply.

The evaluative problem is whether this layered arrangement improves reconstruction of legitimate reuse without expanding the exposure of persons or the cost of care beyond what the purpose warrants. A small independent Commons may not need a deposited provenance graph for every working note. A named author may appropriately prefer a public and attributable record; a student or patient whose identity should not be exposed may require a bounded, nonpublic record or no retention. Maintaining traceability is a conditional responsibility, not an overriding claim to preserve every identifiable detail. Only the relevant competent institutions and rights holders can decide contested permissions, while scholarly users remain free to study the independently open aspects of the research.

19.9 Contributor Choice, Withdrawal, and Restricted Identity

A voluntary Commons requires meaningful choices at entry and over time. Prospective contributors need to understand what they are contributing, the rights they control, what permissions they propose to grant, how their contributions may be identified, and what changes to the arrangement are possible. They should not be induced to surrender broad rights by inaccurate promises of future academic credit, employment, institutional access, or guaranteed returns. A useful participation process may include a short explanation of artifact-specific licence consequences, a choice of public or restricted attribution where lawful, and routes to ask for clarification without risking exclusion from unrelated open activities.

Withdrawal requires a typed response. Ceasing future work, removing public attribution, correcting inaccurate provenance, changing future distribution practices, invoking a statutory privacy right, and retracting a licensed permission are different matters. For example, CC BY 4.0 allows compliant downstream users to retain granted permissions despite a later change of mind by the licensor; however, this does not settle every privacy, personality, or third-party issue (Creative Commons, 2013b). The Commons should explain surviving permissions before contribution and identify a competent process for other requests. It must not promise both unrestricted permanence of historical records and unconditional deletion of every contribution. Where a change cannot be made retroactively, an accurate correction or restricted public display may still be required or appropriate.

Some historical records may need restricted retention for dispute resolution, research integrity, or

other legitimate grounds, while public displays are corrected or removed. A pseudonymous contributor may have interests in anonymity that conflict with ordinary expectations of visibility in scholarly credit. Accessible complaints processes should permit safety-sensitive concerns to be addressed without public exposure of protected identities. Whether records may be anonymised, retained, destroyed or disclosed is context-dependent and cannot be fixed by a generic Commons manifesto.

19.10 Disputes, Power, and the Governance of Rights Claims

Contribution disputes are rarely only questions of metadata completeness. They may concern unequal bargaining power, unrecorded conceptual labour, incompatible collaborators' memories, informal promises, contested ownership, inappropriate disclosure, or opportunistic attempts to appropriate a successful downstream result. A senior researcher, institutional sponsor, repository administrator, student, volunteer, and external critic may have markedly different capacities to preserve evidence and challenge an initial allocation. An apparently consensual licensing decision may therefore require careful inquiry into the circumstances under which consent or agreement was obtained.

An appropriate review process distinguishes a record correction from an authorship determination, a contractual interpretation, a claim of copyright infringement, and a complaint concerning institutional misuse. The Commons may be competent to correct its own public metadata or suspend distribution under its control. It may not be competent to issue a binding judicial decision about ownership, override an academic publisher's authorship process, or resolve an institutional employment dispute. In these cases it should preserve the relevant evidence, explain its limited remit, and refer the matter to an appropriate external decision maker where possible.

A provisional decision pathway can be stated as follows: identify the contested artifact and use; preserve the relevant version and evidence under appropriate access controls; identify affected contributors and sources of authority; assess the competence and conflicts of interest of proposed reviewers; request reasoned accounts; distinguish uncontested historical facts from disputed claims; adopt an authorised interim measure if justified; record a bounded decision and the rationale for correction or escalation; and set a review condition. For a Commons governed by one founder, a promise of fully independent adjudication would be misleading. A narrower and more credible promise is transparent correction, evidence preservation, recusal when possible, and external review for serious conflicts.

A particular danger is *provenance capture*: persons with administrative control may determine which contributions remain visible, what licences are advertised, and which accounts count as authoritative. Another is *credit inflation*: presenting every dependency as a claim to subsequent authorship or revenue. The opposing danger is *contribution erasure*: retaining an artifact while obscuring the labour, judgments or risks that made it possible. Effective governance requires procedures to examine each mechanism without reducing plural contributions to a singular quantitative score.

19.11 Infrastructure Coupling, Evaluation, and Historical Revision

Contributor rights and provenance depend on other constitutive infrastructures, but their purposes remain distinct. Normative infrastructure examines law, ethics, and agreement authority; information infrastructure makes artefact metadata and applicable restrictions intelligible; historical infrastructure preserves records and their contexts; epistemic infrastructure evaluates scholarly claims; governance infrastructure handles disputes within its competence; public communication infrastructure avoids falsely implying institutional sponsorship; and disciplinary research infrastructure supplies legitimate opportunities for reuse. Planning and decision infrastructure may use contributor inputs, but cannot treat licence metadata as safety approval. The subsequent value-circulation analysis will ask what additional mechanisms are needed for benefits, capabilities and opportunities to return through these relations.

A useful differential test gives a new investigator three artifacts: a synthetic dataset with a documented licence, a separately authored analysis of that dataset, and a handbook containing a mixture of original and third-party material. Ask which reuse actions are permitted, which citations are scholarly good practice rather than legal conditions, and which rights cannot be resolved without further evidence.

Table 28: Illustrative failure modes and conditional responses for a contributor-rights infrastructure. No row constitutes legal advice or a verified institutional procedure.

Failure mechanism	Possible manifestation	Research and governance response
Unknown title or third-party rights	A purportedly open dataset contains restricted source material.	Stop questionable redistribution, trace sources and seek competent review.
Credit or authorship conflation	A contributor-role label is presented as a guarantee of coauthorship.	Separate role description from venue-specific authorship determination.
Incompatible permissions	Different source components have conflicting terms.	Record component-level conditions; consider lawful replacements or narrower release.
Misleading withdrawal promise	Participants expect all existing public copies to disappear.	Explain licence scope, distinguish feasible removals and applicable legal remedies.
Provenance capture	Stewardship power suppresses inconvenient contributors.	Permit contested records, reasoned correction and external referral.
Historical over-retention	Sensitive identity records are kept without justified safeguards.	Review retention basis, access, minimisation and legitimate deletion.

Add a contributor who withdraws from the Commons after the initial licensed release. A simple accurate rights notice may solve the problem as well as a bespoke platform; a chain diagram that incorrectly gives the dataset creator ownership of a later algorithm fails. The outcome measures provenance and permission interpretability, not downstream income, true research impact, or the validity of the algorithm itself.

An institution-specific configuration may evaluate this infrastructure through several bounded questions. Can a later participant identify the actual provenance and permitted uses of a specific artifact? Do contributors have intelligible means to review their recorded roles, correct errors, and protect restricted identities? Are third-party materials distinguished from newly created work? Does the Commons avoid both unlicensed reuse and unnecessarily restrictive assertions? Do decisions about disputes have recorded reasons and appropriate authority? Is the ongoing maintenance burden proportionate to the knowledge and rights risks involved? The answers may differ by institution, discipline, jurisdiction, and artifact type; a universal numerical score is unlikely to capture them adequately.

The proposed infrastructure is not successful merely because each artifact has a licence tag or every participant appears in a record. It is successful in the limited and revisable sense that participants can identify relevant relations, understand plausible permissions and their uncertainties, exercise available correction procedures, and undertake legitimate new work without silent appropriation. Such an arrangement may make future generative value circulation possible, but the existence and distribution of that value require separate inquiry. The design problem for the next section is therefore not to restate attribution rules, but to examine the historically contingent pathways by which research, recognition, resources, capabilities, and opportunities can return to participating subjects and support further creation.

20 Generative Value Circulation and Intertemporal Return

The preceding section distinguished contribution history, scholarly credit, legal rights, and the permitted reuse of particular artefacts. Those distinctions are necessary for legitimate cooperation, but they do not establish that participants, affected communities, or subsequent researchers actually benefit from the work they help make possible. The present section examines a different constitutive object: the historically situated relations through which heterogeneous forms of value may be generated, recognised, transmitted, transformed, returned, and used to support further activity. Its objective is to establish a design grammar for those relations, including their institutional preconditions, interruptions, unjust distributions, and epistemic limits. It does not postulate a conserved substance called *value*, nor a guaranteed

circular economy arising from the existence of a Commons.

The intellectual antecedents require explicit differentiation. Public-service scholarship has analysed value creation and co-destruction in service ecosystems rather than identifying value exclusively with provider outputs (Osborne et al., 2021, 2022). Knowledge-commons research supplies a comparative framework for studying how groups share and govern information and other resources (Frischmann et al., 2014a). Research on commons-based peer production considers the social and ethical conditions of co-operation beyond ordinary market or managerial coordination (Benkler and Nissenbaum, 2006). Most directly, generative justice is Ron Eglash's established normative concept. His 2016 exposition and subsequent work with collaborators emphasise value generators' ability to shape productive conditions and sustain non-extractive circulation across ecological, labour, and social domains, rather than treating delayed compensation as a sufficient remedy for extraction (Eglash, 2016; Eglash et al., 2024). The present analysis draws on these traditions to propose a *typed, historical and institution-sensitive* account of possible circulation in a university hospital volunteer research Commons. The categories of recorded attribution, licensed access, experienced use, and future capability below are this manuscript's analytical reconstruction; they are not a taxonomy attributed to Eglash or a demonstration that these relations already operate at any hospital.

A proposed Commons may operate independently with public publications, freely reusable materials, and genuinely synthetic datasets. That scope is sufficient for investigating intertemporal research relations without claiming access to hospital operations, patient information, or an existing institutional partnership. If an institutional collaboration later becomes possible, its obligations, resources, and permissions must be examined on their own terms. In particular, the possibility of producing public value does not confer a right to enlist patients, volunteer labour, or clinical systems in an experiment.

20.1 Value Relations and the Constitutive Object of Circulation

A useful first distinction concerns *generating* value and *obtaining* value. A volunteer may make a previously confusing route more intelligible to a service user. An engineer may publish a robust optimisation procedure. A historian may recover why a discontinued programme functioned under earlier conditions. A maintainer may correct a broken dependency so that someone else's simulation remains usable. In each case, the activity can have consequences that are valuable to an identified subject under a contextually justified criterion. Yet the distribution of these consequences need not resemble the distribution of labour or intellectual effort that made them possible.

The term *generation* therefore refers here to an activity or transformation that creates a situated possibility of benefit, capability, knowledge, care, or institutionally justified improvement. *Recognition* refers to the subsequent identification and evaluation of such a possibility by persons or procedures whose competence and standing must themselves be examined. *Propagation* concerns a relationship through which a result, practice, resource, or question becomes influential in another setting. *Return* concerns a benefit or newly available capability becoming meaningfully accessible to an earlier contributor or an appropriately identified community. *Generative reproduction* concerns the renewed conditions for further independent creation. These relations can coincide in particular cases, but they are not interchangeable.

The distinctions are analytically consequential because each proposed connection can fail. A volunteer's correction may improve a shared method without receiving public recognition; a cited article may circulate widely while remaining unusable by its original collaborators; a newly released tool may become accessible yet never improve anyone's capacity to act. Conversely, a quiet mentoring relationship can support later independent research without leaving a highly visible citation path. Consequently, recognition records are evidence of how value is represented, not proof that value returned. The research task is to determine which resources or capabilities became available to which participants, under what lawful conditions, and what additional relations were necessary to use them.

Definition 20.1 (Situated generative circulation infrastructure). A *situated generative circulation infrastructure* is a revisable configuration of legitimate access arrangements, interpretive resources, productive capabilities, contribution and decision interfaces, resource stewardship, and historically accountable

practices through which value-bearing activities and their consequences can influence subsequent activity, become appropriately available to affected subjects, and potentially support further generation. Its existence establishes neither the magnitude nor the distribution of actual benefits, and it cannot create rights or authority beyond those legitimately held by its participants.

This definition is deliberately functional. An independent research group may realise parts of the infrastructure through maintained open methods, contributor discussions, and transparent reuse conditions. A federation of university and civic organisations may use multiple stewards, institutional agreements, community assemblies, and differentiated repositories. Neither arrangement is privileged without examining the subjects, resources, laws, histories, and risks involved.

20.2 Three Reality Levels and the Interpretation of Value

At the level of *ontological reality*, the framework suspends a final answer to what value *ultimately* is, or what persons, institutions, and knowledge are independently of their situated relations. This suspension should not be confused with moral indifference. It prevents an administrative unit of measurement, a monetary price, or an elegant mathematical flow from being treated as an exhaustive account of the reality being evaluated.

At the level of *relational reality*, the relevant subjects and capacities are historically constituted. A method becomes useful because someone possesses the background to understand it, a research problem has been constituted, relevant tools are maintained, rights permit the intended activity, and sufficient time or social support exists to act. Whether a service encounter creates value likewise depends on what the affected person needed and how the activity altered their practical possibilities. The same artefact can increase one person's agency and introduce another person's burden. These relations include asymmetries of institutional power, access to resources, professional expertise, visibility, and authority.

At the level of *manifestation reality*, value becomes partially accessible through reports, research outputs, testimonies, citations, statistics, meeting records, or observed subsequent action. Such manifestations can support inference, but their meaning depends on how they were produced. A publication count does not identify which participants gained usable research capabilities. A repository download does not show that a licensed resource was understood, or that its use had beneficial consequences. A recorded return payment does not settle whether the recipient lost control of the underlying conditions of production. Conversely, invisible mentoring or quiet correction may matter greatly even when the information infrastructure cannot provide a complete record.

For this reason, any proposed evaluation must state *whose* value is being examined, *which* evaluative criteria are invoked, *what* evidence is available, and *which* groups or effects may remain unseen. The result is not a single universal accounting measure but a set of appropriately typed, disputable evaluations. Epistemic validation, legal permission, governance legitimacy, and value recognition remain distinct even when the same committee discusses them.

20.3 Heterogeneous Value Forms and the Conditions of Recognition

At least five families of value relations merit examination in a Commons: practical or public-service benefit, epistemic achievement, participant capability, relational opportunity, and material or monetary resources. The families overlap in lived experience but do not share an agreed additive unit. An improved mathematical model may facilitate training, lower a future researcher's entry cost, and produce a publication. A service user may instead care primarily about comprehensible information, dignity, or the reduction of unnecessary uncertainty. Neither the value of care nor the value of a person's capacity for inquiry is adequately represented by counting publications or volunteer hours.

The families of value considered here are deliberately non-exhaustive and not mutually exchangeable. Relief from avoidable administrative burdens, improved language access, the preservation of a minority perspective, or an increase in research autonomy may be significant even when publication

Table 29: Illustrative value forms, possible manifestations, and non-equivalences. These are evaluation prompts, not empirical measurements or a universal value taxonomy.

Value relation	Possible warranted evidence	Important limit
Service and public benefit	Situated accounts of accessibility, assistance, or reduced burden	Satisfaction and activity totals are incomplete proxies
Epistemic contribution	Reproducible analysis, justified interpretation, critique, negative result	Acceptance or citation does not certify truth
Generative capability	Ability to formulate and pursue subsequent independent work	Training attendance does not establish autonomy
Relational opportunity	Usable mentoring, translation, collaboration, legitimate voice	Network size does not establish fair influence
Material support	Time, equipment, funding, infrastructure maintenance	Monetary flow does not imply non-extraction

numbers remain unchanged. A proposed common metric can obscure the differences between participant well-being, patient-facing public benefit, scholarly quality, and durable organizational competence. Evaluation should therefore preserve the value perspective and evidence status of each claim. A benefit reported by one subject may involve an offsetting cost borne by another, including those who maintain the infrastructure but are absent from the publication record.

Recognition is itself institutionally mediated. Those who define the success criteria, allocate publication opportunities, select whose testimony is recorded, or decide what maintenance work counts as a contribution can shape the apparent distribution of value. A volunteer’s refusal, a researcher’s methodological criticism, or a participant’s decision not to publicise an experience can be relevant to evaluating the Commons even when none appears as a conventional positive output. The design problem is therefore not to eliminate judgement, but to distribute standing appropriately, identify conflicting evaluations, and document the reasons for provisional choices. Such recognition must remain open to revision and must not become a substitute for rights or material support.

20.4 Temporal Pathways, Branching Lineages, and Qualified Return

An activity’s consequences can unfold through long, branching, and partially hidden histories. Suppose contributor a prepares a synthetic scheduling benchmark at time t_0 . A second researcher corrects its assumptions at t_1 , a third develops a fairness analysis at t_2 , and a later educator uses the revised environment at t_3 . Some participants may receive new knowledge or research opportunities; others may never hear of the subsequent developments. There may be multiple paths, dead ends, changes of licence or research scope, and uses independent of the original artefact. No ordinary provenance graph can fully recover this history, and no genealogy determines what the respective contributors legally or morally own.

We therefore distinguish an *influence pathway* from a *qualified return relation*. Let $\mathcal{E}_{[t,u]}$ denote historically situated events and artefacts within a specified observation interval, and let $\mathcal{L}_{[t,u]}$ be their evidenced, typed relationships, such as citation, permitted adaptation, methodological influence, resource provision, mentorship, or documented collaboration. A possible descriptive pathway is a finite sequence of type-annotated links

$$\pi = (e_0 \xrightarrow{\ell_1} e_1 \xrightarrow{\ell_2} \dots \xrightarrow{\ell_n} e_n), \quad e_i \in \mathcal{E}_{[t,u]}, \quad \ell_i \in \mathcal{L}_{[t,u]}, \quad (36)$$

where every edge type requires evidence appropriate to the claim. Equation (36) represents a *descriptive* pathway, not a quantitative transfer of conserved value. Methodological influence is not legal derivation; a licence is not proof of a beneficial use; and a link to a later paper is not proof that the original contributor received anything. Paths may be unknown, incomplete, non-exclusive, or constituted differently under rival historical interpretations.

For an identified subject or community s , value type q , and later time u , the phrase *qualified return* should be used only when there are contextually warranted grounds for at least three separate judgements: a candidate benefit has become meaningfully available to s ; the relevant access or use is legitimate; and s has a realistic opportunity to understand or employ it if desired. These are distinct from whether the subject actually chooses to use the benefit and from whether the use improves their circumstances. We denote the design-side possibility, rather than an empirically established outcome, by

$$\text{ReturnPossible}_{s,u}^q(b) := \text{Available}_{s,u}^q(b) \wedge \text{Permitted}_{s,u}(b) \wedge \text{Usable}_{s,u}^q(b), \quad (37)$$

where b is a particular candidate benefit and the predicates remain evidence-dependent, subject-relative judgements. Equation (37) is not an executable compliance test; it does not imply actual return, economic rights, or an approved institutional arrangement. In particular, *permitted* refers to the specific use in question, not to general membership in a Commons.

There is an important type distinction between this conceptual condition and an investigator's warrant to assert it. The permission inquiry in Equation (35) is indexed by user, component, contemplated operation, jurisdiction, version, evidentiary basis and observer. By contrast, Equation (37) abbreviates a *proposition about the candidate opportunity* for ease of exposition. An investigator may evaluate that proposition only after specifying the beneficiary's contemplated use and relating it to appropriately scoped permission evidence. A positive reviewer label for one copying operation does not satisfy the condition for public republication or hospital deployment; a contested or unresolved permission claim should leave the corresponding opportunity *unestablished for that use*, not silently make it true or assert that the underlying entitlement is absent.

Nor can a later record of use repair an earlier missing permission or by itself certify successful return. Actual uptake, normative permissibility and improvements in the participant's capabilities are separate historical and evaluative claims. To make the difference observable, a fictional contributor might be able to download and lawfully run an improved method, choose to use it in a study, and nevertheless lose the time needed for future research because maintenance obligations grow. This history could contain genuine realised epistemic benefit alongside a decline in a specified practical capacity. The model must permit the two judgments to coexist.

The temporal structure can be open rather than literally circular. A result may benefit an unfamiliar future scholar or a public-service community without returning to its original contributor. Such outward propagation is not necessarily a defect. Conversely, a return to the original contributor need not be just if it excludes affected persons or appropriates the work of subsequent creators. Accordingly, the term *circulation* should signify examinable relations of renewal and re-entry, not a normative demand that every path close, or a presumption that every contributor deserves control of the full derivative lineage. Generativity must be considered together with the standing of others who create value along the path.

20.5 Return Opportunities, Experienced Benefits, and Distributional Claims

The conjunction in Equation (37) names three separately assessed conditions for an opportunity; it should not be read as an empirical event detector. Each condition can be evidentially supported, refuted for the specified use, contested, or unknown. A scholarly licence may support an assessment of permitted copying without showing that the potential beneficiary possesses a working computer, enough time or the relevant disciplinary knowledge. A documented training invitation may indicate access in principle without showing that a participant was able to attend. A retrospective survey about satisfaction would describe an experience under its own evidentiary limits rather than establish the independent contribution of the Commons.

For clarity, distinguish three propositions. A candidate opportunity is denoted $\text{ReturnPossible}_{s,u}^q(b)$. Actual engagement by subject s with benefit b over an observation interval $[u, v]$ is described by $\text{UseClaim}_{o,[u,v]}^q(s, b; e)$. A further claim that this engagement improved a relevant capability is denoted $\text{CapChangeClaim}_{o,[u,v]}^q(s, b; e')$. Evidence e and e' may differ; their sources and lawful collection con-

ditions must be specified. The relation between these descriptions is constrained by two non-entailments:

$$\begin{aligned} \text{ReturnPossible}_{s,u}^q(b) &\not\Rightarrow \text{UseClaim}_{o,[u,v]}^q(s, b; e), \\ \text{UseClaim}_{o,[u,v]}^q(s, b; e) &\not\Rightarrow \text{CapChangeClaim}_{o,[u,v]}^q(s, b; e'). \end{aligned} \quad (38)$$

Equation (38) does not deny that opportunities sometimes lead to use or that use sometimes increases capability. It states that neither downstream proposition can be inferred from the preceding record without further evidence. An actual benefit may be unobserved, and the practical cost of observing it may exceed the justified scope of inquiry. A participant may permissibly decline both the opportunity and attempts to measure its consequences. The claims are additionally distinct from a putative legal entitlement to compensation.

Return is also subject-specific and distributional. An openly available training method may support a well-resourced graduate student’s independent project while remaining unusable for an unpaid volunteer without time, accessible documentation, or computational resources. A method may support public benefit yet increase the maintenance burden of the original contributor. Investigators should therefore record, for a specified beneficiary and a specified prospective use, whose opportunities are being assessed and which others bear the costs. Such inquiry cannot conclude that a “closed loop” is intrinsically more just than an open pathway serving previously unknown beneficiaries. The generative-relational contribution here lies in examining the historically co-constituted conditions of both opportunity and burden, not in postulating an automatic conservation, accumulation or redistribution of value.

A further distributional difficulty arises when the recipient of a benefit and the person bearing its enabling costs are not the same. A revised benchmark might give scholar s a genuine new analytic ability while maintainer m loses discretionary time to repeated support requests. Both claims could be warranted without a common unit in which to offset them. In particular, *use by s* is not the same relational predicate as *maintainability for m* ; the latter depends on commitments, skills, resources and legitimate expectations over a subsequent interval. The capacity comparison in Equation (41) therefore needs a declared set of affected bearers and tasks, not only evidence that s used the resource.

The reverse inference is also unsafe. A new maintainer may make a method easier to sustain without any observed downstream beneficiary choosing to use it. Responsible inquiry may identify a future option, an actual uptake event, a benefit for one actor and a redistributed burden on another as *coexisting but non-equivalent* historical relations. Absence of evidence about a person’s experience should remain an unresolved manifestation claim, not a finding that no benefit occurred. These conditions leave the proposition of net generative improvement open even when a contribution lineage is well documented.

20.6 Institutional Mechanisms of Non-Extractive Return

Candidate return mechanisms take several non-equivalent forms. *Knowledge re-entry* permits a contributor to use a lawful, documented improvement; *capacity re-entry* adds training, tools, accessible formats, or critical support needed to use it; *relational re-entry* creates an actual opportunity to propose or participate in a new inquiry; and *material re-entry* may provide access to resources, funded maintenance, paid work, or a separate voluntary economic arrangement. A mechanism is not established by simply promising openness: each requires an identifiable eligible subject, usable object or opportunity, maintenance responsibility, and legitimate conditions of access. Different contributors may prefer public benefit without personal return. The institutional task is to prevent hidden appropriation or misleading promises, not enforce an identical reward on every act.

A mechanism is more substantial than a promise when participants can identify *what* it makes available, *who* is entitled or eligible to use it, *under which conditions*, *who maintains the arrangement*, and *how* it may be challenged or revised. For example, releasing the source code for a research environment may enable future reuse, but only if dependencies, documentation, appropriate licences, and reasonable alternatives for people without specialist equipment are considered. Making a dataset public may create opportunities while exposing others to privacy or reputational risks; some datasets must remain inaccessible or be replaced with genuinely synthetic material. Inviting contributors to governance discussions

Table 30: Candidate return mechanisms and the independent conditions that require examination. The table proposes design questions rather than entitlements or proven benefits.

Mechanism	Constitutive condition	Typical failure or conflict
Knowledge re-entry	Lawful usable access to revisions, methods and critique	Metadata exists but outputs are inaccessible or unintelligible
Capability re-entry	Support for self-directed future work and critical judgement	Participation produces dependence or unpaid maintenance
Relational re-entry	Legitimate access to voice, collaboration and decisions	Consultation without authority; prestige-based exclusion
Material re-entry	Sustainable stewarded resources or prospective agreements	Central appropriation, unsupported promises, unfunded labour
Public-service return	Evidence of benefit to relevant affected persons	Visible activity without relevant benefit or informed standing

can matter, but only if the invitation affords actual, appropriately scoped influence rather than merely a record of consultation.

Economic return requires special care. Historical contribution, public praise, and an open licence do not automatically confer royalties, equity, a right to restricted downstream work, or coauthorship of later publications. Where contributors desire specific economic distributions, suitable ex ante agreements and legitimate authority are required, subject to the relevant jurisdiction and to third-party rights. Open licences already granted validly may limit what can later be changed. A Commons should also permit contributors to retain lawful independent activity rather than demanding exclusive assignment of their entire future research programme. These normative questions connect directly to Section 19, but are not resolved merely by its contribution and rights records.

The design should not infer economic or non-economic returns from a licence label or the appearance of an artifact in a provenance graph. It should instead ask, for a specified potential beneficiary, whether the later artifact is lawfully obtainable, practically interpretable, materially usable, and supported when support is a condition of its use. A code repository with inaccessible dependencies may satisfy an attribution condition without providing a workable research opportunity. Conversely, reciprocal criticism or a modest mentoring arrangement may generate substantive capability without a large public release. These observations should be evaluated relative to legitimate restrictions, resource constraints, and plausible simpler alternatives such as ordinary open publishing and academic supervision.

20.7 Asymmetry, Extraction, and Interrupted Circulation

Generative justice directs attention to who governs the conditions under which value is produced and whether value is extracted in ways that undermine the producers' continuing capacity (Eglash, 2016; Eglash et al., 2024). This is a normative orientation, not an empirical demonstration that any particular Commons has attained non-extractive relations. A research Commons may be formally open yet practically extractive when unpaid contributors perform extensive translation, moderation, technical maintenance, or care work while visible researchers capture authorship, publicity, and funding. Different patterns of extraction can appear in public-service practice as well: a volunteer programme may use expressions of altruism to legitimise unrealistic workload expectations, or make training opportunities conditional on continuing labour beyond freely accepted roles.

Unequal benefits are not sufficient evidence of extraction. A contributor may deliberately create a public good whose beneficiaries are strangers, and a legitimate gift need not be balanced by private compensation. Extraction is a more demanding relational hypothesis: it concerns whether control over decisions, conditions of participation, recognition, access, or scarce resources predictably appropriates benefits while restricting the contributing subjects' meaningful choice, voice, and continued generative possibilities. Investigators should distinguish coerced or misrepresented dependence from freely chosen asymmetric support, and evaluate whether a participant can revise or leave the arrangement without

unfair penalty. No universal numerical equality between contributions and returns follows from the present theory.

Circulation can fail through several mechanisms. A *recognition bottleneck* occurs when one individual or organisation controls whose contributions become visible. An *access bottleneck* occurs when technically published resources require credentials, equipment, language skills, or permissions unavailable to intended participants. A *translation bottleneck* appears when disciplinary ideas are transmitted without preserving their uncertainty and interpretive context. A *maintenance bottleneck* appears when the personnel who maintain datasets, archives, legal guidance, or community dialogue have insufficient time or support. A *governance bottleneck* appears when the Commons cannot correct inequities because meaningful revision is monopolised by an interested actor. Finally, a *temporal bottleneck* arises when beneficiaries need a resource after its links, dependencies, responsible persons, or permissions have become unavailable.

These mechanisms may interact. Rapid publicity can increase attention without increasing capacity. More contributors can create demands for review, conflict resolution and archival maintenance. Wider access can improve reuse while making personal information easier to infer. New funding can stabilise operations while allowing a sponsor to control research questions or dissemination. Thus the design must consider the *coupled historical development* of the infrastructures rather than optimise each metric independently. A system that maximises short-term outputs at the expense of consent, interpretation, or stewardship may impair the very conditions that support future contributions.

20.8 Resource Costs, Institutional Coupling, and Situated Configurations

Value-return arrangements are not costless. Provenance auditing, open publication, repository hosting, training, accessible materials, peer review, facilitation, legal advice, complaints, and archival reconstruction can all consume time and attention. Some costs are visible financial expenses; others are redistributed to volunteers, students, maintainers, or affected communities. Consequently, sustaining circulation requires resource stewardship and the ability to reconsider which forms of return can responsibly be promised. The following section examines resource provision and institutional reproduction as independent design objects. Here, their relevance is to the present feasibility of each circulation mechanism.

A small independently constituted research Commons might begin with one robust synthetic scheduling environment, openly documented assumptions, an explicit licence register, a maintained version history, an accessible criticism channel, and a clear statement that no downstream payment is promised. A second research group might extend the work and publish comparative findings under its own chosen lawful conditions. Return might consist in independent reuse and reciprocal critique rather than income. A cooperative of contributors might instead adopt prospective funding, labour compensation, or stewardship arrangements, if it can legitimately and sustainably do so. A formally authorised hospital partnership, if ever established, would add separate obligations concerning the roles of personnel, patient protection, service quality, approvals, confidential knowledge, and institutional accountability. No configuration should be represented as universally superior merely because it is organisationally more elaborate.

This also illustrates the interfaces among the fifteen infrastructure functions developed earlier. Public-problem constitution identifies whose needs are relevant. Normative and rights infrastructures articulate permissible uses and obligations. Information and communication infrastructures make materials discoverable and comprehensible. Disciplinary and interdisciplinary environments support genuine knowledge creation and translation. Epistemic validation examines claims of success. Governance and decision infrastructure allocates competent authority and handles contestation. Historical infrastructure preserves reasons and partial lineages. Participation infrastructure protects autonomous entry and exit. Safety infrastructure separates research openness from prohibited access to people and data. Resource stewardship determines whether any promised opportunities can remain available. A circulation mechanism can be impaired at any interface even when the corresponding technical artefact continues to

exist.

20.9 Illustrative Histories and Discriminating Evaluation

Three hypothetical histories clarify the distinction between circulation mechanisms and established benefits. In the first, an engineering participant supplies a synthetic scheduling dataset with documented assumptions. Another scholar corrects a fairness constraint, publishes reproducible comparisons, and licences an independent implementation. The first participant can lawfully reuse the implementation and has the knowledge required to interpret the improvement. This is a candidate case of epistemic and capability re-entry. Whether actual value returned depends on observed opportunities, choices, and subsequent activity. It does not make the first participant a coauthor of the second scholar's paper or owner of the later algorithm.

In the second history, an independent group publishes a handbook and publicly advertises a proposed training programme. The publication is cited widely, but no resources are provided to check changing rules, translate material, respond to complaints, or distinguish the independent handbook from an institutionally approved procedure. Public recognition increases while the conditions for responsible reuse decay. On the framework proposed here, the manifestation of propagation cannot establish generative reproduction. This conclusion remains a testable interpretation of a hypothetical configuration, not a documented institutional outcome.

In a third history, contributors produce useful research methods while administrators or prestigious authors retain control over release decisions and funding. Public outputs increase, but maintainers report that they cannot continue independent work, contributors face pressure to surrender credit, or dissenting voices lose access to collaboration. The distribution of benefits may show both public-service improvements and an extractive relation toward particular contributors. An adequate evaluation must permit these findings to coexist rather than translate them into one positive or negative aggregate score.

20.10 Research Tests, Limitations, and Historical Revision

Empirical study should therefore examine *comparative conditions* rather than presuppose the superiority of a Commons label. Candidate observations include the practical reuse of research environments by people not involved in their creation, participants' ability to pursue independent questions, the maintenance of necessary dependencies, the costs of participation, the distribution of decision-making voice, complaints and corrections, and the continuity of access across personnel turnover. Relevant negative evidence includes unused open artefacts, inaccessible derivatives, unresolved rights conflicts, contributor exit following imposed burdens, failed translations, and changing research problems that render older resources inappropriate. Such observations should be interpreted through the available qualitative and quantitative methods of the relevant disciplines, with consent, privacy, and sampling limitations preserved.

A return claim should be tested using a concrete, lawful-use task rather than citation counts alone. Identify a contributor who may reuse a later artifact, determine what the permission actually covers, and examine whether the contributor possesses the information, resources, access and freedom to pursue a genuinely new question. Record any cost shifted to a maintainer or an excluded participant. Then compare the observed possibility with what the same person could have obtained through a public repository, ordinary mentoring, or an existing shared laboratory. A graph of historic dependence is helpful for selecting a test case but cannot establish a causal benefit by itself. If the special Commons infrastructure adds cost without improving legitimate capability or protecting someone from a specific injustice, its design rationale requires revision.

A particularly demanding counterfactual comparison is whether an otherwise similar project without an explicit Commons infrastructure could produce equal or better learning, recognition, and subsequent reuse through ordinary mentorship, disciplinary publication, or public funding. Another comparison concerns an apparently closed organisation whose members enjoy substantial practical access, voice, and continuity despite limited public dissemination. If the proposed infrastructure has no distinguishable

effects on legitimate opportunities or future generative capacity once these alternative explanations are examined, its explanatory and practical claims should be revised. Institutional success cannot be assumed from a constructed model, a visually complete circulation diagram, or an isolated account of participant satisfaction.

The resulting theoretical claim is intentionally modest: historically traceable contributions and lawful rights can enable, but do not entail, the subsequent availability of value; circulation depends on situated interpretive, resource, normative, and relational conditions, and its benefits may accrue unequally across time. The desirable relation between circulation and the reproduction of future generative capacity is therefore a matter of deliberate institutional design and empirical examination. This section's analysis of possibilities, interruptions, and return mechanisms prepares the inquiry into resource stewardship, evaluative obligations, and institutional reproduction developed in the following section.

21 Resource Stewardship, Evaluation, and Institutional Reproduction

Value circulation presupposes infrastructures that someone must actually maintain, criticize, and sometimes discontinue. A method can remain legally reusable while its software ceases to run; a research Commons can produce more papers while exhausting the people who review them; an archive can remain online while no one responds to a consequential correction. The object of resource stewardship is the capacity to uphold specific obligations and generative conditions at acceptable cost, not the indefinite survival of an organization. This section therefore examines whose work supplies that capacity, how obligations are financed and bounded, how evaluative measures alter incentives, and when transfer or responsible closure is preferable to continued growth.

The inquiry proceeds from the relational analysis developed in Section 20, but has a distinct object. Stewardship concerns the allocation, care, replenishment, and legitimate relinquishment of the conditions under which the Commons can operate. Evaluation concerns the justified interpretation of its activities, burdens, outcomes, and alternatives. Reproduction concerns the historically contingent renewal or transformation of capabilities, responsibilities, and relationships. None entails perpetual organisational survival, continuous numerical growth, or the elimination of resource scarcity. The relevant design question is whether the Commons can sustain or appropriately transfer the functions that its participants have good reasons to maintain, within the limits of legitimate authority and available resources.

This question engages several established literatures without assimilating their concepts to generative relational theory (GR). Ostrom's work on commons governance makes institutionally differentiated rules, participants, resources, and multilevel interaction central to the study of collective action (Ostrom, 1990, 2009). Research on invisible work identifies the unequal visibility of the labour through which apparently self-sufficient systems function (Star and Strauss, 1999); scholarship on repair brings breakdown and maintenance into analyses often dominated by innovation (Jackson, 2014). Organisational learning and memory research treats accumulated experience and the conditions for knowledge transfer as substantial institutional objects (Argote, 2013; Walsh and Ungson, 1991). In evaluation, Campbell identified difficulties in attributing change to an intervention and the vulnerability of indicators to organisational incentives (Campbell, 1979); developmental evaluation provides a distinct approach to learning under changing and uncertain conditions (Patton, 2011). The following framework uses these as intellectual antecedents for a provisional design grammar; it does not claim that a university hospital Commons has already demonstrated a beneficial result.

21.1 Stewardship Relations and the Constitutive Object

A resource is not solely an asset possessed by an organisation. The possibility of using it depends on rights, competencies, time, accessible descriptions, appropriate technologies, organisational memory, and the claims of other participants. A synthetic dataset may be deposited under an open licence yet cease to be useful if its construction procedure is lost. A research library may remain intact while the person who understands its classification system leaves. A public communication channel may still exist

when nobody has the capacity to correct inaccurate statements. Resource stewardship must therefore examine both what is available and the relations that make availability consequential.

Within a proposed university hospital volunteer research Commons, candidate resources include money, meeting space, hardware, data storage, literature access, software dependencies, translation services, administrative capacity, mentoring time, specialised legal or methodological advice, and the attention of researchers and contributors. Affected participants also bring capacities that should not be conceptualised as an unowned resource pool. Voluntary effort is a choice under particular conditions, accompanied by limits, personal commitments, and sometimes material or reputational risks. A student who agrees to test a benchmark has not thereby accepted indefinite responsibility for infrastructure maintenance. Nor may a hospital's personnel or patients be assigned duties or used as research inputs through a Commons plan without competent institutional authority.

Definition 21.1 (Situating resource stewardship infrastructure). A *situated resource stewardship infrastructure* is a revisable configuration of persons with legitimate responsibilities, available material and epistemic means, explicit and implicit maintenance obligations, decision and accountability procedures, and historically recoverable records through which a Commons may care for, redistribute, renew, transform, or responsibly discontinue its constitutive functions. The existence of these arrangements does not establish that their resources are adequate, equitably distributed, or capable of reproducing the institution indefinitely.

The unit of evaluation is accordingly not just the financial account, total volunteer hours, or number of available files. It is the relation between warranted functions, their direct and indirect resource requirements, the individuals who carry the burdens, and the historically changing conditions of use. One project may have substantial financial support and poor epistemic stewardship; another may have minimal cash expenditure and a strong, transparent capacity to maintain a narrowly scoped research environment. Their adequacy is relative to what they undertake, their obligations, and what they can credibly sustain.

21.2 Three Reality Levels and the Visibility of Resources

At the level of *ontological reality*, the ultimate status of productive capacity, institutional continuity, and value remains suspended. Neither the bookkeeping representation of an organisation nor a general theory of social reproduction exhausts what these objects are. The distinction prevents resource indicators from being mistaken for an ontology of persons or for a complete measure of what their participation means.

At the level of *relational reality*, capacities and shortages arise through historically developed relations. The usefulness of an archive depends on its possible interpreters and legitimate users; the availability of funding depends on conditions imposed by supporters and decisions made by governing actors; the endurance of a handbook depends on continuing interpretation of relevant practice and law. A volunteer's apparent availability may conceal childcare, employment, accommodation or travel burdens. Maintenance labour is often constituted as someone's default responsibility through habits rather than explicit agreements. Such historical arrangements are part of the object of research, not background noise to be removed from a resource model.

At the level of *manifestation reality*, budgets, staffing tables, hours logged, successful experiments, repository issues, meeting notes, survey responses, and funding reports make only selected aspects of those relations observable. A zero-cost software repository may depend on costly personal labour and prior public investment. A balanced monetary budget may coexist with exhausted maintainers. A low public complaint count can reflect satisfaction, barriers to complaint, fear of retaliation, or lack of meaningful responsiveness. Equally, an increased number of reported problems can result from improved recognition and more credible channels for criticism, rather than from deteriorating conditions. These possibilities require competing interpretations rather than a predetermined preferred reading of each indicator.

The three levels also reveal a temporal difficulty. A configuration that appears sufficient for an immediate research demonstration may be incapable of preserving source records or handling future

Table 31: Illustrative resource classes and stewardship questions. Categories may overlap; the table specifies investigative functions rather than measured resource quantities.

Resource relation	Stewardship object	Possible failure or missing evidence
Human time and attention	Availability, consent, mentoring, review, coordination and rest	Unrecorded maintenance, unsustainable obligations, declining ability to refuse
Financial and material means	Funding conditions, infrastructure expenses, equipment, contingency resources	Restricted funds used beyond purpose, absent replacement budget, costs shifted to contributors
Epistemic and technical capacity	Methods, licences, reproducibility, dependency repair, interpretive expertise	Broken environment, single-expert dependency, unverifiable research claims
Normative and governing capacity	Competent authority, dispute response, accessible reasons, external interfaces	Authority confusion, unaddressed complaints, conflicted allocation decisions
Historical and relational capacity	Provenance, archives, continuity of roles, situated relationships	Lost decision reasons, inaccessible records, informal succession without consent

changes in rights and dependencies. Conversely, investment in documentation or mentor preparation can be interpreted as an unproductive cost by short-horizon evaluation despite potentially expanding future capacity. The proposed analysis asks what evidence would distinguish these possibilities and what uncertainty must remain visible.

21.3 Resource Classes, Maintenance Liabilities, and Stewardship Records

A usable design should record more than stocks and flows of money. The resource classes in Table 31 are analytically differentiated because losses, responsibilities, and appropriate remedies are not identical. The table does not offer exhaustive categories or imply that each resource can be converted into a common monetary unit.

A proposed stewardship state may be described as a typed record rather than an additive resource balance:

$$\text{Stew}_t = (\text{Res}_t, \text{O}_t, \text{W}_t, \text{G}_t, \text{H}_t, \text{U}_t). \quad (39)$$

Here, Res_t denotes resources and usable capacities under specified conditions; O_t denotes standing legal, ethical, contractual, and institutional obligations; W_t denotes maintenance and coordination work, including its distribution; G_t denotes legitimate governing and stewardship competences; H_t contains recoverable historical reasons and dependency records; and U_t identifies uncertainty, unresolved claims, and unobserved costs. The record Stew_t is a local stewardship description rather than the full relational state $\mathcal{C}_{I,t}$ of Equation (44); in particular Res_t is not identical to the relation component R_t of that state. Equation (39) is a proposed documentation schema, not a predictive formula, a certification of sufficiency, or a claim that these heterogeneous elements can be quantitatively summed.

A stewardship record is useful only if it changes what the institution can responsibly promise. For each continuing research object or public-facing service, it should identify an actual responsible person or organization, an estimated burden, a funded or candidly unfunded period, access and licence obligations, the correction route, and a credible stopping or transfer condition. Expected donor income is not secured funding, expressions of interest are not committed maintenance labor, and an informal hospital contact is not institutional endorsement. Information about personal circumstances should be retained only when genuinely necessary and appropriately permitted. The lean alternative may be a short named-maintainer and sunset notice; a more elaborate resource register must justify its costs by preventing identifiable failures.

21.4 Invisible Labour, Care, and the Limits of Voluntary Contribution

The labor that makes a Commons usable often appears in its outputs only indirectly: someone updates dependencies, responds to accessibility problems, checks third-party rights, repairs ambiguous instructions, or declines a dangerous request. Star and Strauss demonstrate how the visibility of work depends on the context and indicators through which it is represented (Star and Strauss, 1999). Jackson's account of repair highlights the practical work of keeping sociotechnical arrangements functioning (Jackson, 2014). These analyses motivate a differentiated stewardship inquiry, not the claim that all background work creates coauthorship or proprietary rights. A maintenance plan should name required tasks, consented responsibilities, available compensation, and a genuine stopping condition; it should also avoid turning the recognition of invisible work into intrusive surveillance of contributors.

Three design issues follow. First, labour allocation requires explicit boundaries: the expected work, anticipated duration, training, availability of alternatives, and procedures for refusing additional tasks. Second, recognition and compensation arrangements should be fitted to the actual work and applicable norms. Public thanks cannot automatically justify sustained work that a governing body would otherwise need to fund; conversely, a participant may prefer an occasional, self-directed contribution without entering a paid or continuing position. Third, the organisation must examine whether its apparent affordability is achieved by exporting costs to people with less institutional power, including students, volunteers, translators, caretakers, or junior researchers.

The availability of self-directed research opportunity does not remove these questions. An open optimisation benchmark can genuinely facilitate independent work while the same initiative imposes an inappropriate expectation that participating students provide operational scheduling services without pay or approval. The design should therefore keep research access independent of volunteering obligations. Roles involving actual service delivery, supervision, or interaction with patient-related environments remain subject to the competent institution's arrangements, not a research Commons's informal assignment.

Sometimes the responsible institutional response is to promise less. A synthetic benchmark might be released with a defined maintenance window, a stable archived version, and a statement that further technical support is not assured. A proposed Commons might suspend new registrations until it can answer existing questions or decline an external collaboration that would create unsupported obligations. Such decisions can preserve trustworthiness by aligning public claims with actual stewardship capacities. A clearly dated "historical and unmaintained" status is more informative than an indefinitely "active" label that invites reliance without a respondent. The design problem is not to maximize apparent openness but to specify which relationships can still be responsibly sustained.

21.5 Resource Provision, Funding Relations, and Institutional Power

Resource provision can influence the purposes and authority structure of the Commons. A funder may support a research objective, stipulate reporting conditions, or restrict the uses of contributed resources. A university research group may provide equipment and supervision while retaining authority over those institutional resources. An independent association may rely on donations, memberships, grants, publication revenue, or a small core of self-funded contributors. These arrangements are not interchangeable, and none is presumed legitimate solely because resources have been contributed.

The normative design question is not simply how to maximise inflows. It is how the conditions attached to resources affect public-problem constitution, research independence, contributor autonomy, access arrangements, and the distribution of decision authority. A sponsor may reasonably expect transparent financial reporting without obtaining power to suppress warranted negative findings. A contributor's provision of equipment does not by itself create permission to access another institution's protected records. Financial scarcity may justify prioritisation, but cannot transform an unauthorized activity into an authorized one. Similarly, institutional prestige may facilitate communication while intensifying pressure for favourable results or discouraging open criticism.

Commons governance research provides a basis for examining how rules and institutional configurations condition collective action without specifying a universal organisational form (Ostrom, 1990, 2009; Frischmann et al., 2014a). For the proposed framework, a minimum resource-governance arrangement should establish identifiable budget responsibilities, permissible sources and uses, conflict-of-interest review, restrictions on donor influence, opportunities for contestation, and an intelligible record of material commitments. It should also distinguish the Commons's own resources from resources owned or controlled by collaborating institutions. Financial transparency does not entail exposing protected personal transactions or confidential institutional information to unrestricted publication.

A small project may reasonably lack separate financial staff, standing committees, or professional administrative software. That does not eliminate its responsibility to represent itself accurately. A sole researcher may openly state that a provisional research environment is maintained personally, supported by no stable institutional funding, and offered without service continuity guarantees. A larger multi-party organisation may instead need delegated budgets, succession arrangements, independent checks, and formal coordination agreements. The relevant criterion is whether an arrangement can carry its actual promises, obligations, and exposure to harm at a defensible cost, not whether it resembles a particular organisational template.

21.6 Evaluation Regimes, Indicator Effects, and Epistemic Restraint

Evaluation constitutes part of the infrastructure because it shapes what contributors attempt, what managers recognise, and which activities attract support. A Commons that treats repository downloads as its principal success measure may devote resources to publicity rather than interpretability. A service organisation that rewards volunteer hours may neglect whether the hours were useful or freely undertaken. A research programme assessed only through publication counts may fail to document software repair, mentorship, correction, or negative results. These are possibilities to investigate, not empirical generalisations about all such institutions.

Campbell's treatment of planned social change establishes a foundational caution: social interventions take place amid concurrent changes, so observed movement in an indicator is not itself evidence that the intervention caused it (Campbell, 1979). Evaluation also risks altering the practices it measures. The San Francisco Declaration on Research Assessment is an established intervention against inappropriate reliance on journal-based metrics for judging scientific contributions (San Francisco Declaration on Research Assessment, 2013). Developmental evaluation offers a different but relevant literature concerning inquiry and learning in complex, changing settings (Patton, 2011). Our proposed relational account does not replace causal inference, disciplinary standards, or participant testimony with a universal generativity score. It identifies questions that an evaluation process should keep open.

Evaluation should identify the specific decision it is meant to inform: whether to maintain a benchmark, expand participation, revise access terms, compensate a coordinator, or close an unsupported activity. The appropriate evidence will differ. High contribution counts may coexist with unpaid review overload; low publication numbers may accompany careful refusal of unsafe uses and robust training. The evaluation should invite contestation from those who declined to join, withdrew, or supplied invisible work, while avoiding unnecessary collection of identifiable accounts. Comparative evidence can ask whether an ordinary maintained repository or mentorship arrangement performs the same needed function at lower cost. Inferences about causal institutional effects require explicit treatment of selection, changes in the environment, missing evidence, and ethical limits on observation.

The evaluative consequence may be a recommendation to reduce activity, transfer stewardship, revise a public claim, or discontinue an unsupported service. Negative results can be generative if their reasons are made appropriately recoverable and if they prevent the repetition of costly or harmful designs. A report that judges every active programme positively because it survived to be measured would undermine the critical function of evaluation.

Table 32: Illustrative evaluative domains and interpretive risks. An indicator may inform inquiry without serving as a complete or commensurable value measure.

Evaluation domain	Candidate observations	Interpretive and incentive risks
Research continuity	Independent reuse, reproducible results, issue resolution, interpretive handoffs	Downloads mistaken for use; one successful replication mistaken for general validity
Participant capacity	Voluntary choice, access to mentorship, feasible workload, exit experiences	Selection effects; coerced commitment masked by retention; unobserved opportunity cost
Normative and governance quality	Correction responses, reasons for decisions, permission checks, complaints handling	Lower complaint count mistaken for legitimacy; confidentiality limits wrongly treated as concealment
Public and service value	Affected-person accounts, bounded outcomes, unintended harms, service quality where authorised	Attribution without comparison; indicators substituted for the values of affected subjects
Resource reproduction	Maintenance backlogs, dependency coverage, successor capacity, restricted liabilities	Monetary balance mistaken for functional sufficiency; hidden or outsourced unpaid work

21.7 Coupled Capacity Dynamics and Conditional Reproduction

Stewardship decisions produce effects beyond the resources immediately allocated. For example, additional outreach can increase interest in participation while simultaneously increasing mentoring, translation, communications, and complaint-handling workloads. Strong archival obligations can enable long-run recoverability while consuming the time otherwise allocated to new experiments. Funding for a short-term research result may improve one method and simultaneously create dependencies that lack support after the funding period. A participant's departure may eliminate not just an hour of work but a historically situated interpretation of a problem. These are coupled changes whose signs and magnitudes cannot be assumed in advance.

One can represent a possible relation between capacity states without imposing a scalar law of organisational growth:

$$K_{t+1} \in \mathcal{T}_t(K_t, \text{Input}_t, \text{Maint}_t, \text{Loss}_t; N_t, U_t). \quad (40)$$

Here, K_t denotes an institution's situated and typed generative capacities; Input_t its legitimate new inputs and opportunities; Maint_t its repair, learning, and maintenance practices; Loss_t losses, obligations, and capacity-reducing disruptions; N_t the relevant normative and institutional boundaries; and U_t unresolved uncertainty. The relation $\mathcal{T}_t$ represents a set of historically possible transitions, not an estimated transition operator or a guaranteed trajectory. Equation (40) is deliberately non-predictive, because both the participating actors and the available choices can change with the institution's history.

The practical implication is to examine bottlenecks rather than chase an abstract maximum of outputs. For a given research environment, the limiting condition may be the availability of legitimate access permissions, methodological review, translation capacity, funding, or trusted maintainers. Additional storage or publicity does not necessarily remove those bottlenecks. A maintenance reserve may have value precisely because it permits an otherwise unremarkable response to a foreseeable dependency failure. A transparent reduction of scope can preserve a viable and meaningful capacity while preventing overstretched participants from incurring indefinite obligations.

The meaning of *reproduction* should be kept broad and conditional. An organisation may reproduce a programme, transfer a method to another steward, preserve an archive for independent use, or transform a service into a different form. It may also conclude that particular practices should not be continued. What deserves study is the justified continuation or revision of capacities and obligations, not institutional longevity as an unconditional good.

21.8 Typed Capacity Comparisons, Maintenance Burdens, and Responsible Closure

The set-valued transition of Equation (40) is not a numerical balance sheet. For a specified activity, K_t may contain different kinds of capability, including a person’s ability to conduct an independent analysis, access to maintained software, trustworthy technical review, available supervisory attention, and an institution’s ability to discharge accepted obligations. Some are held by individuals and some arise only through relations among subjects. Their availability can be restricted by legitimate boundaries; a researcher’s loss of access to an unsafe dataset is not automatically a reduction in overall justifiable generativity. Summing these items would assume interpersonal comparability and legitimate substitutability not established by the model.

A bounded comparison can instead use a declared family of questions Q and a context-specific, possibly incomplete comparison relation $\succeq_{Q,c}$ on two proposed capacity descriptions. In schematic terms,

$$K_{t+1} \succeq_{Q,c} K_t \quad (\text{qualified comparison in declared context}). \quad (41)$$

Equation (41) is a context-qualified comparison assertion, not a demonstrated mathematical order or an empirical growth condition. No reflexivity, transitivity or universal ranking is assumed without further justification. Its use depends on explicit comparison dimensions, observation conditions, relevant subjects and defensible treatment of trade-offs. Descriptions may remain incomparable: better public documentation may coexist with worse maintainer autonomy, or increased user reach with weaker reliability. In particular, it would be misleading to infer the relation merely from increased publication, volunteer registration or repository traffic.

An intertemporal resource commitment has at least a *promised* dimension and a *supported* dimension. A Commons might announce that a method will remain accessible for five years but have only enough steward time to support the next six months. The announcement is neither a resource nor an entitlement created by wishing it into existence. Competent analysis should locate who made the commitment, to whom, with what authority and applicable obligations, what resources are actually available, and which failure or sunset arrangements could be legitimate. This is particularly important for volunteer labour, whose nominally donated character should not make continuing expectations invisible. Where commitments cannot be met, narrowing scope, transferring specified duties, correcting claims and honouring surviving obligations may be more responsible than expanding the network of dependencies.

The resulting capacity analysis connects, but does not collapse, the value-return question in Section 20. A lawful opportunity to reuse code can exist when no maintainer is available; a maintainer can work diligently while beneficiaries still lack the skills to reuse an artifact. Conversely, modest, time-limited assistance may make a previously inaccessible method practically useful. Each proposition needs its own evidence. The model therefore leaves open whether a more elaborate Commons improves the durability of capacity compared with an ordinary repository and documented ownership of a maintenance task. A minimal legitimate arrangement may be fully sufficient.

A qualified capacity comparison in Equation (41) is a *claim about specified capacities*, not the sum of independently recorded opportunities, citations or financial commitments. This matters when the beneficiaries and bearers of maintenance duties differ. In a synthetic two-period history, researcher a gains access to a reusable method while unpaid maintainer m absorbs additional correction work and a promised support grant fails to materialise. The available evidence may support a gain in a ’s task-specific capability, a loss in m ’s discretionary research time, and an unresolved claim about the initiative’s long-term stewardship. It need not establish that $K_{t+1} \succeq_{Q,c} K_t$ for a question family that expressly includes both actors and maintained obligations.

A further complication is temporal non-comparability. If the research activity changes, a former stock of usable tools may become irrelevant even while a different capacity emerges. The comparison must identify whether Q still refers to meaningfully comparable tasks, whose standing was counted, what substitution between resources is permitted, and what evidence bears on unrecorded labour. A reviewer should report a *partial* or *indeterminate* comparison rather than manufacture a scalar result when these conditions cannot be defended. The set-valued transition in Equation (40) remains a family of hypotheses to investigate, not a demonstrated causal transition law. For a small research project, a dated note about

who maintains the repository and what happens if support stops may be more informative than a resource dashboard.

A comparison of capacities becomes particularly fragile when a project records *outputs* but not the actors who continue to bear its obligations. For a declared set of affected subjects S_c and evaluative tasks Q_c , the analyst should seek separate descriptions of capacity and maintenance exposure for each materially affected bearer. A favourable statement about a beneficiary should not silently be substituted for the contextual relation $\succeq_{Q,c}$ concerning all relevant bearers; nor does one maintainer's reported hardship establish that an otherwise independently valuable research result should be suppressed. The practical issue is which alternative responsibility, support, narrowing or exit arrangement can be justified for the actual participants.

One prospective synthetic test can hold a method's measured benchmark performance constant while varying only the credibility of an offered maintenance resource, a contributor's withdrawal, and the distribution of support work. If assessors nevertheless rate institutional generativity solely by uptake or total output, the error concerns an omitted relational bearer. If they correctly identify the burden from an ordinary human-readable project note, a more elaborate temporal model has not proved its additional value. The outcome of such a test would concern reviewers' classifications, not empirically measured reproduction of actual human capabilities.

21.9 Adaptation, Succession, and Responsible Termination

A Commons is historically fragile where responsibilities are held informally by one person. Successor preparation, intelligible records, appropriate licences, a reviewable rights register, documented accounts, and explicit limits of authority may reduce this fragility, though none can guarantee that another person will agree or possess the necessary competence to continue. The transition between stewards is also an occasion for normative reconsideration. A new generation of participants may reject inherited assumptions, contest governance arrangements, or alter the disciplinary purposes of a research environment. Succession therefore involves interpretive and political work, not just transfer of passwords or server access.

A practical protocol should identify what decisions can be delegated, which activities require independent authorization, who may archive or cease publication, and which records must be retained or restricted according to applicable obligations. Pending complaints and contributor-rights disputes require particular attention, since an organisation should not erase responsibilities by declaring a project closed. A contributor's valid rights and licences may continue after an infrastructure ceases maintenance, and neither the expiry of a grant nor the termination of a research team automatically extinguishes external legal obligations.

Four broad options merit consideration when reproduction is uncertain: *repair*, if the original purpose remains justified and the capacity can be restored; *reconfiguration*, if scope or governance must change; *transfer*, if a competent and legitimate successor can assume specified functions and obligations; and *termination with preservation*, if continuation would be misleading, unauthorised, unsafe, or excessively extractive. Their appropriateness depends on affected subjects, residual duties, and context. The ability to terminate a project without abandoning archival, safety, or rights responsibilities can itself be an achievement of institutional design.

Termination should be described accurately to public users. If a released scheduling dataset is preserved only for historical comparison, the repository should not present it as a current operational recommendation. If a handbook is not being updated, readers should be able to see the revision date and limits of applicability. If a Commons cannot maintain an effective complaints channel, it should reconsider claims about current accountability. Archival availability and active institutional support are distinct statuses, just as historical recoverability differs from present authorization.

21.10 Institutional Configurations, Failure Tests, and Historical Evaluation

An independently constituted Commons may begin with one public or genuinely synthetic disciplinary environment, a recorded licence and contribution policy, a bounded maintenance commitment, a modest continuity reserve, and a transparent communication channel. Its resource infrastructure may be mostly human and documentary, rather than a complex administrative system. The relevant obligations are still real: accurate representation, appropriate access control, reasonable responsiveness to known harms, and respect for the limits of the promised service. The fact that a project is small does not transform unofficial documents into hospital policy or authorize research involving people.

A discriminating stewardship test should combine three disruptions: the principal maintainer becomes unavailable, a critical tool dependency changes, and a contributor identifies a harmful error in a public record. Investigators should ask what commitments still bind the Commons, who is competent and resourced to issue a correction, which activities must be frozen, and what rights or archival obligations survive closure. Compare a lightweight named-maintainer/sunset protocol with a proposed more elaborate succession structure. The test is not passed because files remain online or publication counts rise; it is passed, provisionally, when the necessary public and contributor obligations can still be met or responsibly transferred without imposing indefinite unpaid duties. A small Commons may legitimately choose closure instead of institutional expansion.

A federated arrangement involving multiple independent laboratories or civil-society organisations may need agreed stewardship divisions, pooled infrastructure support, shared but qualified metadata, succession mechanisms and procedures for allocating unexpected burdens. A formally authorized hospital partnership, if one later develops, would add independently assessed service obligations, clinical safety requirements, professional authority, data safeguards, and perhaps continuing training. These three configurations do not form a simple ranking of sophistication. They face different exposure to harm, available capacities, and legitimate purposes.

Several hypothetical failures can discriminate among interpretations of sustainability. In the first, a project attracts many new contributors and publishes frequently while documentation and code dependencies become progressively harder to maintain. Expansion of visible output may accompany contraction of independent usability. In a second, a widely praised volunteer programme records stable participation but depends on one unpaid coordinator whose continued work has become obligatory in practice. A financial report might classify the programme as inexpensive, while a relational investigation would identify concentrated burdens and weak succession. In a third, a project with modest publications discloses its limitations, repairs critical methods, preserves dissent, and transfers a useful archive to a competent successor before closing. Its termination need not represent failure in the same sense as the first two cases.

Evaluation should seek discriminating evidence for these hypotheses. Relevant records might include actual maintenance time, the ages and severities of unresolved dependencies, changes in the ability of newcomers to reproduce results, the consent and autonomy of those assigned ongoing work, the availability of successor competence, complaint and correction response, lawful retention arrangements, and the practical usability of historical outputs. Potential rival explanations include changes in funding, shifts in institutional leadership, disciplinary standards, or selection among participants. Measures should be proportionate, privacy-respecting and open to critical reinterpretation.

The framework therefore yields a limited but important design claim: sustaining a generative Commons involves the responsible stewardship of the conditions of future activity, not simply the maximisation of activity itself. Its functions are fulfilled only insofar as particular persons can legitimately use, examine, revise, and, when warranted, relinquish institutional arrangements without invisibly transferring excessive burdens to others. Resource adequacy, evaluation quality, and historical reproduction remain situated questions requiring empirical inquiry and normative judgment. This completes the analysis of the fifteen constitutive infrastructure functions and prepares the subsequent examination of their institution-specific coupling and configuration.

22 Infrastructure Coupling and Institution-Specific Configuration

The preceding fifteen infrastructure analyses distinguished the conditions through which a Commons may formulate public problems, exercise normative judgement, preserve knowledge, enable research and voluntary participation, coordinate decisions, recognise contributions, circulate value, and maintain its capacities. Those functions are not independently complete units that can simply be assembled into a working organisation. A legitimate publication might depend on a sound evidentiary review and a source-specific licence; a scheduling exercise might depend on lawful data access, competent model criticism, a feasible human workload, and permission to act; a historical archive might depend on a retention rule, an interpreter able to recover its context, and a steward able to honour subsequent restrictions. The conditions of one activity may consequently involve functions whose responsible actors, resources, and normative authority lie in different organisations. This section examines *infrastructure coupling and institution-specific configuration* as a distinct problem of constitutive institutional engineering.

The analytical object is the dependence of a specified activity upon arrangements that may be distributed among different actors and organisations. The comparison begins with the activity, its affected subjects, and the actual institutional baseline, not with a requirement to fill fifteen administrative boxes. Investigators should identify the smallest set of functionally consequential dependencies, ask which existing arrangements already support them, specify who can authorise or challenge each interface, and examine the cost of adding or retaining it. Section 6 introduced the many-to-many realisation relation; the present section concerns the evidentiary and normative conditions under which such realisations may be coupled. Ostrom's analysis of action situations (Ostrom, 2005, 2009), Star's relational account of infrastructure (Star and Ruhleder, 1996), modular design (Baldwin and Clark, 2000), and classificatory consequences (Bowker and Star, 1999) supply distinct foundations. The fifteen-function coupling grammar is our provisional synthesis, rather than a result established by those sources.

22.1 Functional Coupling as a Constitutive Institutional Relation

Coupling refers here to a historically situated relationship in which the possible operation, interpretation, legitimacy, maintenance, or consequences of one infrastructure function are conditioned by another. This is more specific than the observation that organisations are connected. If an independent research repository publishes a synthetic benchmark, the research environment (F_8) depends on information organisation (F_6) to communicate the dataset's version and on validation (F_7) to make reported comparisons critically examinable. Its rights register (F_{13}) may establish permissible reuse; its communication infrastructure (F_{10}) must represent the status of the work accurately. An apparently complete benchmark can remain epistemically unusable if the baseline is undocumented, and a technically reproducible benchmark can still be publicly misleading if it is advertised as a tested hospital solution.

A coupling is not inherently beneficial. A shared register may reduce the effort needed to reconcile provenance across research and archival work; the same register may expose restricted material if it incorrectly collapses publication status into access status. The assessment must therefore specify both the *capacity gained* and the *new failure path* created by an interface, with a responsible reviewer for each. When no independent decision or information transfer is necessary, coordination through an existing person or a documented handoff may be sufficient. The burden lies with a proposed additional interface to show why that simpler arrangement is inadequate for the activity at issue.

The coupling relation must be distinguished from several neighbouring objects. *Co-location* means that two activities are performed by the same person or housed in one repository; this does not establish a functional dependency. *Interface agreement* specifies how two activities are expected to communicate or exchange resources; it may remain untested. *Authority* concerns a recognised entitlement to decide or permit a specific activity, which cannot be deduced from technical interoperation. *Causal efficacy* refers to effects of historically constituted relations, which may not be captured by a planned interface or a coordination chart. The design analysis should preserve these distinctions rather than treating an organisational diagram as an adequate account of institutional reality.

Definition 22.1 (Situated infrastructure coupling). A *situated infrastructure coupling* is an evidenced, proposed, or disputed relationship among distinguishable institutional functions, together with the historically specific persons, arrangements, permissions, epistemic conditions, and resources through which one function can enable, constrain, interpret, correct, or impose burdens upon another in relation to a specified activity. Its existence alone establishes neither the sufficiency nor the legitimacy of the resulting institutional configuration.

The three GR reality levels clarify the definition’s epistemic limits. At the first level the ultimate ontological status of an institution, capacity, or value remains suspended; the classification does not purport to describe elementary substances of social reality. At the relational level, real possibilities and constraints emerge through historically conditioned persons, norms in use, technical artefacts, competencies, resource flows, and power relations. At the manifestation level, diagrams, agreements, handbooks, approvals, schedules, interviews, incident reports, and repository metadata express only partial, context-dependent evidence of those relations. An implementation record may show that a responsible person was named without establishing that the person accepted, understood, or could fulfil the responsibility. The design must therefore permit the discovery that a recorded coupling is inactive, contested, ineffective, or harmful.

22.2 Typed Dependencies, Directionality, and Interface Status

The analytical set $F = \{F_1, \dots, F_{15}\}$ is retained from Section 6. An institutional arrangement is represented there by the many-to-many relation $\rho_{I,t}$ between functions and concrete supports. For coupling analysis, a further descriptive record is helpful. Let Θ denote a *vocabulary of relationship types* such as enabling, constraining, interpretive, corrective, and resource-bearing. It refines or groups the local architectural dependency types T_{arch} in Equation (9), but is not identical to that earlier vocabulary; let S_{dep} denote the evidentiary-status vocabulary for those dependency claims, including proposed, observed, and disputed. For institution I at time t , define the annotated candidate relation

$$\text{Dep}_{I,t} \subseteq F \times F \times \Theta \times S_{\text{dep}}, \quad (F_i, F_j, k, s) \in \text{Dep}_{I,t}. \quad (42)$$

The tuple records an assertion that F_i conditions F_j in manner k , with evidentiary status s . The status is attached to the specific asserted dependency; a disputed dependency is not an established edge, and an observed coordination event is not necessarily evidence that one function caused another to succeed. Here $\text{Dep}_{I,t}$ is not the design-option set $\mathcal{D}_{I,q,t}$ in Equation (5). Equation (42) is a research notation for differentiated claims; it is not a measured causal network and does not certify an institution’s readiness. Every nontrivial relation should be accompanied by a narrative explanation of the relevant activity, concrete participants, evidence, applicable permissions, limits, and an actor competent to review the interpretation. The ordering of F_i and F_j matters: information sharing may enable a review, while a review may in turn constrain what can responsibly be shared. The resulting relation can be reciprocal without being symmetrical.

Consider a Commons announcement for an open, nonclinical research workshop. The communication function F_{10} relies on information organisation F_6 for accurate programme details and on the normative function F_2 to distinguish the workshop’s independent status from any institutional endorsement. Participation F_{11} requires intelligible role descriptions and the ability to decline. Research validation F_7 conditions which scientific claims can be stated as established. The resource-stewardship function F_{15} places a practical limit on the number of inquiries that can be answered and events that can be maintained. Yet the workshop may also generate feedback that revises the information register or the research problem itself, creating opposite-direction relationships. The arrows in a diagram would need to distinguish availability of materials, review obligation, authority to approve claims, and evidence of actual communicative understanding.

A functioning interface is not synonymous with a data exchange or formal memorandum. A translation note may serve as an interface between engineering and legal inquiry while explicitly maintaining

Table 33: Candidate coupling types and review requirements. The examples are hypothetical design situations, not observed institution-wide dependencies.

Relation type	Illustrative functional relation	Question requiring independent review
Enabling	Information access F_6 makes a research environment F_8 usable	Is the resource intelligible and accessible to the intended participant?
Constraining	Normative and safety functions F_2, F_4 limit operational planning F_{12}	Which actor has authority over the activity, and within what scope?
Interpretive	Historical records F_5 condition epistemic validation F_7	Does the record preserve relevant context rather than merely a citation?
Corrective	Governance F_3 and public response F_{10} permit correction of misleading claims	Can affected persons realistically contest and obtain a response?
Resource-bearing	Stewardship F_{15} conditions training F_{11} and research maintenance F_8	Who bears the time, money and opportunity costs, including invisible work?

non-equivalence between mathematical feasibility and legal permissibility. A review process can interface with communication by correcting an overstatement rather than transmitting confidential data. Refusal, suspension, or withdrawal can constitute an appropriate output of a boundary-maintenance interface. Indeed, where a proposed connection would falsely imply institutional authority, *the deliberate absence of that connection* may be a required design property. Modularity is useful as a comparative source because it invites inquiry into separately developed components and explicitly maintained interfaces (Baldwin and Clark, 2000); it should not be interpreted as evidence that social or normative functions can always be decomposed without remainder.

22.3 Activity-Specific Dependencies and Conditional Readiness

The functional classification should be open to revision at both the analytical and institutional levels. An investigator may find that an apparently single institutional practice performs distinguishable normative and epistemic functions, or that two listed functions are adequately carried by one arrangement. Such findings need not threaten the typology: its usefulness concerns differences in obligations and consequences, not the preservation of fifteen separate administrative units. An asserted dependency should be withdrawn or narrowed when the purported conditioning relation has not been demonstrated, when a less burdensome substitute performs the same work, or when the interface lacks legitimate authority.

A requirement for *all fifteen functions* to be developed to equal depth before a Commons performs any public or synthetic research would be poorly justified. Conversely, an assertion that one valuable research module can operate without normative, epistemic, information, or maintenance arrangements would conceal relevant dependencies. The appropriate unit of initial design is a *bounded activity*, with a specified purpose, relevant subjects, resources, potential harms, public claims, and competent permissions. The minimum constitution of functions follows from the claims and responsibilities that the Commons actually undertakes, rather than from an abstract maturity score.

Let a represent such an activity, and let $F_a \subseteq F$ denote the function set whose support is judged materially relevant to that activity. Let $W_{I,t}(a)$ be a documented collection of evidence and unresolved questions covering the actual arrangements, available expertise, resource commitments, authority, and applicable safeguards. A provisional assessment is then an interpretive judgement

$$J_{I,t}(a) = \text{Review}_{I,t}(a, F_a, \rho_{I,t}|_{F_a}, \text{Dep}_{I,t}|_{F_a}, W_{I,t}(a)), \quad (43)$$

where $\text{Review}_{I,t}$ denotes a human, institutionally situated procedure rather than an algorithm or a universal decision rule. Equation (43) can organise justified questions about whether and how to proceed, defer, narrow, or refuse a proposed activity. It does not produce a proof of legality or safety, and an independent Commons review cannot substitute for the approval of an organisation that holds the relevant authority. Review competence, applicable laws, and suitable evidence must be determined in context.

Suppose a small independent group proposes to publish a synthetic scheduling benchmark for comparative algorithm research. The bounded activity needs an intelligible problem statement (F_1), appropriate source and reuse conditions (F_2, F_{13}), a clear independent-project status and safety boundary (F_4), a usable and criticisable research environment (F_7, F_8), information access and accurate publication (F_6, F_{10}), a person capable of correcting the release (F_3), and realistic maintenance expectations (F_{15}). Historical provenance F_5 becomes materially relevant as soon as versions, decisions, and downstream research depend on the benchmark; value-return arrangements F_{14} may be modest but should not be misrepresented as automatic. The functions can be supported by overlapping material arrangements, potentially a repository, a contributor-rights note, a documented baseline and a responsible researcher. The arrangement is not thereby authorised to allocate actual hospital personnel.

Consider instead a volunteer-led event inside a hospital. Planning and simulation (F_{12}) may support scenario analysis, but the proposed activity also depends on the hospital's competent safety, supervision, institutional permissions, service procedures and potentially additional review processes. An independent Commons cannot supply those functions simply by writing its own handbook or calling a dataset "de-identified." If permissions are unavailable, the bounded activity may be restricted to an independent research simulation, or not performed. The practical value of an activity-specific analysis lies partly in recognising boundaries and postponing commitments that a proposed project cannot legitimately satisfy.

The activity review in Equation (43) draws upon reported dependencies; it must not reclassify them as established causal links. In particular, a claimed dependence of public communication on a new provenance interface can be motivated by a plausible risk without proving that an existing versioned repository is deficient. Reviewers should identify the relevant functional need, inspect the concrete arrangement already meeting it, and state the *residual* failure mechanism expected to remain. The evidence set $W_{I,t}(a)$ is consequently open to missing, disputed and inaccessible sources; absence of a dependency record cannot serve as proof that no obligation exists.

A useful minimum-change counterexample is a fictional independent synthetic benchmark with an accurate licence manifest, a dated correction history and one responsible maintainer. If an added typed platform detects no consequential mistake missed by that arrangement but requires more personal identifiers or unpaid stewardship, the added platform is not justified by the function catalogue. Conversely, an existing ledger might conceal a disputed component licence across a change of maintainer; in that specific case a modest component-specific review field could be warranted without creating new departments or demanding complete reconstruction of every past social relation. The proposed research contribution is the *activity-specific analysis of residual dependencies and burdens*, not the claim that a greater number of functions or links implies better governance.

For the decision, rights, return and stewardship functions, the practical boundary is an *interface question*, not a requirement to pool their records. A publication reviewer may need to know whether the proposed reuse has an unresolved component-rights question, without obtaining private contributor correspondence. An adviser deciding whether a benchmark should remain online may need the existence and approximate size of a maintenance obligation, without receiving a purportedly universal measure of contributors' wellbeing. Likewise, the institution competent to approve a real service act may need safety and supervisory evidence, not the Commons's internal value-return ranking. A bounded interface should specify the minimum transferable statement, its review status, the actor empowered to act on it, and an explicit route for correcting or declining the transfer.

The residual-value test applies symmetrically to greater and lesser integration. A fully centralised register can increase disclosure risk and mistakenly project internal authority outward; excessive separation can conceal a licence conflict, a withdrawal or a cost shifted to an unsupported maintainer. The proposed coupling model is useful only if a proportionate design distinguishes those errors better than familiar version control, documented delegation and direct human communication. It may properly recommend that no additional data be linked.

22.4 Bottlenecks, Failure Propagation, and Institutional Over-Coupling

Dependencies are consequential because performance and failure can propagate. A research group may have skilled contributors and a valuable problem but lack a permitted data source. Additional algorithm developers will not cure that deficiency. A project may attract attention through public communication but lack the capacity to explain its limits or answer participants' questions. Recruitment can then create an expectation the organisation cannot fulfil. A historical archive may contain many files yet fail to preserve the reasons for changing research assumptions; new researchers may reproduce the old method mechanically while overlooking the circumstance that made it inappropriate. These examples show different relationships between function availability, system activity, and justified outcomes.

A bottleneck is not necessarily the function with the smallest budget or fewest staff members. It is a limiting relation for a specified activity under specified conditions. The relevant limit can be legal competence, methodological validity, informed consent, accessible communication, the time needed for responsible review, or maintenance resources. More investment in an unconstrained function may increase burden on the bottleneck. Publicity can overwhelm inadequate participation support; automated scheduling can increase demands upon a coordinator who must negotiate exceptions; apparently free open-source resources can increase future documentation and dependency costs. It is therefore important to record *induced obligations* alongside expected benefits.

Failure can also pass through classification decisions. A shared registry might classify a contributor's restricted draft as publicly reusable. If that status is accepted without verification, the information-sharing function can propagate the error through research reuse, public publication, and later archival records. The wrong record may become harder to correct as derivative works and citations accumulate. Bowker and Star's work on classification clarifies why categories and standards are socially consequential and not merely neutral arrangements (Bowker and Star, 1999). Here the proposed application is specific: a Commons should maintain a way to contest status classifications, correct affected records, preserve an accurate correction history where legitimate, and inform persons who may have relied on erroneous permissions. The ability to discover error before reuse may be more consequential than the elegance of the register's interface.

Over-coupling arises where satisfying one function becomes unnecessarily conditional on participation in another. Open benchmark access, for example, should not ordinarily depend on completing unpaid hospital service. A sponsor's insistence that funding, favourable publicity and research review be managed by one authority may make criticism costly even when formal review procedures exist. A proportionate design should ask which links are materially necessary, which are convenient but optional, which introduce leverage over participants, and which should remain separated to preserve independent judgment. Equally, separation requires a reliable means to transmit corrections when misleading scientific claims or rights classifications propagate between functions.

The possibility of *decoupling* is not uniformly beneficial either. Separating publication from research review can facilitate independent criticism, yet separating the two without a means of exchanging corrections can perpetuate misleading claims. Distinct hospital and Commons governance should preserve authority boundaries, while an authorised collaboration may need an explicit escalation channel for incidents that affect both domains. The design object is selective, differentiated coupling: maintain necessary interfaces, limit unsupported transfers of authority, and provide competent mechanisms for repairing or ending harmful dependencies.

22.5 Institution-Specific Configurations and Comparative Design Choices

University affiliation may provide several potential mediating resources: academic libraries, disciplinary research groups, students' temporal proximity, educational supervision, ethics expertise, and existing public-service networks. Their existence does not establish that a particular Commons can use them. Some universities may have formal hospital relationships with strong restrictions on cross-unit information access; another institution may have few administrative links but sustained collaboration among individual researchers. A non-university hospital may possess an effective volunteer programme and

Table 34: Hypothetical configurations of Commons functions and their differentiated institutional design risks. No column describes an observed hospital or a universally preferred arrangement.

Configuration	Potentially appropriate constitutive arrangements	Characteristic limitation or design tension
Independent research Commons	Public and synthetic inquiry; source records; basic licence and correction mechanisms; modest steward commitment	Limited authorised access to institutional services; concentrated maintenance and weak independent appeal capacity
Federated interdisciplinary Commons	Shared problems and translation interfaces; differentiated discipline-specific review; negotiated rights and division of stewardship	Contested authority, uneven disciplinary influence, interface burdens, fragmentation of evidence and maintenance responsibilities
Authorised hospital partnership	Action-specific agreements, competent clinical/service safeguards, restricted-data separation, role supervision and incident escalation	Higher safety and administrative obligations, risks of authority confusion, institutional capture and inaccessible research outputs

research partnerships that fulfil several of the same functions. The institutional configuration should therefore be described by *evidenced capabilities and permissions*, not by a type label treated as a guarantee of superiority.

Three ideal-typical configurations make this activity dependence examinable. In an *independent public research Commons*, a small steward may support an open synthetic module, provenance register, correction channel and bounded maintenance commitment. In a *federated disciplinary Commons*, several institutions may jointly define research problems while retaining distinct authority over personnel, ethics, permissions and publication. In an *authorised service partnership*, an independent research relation may coexist with a separately governed hospital activity, but only through an action-specific and appropriately reviewed interface. These are analytical configurations, not developmental ranks: the same legal entity might support more than one, and similar labels across institutions may conceal different decision powers.

The categories should be treated as comparisons of *possible relations*, not as a growth ladder. A small independent project can make a genuine methodological contribution without ever becoming an operational partner. A federated collective may successfully support public research while keeping distinct institutions' records separate. A formal partnership might help a service yet create fewer independent research opportunities if access to public work is tied to institutional status. Conversely, a particular Commons may need to contract, withdraw a public claim, or terminate an unsuitable partnership in order to protect its legitimacy and participants' generative capacities. The relevant criterion is whether an actual configuration supports a defensible purpose without unjustified harm or burden, rather than whether it occupies the most institutionally elaborate category.

The design-choice analysis of Section 5.9 places an additional constraint on the coupling relation. A dependency marked as relevant to an activity may already be supported through an ordinary existing process; the relation does not establish that a newly constructed Commons interface is needed. Nor is an unobserved dependency automatically absent. A reviewer should distinguish the existence of a responsibility, the adequacy of an inherited arrangement that performs it, and the incremental benefit and cost of a proposed change. This distinction is especially important when additional record keeping could expose participants, transfer burden to less powerful actors, or divert resources away from the activity under study.

22.6 Constitution, Sequencing, and the Revision of Interfaces

A sequence for establishing a Commons should be justified by its intended activities and dependencies. There is no context-independent order in which fifteen functions must be completed. A defensible independent starting arrangement may begin by documenting a question and its limits, specifying normative

and contribution conditions, creating one usable disciplinary research environment with lawful or synthetic materials, and establishing a way to receive criticism and maintain historical context. Once a first participant reuses a resource, new obligations can emerge around attribution, code maintenance, disagreement and correction. Thus a minimal constitution is not the smallest possible set of documents. It is a bounded relation between an actual promise, available capabilities, those affected by it, and the institution's ability to answer for what it undertakes.

Sequential constitution should be revisable. A group might first publish a theoretical handbook as an explicitly independent research product. If external contributors arrive, it may need a better role definition, licence record and complaint channel. If independent engineering and law researchers begin examining one problem, it may need interdisciplinary translation and separate standards of validation. If a hospital subsequently invites an authorised pilot, the project's prior openness cannot override the need for separate institutional review and service responsibilities. A prior agreement or repository should be reassessed in light of the new activity instead of assumed to extend automatically to its more consequential uses. The transition-focused analysis in Section 10.4 makes that reassessment explicit without creating a new Commons power of approval. A change in evidence or intended audience may also require the scoped inferential check of Section 13.6; a new public deposit or provenance link may require the rights and exposure review of Section 19.8. Coupling these functions means making their distinct decisions visible at the interface, not substituting one decision for the others.

Developmental evaluation offers one relevant intellectual resource for learning amid changing project conditions (Patton, 2011); such evaluation does not supply a substitute for specific legal or ethical duties. An adaptive design process should preserve a revision trail: what arrangement was expected to work, what evidence challenged it, whose interests were affected, what alternatives were considered, who had authority to decide, and what was learned from unsuccessful experiments. An infrastructure can be reconfigured by creating an interface, narrowing its scope, changing a maintainer, adopting a different licence for *future* materials where lawful, replacing a method, or ceasing an activity. Existing licence grants and residual obligations cannot necessarily be withdrawn by unilateral revision.

Importantly, reconfiguration should allow the affected subjects to challenge which dependencies are represented as necessary. An administrator may claim that continued research access requires volunteer service because the two activities are institutionally proximate; the participant may reasonably challenge the link. A funder may condition support on promotional exclusivity that undermines criticism; a project may have to decline the resource. A hospital may refuse access to protected information even when researchers believe it would improve their work. These are not merely logistical inconveniences. They reveal the normative and political-economic structure through which the configuration is sustained and whose generative capacity it prioritises.

An activity-specific assessment should specify a comparator before recommending a new interface. For a synthetic research release, the counterfactual might be an ordinary maintained repository with existing licences and competent review. For an authorised volunteer activity, it might be the hospital's established scheduling, supervision and escalation procedures. The investigator should name the residual unhandled duty or failure path, the proposed change, the additional maintenance and exclusion risks, and the observation that would show the intervention did not improve the bounded task. Counting completed registers or listed functions is not a measure of success.

22.7 Situated Tests, Rival Explanations, and Historical Reproduction

The success of coupling should be investigated through differentiated observations rather than a total score. A configuration record can identify whether a source is lawfully accessible, whether a new participant can reproduce a result, whether an independent reviewer can locate the assumptions behind a claim, whether a volunteer can decline a role without penalty, and whether a Commons can correct a misrepresentation about its institutional status. These tests examine different functions and their actual relations. A diagram that contains fifteen labelled boxes cannot establish any of them. The observation of an effective interface in one context also cannot establish that the same arrangement will remain

adequate after authority, participants, funding or the underlying problem changes.

A useful counterexample concerns abundant resources and weak interfaces. Imagine a well-funded collaborative initiative with separate publicity, research and documentation teams. Its outputs may be plentiful while a restricted resource is misclassified, review comments are not transmitted to the publication team, and a public event uses superseded training instructions. The apparent strength of individual functions has not produced a reliable cross-functional arrangement. An opposite counterexample is a small independent research effort with one documented synthetic dataset and limited outreach, but carefully specified rights, a replicable baseline, contextual change history and a responsive correction process. The smaller project may offer more credible independent usability for its bounded purpose. This would not establish its superiority in other purposes, especially any requiring authorised patient-facing service.

A second contrast concerns explanation. Suppose participants cease contributing after a project increases the number of cross-disciplinary meetings. A simple coordination account might conclude that the meetings imposed unnecessary burdens. A relational investigation should also examine whether the relevant research problem lost disciplinary meaning, whether one discipline acquired disproportionate influence, whether earlier contribution rights became uncertain, or whether participants' external commitments changed. Increased coupling and decreased participation can coincide without the former being the sole cause. Rival explanations, historical changes and missing testimony should remain visible in the evaluative record.

The most consequential failures may emerge after apparent success. A frequently reused scheduling benchmark may be cited over many years while its initial context is lost. A successful publicity effort may impose unacknowledged care and translation work on a small group of maintainers. A highly standardised contribution register may suppress differences among legal authorship, technical assistance and informal intellectual influence. Because institutional benefits and harms may develop over different time horizons, historical recoverability (F_5), evaluation and maintenance (F_{15}), and continuing opportunities for criticism (F_3, F_7, F_{10}) are not optional decorations attached after deployment. They constitute the conditions under which coupling can remain open to responsible correction.

The subsequent comparative programme should examine whether specific dependencies are *explicit*, *contestable*, *maintainable*, and *revisable*, and should identify which observed difference, if any, arises because a dependency is typed rather than merely listed. These criteria are questions for design review, not a composite index of institutional worth. If a simple repository and one competent steward provide the required capability, the more elaborate configuration may offer no gain. The temporal formalism that follows can preserve alternative histories of a coupling without declaring one history causally sufficient, normatively legitimate, or institutionally complete.

23 A Typed Temporal Model of Generative Commons

The preceding analyses have established a differentiated institutional vocabulary: participants enter relationships through situated conditions, disciplinary environments make some forms of inquiry possible, normative and epistemic infrastructures constrain the standing of claims and actions, contributions acquire historically traceable but limited rights, and resource arrangements affect the capacity to undertake further work. Section 22 examined the mutual conditioning of fifteen infrastructure functions. Those analyses cannot be integrated simply by adding their individual indicators or by drawing an undifferentiated network of actors and documents. A formal model adequate to their purposes must keep relations of distinct types separate, represent their changing historical circumstances, and remain explicit about what the available records do not establish.

This section develops a *typed temporal model of generative Commons* with a deliberately modest purpose: to prevent an inference valid for one relation type from silently passing into another. The model should help specify disagreements about provenance, permission, epistemic warrant, authority, value and capacity over time; it should not purport to calculate a universal social value or derive decisions from a graph. It reconciles the earlier local accounts of situated relations (Section 3), decisions (Section 18), rights (Section 19), return (Section 20), stewardship (Section 21), and coupling (Section 22). The test of

this reconciliation is whether it permits a clearer or different warranted conclusion than a conventional chronology or contribution ledger.

23.1 Temporal Scope, Institutional Boundaries, and Three Analytical Levels

Let I denote an analytically bounded configuration of Commons practices and institutional interfaces, not necessarily one legal entity, and let $\mathbb{T}_I$ be a partially ordered set of relevant historical positions. The relation $t \preceq u$ should be used only where the ordering is supported by the reconstructed history. Event occurrence, archival recording, publication, and the applicability of a normative source may have different dates; a late record about an early decision must not be mistaken for a newly occurring decision. Where two workstreams develop independently or ordering evidence is absent, the model permits incomparable positions. This temporal discipline makes versioning and conflicting testimony relevant to the analysis rather than forcing historical plurality into a single apparent timeline.

The ontology of the model follows the three-level distinction in Definition 3.1. At the *ontological* level, the ultimate status of value, institutions, and relational beings remains suspended. The symbols below are not primitives from which that status is derived. At the *relational* level, participants, capacities, permissions in practice, relationships, and institutional constraints are historically constituted and may exert causal or generative effects. At the *manifestation* level, evidence of those relations is made available through observations, records, interviews, codes, documents, and interpretations. The manifestation map of Equation (1) remains partial; a stored trace cannot be treated as the institution itself.

The typed state is a schema for *questions that can be asked*, not a complete database of social reality. A researcher may lack evidence concerning an unrecorded contributor, a private grievance or a legally restricted decision. The absence of a field in the investigator's description can therefore express genuine absence, unknown status, lawful non-disclosure or deliberate non-retention; these alternatives should not be merged into an unqualified negative value. An inquiry can remain rigorous while declining to collect identifiable details whose incremental evidentiary value does not justify the privacy, safety or maintenance burden.

23.2 A Parsimonious Typed State and Its Institutional Projections

We propose the following descriptive state schema. Its elements are *heterogeneous collections and records*, not components of a single numerical vector:

$$\mathcal{C}_{I,t} = (A_t, X_t, J_t, R_t, N_t, H_t, V_t, B_t)_I. \quad (44)$$

Here A_t identifies relevant participants and, where appropriate, groups with specified standing; X_t contains artefacts and available material or knowledge resources; J_t identifies institutional roles, jurisdictional boundaries, and candidate authorising positions; R_t is a set of typed candidate relations among participants, artefacts, and arrangements; N_t contains normative-source, applicability, licence, and permission *claims*, together with their provenance and possible conflicts; H_t records temporally situated contributions, decisions, versions, events, and historical interpretations; V_t contains typed and situated value *claims*, including claims of harm or non-value; and B_t concerns resource burdens, obligations, maintenance practices, and available generative capacities. The index I indicates a specified scope; one relation may cross its boundary without conferring control over the neighbouring institution. Every component can be incomplete, contested, or inaccessible to a particular observer.

Definition 23.1 (Typed temporal Commons description). *A typed temporal Commons description consists of (i) a bounded and revisable institutional scope, (ii) a partially ordered set of relevant times, (iii) typed claims concerning actors, resources, roles, relations, norms, histories, value, and capacities, and (iv) source- and observer-dependent warrants for such claims. The description does not imply that every candidate relation is operative, that every recorded norm is binding, or that the institution is capable of legitimately undertaking any activity represented in its records.*

Table 35: Local analytical objects as projections of the typed temporal Commons description. Correspondence does not assert equivalence or measurement.

Earlier analysis	State components principally involved	Boundary preserved by the projection
Situated manifestation, Eq. (1)	R_t, H_t, V_t and observer records	A representation may be partial or non-invertible.
Decision record, Eq. (30)	J_t, N_t, R_t, H_t, B_t	Feasibility, warrant, justification, authority, and implementation differ.
Contribution-rights record, Eq. (34)	X_t, N_t, H_t, R_t	Provenance does not automatically transfer legal rights.
Value pathways and returns, Eqs. (36)–(37)	H_t, R_t, V_t, N_t, B_t	Path linkage and lawful opportunity are not realised benefit.
Capacity transition, Eq. (40)	B_t, R_t, N_t, H_t	Transitions are conditional possibilities, not estimated laws.
Infrastructure realisation and coupling, Eqs. (8) and (42)	J_t, R_t, N_t, B_t, H_t	Interface claims neither establish authority nor prove causation.

Table 35 identifies the correspondence between Equation (44) and earlier local models. The table is a reconciliation device; the various earlier objects are not interchangeable. The $F = \{F_1, \dots, F_{15}\}$ infrastructure vocabulary of Section 6 is a *classification of functions* and not a ninth state component. The realisation relation $\rho_{I,t}$ of Equation (8) refers to concrete supports for these functions, while $\text{Dep}_{I,t}$ of Equation (42) records candidate couplings among functions, qualified by relationship type and evidentiary status. Both may be studied through the roles, relations, histories, and resources represented in $\mathcal{C}_{I,t}$. The coupling-type vocabulary Θ and its dependency-status set S_{dep} in Section 22 are distinct from event-claim statuses S^* in Equation (46) and from the generative-capacity state K_t in Equation (40). The historical trace collection $\text{Tr}_{I,t}$ in Equation (17) is distinct from the temporal index $\mathbb{T}_I$ and the interpreted history component H_t ; the information-access disposition $\text{AccessDisp}_{I,t}$ of Equation (20) is distinct from the decision-situation record $D(d)$ of Equation (30). Other local symbols retain their declared domains and evidentiary qualifications; similarly named objects are not silently identified.

The distinction between the proposed analytical domain $\mathcal{C}_{I,t}$ and an investigator’s situated description $\hat{\mathcal{C}}_{I,t}^{(o,e)}$, indexed by observer o and evidence basis e , has a direct comparative consequence. A later account may contain more incidents, attribution disputes or affected participants because reporting became safer or documentation improved, not because the underlying institutional relations multiplied. Research should consequently examine changes in observation conditions alongside candidate changes in practice. A typed record must also distinguish an unknown or withheld state from one judged inapplicable; the hat notation does not imply a statistical estimator or a claim of unbiased observation.

The schema is intentionally parsimonious in one sense and extensive in another. It uses eight broad components so that the fifteen functions can be related without a separate scalar state variable for each. Within any component, however, claims must retain their type. A resource may be a document, a computer environment, or available mentoring time; an institutional role may be an editor, a reviewer, an archivist, or a competent hospital supervisor. Collapsing these into a single stock would obscure differences that the infrastructure theory is designed to explain.

23.3 Local Record Signatures and Partial Institutional Projection

A global descriptive state can become misleading if the various local documents of Sections 7–17 are treated as equivalent observations. A problem framing, a source register, a governance competence claim, an archival trace, a disclosure disposition, an epistemic assessment and a participation screening have *different objects*. One may connect them for a specified inquiry, but their connection is itself a research claim that needs evidence. The relevant integration therefore concerns relations *among* differently typed records, not a requirement that they occupy fields of a universal form.

Table 36: Selected local records in Sections 8–18 and their permitted analytical interfaces. The right column states non-entailments, not findings about an existing institution.

Local object	Primary question represented	Inference that requires a separate warrant
Problem framing $p_{I,t}$, Eq. (10)	Which concerns and values are proposed for inquiry?	Adoption of a topic does not authorise access, recruitment or intervention.
Normative record n and assessment, Eqs. (11)–(12)	Which rule or ethical consideration may bear upon an action?	A cited norm or favourable interpretation does not prove an institution has granted a specific permission.
Governance competence claim AuthRec , Eq. (13)	Who is said to possess decision competence, for what?	A role description is not evidence of a valid or current external delegation.
Safety record BRec , Eq. (15)	How is a proposed data use or activity bounded?	Documenting safeguards does not establish that imported materials or operational acts are permissible.
History trace HistRec and recovery assessment, Eqs. (17)–(18)	What can be reconstructed from legitimately retained traces?	A later record does not imply the event newly occurred or was ever authorised.
Information resource and access disposition, Eqs. (19)–(20)	What is described, and what disclosure decision was recorded?	Metadata and technical access do not establish lawful reuse for another purpose.
Epistemic claim, Eq. (21)	For which claim and setting is evidence warranted?	A research result is not a competent decision to deploy it.
Interdisciplinary qualification, Eq. (25)	Which receiving uses have a defensible translation?	Valid translation for one scholarly purpose is not authority for a service application.
Public message, Eq. (26)	Which speaker asserts what, to which audience?	Publication and positive response do not confer organisational sponsorship.
Role screening, Eq. (29)	Which role conditions are evidenced as supported?	Screening does not constitute the person’s consent or final institutional admission.

Let $\mathcal{L}_{I,t}^k$ be the class of possible local records of kind k made within a bounded institutional setting. For an observer o with legitimate evidence basis e , define a *partial* interpretive projection, when available, by

$$\text{Proj}_{I,t}^{k,(o,e)}(r) = \langle \text{Object}^k(r), \text{Assert}^k(r), \text{Warrant}^{(o,e)}(r), \text{Scope}_{I,t}(r) \rangle, \quad r \in \mathcal{L}_{I,t}^k. \quad (45)$$

The equation defines a *descriptive typing convention*, not an always-defined function, a statistical estimator or a legal decision procedure. If a record cannot lawfully be inspected or its issuing competence is unclear, its projection can remain undefined or explicitly contested. The components identify the object represented, the assertion made about it, the observer’s grounds for considering that assertion, and the institution-, use- and time-specific boundary. This construction does not turn an alleged relationship in R_t into an established relationship or a historical narrative into a present permission.

Not every local activity requires all of these records. Independent synthetic research may be adequately documented through a dated research question, an original artefact’s provenance, and a bounded methodological report. By contrast, the proposal to test its conclusions with actual service participants may activate genuinely different duties and external decision makers. The correct complexity of an institutional record is therefore a comparative question: what additional warranted distinctions does it yield relative to a clear narrative and established procedures, and what are its privacy, labour and maintenance costs? In some cases a less dense record is superior because it avoids collecting unnecessary information or fabricating an appearance of review.

23.4 Typed Relations, Historical Events, and Evidentiary Standing

A relational event is identified by the occurrence or proposed occurrence it concerns, its participants and artefacts where known, and the specific relation type asserted. Relevant types include *produced*,

reviewed, cited, licensed, adapted, communicated, mentored, authorised, refused, contested, maintained, and withdrawn. They should not be treated as edges of one undifferentiated social graph. In particular, *cited* differs from *adapted under a licence*, *reviewed* differs from *approved by competent authority*, and *invited* differs from *consented*. Even the type *authorised* requires a record of who purported to authorise what, within which competence, and under what conditions. The assertion may later be disputed or shown to exceed that competence.

A minimal event-claim record can be represented as

$$\gamma = (\text{id}, \tau, \text{participants}, \text{objects}, \text{kind}, \text{source}, \text{status}, \text{scope}), \quad \text{status} \in \mathbf{S}^*, \quad (46)$$

where τ specifies the relevant event and recording times, *kind* is a typed relation, *source* identifies the origin and limits of the evidence, *scope* identifies the claim's institutional and temporal reach, and $\mathbf{S}^*$ is an open vocabulary of evidentiary statuses. At minimum, the vocabulary should distinguish *documented observation*, *inference*, *disputed interpretation*, and *hypothetical design claim*. These labels qualify particular *claims*, not entire persons or institutions. An observed meeting can coexist with a disputed interpretation of its purpose. A later archival source can change an inference while leaving the occurrence of the meeting uncontested.

The source field in Equation (46) should describe the evidence needed to appraise the assertion. For research artefacts it might include version identifiers and citations; for a decision it might include a reasoned record and competence check; for a claimed experience it might include appropriately protected participant testimony and its interpretive context. The W3C PROV ontology and its family overview provide an established reference for exchanging provenance assertions concerning entities, activities, agents, and qualified influence relations (World Wide Web Consortium, 2013b,a); it does not itself establish validity, moral authorship, or institutional legitimacy. The proposed event record is a theoretical extension suited to the Commons questions, not a claim that PROV defines the model's ethics or temporal ontology.

A typed path is not automatically a chain of causal, normative or ownership implications. Suppose x_2 cites x_1 and x_3 incorporates an adapted component of x_2 . The path can justify questions about intellectual lineage, while remaining insufficient to prove that x_1 caused x_3 , that its creator meets authorship criteria for x_3 , or that a particular licence obligation reaches every component of x_3 . Each step requires a type-specific interpretation and evidence. In particular, transitivity of a provenance relation, where defined, does not imply transitivity of permission, consent, responsibility, benefit or causal efficacy. Alternative sources and parallel work should remain possible in the description.

The historical representation should therefore preserve *rival explanatory structures*. Rather than automatically merging inconsistent records, an analyst may retain two proposed pathways with different sources and uncertainties. Some disagreements concern incompatible observations; others concern contested categories or relative causal importance. Treating both as simple database conflicts would erase distinctions between epistemic uncertainty, interpretive pluralism, legal disagreement, and the power to control the institutional narrative. This matter connects directly to historical recoverability in Section 11 and epistemic validation in Section 13.

23.5 Event Occurrence, Record Formation, and Retrospective Revision

The word *temporal* has several meanings that should not be assigned indiscriminately to one timestamp. For a claim γ in Equation (46), the component τ is best understood as a structured and possibly incomplete temporal description. It distinguishes the putative occurrence interval τ_{occ} from the time a particular account was made or entered into a record τ_{rec} . Where relevant, it separately records the time at which a stated permission, prohibition, or institutional role is claimed to have applied, τ_{app} . These coordinates are not required to be known precisely or to share the same evidentiary sources; in some cases the ordering of purported events remains contested. Accordingly, write

$$\tau(\gamma) = (\tau_{\text{occ}}, \tau_{\text{rec}}, \tau_{\text{app}}), \quad \tau_{\text{occ}}, \tau_{\text{rec}}, \tau_{\text{app}} \text{ may be partial or disputed.} \quad (47)$$

This equation is a *typing convention* for documentary inquiry; it asserts neither a complete clock nor a unique chronology. In particular, a record entered at t_3 stating that a meeting occurred at t_1 need not indicate any new meeting at t_3 . A purported approval that was valid at t_1 need not authorise a materially different action at t_3 . An uncertain historical interval must not be replaced with the analyst's chosen point date without preserving that choice and its evidence.

Claims also undergo *epistemic updates* without a corresponding change in the activities they describe. A reviewer may learn that the original document cited an obsolete licence, discover that a reported participant declined involvement, or change the interpretation of a historical decision after consulting an authoritative source. The active account $\hat{\mathcal{C}}_{I,t}^{(o,e)}$ can then change even if the relevant relational circumstances at the earlier occurrence time did not. One should record which source and reasoning justified the revision and whether the earlier assertion is contradicted, narrowed, superseded, or merely supplemented. It is particularly important not to infer that a revised account retroactively changes a person's consent, creates a former institutional delegation, or alters the rights held by a third party. There may, of course, be genuine legal acts with retrospective effect in some legal orders, but any such effect must be established from that applicable law rather than generated by the record's version system.

Two apparently divergent archives can therefore correspond to the same past practices. One repository may record only versions of published artefacts. Another may also record failed recruitment, restricted objections, a disputed authorship decision and subsequent maintenance burdens. The second may yield a more informative *manifestation* of the relational history without establishing that the persons described held different ultimate ontological properties or that additional institutional events occurred. Conversely, two archives with identical public timestamps and publication counts can conceal materially different relations of dependence, exclusion, competence and permission. A comparative inquiry must examine the processes generating the records, including who could speak, whose testimony was excluded, and what could properly be preserved.

This distinction addresses a potential mathematical misreading. The partial order $\preceq$ on $\mathbb{T}_I$ represents only those historical comparisons warranted by the analytical reconstruction; it does not create an algebra of normative inheritance. Relations typed *documented* or *purportedly authorised* cannot be composed with provenance or chronological succession to yield *valid authorisation*. No closure rule is provided for such a derivation. If an application is followed by a meeting and a favourable informal communication, the model records those events as candidates; it does not infer committee approval unless a competent decision of the required kind is evidenced. A simple chronology may serve equally well where that distinction is obvious and the evidentiary burden of typed records is disproportionate. The formal proposal is justified only when its separation of occurrence, observation, and institutional validity changes a warranted conclusion.

23.6 Typed Inference, Open Evidence, and Non-Transferable Authority

The point of typed representation is not simply to attach different words or colours to the same arrow. It is to identify which operations on a relation are meaningful, what further evidence each operation requires, and which apparent conclusions remain unjustified. This is particularly important when a project history connects published research to a possible hospital service. A provenance relation between two artefacts can be well supported while the supposed chain of authorisation for deploying one of them is absent or contested. Those judgments have different objects and different competent interpreters.

For a bounded question, write U_α and U_β for two specified classes of objects, such as artefacts and contributors, or proposals and authorised decisions. A candidate relation of kind k should be typed as

$$\text{Rel}_{I,t}^k \subseteq U_\alpha \times U_\beta, \quad \text{Claim}_{I,t}^k(x, y; e, o, s), \quad x \in U_\alpha, y \in U_\beta. \quad (48)$$

The second expression records an observer o 's assertion about a relation with source basis e and claim status s . It does not assert that (x, y) actually belongs to the first, relationally operative set. Some instances of k describe legal or institutional relations whose validity depends on an external normative order; others describe causal, epistemic, communicative, or historical relations. The source of the type

Table 37: Hypothetical typed paths and their non-implied conclusions. Each row is an inference test, not an actual case or a legal determination.

Supported or asserted path	Non-implied conclusion	Additional inquiry that could matter
Paper x cites paper y ; model z reuses code from x	Creator of y owns z or qualifies as its author	Component lineage, governing licence, contribution and authorship standards
Synthetic algorithm passes a documented test; a volunteer coordinator receives its report	Real scheduling is safe and approved	Population assumptions, accountable service review and competent operational authorisation
A consent record exists for study a ; the activity changes substantially to b	Consent or ethics approval covers b	Actual consent scope, amendment review, applicable rules and participants' standing
A disputed decision was archived at t_1 ; a correction was entered at t_3	The correction validly changed the original decision at t_1	What occurred then, what was merely discovered later, and any competent legal act

distinction is the research question and applicable practices, not an ontological claim that the selected classes exhaust social reality.

Composition requires more than two successive edges. If a candidate relation has signature $U_\alpha \times U_\beta$ and another has signature $U_\gamma \times U_\delta$, their endpoints must first be compatible. Even when $U_\beta = U_\gamma$, there is no general rule that the compound relation has the meaning of either input. A typed composition is admissible only where an explicitly justified rule $\text{Comp}_{k_1, k_2 \Rightarrow k_3}^{I, t}$ is available, with its scope, evidentiary burden, and applicable normative conditions stated. In the absence of that rule, a two-step path is still a traceable sequence, but not a derived grant of rights or a proven causal chain:

$$\text{Claim}^{k_1}(x, y) \wedge \text{Claim}^{k_2}(y, z) \not\Rightarrow \text{Claim}^{k_3}(x, z) \quad \text{without a warranted composition rule.} \quad (49)$$

The institutional and observer indices, evidentiary basis and status are suppressed in Equation (49) solely to make its logical point legible. Equation (49) is a restriction on the analyst's inference, not a proposition that actual consequences can never travel through multiple relations. For example, a chain of licences may have an effect under a particular applicable licence and legal order, but that effect must be shown rather than stipulated by chronological or graph-theoretic reachability. Likewise, a technically validated synthetic tool may inform an authorised proposal without inheriting that proposal's service permission.

Missing evidence should be represented differently from negative evidence. In a particular inquiry, a claim may be supported, directly contradicted, presently undetermined, or not inspectable because information is legitimately withheld. These labels refer to *observer-relative evidentiary positions*, not four exclusive states of the underlying relation: rival observers may hold contrary claims, and disclosure restrictions may coexist with an authoritative private determination. Nor should the analyst read a missing permission record as proof that a permission was absent, or treat uncertainty as a licence to proceed. Where affirmative authorisation is required, an undetermined or inaccessible status does not furnish that authorisation; the appropriate disposition may be to restrict the research claim or defer the contemplated action.

This discipline also tests whether the model adds anything to simpler institutional records. If an ordinary versioned account already makes the type boundaries, evidence gaps and rights of challenge clear, a specialised graph might add no material explanatory or practical value. Conversely, the typed model becomes useful where a plausible path appears to cross distinct evidence, authority or causal domains, and a reader can locate the precise unjustified transition. The objective is better discriminating inquiry, not a claim that formal notation itself increases truth, autonomy, safety or welfare.

23.7 Situated Normative Permissions and Human Decision Processes

Normative conditions must not be represented by one unqualified binary variable labelled *permitted*. A permission may refer to reading a document, redistributing a dataset, using software commercially, accessing an institution's facilities, conducting research involving people, or acting in a patient-facing role. Each action has a different source and scope of authority. A Commons contributor agreement may cover public research materials while having no power to authorise hospital activities. Public availability of an artefact may not settle copyright or confidential-information duties. An international ethical guideline may inform a justification without operating as the applicable local legal rule.

Accordingly, N_t should register *candidate normative claims* with their sources, versions, operative dates where relevant, action scopes, decision makers, exceptions, and unresolved conflicts. A claim that a licence applies to a particular version of an artefact should be distinguished from an inference that a later derivative can be published under the same conditions. Similarly, a competent institution may approve a specific project activity without giving participants transferable authority to conduct other activities. There is no default inheritance of hospital or university authorisation through membership, proximity, expertise, or favourable research results.

The record of an actual choice is represented locally by Equation (30); its conditional evaluation remains the human procedure of Equation (43). To relate them to the temporal state, consider a proposed action a in context I, t and a set of versioned reasons and evidence W . A warranted decision requires examination of the problem, competing alternatives, normative standing, safeguards, resources, and responsible authority, but is not *computed* by the schema. A model can document why the reviewer recommends proceeding, revising, deferring, or refusing. It cannot adjudicate an unsettled question of law or substitute for an organisation's competent approval.

This treatment also clarifies why apparently successful plans cannot be promoted into legitimate practice by formal optimisation alone. A simulated volunteer schedule may satisfy availability and coverage constraints yet fail to account for changes in consent, competence, language accessibility, fatigue, or supervision. A public simulation can be studied under an independent research protocol using lawful synthetic information. Conversion to a real service requires separately established procedures and permissions; the relevant actor, artefact, and relation types change. The transition is not simply a replacement of simulated numbers with patient or staff records. A transition record as developed in Section 10.4 can enter the temporal description as a documented event with a claim of changed scope, source evidence and a competent decision still to be established. The model must distinguish a researcher's request, an institution's actual decision and an observer's inference about that decision. An event with missing authorisation should not become a positive permission through graph propagation or a subsequent high-performing experiment.

23.8 Value Claims, Circulation Paths, and Qualified Return

A Commons may generate public-service benefits, disciplinary knowledge, individual capacities, material resources, and new participatory opportunities. These goods can have different bearers and evaluative standards, and some consequences may be harmful. Equation (2) already locates a value claim by subject, kind, context, and evidence. In the temporal state of Equation (44), V_t retains these qualified claims rather than merging them into an institution-wide index of success. Claims of better access to a method, increased recognition of a volunteer, or improved public communication need distinct evidence; even several favourable findings need not establish an improvement for every affected person.

The pathway in Equation (36) can be understood as a possible finite sequence of typed events recorded within H_t and linked by R_t . It is not a circulation of a conserved substance. A contribution can be cited repeatedly while becoming practically unusable, or it can enable a later researcher without generating visible citation counts. An open repository may make a tool available while its documentation, equipment demands, or language requirements prevent a particular contributor from using it. The relevant distinction is between *provenance linkage*, *legitimate opportunity*, *actual uptake*, and *evaluated benefit*.

Table 38: Distinct temporal claims about one downstream research artefact. The examples indicate research questions and neither legal determinations nor observed effects.

Claim type	Candidate evidence	What the evidence does not establish
Historical dependence	Dated versions, documented method use, explicit source references	Necessity of the upstream contribution or rights over later work
Legitimate access	Applicable licences, relevant access conditions and competence review	Practical usability or benefits to particular contributors
Re-entry opportunity	Accessible method, functioning tools, interpretable results, relevant skills	Actual uptake or equal distribution of opportunities
Realised disciplinary benefit	Documented new work, critical assessment and situated testimony	General public value, fair compensation, or safety in practice
Future capacity reproduction	Maintained environment, demonstrable skills and available review arrangements	Indefinite sustainability or universally positive development

Equation (37) makes a limited design-side claim: a particular benefit b can represent a *possible return* to subject s when it becomes meaningfully available, lawfully usable for the proposed purpose, and realistically intelligible or practicable for that subject. The temporal state additionally records whether the subject actually chose to engage and whether evidence supports a resulting benefit or burden. Neither condition follows from the return predicate. A person may reasonably refuse to use a new resource, or face circumstances that prevent uptake. This does not make their prior contribution defective; it indicates the limits of the particular return pathway.

Value pathways need not close upon the original contributor. A researcher may publish a method that enables a future public service to perform better without a personal return; a recipient may derive substantial benefit while the originating Commons ceases to exist. Conversely, a closed return to founders may concentrate power and deprive later contributors of fair opportunities. Whether a given distribution is appropriate requires normative reasoning, affected-person standing, legal boundaries, and evidence of its consequences. Eglash’s generative-justice framework foregrounds non-extractive conditions and the circulation of benefits toward those who generate them (Eglash, 2016); the subject- and context-specific pathway model here is our proposed analytical reconstruction, not a mathematical theorem established by that literature.

23.9 Cross-Domain Claim Chains and the Non-Closure of Generative Return

The local models of decisions, rights, return and stewardship now permit a sharper statement of the problem of apparent closure. A technical result can be reproduced, released under an applicable licence, reused by a later scholar, and recorded in an institutional history. Those events may support a credible research lineage. They do not establish that the original contributor received a material benefit, that a patient-facing intervention was authorised, that the public derived a benefit, or that the Commons acquired additional sustainable capacity. In particular, a graph-theoretic cycle returning to its starting contributor is not a warrant for a legal, causal, or moral cycle.

A candidate cross-domain interpretation should name its source and target types and specify the missing warrant at each transition. Table 39 gives a compact set of counter-inferences. The table is intentionally *not* a universal workflow: its columns describe analytical questions appropriate to one proposed transfer, and a simple original report or repository record may answer them adequately.

A useful inference discipline is thus *conditional reconstruction*, not mechanical deduction from an archive. Suppose a contributor lawfully uses a revised public model after its initial release. This can justify a claim about legitimate access and, if appropriately observed, an instance of use. An asserted increase in independent research capability still calls for evidence about what the contributor was able to do that was previously unavailable, and consideration of rival explanations such as mentoring, prior skills or external funding. The actual contribution of the Commons also requires a comparison with the nearest credible alternative institutional arrangement. Changes in the observation record or retrospective

Table 39: Cross-domain non-entailments in a hypothetical research Commons. Each additional inquiry is use-, evidence-, competence- and context-specific, not a universal certificate.

Observed or documented antecedent	Non-entailed conclusion	Independent question requiring investigation
Computationally reproduced benchmark	Suitability for a real service	External relevance, practical risk and competent evaluation
Published licence or repository metadata	Permission for every proposed reuse	Rights holder, component, version, use and applicable restrictions
Contribution or citation path	Downstream ownership or payment	Applicable entitlement, agreement and separate transfer mechanism
Return opportunity under stated conditions	Actual use or improved capability	Experience, feasible access, changed capacity and competing causes
Authorised proposal	Safe or actually executed intervention	Conditions of implementation, monitoring and historical evidence
Increased output or reach	Reproduction of generative capacity	Maintenance labour, burdens, survivable obligations and user autonomy

attribution may modify an analyst’s belief without changing what happened earlier.

The three analytical reality levels prevent a further confusion. At the ontological level the model does not purport to constitute value or persons through type declarations. At the relational level actual possibilities and obligations emerge through historically conditioned actors, resources, norms and powers, including relations that are not recorded. At the manifestation level the type-labelled evidence makes a selected interpretation contestable but cannot make the unknown fully visible. A Commons should therefore be able to produce a *negative conclusion*: some relationships remain unverified or unnecessary to trace, and the least burdensome legitimate configuration is preferable to a more expansive record system when both answer the relevant question equally well.

23.10 Scoped Joins Across Decision, Rights, Return, and Stewardship Records

The cross-domain non-entailments of Table 39 have a methodological consequence for the construction of historical explanations. A join between two records is informative only if the records refer to compatible subjects, artefacts or components, proposed acts, historical periods and institutional scopes. An identical project title or persistent identifier can locate records for comparison, but it is not sufficient to prove that their predicates describe the same use. A reviewed permission claim about downloading a model cannot simply be joined with an institutional decision about public communication and read as authorisation to distribute volunteer instructions. The analyst must retain the different evidentiary and normative sources even where the same actor appears in both records.

Let a *scoped join* denote, in prose, a justified comparison of two or more typed claims after checking referential identity, relevant time, use-specific scope, sources and outstanding disagreement. Unlike the relational composition discussed in Section 23.6, the operation initially *places claims alongside one another*; it does not create a new normative or causal relation. A subsequent explanatory inference requires an independently argued bridge. This limited operation is sufficient to expose some mistakes that a plain sequence of historical events would conceal. It may be accomplished with careful prose or a compact ledger, not necessarily software.

More precisely, let $r_i \in \mathcal{R}_{\tau_i}$ denote a record of kind τ_i and let $\text{key}_c(r_i)$ preserve its subject, component, proposed use, temporal and institutional indices in comparison context c . The admissible inspection domain $\mathcal{D}_{c,t}^o(\tau_1, \tau_2)$ contains only pairs the observer o may legitimately examine at review time t . On this domain, the scoped comparison has the typed signature

$$\begin{aligned} \text{Join}_{c,t}^o : \mathcal{D}_{c,t}^o(\tau_1, \tau_2) &\longrightarrow \mathcal{R}_{\tau_1} \times \mathcal{R}_{\tau_2} \times \Sigma_{\text{cmp}}, \\ \text{Join}_{c,t}^o(r_1, r_2) &:= \langle r_1, r_2, \text{Compat}_{c,t}^o(\text{key}_c(r_1), \text{key}_c(r_2)) \rangle. \end{aligned} \quad (50)$$

Table 40: Fictional cross-domain record comparisons with different defensible conclusions. The examples are neither empirical findings nor institutional or legal determinations.

Compared traces	Warranted interpretation	Additional conclusion left open
Synthetic code is released; editorial approval concerns a research article	Source and publication decisions can be located and distinguished	Authorisation to apply the code in an actual hospital roster
A repository displays a licence; the package includes a third-party figure	A licence notice exists for a versioned bundle	Authority to license or reuse the figure in the proposed way
A contributor uses a lawful derivative; maintenance work increases for another person	Uptake and distribution of labour can be reported separately	Net improvement of joint generative capacity
An archive gains a later correction describing an earlier decision	The evidentiary account changes when the correction is added	An actual historical approval with the scope now asserted
A small independent project keeps a concise, accurate changelog	Bounded provenance and critical review are supported by existing procedures	Need for a new typed platform or hospital partnership

Here $\Sigma_{\text{cmp}} = \{\text{supported, excluded, unresolved, contested}\}$ labels the evidentiary standing of *comparability for the specified inquiry*. The operation is partial on the full Cartesian product because some record pairs cannot properly be inspected; that condition is distinct from inspecting two records and finding that their correspondence remains unresolved. The function **Compat** is an evidence-qualified assessment of *referential and scope compatibility*; it is not a rights judgment or a claim that the two records are causally related. “Supported” permits their side-by-side interpretation for the specified question, while “excluded” reports an identified scope conflict; “unresolved” and “contested” preserve deficiencies or material disputes. Because **Join** returns the original typed records and an explicit comparison status, its output is not a new element of either source class with newly acquired legal or causal force. Where inspecting a record is unauthorised, the pair is outside $\mathcal{D}_{c,t}^o$; a lawful, non-identifying statement of that limitation may suffice. Compatibility does not have a presupposed transitivity property: two records may each be comparable with a general project history yet refer to incompatible contemplated uses when joined directly.

This comparison is not the qualified relational composition of Section 23.6. Composition would require an independently warranted rule $\text{Comp}_{k_1, k_2 \Rightarrow k_3}^{I, t}$ and would address a proposed target relation of kind k_3 ; a scoped join only pairs source records and assesses their comparability. Its output remains a tuple of records even when the status is **supported**. Neither operation changes the evidence-sensitive admissibility judgment $\widehat{\text{Adm}}_{c,t}^o$ of Section 18, a purpose-specific **PermClaim** from Section 19, or an observed capacity state K_t from Section 21.

A separate bridge would need to name a proposed target claim, its competent sources and the additional observations required. For example, even an uncontroversially compatible pair consisting of a rights-review record and a publisher’s decision cannot establish that the publication was accessed, that a particular scholar benefited, or that capacity subsequently increased. Conversely, a later observed capacity gain does not retrospectively cure an earlier disputed licence or create an institution’s authority to issue service instructions. The formal comparison is thus a way to make a *prohibited shortcut visible*, not a device that transforms documentary proximity into normativity or causality.

The first three comparisons distinguish a research output, a use-specific entitlement, and a redistribution of practical burdens. They may be empirically and normatively connected, but there is no default direction of transfer from a supported statement in one domain to a conclusion in another. The fourth case keeps the dates and identities of an earlier event and its later interpretation separate, consistently with Section 23.5. The fifth is a deliberately negative case for an unnecessarily elaborate infrastructure. It tests whether the proposed formalism notices its own lack of incremental value instead of treating

record proliferation as generative success.

At the ontological level, the record types do not constitute persons, legal orders, value or historical events. At the relational level, actual capacity, power, obligations and opportunities can change even where the archive is silent, and archival activity can change without corresponding relational transformation. At the manifestation level, a join supplies an explicitly partial representation for a situated question. Such distinctions are academically useful to the extent that they make competing interpretations criticisable and alter warranted inferences. The minimal research requirement is thus a comparison that asks *which specific erroneous conclusion* the typed method prevents, compared with an equally careful narrative or existing ledger, and at what evidentiary, ethical and maintenance cost.

23.11 Capacity Transitions, Resource Burdens, and Functional Coupling

The resource component B_t does not represent a fungible stock of institutional wealth. It may include available mentor hours, maintainable research software, competence in normative interpretation, access to archival context, secure review procedures, and the obligations associated with those resources. It can also include constraints that make a formally available resource unusable. A well-funded project might lack interpreters able to make a historical record intelligible; a strong publication record might conceal an unmaintained code dependency; an institution with many volunteers might lack supervisors qualified for a particular activity. The significance of a resource depends on a particular action, actor, and historical time.

The conditional transition of Equation (40) is retained as the principal representation of possible capacity change. It does not require an additional deterministic equation for the complete Commons state. Instead, for $t \preceq u$, one may ask whether historically evidenced events, maintenance choices, obligations, departures, and newly constituted relations support a *candidate transition* of particular capacities between B_t and B_u . A transition involving a change of actor roles or loss of maintenance expertise may not be expressible by the same inventory measures used at the start. A later observer may also revise the earlier state description. Both changes should be represented as part of the research problem rather than concealed as modelling error.

Functional coupling provides a complementary view. Equation (8) identifies candidate supports for F_1 – F_{15} , while Equation (42) identifies the proposed types and evidentiary status of dependencies among functions. Their relation to the temporal state is activity-dependent. A corrected licensing entry may affect what research can lawfully be reused; a revised classification of information may change the scope of public communication; a new review practice may reveal that a previously claimed result was overstated; and additional outreach may consume capacity needed to maintain the research environment. The same interface can enable an activity at one time and create a harmful bottleneck under changed conditions.

A particularly important possibility is *justified disconnection*. If a Commons cannot establish the authority to undertake a hospital-facing activity, keeping the public research environment independent can preserve legitimate research opportunities without exposing participants to unauthorised operational claims. If an archival resource becomes unsafe to disclose, restricting it may protect rights while temporarily reducing access. If volunteer participation imposes an inequitable workload, limiting recruitment may improve conditions for meaningful future participation. Greater density of network links and larger output totals are therefore not necessary indicators of increased generative capacity. The relation among change, value, and legitimacy remains subject to empirical and normative examination.

23.12 A Worked Synthetic Research Lineage

Consider a hypothetical Commons concerned with the research problem of allocating voluntary availability across nonclinical public-service tasks. The initial artefact x_0 is a publicly documented, wholly synthetic scheduling dataset, accompanied by a stated problem formulation and a licence applicable to its original components. Contributor A creates it at time t_0 . The Commons records the assumptions about participant availability, the fact that no real patient or volunteer records are used, the mathematical

Table 41: Illustrative event and claim types in a synthetic research Commons. The times and outcomes are hypothetical; no clinical, legal, or operational endorsement is implied.

Time	Candidate event	Distinct claim requiring assessment
t_0	A creates synthetic x_0	Provenance, release permissions, and scope of its assumptions
t_1	B revises benchmark as x_1	Component reuse, methodological correction, and independent authorship
t_2	C studies fairness using x_1	Conditional epistemic warrant, not real-world fairness or service approval
t_3	A considers using x_2 ; public summary issued	Qualified reuse opportunity; separately assess accuracy of institutional claims
t_4	Research dependencies lose maintainers	Degraded usability, repair obligations, and justified archival or succession choices

constraints represented, and the limitations of the illustrative setting. The project has a documented independent status and is not presented as a working hospital scheduling system. These records describe an artefact and a provisional research activity; they do not establish that the synthetic scenarios accurately approximate any particular hospital.

At t_1 , researcher B identifies an unrealistic assumption in x_0 and publishes a revised benchmark x_1 . Some components of x_1 reuse licensed components of x_0 ; others are independently written. The Commons records version-specific reuse claims and the reason for the revision. A documentation record may support a relation $\text{adapted}(x_0, x_1)$, whereas a separate publication may support only $\text{cited}(x_0, x_1)$. Those claims are not substitutes for determining which rights actually attach to the components reused. If the licensing question is unclear, the provenance record should identify the uncertainty and the need for competent interpretation.

At t_2 , researcher C develops a fairness analysis x_2 using x_1 as a baseline and comparing more than one relevant distribution of burden. Its reported improvement is relative to a stated synthetic objective and evaluation design. The claim does not imply that affected people in a real hospital would regard the allocation as fair. Meanwhile, A may gain access to the improved benchmark and, if permitted and usable, may use it for a further research project at t_3 . This is a candidate *return opportunity* under Equation (37); actual learning or research benefit requires separate evidence. If A lacks the tools, time, or language support needed for use, the nominally open artefact may fail the usability condition.

Now suppose the Commons publishes a public description at t_3 calling the research an “approved hospital scheduling system.” That communicative claim would be unsupported by the preceding research lineage, irrespective of the model’s mathematical performance. A correction might require public communication review, archival amendment, a record of who issued the original statement, and a clear separation between the valid mathematical findings and the incorrect assertion of institutional authority. Alternatively, if the maintainers depart and the code ceases to run at t_4 , earlier citation and licence records may remain accurate while the practical generative opportunity diminishes. The resource transition is relevant even though the formal research genealogy remains intact.

The example reveals several possible histories compatible with the same sequence of file versions. The original dataset may have been useful mainly for pedagogy rather than research; the later fairness result may depend chiefly on an independent methodological innovation; A may never use the revised environment; or the public communication failure may be corrected immediately. The model should record these alternatives rather than treating the temporal ordering x_0, x_1, x_2 as an established causal decomposition or a complete description of value circulation. Its utility is the disciplined separation of evidence and inference, rights and benefits, and institutional opportunity and realised action.

23.13 Discriminating Questions, Formal Limits, and Research Obligations

The model’s incremental usefulness can be examined through three comparisons with an ordinary chronology. First, *representational discrimination*: can two cases with identical output counts but

different rights, authority, maintenance or participation conditions be distinguished without inventing a common value unit? Second, *historical recovery*: can a later investigator reconstruct the status, evidence and reasons for a contested claim rather than merely the sequence of files? Third, *contestable correction*: can someone challenge an attributed influence, permission or benefit claim while respecting restricted information? The corresponding null finding is that the typed schema adds no materially relevant distinction beyond an accurately maintained narrative and ordinary institutional records.

Empirical studies should specify observational windows, relevant subjects, artefact classes, candidate mechanisms, competing explanations, and the procedures by which evidence is collected. A temporal association between infrastructure publication and volunteer engagement could reflect publicity, prior motivation, academic supervision, institutional recruitment policy, seasonal constraints, or selection effects. A sequence linking two research outputs could reflect a traceable citation or a genuine reused component without demonstrating that the initial artefact generated the later intellectual contribution. Cross-institutional comparisons require particular caution because categories such as “volunteer”, “Commons contribution”, “research approval”, and “service benefit” may vary in legal scope and operational meaning. Harmonising labels is not enough to harmonise the practices they represent.

The model cannot infer missing lived experience from a dense archive, cannot assign monetary equivalents to heterogeneous normative values, cannot establish institutional permissions from machine-readable licences, and cannot certify that a procedure is safe because its simulated constraints were satisfied. It does not estimate causal effects, supply a unique fairness ordering, or guarantee the reproduction of generative capacity. Moreover, the records necessary for a theoretically complete history may be disproportionate, privacy-invasive, or too costly to maintain. Responsible modelling sometimes requires deliberate abstraction, restricted retention, or a decision not to trace a person-level pathway at all. Such omissions should be acknowledged as methodological and normative choices when doing so is legitimate.

The model is therefore best understood as a bounded formal synthesis, not an algorithm for managing a Commons. Equation (44) specifies distinguishable categories of inquiry, and Equation (46) qualifies historical assertions; neither proves that the underlying relations are operative. Its further use depends on identifying an actual research decision improved by that differentiation and on estimating the cost of obtaining and maintaining the supporting evidence. Section 24 develops counterexamples involving similar public outputs but different permissions, histories and burdens. Those cases should challenge, rather than merely illustrate, the apparent usefulness of the formal vocabulary.

24 Illustrative Configurations, Comparative Cases, and Failure Mechanisms

The fifteen infrastructure functions, their activity-specific couplings (Section 22), and their typed historical representations (Section 23) can appear persuasive when applied only to favourable examples. This section instead constructs contrasts in which similar visible outputs coincide with differing consent, authority, epistemic warrant, resource burdens and possibilities for reuse. The question is what the framework can discriminate, what would be equally clear in a simpler institutional account, and whether the proposed interfaces sometimes contribute to rather than correct a failure. The examples are stipulated comparisons, not observations or representative samples of hospitals.

The cases are *analytic constructions*; their attributes should not be read as established frequencies, typical practices, or outcomes in real hospitals. Their analytic purpose is to expose the assumptions necessary to claim a mechanism. When two configurations are compared, the investigator should state which features are deliberately held constant, which vary, which outcomes are merely posited, and what empirical record would be needed before making an actual causal or evaluative judgment. This explicit status is particularly important when a hypothetical “authorised partnership” appears beside an independent Commons, since the name alone does not certify any permission.

24.1 Comparative Object, Analytical Levels, and Case Status

A *case* in this section is a bounded configuration of actors, activities, institutional relationships, candidate normative conditions, records, and subsequent possibilities. Its boundary is chosen with reference to a research question, not presumed to coincide with a registered organisation. An independent Commons may include public contributors from several universities; a hospital may collaborate on a particular project without transferring control of other activities; and a student may simultaneously occupy research, educational, and volunteer roles with different permissions. What matters is which role is operative in the particular event and how its relevance has been established. An institutional label such as “university-affiliated” is not itself evidence of a working interface or an authorised action.

The three GR analytical reality levels remain operative throughout the comparison. At the first level, the ultimate ontology of organisations and value is suspended; the examples do not seek to derive social facts from irreducible categories. At the second, historically situated relationships, capabilities, constraints, and responsibilities may change the opportunities actually available to people. At the third, schedules, data catalogues, audit reports, contribution records, published papers, advertisements, and interviews provide partial manifestations of those relationships. Accordingly, an identical published output can be compatible with divergent underlying histories. A difference in the completeness or credibility of records may also limit comparison, even when the analyst believes that a meaningful relational difference exists.

The typed state $\mathcal{C}_{I,t}$ in Equation (44) and the event-claim discipline of Equation (46) provide a common descriptive language. They do not allow the analyst to read off legal status, actual benefits, or causal effects. Hypothetical events are assigned that status rather than entered as observations; records of claims about an event are not conflated with the event; and a temporally ordered provenance pathway is not treated as proof of causal necessity. The comparative objective is to locate potentially discriminating conditions between rival interpretations of a trace, rather than to claim a numerical measure of “generativity.”

For this purpose it is useful to distinguish *visible-output resemblance* from *relational equivalence*. Let $O_{I,t}$ denote a declared, narrowly specified collection of indicators or artefacts visible to an evaluator, and let $\simeq_O$ indicate similarity only with respect to that declared collection. Then the comparison may begin with

$$O_{I,t} \simeq_O O_{J,u} \not\Rightarrow (N_{I,t}, H_{I,t}, V_{I,t}, B_{I,t}) \simeq_R (N_{J,u}, H_{J,u}, V_{J,u}, B_{J,u}), \quad (51)$$

where N, H, V, B refer to the normative, historical, value-claim, and resource/capability components defined in Section 23. The relation $\simeq_R$ denotes a proposed, case-specific standard for comparing relevant relational conditions, not an already established equivalence relation over complete social states. Equation (51) states a limitation on inference: equal counts or similar artefacts do not warrant equivalence of permissions, histories, benefits, and capabilities. It does not assert that their differences have been empirically established.

24.2 Independent Research as a Sufficient Institutional Outcome

Consider an independent author who publishes an original, genuinely synthetic volunteer-scheduling generator, together with a comprehensible problem statement, verified baseline code, a specific open licence and a maintenance limit. An unrelated methods group reproduces its results, criticises an assumption and publishes an independently licenced improvement. The first author considers the criticism and revises the original research. No party has volunteered at a hospital, encountered a patient, sought internal records or requested an operational role. The research produces a meaningful scholarly exchange entirely within permissions available for the public materials. The absence of a hospital interface is a defining condition of the example, not a defect requiring an additional coordinator or approval process.

The case permits several rival interpretations of value. Ordinary publication and scholarly correspondence may suffice to explain reuse and revision. A repository’s version history may already establish

the relevant chronology. A separately organised Commons may contribute clearer dispute handling, accessible methods or a more reliable continuity arrangement, but these additions must earn their place by preventing a specified error or enabling a benefit that would not otherwise be feasible. Even if a subsequent scholar cites the original work, neither an extra contribution entitlement nor a monetary return is thereby established. The paper's model adds value only if it identifies a consequential distinction obscured by those ordinary practices.

Now suppose the first author lacks funds to maintain a complicated permission registry, yet can sustain a versioned research repository and a public correction address. Requiring a full fifteen-function administrative structure could divert labour away from the original research and impede the exchange it purports to support. On the stipulated facts, a proportionate configuration may use one maintained repository and a narrow rights notice, and may close responsibly after an announced term. The preferred configuration remains an empirical and normative question in real cases, but this example establishes a coherent candidate for *sufficiency without institutional escalation*, which a serious evaluation of the theoretical framework must be able to recognise.

24.3 Three Institutional Configurations and Their Boundaries

Consider first an *independent public research Commons* organised by a small group of researchers or even a single steward. Its initial assets might include an openly available literature guide, an original synthetic scheduling generator, a documented optimisation baseline, a rights register, a historical decision log, and a mechanism for corrections. Participants could make research contributions without undertaking hospital duties, and their contributions would remain governed by applicable permissions, licences, scholarly norms, and their own decisions about participation. The founder could legitimately manage the resources within their authority while describing the governance accurately. The same founder could not confer institutional research-ethics approval, hospital service roles, or unrestricted rights over material created by third parties. This configuration tests whether substantial disciplinary value can arise without privileged access to clinical operations, and whether limited stewardship capacity makes the apparent openness fragile.

A second configuration is a *federated interdisciplinary Commons*. Several separately responsible research groups may share public problem descriptions and mutually intelligible artefacts while retaining discipline-specific review, training, intellectual-property arrangements, and methodological practices. A boundary object, such as a synthetic volunteer-scheduling benchmark, may permit productive coordination while carrying different significance for optimisation, education, law, history, and public-service research. In line with work on boundary objects and knowledge translation (Star and Griesemer, 1989; Carlile, 2004), an interface can support cooperation without making disciplinary concepts interchangeable. Federation also introduces costs: disputed definitions, incompatible metadata, asymmetric publication incentives, and the need to identify who has standing to revise shared resources. A shared committee may legitimately set the version of a joint benchmark while lacking authority over the participants' home institutions or the separate publication decisions of its members.

A third configuration is a *separately authorised hospital partnership*. A university hospital, or another competent service institution, may decide to cooperate on a specific volunteer-support, education, or research activity within its own applicable governance arrangements. Its service responsibilities, professional supervision, safety requirements, and any data-access or research-ethics decisions remain with competent bodies. A research Commons could offer a nonclinical prototype, an educational environment, or independently produced background knowledge, and the institution could choose whether and how to examine it. The partnership would require explicit interfaces defining authorised activities, responsible roles, information boundaries, evaluation procedures, and termination conditions. It cannot be inferred merely from the co-location of university and hospital or from the substantive plausibility of the Commons proposal.

These ideal types contrast the locus of authority and research stewardship, not an institutional maturity scale. The independent configuration need not aspire to hospital integration; the federated con-

Table 42: Three hypothetical institutional configurations. Entries describe questions to resolve, not facts about existing institutions or mandatory organisational forms.

Dimension	Independent research	Federated disciplines	Authorised partnership
Constitutive advantage	Low dependency on third-party operational access	Complementary research expertise and criticism	Potentially informed relation to a situated service problem
Main constraint	Limited stewardship and review capacity	Translational and governance burdens	Distinct external authority, safeguarding and accountability
Permissible initial materials	Public, original or legitimately licensed; genuinely synthetic examples	Shared materials under compatible rights and agreed interfaces	Only materials and activities separately permitted for the specified purpose
Characteristic failure	Founder bottleneck or uncorrected claim	Misleading disciplinary equivalence or capture	Research or Commons status mistaken for institutional authorisation
Distinctive evaluation	Independent reuse and sustainable maintenance	Quality of translations and equitable participation	Service-relevant evaluation subject to consent and governance

figuration may use partial and negotiated links without common ownership; the authorised-partnership configuration may remain a narrow, time-limited interface alongside independent research. Their comparative value depends on specifying which concrete activity, applicable permissions, and affected actors are under examination. A project may combine features or change configurations over time without making the categories into mutually exclusive real-world entities.

24.4 A Shared Synthetic Research Problem and Divergent Histories

A shared synthetic scheduling problem supplies a controlled thought experiment without borrowing patient, volunteer or hospital operational data. Stipulate the same publicly released problem definition, baseline algorithms and initial output targets across configurations. Vary instead the source and version of permissions, the role of the independent reviewer, the form of contribution attribution, the ability of new participants to decline related service, and the funded responsibility for maintaining the benchmark. Any difference in the stipulated experience is then a proposed consequence for investigation, not proof that changing governance alone would produce it.

In trajectory *A*, a small independent Commons publishes the generator and receives a mathematical improvement proposed by a student. Another participant identifies that the original fairness definition disadvantages volunteers with intermittent availability. The steward records the objection, releases a corrected benchmark version, retains the superseded version with a documented reason, and explains how the earlier result’s scope has changed. A later contributor experiments with robust scheduling under new synthetic absence assumptions. Under the stipulated conditions, knowledge can become more critically reusable over time. The relevant value is not exhausted by the initial performance score; it includes a corrected problem representation, the ability to inspect the decision history, and further research paths. Whether any particular contributor actually acquires enduring research capacity remains an empirical question.

In trajectory *B*, an otherwise similar Commons publishes the same generator, algorithm and output count. Its advertised result refers to a “hospital-validated schedule,” although no service institution reviewed the model. It fails to identify a borrowed dataset’s licence and does not retain a readable specification of the optimisation baseline. A student who discovers the attribution mistake cannot determine whom to contact or whether the released files may be redistributed. The observed number of datasets, code commits and papers can still resemble trajectory *A*. Yet the conditions of legitimate reuse, epistemic criticism and subsequent participation are materially different under the hypotheses. What fails

is not merely publicity: a misleading status claim can alter expectations, obscure normative boundaries, and discourage corrective participation.

Trajectory *C* adds an interdisciplinary federation. The computational team publishes a scheduling model; an education group studies how a fictional training course might support novice volunteers; a jurisprudential group compares categories of permission and responsibility using public legal materials from specified jurisdictions; and a historian reconstructs successive published problem definitions. The teams preserve discipline-specific standards and document the translation of shared terms such as “availability,” “volunteer,” and “fairness.” The relationship can be productive even if no integrated scheduling system is ever adopted. A competing trajectory with the same number of coauthored reports may instead suppress unresolved conceptual disagreement for the sake of publishing quickly. The immediate output count cannot discriminate between qualified intellectual mediation and terminological compromise that conceals serious differences.

A fourth trajectory *D* imagines that a competent hospital authority is interested in examining a prototype. Before any operational test, responsible parties specify the data conditions, activity scope, review competence, limits on student roles, incident response and publication status. The hospital may accept a narrowly bounded evaluation, decline a proposed service use, or defer the inquiry. Those outcomes are not research failure by definition. An attempted deployment without such approvals would not become permissible merely because the synthetic benchmark performed well. The authorised trajectory and the unapproved one must not be combined into one history merely because they concern an identically named algorithm.

24.5 Matched Outputs and Non-Equivalent Generative Conditions

A matched-output contrast is informative only when the matching criterion is narrow and explicit. Imagine two projects with the same number of visible publications and contributors over a defined interval. One might have consent-compatible contribution records, an independently maintained codebase and accessible correction history; the other might rely on unpaid repair, ambiguous reuse claims and inaccessible dependencies. Those histories differ in ways that publication counts cannot capture. Yet even the first configuration is not thereby shown to generate greater value: participant learning, public use and long-term capacity would require additional evidence, and unmeasured differences in funding or prior expertise could explain apparent advantages.

The comparison also needs to resist the temptation to make the first project an unquestioned success. The presence of a licence file does not guarantee accessible code, competent review, or future benefits. A person may have a formally preserved attribution yet no time, funds or computational resources to use the subsequent work. Likewise, apparently extensive governance participation may privilege those able to attend meetings, speak the dominant language, or accept unpaid administrative work. A more responsible comparison asks which conditions are exercised in practice, whose costs are omitted from the output measures, and what evidence would reveal corrective feedback. These questions follow the distinction between documentary manifestation and historically effective relational capacity.

These examples identify a possible form of *indicator equivalence with relational divergence*. They do not establish that the preferable conditions will always generate higher value, nor do they prove that the alternative arrangements necessarily cause harm. The framework becomes informative when it directs the investigator to seek evidence beyond visible output totals and supplies conditions under which its explanations could fail. If conventional research mentoring, ordinary institutional good practice or prior participant selection accounts fully for the observed differences, a distinct contribution of the Commons-specific account would remain unproven. Such possibilities should remain active rivals, not be absorbed into a favourable GR interpretation after the fact.

24.6 Failure Propagation Across Institutional Functions

Institutional failure can arise at an interface even when its constituent functions appear locally adequate. Suppose a dataset catalogue correctly stores a release label, but an outreach message copies an outdated

Table 43: Illustrative matched-output contrasts. All trajectories are hypothetical; the last column describes discriminating evidence that would be needed in actual research.

Similar visible trace	Possible divergent relations	Potential discriminating evidence
Same number of published models	Documented criticism and reproducibility versus opaque or inapplicable baselines	Independent attempts to run baselines, version history, reasons for change
Same volunteer registration count	Informed role choice versus dependence or institutional pressure	Voluntary, appropriately protected accounts of choice; observable exit conditions
Same contributor citation count	Lawful, usable downstream reuse versus attribution without practical access	Licence scope, actual resource access, independent reuse traces and participant accounts
Same number of recorded meetings	Meaningful contestation versus consultation without decisional standing	Authority records, reasoned replies, dissent and remedial action
Same archived file count	Recoverable context versus unreadable, unjustifiably retained traces	Reconstruction exercises, representation information, access and retention review

label after the underlying rights status changes. Or a scheduling model is epistemically tested within an independent research project, but its output is later circulated as though authorised for real services. These are different transitions: information classification, publicity, validation and operational authority require their own checks. A causal inquiry must distinguish the triggering misclassification from the structural conditions that allowed it to propagate, such as diffuse responsibility or missing correction pathways.

A related failure arises when normative documentation and operative authority become confused. A Commons may publish a carefully argued ethical handbook, and a participating student may interpret its detailed procedures as hospital-approved instructions. If a publicity page omits the handbook's independent and provisional status, the error is jointly communicative, normative, and governance-related. The Commons can correct its own presentation and materials; it cannot retrospectively ratify institutional conduct or decide on behalf of an external service provider. Where uncertainty remains, declining to perform a proposed activity may be the appropriate outcome. This is not an argument that independent handbooks are inherently undesirable, but that the normative status of a text is part of the infrastructure needed to interpret it responsibly.

A third failure concerns historical recoverability. Suppose an older version of a research dataset has been preserved and properly licensed, but the experimental environment, variable definitions, rationale for exclusions, and warnings about prior bias have disappeared. Its bytes remain available, yet a new researcher cannot responsibly reconstruct what the original result meant. Merely improving a search index will not repair missing interpretive context. Reproduction of the historical experiment may be impossible, while later reinterpretation could still be possible if surviving source records and responsible accounts are carefully distinguished. A historian's decision to mark some assertions as indeterminate can be a valid epistemic outcome rather than a deficiency to be filled by fabricated certainty.

A fourth failure involves volunteer participation and organisational maintenance. Imagine that an independent Commons offers excellent reusable methods but recruits contributors through messages suggesting that research opportunities depend upon a fixed number of hospital volunteer hours. Even without an explicit contract, the claim may make a purportedly voluntary choice socially costly or misleading. If experienced contributors later leave, the project can become dependent on an under-recognised individual who performs most editorial, security, and dispute-resolution labour. The platform may continue to display increasing outputs while losing the capacity to correct errors or answer reasonable complaints. Invisible work and repair therefore matter alongside visible innovation (Star and Strauss, 1999; Jackson, 2014). A narrowing of activities, a pause in publication, or legitimate succession may preserve more

generative potential than further recruitment.

A fifth failure concerns concentration of authority. An interdisciplinary steering group could initially make translation more efficient and then acquire *de facto* control over problem selection, access to shared artefacts, and decisions about attribution. Participants from less resourced disciplines might formally retain voice but lack time or standing to challenge decisions. The governance infrastructure could remain procedurally elaborate while real power becomes concentrated. Distinguishing decision records, actual influence, competent authority, and avenues for exit is therefore necessary. Likewise, a hospital partner may require that a particular operational interface remain closed even when Commons members favour openness; that constraint may be legitimate and is not itself evidence of capture. The case requires examining whose authority is exercised, for which purpose, and under which governing conditions.

These paths show that *deliberate disconnection* can sometimes be a generative design choice. A public synthetic benchmark can remain available while access to an institutional dataset is restricted; a research interpretation can remain open for criticism while operational instructions are controlled by competent service actors; an archive may expose metadata while withholding or lawfully disposing of personal records. The goal is not maximal connectivity. It is appropriate coupling under applicable rights, justified risk boundaries, and historically available capacities.

24.7 Institutional Variations, Substitutions, and Proportional Design

The cases also permit comparison of how a function can be realised through different arrangements. A one-person Commons might maintain an original literature guide, contribution ledger, clear licences, and a modest process for publicly recording corrections. A federation might rely on established disciplinary review processes rather than create a single universal research-quality committee. A hospital partnership might adopt some public methodological materials while keeping its own formal approval, risk management, and supervisory structures. Each configuration can discharge relevant functions without replicating fifteen separate organisational units. The decisive questions concern who performs each function, whether participants can actually use it, and whether responsibilities remain manageable.

Substitution has limits. A readable manual may support training but cannot substitute for competent supervision when real activities require it. An open-source repository may provide a useful historical trace but cannot substitute for a lawful consent or data-sharing basis. A committee's general agreement about public value cannot substitute for a contributor's rights or an external ethics approval. A computational simulation may help anticipate bottlenecks but cannot substitute for clinical judgement or human authorisation. At the same time, a project that uses only independent synthetic research may have no reason to seek clinical data or construct an unnecessarily elaborate hospital interface. Proportional design requires a precise distinction between functions that are relevant now, functions that may become relevant under a changed activity scope, and arrangements that would introduce unneeded dependence.

A useful countercase concerns resource scarcity. Suppose two research groups can each maintain one functioning, well-documented disciplinary module. One chooses to establish an extensive joint platform with multilingual interfaces, several committees, and an ambitious event programme before it can maintain the original module. The other prioritises stable research artefacts, independent reuse, correction mechanisms, and a small number of transparent relationships. It is not predetermined that the second configuration will be better; federation might later provide expertise that the small group lacks. But the example illustrates the need to evaluate the opportunity costs of institutional complexity, including the capacities lost to administration, coordination and symbolic expansion. Long-run generative reproduction depends on maintenance and the ability to revise scope, not on the largest feasible organisational footprint.

The same conditional reasoning applies to geographical and organisational proximity. A university hospital may offer channels for student communication or shared disciplinary problems, but students can have limited time, weak interest in the proposed work, or institutional obligations that constrain involvement. A distant participant may make a more valuable contribution through open research resources than a nearby person encouraged to participate without appropriate support. The comparative question

is which dimensions of proximity are activated, for whom, through what mediating arrangements, and at what cost. Affiliation alone should not serve as a proxy for reciprocal benefit.

24.8 Retrospective Correction and Minimal Institutional Sufficiency

An additional stipulated contrast isolates the difference between an institutional change and a changed historical description. Two independent research projects have identical synthetic datasets, published optimisation results, and ordinary version histories. At t_1 , each project publishes a licensing notice believed to cover a reused diagram. At t_2 , both discover that the diagram was supplied by a third party whose redistribution permission had not been established. The error was not created by the act of discovery; nor does entering a correction into an archive at t_2 itself confer rights over the third-party work. The material question is whether the public use can be rectified by the competent rights holder's permission, a lawful replacement, justified removal, or another valid resolution. Publication counts and the timestamp of the correction cannot answer that question.

In project P , an ordinary maintainer responds by limiting access to the affected version, publishing a scoped correction, and obtaining competent advice if needed. In project Q , an elaborate record differentiates the time of original release, the time the issue was first observed, competing interpretations, the asserted licence's historical scope, and subsequent release conditions. The typed account may offer greater recoverability of a contested sequence, but it may also consume more effort and expose more information than the bounded dispute requires. If the two projects produce equally accurate, proportionate decisions and historical explanations, project Q has not demonstrated a superior Commons merely by recording more event types. If the dispute involves several versions, inconsistent third-party claims, or a later authorised use of different components, the additional distinctions might change the scope of correction. That hypothesis requires an independent criterion and matched evaluation, not self-certification by the proposed notation.

The two histories also show why a correction at t_2 should not be retroactively encoded as proof that the original act was authorised at t_1 , or as evidence that the affected person freely consented to its use. The structured time facets of Equation (47) distinguish occurrence, recording and asserted applicability. The functional-sufficiency test in Section 5.9 asks whether the ordinary existing correction mechanism satisfies the justified task. The empirical comparison in Section 25.8 then specifies how to evaluate any residual explanatory or practical advantage. Each case is fictional, and neither should be mistaken for a finding about the legal resolution of a real licensing dispute.

The permission and capacity interface provides a further matched synthetic contrast. Suppose two otherwise comparable public research packages achieve the same benchmark performance. In package A , a single author controls all of the original code and makes a use-specific licence available, and a steward can maintain the only published environment. In package B , a top-level licence appears identical, but one included component has a disputed source and maintenance is sustained through an unpaid contributor who is considering withdrawal. An observer comparing only the output scores and top-level licence could incorrectly treat both packages as equally reusable and sustainable. A component manifest and an account of actual maintenance duties might discriminate them; a well-written ordinary changelog and human review could equally do so. A relational description has incremental value only if it detects a relevant difference or clarifies an unresolved one at an acceptable cost.

The example also resists a second overgeneralisation. The existence of more permissions or more confirmed uses in package A does not establish a uniform gain in research capability: users may lack the time or expertise to act, while access to a resource may impose new burdens. The absence of a proved right over package B 's disputed component is not a proved infringement. One should keep the question of possible lawful reuse separate from questions of benefit, compensatory entitlement, competent institutional action and durable reproduction. A future empirical comparison could use the pair to investigate whether readers commit fewer unsupported cross-domain inferences when source evidence is held constant. No outcome of that comparison is reported here.

The matched-output contrast also requires matching the *question* used to compare histories. If the

question concerns a benchmark's mathematical output, two configurations with identical assumptions and scores may be equivalent for that purpose. If the question concerns permission for a specified reuse, later access by contributor s , or maintenance duties assigned to m , the same two configurations can have different relevant records. Neither observation implies that a richer dossier produced the beneficial difference. A plausible rival account may attribute the difference to an experienced human reviewer, a prior agreement or a participant's independent skill; another may find that accurate ordinary notes answer the same question. The typed scoped join in Equation (50) is therefore a proposed *comparison discipline* rather than the causal source of any outcome.

An especially instructive fictional negative case would record actual lawful uptake by s , no new hospital service activity, and a reduction in m 's available maintenance time. A representation that calls this a "completed value loop" mistakes historical connectedness for aggregate improvement. A second version might document increased m capacity after a funded handover but no actual uptake by s ; it illustrates improvement in stewardship without claiming received benefits. A defensible analysis preserves both histories and asks whose capacities and obligations are in the scope of judgment. Whether a fuller model changes the answer compared with a clear memorandum remains an empirical question.

24.9 Rival Explanations, Discriminating Observations, and Evidence Ethics

The hypothetical comparisons have explanatory value only if plausible rival mechanisms are specified before interpreting an observed pattern. Selection into the Commons, existing mentorship, disciplinary expertise, institutional prestige, baseline funding and temporal convenience might account for higher engagement without any distinctive fifteen-function architecture. A negative case might also result from unanticipated workload, external obligations, or a reasonable refusal rather than infrastructural failure. The stronger test is whether the proposed typed dependencies locate an otherwise neglected authority, rights or maintenance mechanism that changes a warranted conclusion or an actual decision, at a defensible cost.

To discriminate among these interpretations, researchers could examine variation in specific mechanisms, subject to suitable permissions: whether a previously unconnected participant could identify and pursue an independent research question; whether different research communities could reconstruct a contested translation; whether documented correction altered a subsequent reusable artefact; whether a contributor actually possessed and exercised lawful reuse opportunities; whether withdrawn participants incurred penalties; and whether maintenance obligations could be fulfilled following a responsible steward's departure. These are more informative than asking only whether participants expressed satisfaction. They also require attention to nonparticipants, missing records, unsuccessful attempts and changes in the underlying institutional conditions.

Evidence collection itself is an institutional activity with ethical costs. An investigator should not infer an entitlement to interview patients, review volunteer rosters, analyse confidential disputes, or observe hospital operations from the public relevance of the research. Comparative evaluation may begin with public documents, clearly original synthetic artefacts, consenting research contributors and independently verifiable repository histories. More intrusive evidence requires the relevant consent, research review, access permissions, safeguards, and competent institutional cooperation. Even a publicly available record may create privacy or reputational harms when combined with other records to identify a vulnerable person. Historical research must preserve differences among public claims, private accounts, and the analyst's inferences. An ethical refusal to obtain a sensitive form of evidence may require the researcher to qualify or suspend a conclusion.

Counterfactual inquiry presents an additional difficulty. It may be tempting to claim that a contributor would have obtained greater benefits under a different licence or that a hospital event would have produced fewer incidents under a simulated schedule. Such claims need defensible comparison conditions, not simply plausible narrative alternatives. A synthetic scenario can expose logical possibilities, but it cannot estimate real behavioural responses without validation. Prospective evaluations may predefine observable pathways, rival explanations, ethically acceptable measurements and stopping con-

ditions. Historical comparisons should report selection limitations and possible institutional changes that undermine matched cases. Claims about causality or general applicability remain weaker when such information is absent. The separation between computational model, warranted knowledge and authorised action in Section 18 is directly relevant here (Stermann, 2000; Saltelli et al., 2020; Campbell, 1979).

24.10 Comparative Research Obligations and the Limits of the Examples

These trajectories set requirements for later empirical inquiry, not evidence of the framework's success. Investigators should examine cases in which ordinary repositories or established volunteer coordination already perform adequately; cases in which a detailed Commons architecture fails; and cases where safety or consent warrants a deliberate non-intervention. A defensible comparison records its unit, time window, selected indicators, sources of missingness, competing explanations, and the status of normative judgments separately from measured outcomes. The following section develops such designs, including the conditions under which the proposed categories or formalism should be simplified, separated or abandoned.

The GR interpretation may contribute by organising these otherwise separate questions into a historically conditioned account of relationships among functions. It cannot claim explanatory priority without discriminating evidence. Fifteen function categories are an analytical device, not an exhaustive discovery of institutional reality; the formal state is a partial interpretive record, not a measurable totality; and value judgements remain contested across persons and contexts. The three configurations and the contrasts in Table 42 and Table 43 do not demonstrate that university hospitals outperform other institutions or that Commons participation is more beneficial than independent scholarship. They specify what a careful comparison would have to examine.

The next section turns these obligations into an empirical research design and a statement of theoretical limits. It should specify feasible units of comparison, evidentiary thresholds, normative protection of participants, alternative mechanisms, and conditions under which the theory requires revision. Only a subsequent study conducted within legitimate institutional and research boundaries could examine whether any of the proposed processes occurs, under what circumstances, and for whom. A responsible theory of generative Commons must remain open to the possibility that its infrastructure is too costly, its categories inadequately differentiated, or its hypothesised return paths too weak to justify the expectations placed upon them.

25 Empirical Research Design and Theoretical Limits

The manuscript proposes fifteen context-dependent infrastructure functions, a design grammar, and an evidence-qualified temporal description. Their analytical adequacy and their practical consequences require different studies. A desk-based or appropriately reviewed comparison can assess whether these devices improve *explanation and institutional diagnosis* relative to a carefully maintained narrative, ordinary ledger, knowledge- commons analysis, or existing authorisation process. An evaluation of the *effects of an operating arrangement* instead requires an actual, authorised setting, appropriate longitudinal evidence, and attention to selection, power, participant experience, unintended consequences and maintenance. Successful conceptual discrimination cannot by itself establish improved service, welfare, justice or safety. Institutional analysis (Ostrom, 2005, 2009), comparative case research (Yin, 2018; Ragin, 1987), realist evaluation (Pawson and Tilley, 1997), and causal-design research (Shadish et al., 2002) supply distinct methodological resources, none of which validates the proposed GR reconstruction in advance. International transfer requires renewed assessment of norms and authorities in each institutional and jurisdictional context.

25.1 Research Objects, Units of Analysis, and Evidence Status

The research object can be differentiated into at least four levels. The first is an *infrastructure function*, such as source interpretation, voluntary entry, contribution provenance, or maintenance. The second is a *bounded activity*, such as publishing a synthetic benchmark or organising an authorised service event. The third is an *institutional configuration*: a historically situated arrangement of persons, rules, capacities, and interfaces that supports or restricts multiple activities. The fourth is a *trajectory*, which links activities across time without assuming that the resulting record establishes a complete causal history. These units are connected but cannot be substituted for one another. Evidence that a provenance register exists is not evidence that contributors can exercise their retained rights; evidence that an activity was feasible is not evidence that it was authorised; and an observed new publication is not necessarily a benefit attributable to the Commons.

For each question the investigator should specify *whose* relationship and *which* period are under examination. The same person can be a student, an independent researcher, a donor of methods, a volunteer under hospital supervision, or a research participant, with role-specific permissions and unequal degrees of power. A hospital's legal entity and a research group's joint project are similarly nonidentical units. Temporal boundaries should distinguish when an event occurred, when it was recorded, when an applicable rule took effect, and when a claimed benefit became available. The typed event-claim record of Equation (46) is useful for recording this distinction, but its fields cannot resolve disputed facts or normative validity by themselves.

The three GR analytical levels also carry methodological consequences. Ontological suspension rules out pretending that observational indicators exhaust social reality. The relational level directs attention to historically constituted capabilities, dependencies, and power. Manifestation analysis specifies the documentary, computational, testimonial, and observational traces from which limited claims may be warranted. A research protocol should state when a trace is *observed, reported by a participant, inferred from linked evidence, contested, or hypothetical*. These classifications are themselves revisable and must not be mistaken for a universal hierarchy in which quantitative traces always outrank testimony or interpretive judgment.

25.2 Discriminating Propositions and Rival Mechanisms

A useful proposition must expose itself to a countercase. Each proposed mechanism should be associated with a bounded activity, a rival account, evidence that could distinguish them and a finding that would require narrowing or abandoning the claim. The following propositions are candidate research questions, not confirmed regularities. They should not be read as seven independent causal interventions: proximity, perceived rights, existing mentorship, public communication and participant capacity may be jointly conditioned by the same historical institutional arrangements.

The mechanisms also differ in what could count as a negative result. A comparison can disconfirm *incremental representational value* without testing the ethical validity of the distinctions being represented. For example, a lucid existing approval protocol might avoid exactly the same scope-transfer mistakes as a typed relation system; the latter's mechanism has no demonstrated incremental diagnostic value. Conversely, a synthetic review task might favour a typed form because its headings are more legible, without establishing that the underlying causal reconstruction is true or that real-world decisions would improve. Accordingly, the evaluation must keep three endpoints apart: the accuracy of an interpretation given common source materials, the extra work and exclusion needed to reach it, and the causal or institutional consequences of any decision subsequently taken. The third endpoint is outside the claims of a synthetic source-only comparison.

The table is also a test of whether the framework's proposed distinctions change an investigator's conclusions. For each row a comparison should record (i) which distinction an ordinary description omits, (ii) which evidence becomes newly visible when that distinction is introduced, (iii) whether the added interpretive work changes a defensible decision, and (iv) the time, competence, exclusion and maintenance costs of applying it. A framework that requires greater administrative effort but adds no

Table 44: Candidate empirical propositions, discriminating observations, and alternatives. The rows are design questions, not observed findings.

Focus	Candidate difference to examine	Rival explanation or disconfirming observation
Mediation	Credible university-linked interfaces may reduce the costs of locating relevant problems and collaborators under specified conditions.	Pre-existing personal networks, mentoring, or independent reputation explain the same pattern; proximity exists without use.
Entry	A usable research environment may enable legitimate research participation without requiring prior hospital service.	Participants enter because of grades, pressure, prior expertise, or selection rather than the infrastructure.
Knowledge	Translation records and plural review may help participants detect domain errors and revise claims.	Ordinary disciplinary review achieves the same result at lower cost; translation obscures disagreements.
Rights/return	Clear rights plus genuinely usable downstream outputs may expand later opportunities for some contributors.	Attribution occurs without access or uptake; pre-existing skills and independent sources explain subsequent activity.
History	Records preserving reasons, alternatives, and limits may improve situated reconstruction relative to file preservation alone.	Reconstructors perform equally well using ordinary documentation or tacit mentorship.
Coordination	Explicit distinctions between simulation, recommendation, authority, and execution may expose inappropriate decisions before action.	Equivalent safeguarding occurs through existing procedures, or added records delay correction and induce risk.
Stewardship	Visible recognition of maintenance obligations may improve continuity under particular resource conditions.	Formal reporting increases unpaid labour, concentrates gatekeeping, or fails to prevent loss of capability.

actionable or explanatory discrimination has not established its design advantage. These four comparison criteria are proposed here as evaluative questions, not as an experimentally validated scale.

Table 44 should be read as an agenda of discriminating comparisons. The rows do not isolate seven independent treatments. An apparently beneficial research module may attract already motivated students, while university affiliation may affect both publicity and access to ordinary supervision. Before estimating an effect, a study must state whether it compares information environments, individual choices, institutionally authorised activities, or the later usability of artefacts. Mixing these units can make the observed mechanism uninterpretable even when a statistical difference is found.

One especially important rival account is *selection*. Highly motivated or well-resourced students may be more likely to discover, use, and benefit from open research material regardless of institutional mediation. Ordinary project-based learning, a sympathetic mentor, professional networks, university prestige, or adequate funding may explain later outputs without requiring the full Commons framework. The theory becomes more informative if it can identify conditions or distinctions that such accounts leave unresolved, rather than asserting that all positive consequences originate in generative infrastructure. When the proposed explanation adds no discrimination and increases record-keeping burdens, narrowing or discarding the additional conceptual machinery is a justified outcome.

25.3 A Staged Programme of Public and Synthetic Inquiry

A first stage can test the design language with public and wholly synthetic material, without recruiting hospital volunteers, contacting patients or obtaining restricted institutional records. An investigator might ask independent reviewers to reconstruct why a model changed, identify what evidence justifies a rights claim, or distinguish a simulated feasible allocation from an authorised service decision. An ordinary well-documented repository should be an explicit comparator. This stage can test clarity, error detection, time and burden, but it cannot establish improved hospital service or general population participation effects.

A second stage could compare *documentary configurations*. Different versions of a public problem statement, metadata register, contribution record, or historical decision narrative might be examined for comprehensibility, conceptual consistency, identification of omissions, and the time needed for competent review. Any involvement of research participants, including students or professionals asked to perform assessment tasks, requires prior consideration of appropriate consent and applicable review arrangements. By contrast, purely internal synthetic consistency checks or analysis of lawful public sources may be feasible without a hospital partnership, subject to the researcher's own institutional and legal context. The absence of patient data does not imply that research involving other humans is automatically exempt from review.

A synthetic reconstruction task could offer two equally lawful versions of an invented scheduling-study archive, one with versioned decisions and typed provenance and one using a conventional changelog with clear documentation. To avoid confounding the conceptual framework with presentation quality, both versions should contain comparable factual content and receive equally careful editorial preparation. Outcomes might include whether reviewers correctly identify the operative model assumption, the source of a disputed claim, known uncertainty and the permissible scope of use, together with their completion time and perceived effort. A finding of no material advantage, or added burden without better judgment, would count against requiring the expanded scheme for that task.

A complementary *rights-and-return reconstruction task* could compare a correctly recorded downstream dependency with a deliberately ambiguous hypothetical attribution history. The relevant outcome would not be whether participants assign a moral score to the Commons, but whether they can distinguish historical contribution, academic credit, copyright entitlement, permitted derivative use and an actually accessible later opportunity. This task would require legally qualified review of any purported rights answer, and its hypothetical licences should be checked against the relevant legal texts. A successful task response could validate clarity of the local record under tested conditions only. It could neither settle contested transnational law nor prove that the underlying Commons produces distributively fair returns. These exercises also allow a substantial body of design research to proceed even if institutional collaboration never materialises.

A third stage would examine the coherence of a small independent Commons only *if one actually becomes operational*. It could track its public outputs, correction histories, documentation labour, contributor permissions, contested decisions, and verifiable instances of reuse. Reporting should distinguish offered opportunities from actual uptake and from longitudinal benefit. A repository containing a public benchmark demonstrates the availability of a resource under certain conditions, not that a population of students has learned from it or that patients have benefited. Activities may legitimately stop at this stage. Establishing a hospital partnership is neither the inevitable goal nor a criterion by which the earlier independent work is automatically judged deficient.

25.4 Comparative Cases, Institutional Variation, and Causal Inference

Comparative enquiry should select institutions and activities for relevant contrast, not reputation or availability alone. The independent, federated and authorised-partnership types introduced in Section 24 are initial conceptual configurations, not strata validated by field data. A defensible comparison must examine the actual locus of permission, risk, maintenance labour and disciplinary capacity within each case. Negative and low-resource cases are needed alongside visible successful examples; the absence of a university link can be analytically informative when another network provides equivalent mediation.

Within-case investigation may use event histories, competing explanations, documented decisions and consent-compatible interviews to trace whether the proposed mechanism plausibly operated. Across-case investigation may use structured comparison of similar activities under differing institutional conditions, together with careful attention to temporal precedence and differences in evidentiary completeness. Case-study methodology provides guidance for specifying bounded cases and rival explanations (Yin, 2018), while comparative methodology raises questions about configurations and causal complexity (Ragin, 1987). Realist evaluation's context-mechanism-outcome logic can help ask under what circum-

stances particular arrangements may operate (Pawson and Tilley, 1997). Its realist ontological commitments should not be silently equated with GR's suspension of ultimate ontology; the two approaches may share explanatory questions while differing in their philosophical foundations.

Any quantitative causal claim requires a more precise treatment and counterfactual than "having a Commons". Researchers would need to identify which institutional practice changed, when it changed, who was exposed, whether eligibility and measurement were comparable, and what other processes changed concurrently. Small samples, self-selection, differential attrition and the ethical inadmissibility of randomising access or service roles may preclude credible point estimates. In those cases, process tracing, matched documentary comparisons and transparent descriptive studies may be more defensible, but should not be reported as equivalent causal proof.

25.5 Heterogeneous Measures, Missing Evidence, and Measurement Effects

The framework resists the assumption that one indicator can represent the value of a Commons. Nevertheless, refusing a universal score does not eliminate the responsibility to specify observable evidence. Different purposes call for distinguishable evidentiary families: task-level comprehension, time and burden of acquiring information, source and version accuracy, proportionate correction of errors, actual reuse under documented permission, independently assessed scholarly warrant, participant descriptions of choice, and the ability of later investigators to reconstruct a decision. For resources and stewardship, accounting should include maintenance hours, unresolved work, skills concentration, accessible alternatives, and obligations transferred to successors. These are neither exhaustive manifestations of relational reality nor commensurable units to be added without justification.

The appropriate measurement object should be aligned with the claim. A fairness claim concerning a schedule may require examining who bears inconvenient assignments and whether relevant constraints reflect legitimate choices; it is not established by a high optimisation score. A claim that a contributor has benefited from a later study requires evidence that a benefit was actually available, lawfully usable, and meaningfully taken up when uptake is asserted. A claim of public trustworthiness requires investigation of the institution's reason-giving and correction practices, not merely positive feedback or public visibility. Withholding a communication for justified confidentiality may be consistent with trustworthy governance even though public transparency metrics decline.

Missingness is substantively meaningful and ethically constrained. People who leave a project, refuse interviews, or suffer higher participation costs may be underrepresented in the evidence. Protected records may be unavailable for good reasons, and the research design should not treat their absence as institutional failure by default. Claims should specify observed populations and document what can be inferred about excluded, silent, or non-participating persons without inventing their experiences. Auditability need not entail exposure of restricted personal material. A public synthetic record, a restricted review record, and a documented statement of an evidence limitation may together provide more legitimate accountability than indiscriminate disclosure.

Evaluation itself may alter the institution. If publication counts become targets, research groups may favour easily measured outputs over interpretive depth; if recruitment conversion is rewarded, communication can become coercive; if compliance with a new template determines access to research resources, administrative costs may exclude less-resourced contributors. These possibilities have conceptual precedents in programme-evaluation scholarship (Campbell, 1979; Patton, 2011) and in institutional studies of classificatory work (Bowker and Star, 1999). They remain empirical hypotheses for the present setting. A research design should therefore monitor the costs and behavioural consequences of its own observation practices.

25.6 Ethical Evidence Production and the Boundaries of Research Permission

The status of a Commons as an independent or public-serving initiative does not supply an independent power to conduct human-participant research or use institutional records. A prospective study should determine the applicable jurisdiction, the competent decision-maker, the anticipated privacy and safety

implications, the basis for participant recruitment, and whether ethics review or other institutional permission is required. Hospital-authorized service participation, consent to contribute to a public research project, permission to publish an artefact, and consent to be studied are different institutional relationships. They should not be combined into one broadly worded agreement as if participation in one necessarily licenses the others.

Research involving volunteers or staff raises nontrivial asymmetries even without sensitive patient data. A coordinator may influence a volunteer's perceived freedom to decline, a supervisor may affect a student's grades or opportunities, and public recognition can make withdrawal socially costly. Where competent authorities permit a study, recruitment and consent procedures should minimise these pressures, explain the actual uses of data, provide proportionate options to refuse or withdraw, and distinguish research records from operational records. Not every withdrawal can reverse an already lawful downstream publication, and anonymity is not always compatible with public authorship; the scope of each right should be accurately explained. No design should promise rights beyond what applicable law, licence or agreement provides.

A research question can remain valuable when access is denied. Publicly documented cases, synthetic simulations, conceptual comparisons and critical analysis of legal or governance texts may still be appropriate, provided their evidentiary limits are explicit. In some circumstances a study should not proceed, or a smaller question should replace a more intrusive design. Ethical refusal and bounded non-intervention are not automatically failures of knowledge generation. They may preserve trustworthiness and protect future cooperation.

25.7 Research Protocol Classification and Comparative Observation Without Access Claims

A future test of the proposed infrastructure needs an explicit distinction between *analysing documented institutions* and *intervening in or collecting information about them*. A first research pathway can inspect publicly available standards, institutional websites and published case studies, recording source versions and interpretive uncertainty. A second can compare fictional institutional configurations and synthetic scheduling or provenance records. Neither produces direct evidence about the beliefs, consent, harms or outcomes of actual volunteers. A third pathway could examine experiences or outcomes involving people or restricted records, but only following the competent institution's classification, any required prospective review, appropriate participant-facing arrangements, and actual data-use authority. Access to an institution's public materials does not imply permission to enter its services, recruit people, or reproduce its nonpublic records.

For a proposed third-pathway study, a prospective research record should state the research question, actors, recruitment relation, role of any service coordinator, whether sources are original or secondary, proposed legal and institutional bases for access, anticipated harms and benefits, arrangements for independent review as applicable, plans for secure stewardship, conditions for amendment, and limitations on publication. This is a design specification to support review, not a self-issued ethics approval. Where the 2024 Helsinki Declaration governs the ethical assessment of the type of medical research contemplated, its provisions on committee review, voluntary consent, identifiable data and reporting should be interpreted in their own context; the CIOMS guidance assists further with scientific and social value and the conditions of health-related inquiry (World Medical Association, 2024; Council for International Organizations of Medical Sciences, 2016). The declaration's research-registration and results-dissemination principles should not be transposed into a claim that every philosophical essay or public synthetic benchmark requires clinical-study registration.

The comparative methodology should also specify possible disconfirming cases before selecting an elaborate observational design. For example, ordinary institutional change control may detect role transitions as well as the proposed boundary record; standard open-science documentation may allow equally good reconstruction of computational results; and a clear copyright notice with competent human support may resolve reuse questions without a separate provenance infrastructure. Where such comparators are

sufficient, the Commons proposal has not yet earned its additional maintenance cost. A different failure occurs when a richly documented model detects issues but does not correct an actual misclassification because staff lack the authority or capacity to respond. The observational outcome should therefore distinguish identification of a problem, competent resolution, participant experience, and persistence of the corrected practice.

Measurement plans need to separate outcomes according to those stages. For independent public research, source-tracing accuracy, accurate recognition of permission limits, reconstruction of a synthetic experiment, and time spent correcting a false claim are possible tasks. For authorised empirical research, one could additionally investigate whether participants understand their choices or experience coercive pressure, whether an approved information-use boundary is respected, and whether an operational decision changes fairly distributed burdens. Those latter variables would require sound instruments and lawful collection conditions, and cannot be imputed from absent testimony. An ethical refusal, an inaccessible restricted record, or a cancelled recruitment phase may narrow what can be known; it must not be coded as a successful intervention or silently replaced by fictional data.

This staged design protects theoretical ambition without making access to a university hospital a prerequisite for scholarship. It also allows a negative result to be informative: if a transparent independent comparison can show no improvement beyond established scholarship and proportionate governance practices, the rational revision is a smaller or more conditional Commons theory. What remains unresolved is whether any institution would find the added classification and provenance instruments worth adopting. That question requires evidence not supplied by this manuscript's hypothetical cases.

25.8 Incremental Explanatory Value and Proportionate Comparators

The contribution of a relational framework is not established by its ability to redescribe a case in a larger vocabulary. A comparative task should separate *representational adequacy*, *decision quality*, *institutional effort*, and *distribution of burdens*. For a bounded synthetic research lineage, candidate comparators include an ordinary repository with a well-maintained changelog and documented licence, a repository supplemented by one human reviewer, and a more elaborate typed provenance account. Each should be given comparable source material and editorial care. An evaluation could then examine whether assessors can correctly reconstruct the rights-relevant version, recognise that a purported endorsement is unauthorised, identify which assumptions govern a reported result, and revise a mistaken conclusion when contradictory evidence arrives. Accurate judgments, completion time, reviewer disagreement and maintenance effort address distinct questions; they should not be compressed into one undocumented score.

The comparison should also recognise limits on the inferential unit. A reviewer asked to classify a fictional role change in a synthetic vignette is not assessing actual hospital competence. Review with professional experts may increase the interpretive quality of the exercise while introducing human-participant research questions of its own. In a real institution, a committee that correctly identifies a permission problem but lacks capacity to correct it has not demonstrated the same outcome as one that prevents an unauthorised act. Conversely, a trusted ordinary supervisor who promptly resolves the problem may supply the function without a new Commons procedure. Source accuracy, competent decision, implementation, lived experience and sustained capacity should therefore remain distinguishable evidentiary targets.

A useful design contrast holds the public output constant. Imagine two hypothetical teams publishing the same benchmark and achieving identical synthetic optimisation scores. Team *P* documents its assumptions in an ordinary versioned report; Team *Q* adds temporal claims concerning permission, maintenance roles, disputed contributions, and the opportunity for an earlier contributor to reuse a derivative. If no question under evaluation depends on these additional relations, the expanded account need not be preferable. If a later decision does depend on whether the original licence covers a reused component, which institution can approve deployment, or whether the beneficiary can in fact use the resource, the typed account might expose a consequential distinction. But a competent reviewer of *P*'s ordinary doc-

uments could reach the same conclusion. The research must therefore identify the *residual* difference attributable to the representation, rather than assuming that questions posed in its own vocabulary are unique to it.

An adverse result can take several forms: no additional correct answers, more false confidence in a contested source, slower corrections, increased privacy exposure, or maintenance burdens concentrated among less resourced contributors. Some outcomes will be indeterminate because restricted records, voluntary refusal, or competing interpretive standards prevent meaningful comparison. These are not successes to be recoded as unobservable generativity. The resulting evidence can instead support a conditional recommendation to simplify the model, strengthen one specific interface, restrict the research question, or stop. This comparison connects the design criterion of Section 5.9 to the temporal separation in Section 23.5; it tests whether analytical distinction merits a practical burden, rather than whether the fifteen-function catalogue can be filled in.

A further synthetic comparison should examine *handoff recognition across neighbouring functions*, since a theory of distinct infrastructures risks achieving apparent precision merely by repeating the same warnings. Consider a versioned fictional dossier with: an initially well-scoped public research question; a documented but ambiguous image licence; an internally approved Commons publication; a synthetic scheduling result; an unauthorised suggestion to deploy it; a public invitation; and one interested person who has neither agreed to a study nor been admitted to hospital service. Provide equivalent information to assessors using (i) a readable ordinary case narrative, (ii) a simple linked register with an identified custodian, and (iii) the proposed typed relational representation. Questions should separately test whether each assessor can identify the object and scope of the public inquiry (Section 7), distinguish interpretation from competent decision (Sections 8 and 9), recognise the changed activity boundary (Section 10), reconstruct a dated trace without inheriting its authority (Section 11), distinguish retrieval from warrant (Sections 12 and 13), identify when a translation changes the claimed inference (Section 15), and separate comprehension of an invitation from voluntary admission (Sections 16 and 17).

The dossier and answer key should explicitly permit *insufficient information* when permission, affected-person experience, or institutional competence cannot be established. False authorisation and false scientific confidence count as errors even if they produce a seemingly helpful final plan. Assessors should receive the same source facts, time allowance, and opportunities for clarification, with representation-specific preparation and maintenance costs reported separately. A claim of incremental value would require more accurate or better-calibrated answers to at least one consequential handoff question without an unjustified rise in cost, exclusion or disclosure risk. If the ordinary narrative or register performs comparably, the study supports sufficiency of the simpler configuration. These dossiers are proposed fictional instruments, not collected hospital observations, an approved human-participant protocol, or evidence that the proposed mechanisms already improve outcomes.

25.9 Type-Error Detection and the Cost of Formal Representation

The candidate empirical advantage of the formalism is narrower than an improvement in hospital performance. Under the matched-dossier design specified in Section 25.10, reviewers would adjudicate a fixed set of consequential claims using an ordinary case narrative, a dated ledger with human review, or a typed representation. The source evidence, task definition and legitimate unknowns should remain equivalent across formats. Failure to identify a missing legal, epistemic or historical warrant, but also unnecessary refusal where the fictional stipulations support a permitted act, counts against the representation. Outcome coding, adjudication and cost accounting follow the common instrument specification in Section 25.11; these are separate analytic tests within one prospective comparison, not completed experiments.

A type-labelled record may outperform a chronology because it communicates more clearly rather than because its ontology is truer. Expert readers may also identify every relevant boundary in ordinary prose. A comparison can therefore support only a context-specific advantage in warranted judgments, conditional on the disclosure, training and maintenance burdens incurred. Any later human-participant

evaluation requires its own applicable review; fictional source-only examples do not constitute a field test.

25.10 Comparing Decision, Permission, and Return Assessments Under Equal Evidence

A more specific test of the mechanism proposed in Section 23.10 would examine whether typing reduces unwarranted transfers between evidence about publication, rights, operational decisions and capability outcomes. This test is distinct from proving any actual permission or welfare benefit. A fictional dossier would present the same dated source snippets, contributor roles and artefact components in each experimental arm. One arm would use a careful prose memorandum, a second a compact ordinary version ledger and permission table, and a third the proposed typed record. All three would receive the same distinctions, source quality, explanation of disputed facts and opportunities to request clarification, so that additional information is not quietly counted as a benefit of formal representation.

The primary task would require a reviewer to state whether each of several proposed conclusions is supported, excluded, unresolved, contested or outside the reviewer's assigned competence, and to identify the corresponding source. Claims might include permission to reuse a particular component, authority to issue a service instruction, documented use by a contributor, and improved capacity for that contributor and maintainers. One dossier should contain an unambiguous permitted independent use, to detect gratuitous hesitation. Another should contain a known exclusion for a defined use, to measure unwarranted permissiveness. A third should include a genuine unresolved permission, and a fourth a documented increase in one actor's capability accompanied by reduced maintenance capacity elsewhere. An additional negative-control task could involve a routine version correction fully resolved by a normal changelog. These contrasts prevent a model from receiving credit merely for producing more uncertainty labels.

A reference interpretation should be drafted *before* responses are observed, with separate panels or qualified advisers documenting which points are factual within the fictional dossier, which are explicitly assumed normative conditions and which call for contextual judgment. An evaluator must not construct a supposed universal legal gold standard from the Commons's own rules. Divergent defensible interpretations should be eligible for partial credit or an explicit disagreement code. The evaluation should distinguish false authorisation, false accusation of wrongdoing, unjustified claim of realised benefit, correct recognition of missing evidence, unnecessary refusal in straightforward cases, and reasons grounded in the right source. Inter-rater disagreement, time, training demands, accessibility, risk of sensitive inference and maintenance burden would be reported as separate outcomes, not silently combined into a single score.

Random assignment or balanced crossover may be considered in a later appropriately reviewed human-participant study, with case order and learning effects controlled, but neither design is asserted to have been conducted. A source-only pilot could instead publish fictional tasks, a scoring rubric and a worked comparison without collecting human data. The superiority proposition is genuinely at risk: an ordinary ledger may perform equally well or better, or the typed method may increase false confidence, effort and exclusion. A negative result would narrow the formalism's claimed usefulness; it would not negate the underlying ethical importance of distinguishing consent, permission, evidence and institutional authority. The manuscript offers a research design rather than an empirical result.

The matched-dossier design is not a claim that category errors are unique to hospitals or that typed notation is the only means of avoiding them. It tests a specific possible advantage of source-sensitive cross-domain reasoning under information parity. The primary outcomes should be specified before observing reviewer responses; any exploratory changes should be logged separately. A minimum useful report would show error type and severity, time, justified deferral, and cost by comparator, including straightforward cases where excessive hesitation is harmful. Without an actual governed intervention, the result can address only how fictional claims were interpreted, not whether patients were protected, volunteer consent respected in practice, or benefits returned to a real contributor.

For the cross-domain tests, the evaluation should predefine *claim units* as proposed conclusions about

Table 45: Proposed claim-level data dictionary for synthetic comparisons. The fields are analytic requirements of a future test, not institutional data fields or observations.

Field	Scope and reason for recording
Claim and object	One proposed conclusion, with the relevant actor, component or resource, and kind of relation being asserted
Action and purpose	The specific reuse, service, publication or participation act, rather than a project title alone
Time and scope	Putative occurrence, evidence-record date, claimed period of authority, context and jurisdiction when material
Source and competence	Dated document or stipulated fictional fact, access restriction, issuing body and question within the assessor's remit
Judgment and rationale	Supported, excluded, unresolved, contested, or outside assigned competence, with a reason anchored to the source
Consequence and burden	Error type, defensible deferral, reviewer effort, accessibility, disclosure exposure and maintenance requirements

one actor, component, action, period and institutional scope. Within each task, reference adjudicators would distinguish an explicitly stipulated fictional fact from a plausible but unsupported inference. The answer key should code at least five different errors: promoting a rights-review label into an operative permission; confusing an internal editorial decision with hospital service authority; mistaking documented uptake for benefit or capacity growth; suppressing a maintenance burden borne by a different participant; and treating a later archival correction as proof of an earlier operative authorisation. The comparator formats may differ, but the case facts, permitted inferences, access restrictions, change-of-purpose information and opportunities for correction should be kept equivalent. Equivalence should be assessed by a reviewer not responsible for designing the typed notation.

A prospective primary endpoint can be the proportion of these prespecified, *consequential cross-domain claims* correctly adjudicated with defensible reasons, counting unjustified certainty and unjustified exclusion separately rather than rewarding universal abstention. A distinct descriptive endpoint should report, for each comparator, the number of properly classified unknown or contested cases. Interpretation time, disagreement, accessibility, training, document preparation, privacy exposure and recurring stewardship work should be recorded individually. A practical claim of net advantage would require a specified gain on the consequential task without a disproportionate increase in those burdens; there is no principled basis here for turning them into one arbitrarily weighted “generativity score.” This specification is a proposal, not a registered protocol or a report of collected observations.

Two prospective sensitivity checks matter. First, shorten the dossier to a low-conflict independent research publication: if the plain narrative performs as accurately with less cost, the model has no demonstrated added value in that case. Second, change the contemplated use from public research to a real service instruction *while keeping the artefact and its scientific result unchanged*. Reviewers who treat the original permission as transferable should lose credit, but the evaluators must not presume that an actual hospital would reach one universal legal outcome. The hypothetical task tests recognition that further competent, context-specific determinations are necessary. Benefits or harms to real patients, contributors and stewards cannot be inferred from performance on this classification task.

25.11 A Unified Claim-Level Instrument and Adjudication Standard

The neighbouring-function dossier and the decision-rights-return dossier form *one prospective instrument family*, rather than independent studies with separately claimed results. Each fictional task fixes a source packet and one target claim before applying alternative presentations. Table 45 specifies a common data dictionary and identifies what must be retained even when the comparison uses ordinary narrative prose rather than a formal register.

A reference panel would distinguish a *stipulated fictional fact* from interpretation, a source-

dependent rule and an unresolved question. It should record more than one defensible answer where the scenario does not determine a unique one. Adjudicators must be independent of response coding where feasible and retain disagreements rather than converting the project's preferred vocabulary into a universal legal answer key. The principal error classes are false authorisation, false prohibition, unwarranted scientific confidence, retrospective authority attribution, wrongful inference of realised benefit, and concealment of another actor's maintenance burden. Accurate positive decisions and warranted uncertainty both matter; universal deferral must not be rewarded. Accuracy by claim class and error severity, decision time, training, accessibility, disclosure and recurring maintenance costs should be reported *separately*.

A difference in synthetic judgment quality would support a claim about representation under the specified task, not about safety, governance, clinical outcomes or future generative capacity. If simpler formats are as good or better at lower cost, the distinctive formal representation has no demonstrated marginal practical advantage in that setting.

25.12 Local-Signature Countercases and Partial Evidence

The local-record projections of Table 36 pose a distinct *scope* question within the same comparison protocol: can a reviewer identify what kind of object an individual record speaks about *before* considering its connection to other domains? Four fictional countercases focus on this question: adoption of a research problem without service authority; a downloadable file whose onward-reuse rights are unresolved; a purported historical approval whose date or original source is unverified; and favourable role preparation without the person's assent. The evaluation should use the information-parity and source-sensitive scoring principles of Section 25.11, rather than count these cases as evidence for a separate experimental effect.

The central adverse possibility is that typed local records increase apparent certainty or paperwork without improving identification of the missing warrant. A good narrative, a modest status ledger, and a local typed record may all identify the same deficiency. Where that happens, the inference is that the particular representational expansion lacks demonstrated added value; neither the reality of the relevant rights nor the need for voluntary assent depends upon a successful performance result. These are research specifications for future fictional-task work, not completed observations.

25.13 Adjudicating Mechanisms, Negative Cases, and Theoretical Revision

The model must permit the investigator to reject its own proposed mechanism rather than redescribe every outcome as a different form of generativity. For each claim, the research team should identify a bounded unit, the proposed relation, the admissible evidence and its provenance, rival explanations, and observations that would change the conclusion. The resulting record remains a guide for critical inquiry, not a statistical estimator or an automated normative certification. Some questions will remain indeterminate because their evidence cannot legitimately be collected; those limits are findings about the investigation's scope rather than invitations to infer hidden facts.

The strongest countercases may not be spectacular failures. A small Commons might provide meaningful research opportunities with an ordinary repository and mentor, without maintaining a comprehensive fifteen-function register. An established volunteer programme might achieve respectful participation through familiar professional practices rather than explicit GR terminology. In those cases the proposed framework should ask whether it clarifies otherwise overlooked relations and responsibilities. If it adds no useful explanatory differentiation, a design principle of proportionate infrastructure may recommend retaining the simpler existing arrangement. Alternatively, a system may be formally elaborate yet practically exclude volunteers, obscure legal authority or redistribute maintenance work unfairly. These cases should challenge any tendency to infer substantive success from the presence of documents or administrative procedures.

The number and boundaries of infrastructure functions remain contestable. An existing professional procedure may already resolve an alleged gap; two analytically distinct functions may be adequately

maintained through one practical arrangement; or a single function may require institutional separation because the relevant authorities conflict. If the fifteen-category account repeatedly adds no discriminating capability beyond ordinary institutional mapping, its complexity should be reduced. The same criterion applies to the typed temporal model: if a clear, versioned narrative performs equally well with less effort, the more elaborate notation should not be defended as an end in itself.

There are also theoretical propositions that cannot be adjudicated by a single outcome measure. The independent legitimacy of consent, the importance of not impersonating institutional authority, and an entitlement against unlicensed appropriation rest in part on normative and legal arguments. Empirical observation can reveal failures of implementation and downstream effects, but should not be used to infer the content of binding law or the moral legitimacy of coercion directly from an observed outcome. Conversely, a policy defended in ethical prose does not demonstrate that it works as intended. A responsible research programme should allow separate and sometimes conflicting results from normative analysis, empirical inquiry and practical feasibility assessment.

25.14 Evidence Stewardship, Transparent Reporting, and Research Exit

A study that asks institutions to preserve reasoning and make their claims contestable must apply equivalent discipline to its own procedures. The research team should specify in advance, to the extent appropriate for its method, the comparative question, how cases or synthetic tasks were selected, the status of outcome measures, known risks, and which evidence is likely to remain inaccessible. Where a design evolves through exploratory study, changes should be dated and explained rather than concealed behind a retrospectively seamless narrative. Pre-specified testing and legitimate methodological adaptation serve different purposes and can coexist when their evidentiary claims are distinguished. A protocol should never use the label “pre-registered” merely because a document was uploaded after observations were known.

Research outputs can be layered. Public reports may include synthetic datasets, tested code, method descriptions, version histories, justified limitations and aggregate findings where their release is lawful. Restricted or non-retained records may involve identifying participant statements, confidential institutional deliberations or sensitive access decisions. A restricted record is not a public research asset simply because the Commons values openness. Qualified reviewers may need controlled means to examine decisions, while the public receives enough information to understand the scope and limitations of reported conclusions. Provenance about evidence sources should be preserved only to the extent compatible with legitimate privacy, security and retention requirements. A limitation honestly documented may contribute more to future inquiry than a false appearance of complete reproducibility.

The evaluation must also have a realistic stopping condition. If the burden of maintaining an evidence register, obtaining consent, correcting public misinterpretations or preserving restricted information exceeds the warranted benefit of a marginal comparison, the research may need to narrow its object, revise its method or end. Resources spent validating the framework are resources not available for other intellectual or service activities. The report should therefore document negative and null results, inaccessible cases, declined participation, abandoned analytic routes and reasons for ending inquiry. These are part of the historical conditions under which later scholars could critically reconstruct the study, even where the practical outcome is to reject a proposed mechanism or decline institutional expansion.

25.15 Scope of Generalisation and the Remaining Research Programme

The framework is internationally oriented in its research questions, not globally validated in its conclusions. A university hospital is one setting in which academic disciplines, students and public-service activities may become institutionally proximate; comparative advantage over other hospitals or civic research networks remains unmeasured. Transfer across jurisdictions requires independently examining legal and research-ethics competence, the organisation of voluntary service, available research infrastructure and historical resource constraints. Differences should sometimes be treated as analytically consequential rather than adjusted away through a common label.

The present account also remains selective. It offers only a preliminary reconstruction of political economy, power, generative justice, normative legal structures and long-run relational dynamics. It does not derive a comprehensive theory of rights, estimate causal magnitudes, validate an automated decision system, or settle whether a particular local Commons would be just, sustainable or useful. The existence of retained records, theoretical diagrams and suggested templates does not mean their institutional costs have been measured. The most consequential future work includes ethical and comparative examination of real uses of open research resources; historically informed evaluation of actual opportunities for contributors to reuse downstream results; careful identification of rights and maintenance burdens; and comparative assessment of institutions that do and do not possess particular mediating relationships.

The research programme should have a justified point of revision or termination. A changed licence, withdrawal of participation, inaccessible records, loss of maintainers or persistent inability to distinguish competing explanations may call for narrower questions or a halt. Negative findings and justified non-intervention should be preserved with their evidentiary limitations where retention is lawful and proportionate. At this stage the proposed framework contributes a set of differentiated questions, an institutional design grammar and provisional tools for evaluating them. Whether those tools improve explanation or future generative capacities remains to be established.

Conclusions

The research object of this manuscript has been the possible constitution of a university hospital volunteer commons, rather than an existing volunteer service or an institutionally adopted policy. The paper has examined the conditions under which independent disciplinary inquiry, legitimately authorised service, and separately reviewed studies involving people or restricted information might develop mutually relevant relationships. The boundaries between those activities are constitutive of the question: an academic insight does not provide permission to enter a clinical setting, and volunteer participation does not entail agreement to become a research participant. A useful independent research environment can exist without a hospital partnership, protected information, or a new volunteer assignment.

The literature already provides substantive explanations of public-service value in use, institutional commons governance, heterogeneous volunteer motivations, interdisciplinary proximity, organisational learning and the conditions of generative justice. The present paper does not claim to have originated these insights. Its proposed contribution is a relation-sensitive reconstruction of their conjunction across different activities and times. The problem is whether a contribution that remains traceable and in principle reusable also has a lawful route of use, an actual beneficiary, a realised benefit, and defensible consequences for future productive capacity. These questions can condition one another without becoming equivalent.

The generative relational method distinguishes an ontological question whose final resolution is suspended, historically constituted relationships that may exert causal or generative effects, and partial manifestations through which an observer becomes aware of them. It is therefore possible for a change in documentation to alter what researchers can infer without changing the institutional activity of interest; it is also possible for documents and public representations to influence subsequent practice. The typed temporal vocabulary was developed to make the scope of such claims inspectable. Nevertheless, a modelled event, a reported permission, a reasoned inference, a competent decision, actual use and a resulting capacity transition are different objects. Formal compatibility between their records does not create legal standing, normative legitimacy or a causal pathway.

The fifteen candidate infrastructure functions offer an institutional-design grammar for asking which relationships must be supported, separated, or coordinated within a specified activity. They are analytically distinguishable functions rather than fifteen necessary offices, services, databases or steps of a universal implementation sequence. Their realisation must respond to existing institutional histories, available resources, affected subjects, applicable norms and competent authorities. Where ordinary mentoring, well-kept version histories, accepted review procedures, or established volunteer support already perform a function adequately, creating an additional Commons interface can increase rather than resolve

the problem. The possibility of an adequate simpler arrangement is a reasoned design outcome, not a failure to realise the theoretical ideal.

The proposed mechanisms have different standards of assessment. Entry differentiation asks whether people can contribute to inquiry without an imputed service obligation. Authority separation asks whether distinct permissions and institutional decisions are recognised as such. Historical reconstruction asks whether relevant versions, dates, evidence sources and contested explanations can be interpreted without pretending that every necessary record is available. Qualified return asks whether a possible route of access is exercised and whether its consequences improve the future capacities of specified participants, considering burdens placed on others. These are conditional hypotheses and questions, not established gains in recruitment, accountability, public value, or research productivity.

The most immediate test of the manuscript is a comparison of explanatory performance under matched informational conditions. A carefully written narrative, an ordinary ledger, a knowledge-commons or action-situation analysis, and the proposed typed representation can be assessed against the same hypothetical dossiers. Discriminating observations concern warranted versus unwarranted inference, correction of errors, interpretation time, reviewer uncertainty, accessibility and maintenance burden. An ordinary account that identifies the same authority, rights and evidence boundaries with less effort would defeat the proposed representation's incremental advantage for that purpose. The deeper institutional hypothesis, that a particular Commons improves real participation or future generative capacity, requires a different, ethically and institutionally appropriate longitudinal investigation; no such investigation is reported here.

The potential harms of institutional construction are not merely unintended exceptions to an otherwise positive value cycle. Increased formalisation can concentrate interpretive authority, make unofficial labour invisible, expose information about affected persons, impede voluntary exit or transfer unpaid maintenance obligations to contributors who cannot bear them. A recorded opportunity for return can remain unused, and one participant's gain may coexist with another's loss of capacity. In some settings the justified response is a narrower interface, controlled non-disclosure, independent inquiry, succession or institutional closure, rather than expansion. These are plausible theoretical outcomes that require situated evidence and normative analysis, not consequences established by the present paper.

The formal reconstruction offers a modest methodological proposal: records can be compared within a legitimately inspectable domain, while retaining their source types, contexts and evidentiary limits, as in Equation (50). Even a supported comparison is not itself a permission, institutional decision, observed benefit or law of capacity growth. The linked experimental design tests a narrower claim, namely whether this discipline prevents specified mistaken inferences beyond an equally informative ordinary narrative or ledger. A gain for one contributor coupled with a loss of maintainer capacity is not an aggregate success merely because the historical pathway returns to its point of origin. Such asymmetries may be important research objects even when a compact human account remains the proportionate way to describe them.

The resulting research programme is internationally oriented in its comparative questions, while remaining institution- and jurisdiction-specific in any claims about binding law, legitimate authority and permissions. Ethical guidance can inform inquiry without substituting for the relevant applicable obligations; a draft Commons charter cannot authorise hospital practice. There has been no assumed institutional endorsement, human participant experiment, protected-data processing or measured operational intervention. At its present stage the paper offers a criticisable theoretical reconstruction, a configurable institutional vocabulary and discriminating research specifications. Its development depends on learning when the historical and cross-domain distinctions improve understanding, and when a simpler existing practice provides a more proportionate and responsible account.

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