

DIM Review

International Review of Knowledge Management and Strategic Planning

ISSN 3125-9308

Volume 1, Issue 1 - 2026

From Fragmented Research to Cumulative Strategic Knowledge: A Directed Research Architecture for Federating Scientifically Autonomous Projects

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Article Type: Conceptual and Methodological Research Article

DOI: [to be inserted after official assignment]

Received: [real date] | Accepted: [real date] | Published: [official publication date]

Abstract

Complex strategic problems increasingly generate research across multiple disciplines, institutions and methodological traditions, yet the accumulation of studies does not necessarily produce cumulative knowledge. Existing literatures on team science, interdisciplinary and convergence research, knowledge integration, research portfolio management, evidence synthesis, adaptive learning and science-policy interfaces already address important dimensions of this challenge. This article develops the Directed Research Architecture (DRA), a proposed research-governance architecture for federating independently governed research projects around a shared strategic problem space. The framework comprises five core functions: a Shared Strategic Problem Space, a Shared Evidence Architecture, an Independently Governed Research Portfolio, Contradiction-Preserving Cross-Project Synthesis, and Evidence-Driven Federated Portfolio Renewal. Independent scientific governance is defined through theoretical, methodological, interpretative and publication autonomy. The proposed contribution of the DRA is configurational rather than elemental: it does not claim novelty for portfolio management, knowledge integration, evidence-gap mapping, continuous synthesis or adaptive learning considered separately. Instead, it examines whether these mechanisms can be combined across scientifically autonomous projects while preserving divergent, null and context-dependent evidence and using portfolio-level synthesis to reconfigure subsequent research activity. Cumulative Strategic Knowledge is proposed as the principal scientific outcome. The framework is theoretically specified and empirically testable but is not presented as validated or superior to existing research arrangements. A bounded pilot and independent evaluation are proposed as the next stages of development.

Keywords: Directed Research Architecture; Research Federation; Scientific Autonomy; Cumulative Strategic Knowledge; Research Portfolio; Knowledge Integration; Strategic Planning

1. Introduction

Complex strategic problems rarely conform to disciplinary, institutional or methodological boundaries. Challenges involving public governance, institutional resilience, sustainability, territorial development, technological transformation and long-term strategic planning frequently require evidence generated by different scientific communities.

This has contributed to the expansion of collaborative, interdisciplinary and transdisciplinary forms of research. The Science of Team Science has demonstrated that scientific collaboration depends on identifiable factors including team composition, team formation, collaborative processes and institutional conditions rather than merely on assembling multiple researchers (Hall et al., 2018).

Yet increasing the number of collaborations or studies does not necessarily produce cumulative knowledge. Contemporary scientific production can remain fragmented across disciplines, methodologies and publication streams, making the collective state of evidence difficult to assess (Snyder, 2019). Research accumulation must therefore be distinguished from the progressive organisation of scientific understanding.

This distinction is particularly important for strategic research. A strategically significant problem may attract numerous independent studies while the resulting evidence remains distributed across disciplines, institutions, countries and methodological traditions. Under such conditions, the volume of research may increase without a corresponding increase in the structured understanding of the problem.

Existing research traditions already address substantial parts of this challenge. Team Science examines scientific collaboration (Hall et al., 2018). Interdisciplinary and transdisciplinary approaches investigate integration across disciplinary boundaries. Research portfolio approaches organise multiple projects collectively (Linton & Vonortas, 2015; Canton, 2025). Evidence-synthesis approaches structure dispersed findings, including through continuously updated models (Elliott et al., 2017). Evidence and Gap Maps support systematic identification of knowledge gaps and strategic research priorities (Snilstveit et al., 2016). Contemporary knowledge-integration frameworks also combine insights from interdisciplinary research, co-production and Team Science (Punjabi et al., 2025).

Convergence research further demonstrates that problem-oriented scientific collaboration can include sophisticated processes for knowledge integration and adaptive coordination. Recent studies examine both knowledge integration within convergence research and the orchestration of boundaries across scientific and institutional domains (Misra et al., 2024; Punjabi et al., 2026).

The analytical problem addressed here is therefore not simply how to increase collaboration, create research portfolios or integrate heterogeneous knowledge.

Can independently governed scientific projects be federated around a shared strategic problem through a common evidence architecture without requiring their scientific governance to be unified?

This question shifts the unit of analysis from the individual research team or integrated project toward a federated portfolio of independently governed research projects.

This article proposes the Directed Research Architecture (DRA) as a research-governance architecture through which this problem can be examined.

The term directed does not imply predetermined findings. It refers to deliberate orientation of research attention toward a shared strategic problem space. Within the proposed architecture, constituent projects retain substantive scientific autonomy over theoretical, methodological, interpretative and publication decisions.

Direction therefore concerns the problem space, not the scientific conclusion.

The DRA is organised around five core functions:

- DRA-F1 - Shared Strategic Problem Space
- DRA-F2 - Shared Evidence Architecture
- DRA-F3 - Independently Governed Research Portfolio
- DRA-F4 - Contradiction-Preserving Cross-Project Synthesis
- DRA-F5 - Evidence-Driven Federated Portfolio Renewal

The proposed contribution does not lie in any of these component mechanisms considered independently. Problem-oriented research, portfolio management, evidence-gap mapping, knowledge

integration, evidence synthesis, adaptive learning and research-priority setting are already represented in established literatures.

The potential contribution of the DRA is therefore configurational rather than elemental.

It concerns whether these mechanisms can be organised around independently governed research projects in ways that preserve scientific divergence while enabling portfolio-level synthesis to reconfigure subsequent research activity.

Whether this configuration constitutes a sufficiently distinct research-governance architecture, and whether it produces measurable advantages, remain empirical questions.

The article pursues three objectives. First, it identifies the principal scientific traditions relevant to the coordination of multiple research contributions. Second, it specifies the conceptual and governance structure of the DRA. Third, it formulates observable criteria and testable propositions through which the architecture may subsequently be subjected to empirical evaluation.

2. Problem Statement

The central problem examined in this article is the difference between research accumulation and cumulative knowledge development.

Research accumulation occurs whenever additional studies, publications, datasets or projects are produced on a subject.

Cumulative knowledge requires more.

Individual findings must be positioned in relation to previous evidence. Theoretical and methodological differences must remain visible. Contradictory findings must be examined. Contextual variation must be identified. Remaining uncertainties must be capable of generating more precise subsequent questions.

Methodological literature already recognises that expanding research production can remain fragmented and therefore difficult to synthesise systematically (Snyder, 2019). Research on cumulative learning similarly demonstrates that the existence of additional studies alone does not ensure cumulative scientific development (Dunning, 2016).

Knowledge-integration research adds another dimension: heterogeneous scientific contributions must be actively related to one another rather than assumed to become integrated through collaboration alone (Punjabi et al., 2025; Hoffmann et al., 2022).

The problem becomes more demanding when the relevant studies are not components of one centrally governed scientific enterprise.

Projects may be conducted by different universities, under different funding arrangements, in different countries, using different theoretical frameworks, using different research methods, and producing divergent conclusions.

Such plurality may provide scientific value. However, without an evidence structure linking these contributions, it may also generate collective fragmentation.

Excessive centralisation presents the opposite risk. If portfolio-level coordination determines theories, methods, interpretation or preferred results, scientific coherence may be obtained at the expense of scientific autonomy.

Scientific autonomy must be preserved while cumulative comparability must be deliberately created.

The central analytical unit is consequently the Federated Portfolio of Independently Governed Research Projects, defined as:

a structured set of research projects that contribute to a shared problem space and common evidence architecture while retaining independent scientific governance over theoretical, methodological, interpretative and publication decisions.

The term federation is used here as an analytical term and does not imply a legal, political or organisational federation.

A further distinction is required:

Integration concerns how heterogeneous knowledge is brought together. Federation concerns how independently governed knowledge-producing units are connected without requiring their scientific governance to be unified.

The two processes are compatible but analytically distinct.

Knowledge integration may occur within a centrally organised interdisciplinary project. Research federation, as proposed here, concerns integration across projects whose scientific governance remains substantively independent.

The primary research question is therefore:

How can independently governed scientific projects be federated around a shared strategic problem in ways that support cumulative knowledge development without requiring unified theoretical, methodological, interpretative or publication governance?

Three subsidiary research questions guide the analysis:

- RQ1. Which functions relevant to this problem are already addressed by existing research-coordination, knowledge-integration, portfolio, evidence-synthesis and adaptive-learning frameworks?
- RQ2. Which governance mechanisms are required to combine independent scientific governance with structured cross-project synthesis?
- RQ3. Under what observable conditions can a DRA-compatible federated portfolio be distinguished from a conventional research consortium, integrated programme, research network or research portfolio?

3. Literature Review and Theoretical Foundations

3.1 Scientific collaboration and Team Science

The Science of Team Science provides an important theoretical starting point for understanding scientific coordination.

Hall et al. (2018) identify several dimensions influencing scientific teamwork, including team composition, team formation, collaborative processes and institutional conditions. This body of scholarship demonstrates that productive scientific collaboration cannot be reduced to assembling researchers around a common theme.

The analytical level of the DRA is nevertheless different.

A research project participating in a DRA may itself contain a scientific team. However, the proposed architecture operates principally between projects, rather than only among individuals within a team.

The relevant distinction is therefore not simply team versus portfolio, but integration within a common collaborative research enterprise versus federation across projects retaining independent scientific governance.

The DRA consequently builds upon, rather than replaces, Team Science.

3.2 Interdisciplinary, transdisciplinary and convergence research

Interdisciplinary and transdisciplinary research demonstrate the importance of combining multiple epistemic perspectives when complex problems exceed the explanatory capacity of one discipline.

However, disciplinary diversity does not automatically generate knowledge integration.

Hoffmann et al. (2022) explicitly address leadership, learning and synthesis in inter- and transdisciplinary research, showing that integration of heterogeneous results requires deliberate processes. Punjabi et al. (2025) further develop a conceptual framework for knowledge integration in cross-disciplinary collaboration, incorporating insights from interdisciplinary and transdisciplinary research, knowledge co-production and Team Science.

These developments impose an important constraint on the originality claim of the DRA.

The DRA does not introduce knowledge integration as a new scientific problem.

Convergence research presents an even closer comparator. Misra et al. (2024) analyse knowledge integration within convergence research, while Punjabi et al. (2026) examine boundary orchestration as a mechanism through which knowledge can be assembled, translated and routed across scientific and institutional boundaries.

Consequently, neither problem orientation, adaptive coordination nor knowledge integration should be presented as specific inventions of the DRA.

The remaining analytical question is narrower:

Can comparable integrative functions operate across projects that retain independent scientific governance rather than being incorporated into a single convergence enterprise?

3.3 Knowledge integration and research federation

Knowledge integration and research federation concern related but non-identical phenomena.

Knowledge integration addresses relationships among heterogeneous knowledge contributions.

Research federation, as proposed in this article, addresses relationships among the independently governed projects producing those contributions.

Research federation is therefore defined as:

the structured connection of independently governed scientific projects through a shared evidence architecture that enables cross-project comparison, contradiction-preserving synthesis and recursive portfolio renewal without requiring unified scientific governance.

A federated project may share metadata standards, evidence maps, terminological structures, harmonised variables where justified, or comparative protocols.

These interfaces facilitate synthesis. They do not require central control over scientific theory, methodology, interpretation or publication.

coordination of evidence interfaces and decentralisation of scientific judgement may coexist.

This remains a proposition to be tested rather than an established empirical finding.

3.4 Research portfolios

The movement from isolated research projects to research portfolios is well established. Linton and Vonortas (2015) explicitly analyse the transition from research projects toward portfolios as a response to increasing scale and complexity.

More recent work also demonstrates that portfolio approaches can account for interdependencies among research projects and multiple research-funding objectives (Canton, 2025).

Accordingly, neither the concept of a portfolio nor the idea of inter-project relationships is distinctive to the DRA.

The proposed additional requirement is that the portfolio should function as a persistent evidence architecture.

Projects should remain traceably linked to the shared problem space, existing evidence, specific knowledge gaps, their theoretical and methodological assumptions, their findings, their limitations, and subsequent research questions.

The proposed DRA portfolio is therefore conceived not only as an administrative or funding unit, but as a potential epistemic unit of cumulative learning.

Whether this additional structure produces measurable benefits remains to be established.

3.5 Evidence synthesis and living evidence

Evidence-synthesis methodologies demonstrate that findings from multiple studies can be brought together through explicit procedures.

Living systematic review methodology further shows that evidence synthesis can be continuously updated as new relevant evidence becomes available (Elliott et al., 2017). Living guideline approaches also demonstrate that updated evidence can be related to evolving recommendations (Akl et al., 2017).

The DRA therefore makes no novelty claim for continuous evidence updating.

Its proposed synthesis function is more specifically concerned with cross-project synthesis among independently governed research units.

This synthesis is designed not merely to update an evidence base, but to identify convergence, divergence, null results, negative results, contextual variation, methodological dependence, and residual uncertainty across a federated portfolio.

3.6 Evidence and Gap Maps

Evidence and Gap Maps provide another established mechanism directly relevant to DRA.

Snilstveit et al. (2016) show that such maps can identify existing evidence and knowledge gaps and support evidence-informed policy and strategic research agendas.

Evidence-gap mapping is therefore explicitly treated as an inherited mechanism within the DRA.

The proposed Shared Evidence Architecture extends beyond the map itself by maintaining traceability among gaps, research questions, active projects, methods, findings, contradictions, and subsequent portfolio decisions.

3.7 Adaptive management and learning systems

Adaptive approaches already incorporate iteration, feedback and learning under uncertainty.

Rist et al. (2013) review adaptive management and emphasise the importance of learning and adaptation while also identifying ambiguity in the way adaptive management is sometimes operationalised. Gillson et al. (2019) further connect adaptive management with evidence-based approaches and iterative learning.

Learning Health Systems similarly organise ongoing relationships among evidence, practice and learning. Friedman et al. (2015) explicitly develop a research agenda for the science of learning systems, including adaptability and improvement of the learning process itself.

Consequently, adaptive learning and recursive feedback are not distinctive DRA mechanisms by themselves.

The DRA's narrower proposed feature concerns the use of synthesis to reconfigure a subsequent portfolio of independently governed projects.

3.8 Science-policy interfaces and co-production

Strategically oriented research frequently interacts with institutional decision-making.

Van den Hove (2007) challenges simplistic separation between science and policy and conceptualises their interface as an interactive process.

Greenhalgh and Wieringa (2011) similarly criticise overly linear metaphors of knowledge translation, showing that relations between knowledge and practice are more complex than unidirectional transfer.

Co-production scholarship adds questions of governance and power. Wyborn et al. (2019) demonstrate that relationships among science, policy, practice and institutions influence the production and use of knowledge.

These literatures make an impermeable separation between researchers and institutions inappropriate.

The DRA consequently proposes not a scientific firewall, but an explicit Scientific-Institutional Responsibility Boundary, developed later in the article.

3.9 Research integrity and meta-research

Research integrity provides another foundation for the architecture.

The European Code of Conduct for Research Integrity identifies reliability, honesty, respect and accountability as fundamental principles of good research practice (ALLEA, 2023).

Meta-research further treats scientific processes themselves as objects of systematic investigation. Ioannidis et al. (2015) identify methods, reporting, reproducibility, evaluation and incentives among the principal domains of meta-research.

The DRA therefore does not claim originality for scientific self-evaluation or meta-learning.

Instead, integrity and meta-research principles inform the governance safeguards through which the architecture itself should eventually be examined.

3.10 Theoretical gap hypothesis

The literature reviewed above substantially narrows the possible contribution of the DRA.

Established and emerging research already addresses scientific collaboration, interdisciplinarity, transdisciplinarity, convergence, knowledge integration, research portfolios, evidence synthesis, evidence-gap mapping, adaptive learning, research-priority setting, science-policy interaction, and organisational learning.

The proposed gap is therefore not the absence of these mechanisms.

The reviewed literature instead suggests a narrower configurational question:

whether these mechanisms can be combined around independently governed research projects participating in a shared evidence architecture that preserves divergent findings and uses portfolio-level synthesis to reconfigure a subsequent independently governed research portfolio.

This is a configurational gap hypothesis.

It is not a claim that no antecedent architecture exists.

The potential contribution of the DRA lies in the proposed configuration of established mechanisms rather than in claiming novelty for those mechanisms individually.

Whether that configuration proves conceptually distinct, operationally feasible or scientifically advantageous remains an empirical question.

4. Methodology

4.1 Research design

This study adopts a structured integrative literature review combined with conceptual framework development.

The purpose is not to estimate a single intervention effect or to perform a conventional systematic review of one narrowly specified intervention. Instead, the study compares multiple bodies of scholarship relevant to coordination, integration, synthesis, governance and learning across research arrangements.

The review serves two purposes. First, it identifies mechanisms already represented in adjacent research traditions. Second, it uses these mechanisms to examine whether a specific configurational space remains for the proposed DRA.

Conceptual framework development follows the principle that a framework should organise relationships among concepts rather than merely assemble them (Jabareen, 2009). The review design is also informed by the methodological distinctions among review types identified by Grant and Booth (2009) and by Snyder's (2019) discussion of literature review as a research methodology.

4.2 Review question

The methodological review question is:

Which existing research frameworks address one or more of the functions required to connect multiple scientifically autonomous projects around a shared problem, and how are those functions configured?

The search therefore focuses on mechanisms rather than on the phrase Directed Research Architecture.

Relevant terminology includes team science; interdisciplinary research; transdisciplinary research; convergence research; knowledge integration; research portfolios; evidence synthesis; living evidence; Evidence and Gap Maps; adaptive management; learning systems; programme evaluation; science-policy interfaces; co-production; research integrity; and meta-research.

4.3 Review scope and methodological status

The literature component of this study is a structured integrative and concept-development review rather than a systematic review. Search procedures were used to identify, verify and critically compare relevant conceptual frameworks and research traditions; no claim of exhaustive coverage of all eligible publications is made. The purpose of the literature component is configurational: to determine which mechanisms relevant to the proposed Directed Research Architecture are already represented in established or emerging scholarship, and whether a sufficiently distinct configuration remains for conceptual and subsequent empirical examination.

Accordingly, the study does not report PRISMA-style screening counts or claim systematic-review completeness unless such procedures have been prospectively executed and documented.

Bibliographic searches, source verification and cross-framework comparison are used to support conceptual development, not to estimate an intervention effect or establish comprehensive evidence prevalence.

Only databases, search procedures, dates, search strings and screening information actually documented during the study should be reported as completed procedures. No retrospective screening counts are reconstructed.

4.4 Literature domains

- Science of Team Science
- Interdisciplinary, Transdisciplinary and Convergence Research
- Knowledge Integration
- Research Portfolio Management
- Evidence Synthesis and Living Evidence
- Evidence and Gap Mapping
- Programme Theory and Evaluation
- Adaptive Management and Learning Systems
- Science-Policy Interfaces and Co-production
- Organisational Learning
- Research Integrity and Meta-research

These domains were selected because each addresses one or more functions potentially relevant to the proposed architecture.

Their inclusion does not imply that they are incomplete or methodologically inferior. They constitute the principal conceptual comparators against which the DRA is examined.

4.5 Search logic

Search strategies are organised around functional mechanisms rather than the phrase Directed Research Architecture.

("research portfolio" OR "research programme") AND (coordination OR synthesis OR interdependence OR evaluation)

("knowledge integration" OR "knowledge synthesis") AND (interdisciplinary OR cross-disciplinary OR convergence)

("living systematic review" OR "living evidence") AND (continuous OR updating OR synthesis)

("evidence gap map" OR "research gap") AND ("priority setting" OR research agenda)

("scientific autonomy" OR "research independence") AND (governance OR programme OR collaboration)

("adaptive management" OR "learning system") AND (evidence OR feedback OR iterative)

("science policy interface" OR co-production) AND (knowledge OR governance OR decision making)

("research portfolio" AND autonomy)

("independent research projects" AND synthesis)

The latter searches are particularly important because they address the most discriminating feature of the DRA: coordination across projects that retain independent scientific governance.

4.6 Inclusion criteria

Sources are considered eligible where they satisfy at least one of the following conditions:

- they develop or test a framework for scientific collaboration or multi-project coordination;

- they examine knowledge integration across heterogeneous scientific contributions;
- they analyse research portfolios, programmes or mission-oriented research structures;
- they address evidence synthesis, living evidence or evidence-gap mapping;
- they describe iterative or adaptive evidence-learning mechanisms;
- they examine research autonomy, scientific integrity or science-institution governance;
- they contribute to conceptual framework development or programme-theory evaluation;
- or they provide a framework sufficiently similar to the DRA to challenge its distinctiveness.

The final condition is methodologically important. The review is designed not only to identify supporting literature, but also to detect frameworks that may render the proposed architecture redundant or require its repositioning.

4.7 Exclusion criteria

Sources are excluded where:

- relevance is merely lexical;
- the publication does not address a mechanism relevant to the review question;
- bibliographic identity cannot be verified;
- an authoritative original source is available in place of a secondary summary;
- the source is principally promotional rather than analytical;
- or the source cannot support the claim for which it would be used.

Sources are not excluded because they contradict the DRA.

4.8 Data extraction

For each retained source, the extraction matrix records, where available:

- author(s); year; title; publication source; DOI or persistent identifier;
- research tradition; research design; primary unit of analysis;
- principal coordination mechanism; treatment of knowledge integration;
- treatment of scientific autonomy; treatment of synthesis;
- treatment of contradictory evidence; presence or absence of research-agenda renewal;
- main findings or propositions; limitations; and relevance to the proposed DRA.

The purpose of this matrix is to prevent the conceptual gap from being established impressionistically.

4.9 Functional comparison

The literature is compared according to mechanisms rather than an evaluative ranking.

- DRA-F1 - Shared Strategic Problem Space
- DRA-F2 - Shared Evidence Architecture
- DRA-F3 - Independently Governed Research Portfolio
- DRA-F4 - Contradiction-Preserving Cross-Project Synthesis
- DRA-F5 - Evidence-Driven Federated Portfolio Renewal

Broader coding categories may be used during literature analysis, but they should not be interpreted as a scoring system demonstrating superiority of the DRA.

4.10 Conceptual development procedure

1. Mechanism identification: mechanisms already present in the literature are identified without attributing them uniquely to the DRA.
2. Functional comparison: existing approaches are compared according to their analytical unit and the mechanisms they provide.

3. Governance comparison: particular attention is given to whether constituent research projects retain independent scientific governance.
4. Configuration analysis: the analysis examines whether established mechanisms are already combined within a single research-governance arrangement.
5. Configurational gap hypothesis: any remaining conceptual gap is formulated provisionally rather than treated as proof of originality.
6. DRA specification: the resulting architecture is formalised into functions, operational criteria and testable propositions.

4.11 Bias controls

Because the author is proposing the framework under examination, confirmation bias is a material methodological risk.

- competing frameworks are actively sought;
- similarities that reduce the DRA's originality are retained;
- established findings are distinguished from synthesis and proposal;
- contradictory evidence is not excluded;
- no external source is presented as validating the DRA unless it actually evaluates the architecture;
- and independent methodological review is considered necessary before stronger claims are made.

4.12 Methodological status

The present design can support identification of relevant research traditions; comparison of mechanisms; development of a provisional configurational gap; and formulation of a testable research-governance architecture.

It cannot establish effectiveness, superiority, causal impact, or universal applicability.

Those questions require empirical research.

5. Directed Research Architecture v2.0

5.1 Canonical definition

Directed Research Architecture (DRA) is a proposed research-governance architecture that federates independently governed research projects around a shared strategic problem space through a common evidence architecture, contradiction-preserving cross-project synthesis, cumulative knowledge development, and evidence-driven renewal of subsequent federated research portfolios.

Independent scientific governance refers to substantive autonomy over theoretical decisions, methodological decisions, interpretative decisions, and publication decisions.

Federation is used here as an analytical term and does not imply a legal, political or organisational federation.

5.2 DRA-F1 - Shared Strategic Problem Space

The first function is the establishment of a Shared Strategic Problem Space.

The term problem space is deliberately preferred to a fixed problem statement because the original framing may require revision as new evidence is produced.

The shared problem space provides a common intellectual reference, a basis for identifying evidence gaps, and a framework within which otherwise independent projects can later be compared.

The problem space may originate from researchers, public institutions, universities, professional organisations, funders or other legitimate actors.

However, identifying the strategic problem does not confer authority to determine the theoretical explanation, the research method, the interpretation, or the conclusion.

strategically oriented but scientifically revisable.

5.3 DRA-F2 - Shared Evidence Architecture

The second function is the Shared Evidence Architecture.

This concept includes, but is broader than, evidence-gap mapping.

It may incorporate existing evidence, evidence gaps, research questions, project metadata, theoretical assumptions, methods, units of analysis, contexts, findings, limitations, contradictions, and relationships among projects.

The evidence architecture should make it possible to identify what is already known, what remains uncertain, which project addresses which gap, where findings converge, where they diverge, which conclusions are context-dependent, and which questions remain unresolved.

Its principal function is portfolio-level traceability.

It does not provide central scientific control.

5.4 DRA-F3 - Independently Governed Research Portfolio

The third function is the Independently Governed Research Portfolio.

A DRA-compatible portfolio differs from a collection of centrally governed work packages because each constituent project retains substantive scientific decision rights.

Independent scientific governance comprises four dimensions.

Theoretical autonomy

Researchers retain authority over the theories and conceptual frameworks used to investigate their research question.

Methodological autonomy

Researchers retain authority over research design, measurement and analytical methods, except where harmonisation is voluntarily adopted for scientifically justified comparison.

Interpretative autonomy

Portfolio coordinators, funders or participating institutions do not possess authority to rewrite project-level scientific conclusions.

Publication autonomy

Scientifically legitimate findings should remain publishable, subject to normal ethical, legal, contractual and confidentiality requirements.

Independent scientific governance does not imply isolation.

Projects may share metadata standards, data dictionaries, common outcome definitions, harmonised measures, or comparative protocols.

coordination of interfaces and centralisation of scientific judgement are analytically distinct.

5.5 DRA-F4 - Contradiction-Preserving Cross-Project Synthesis

The fourth function is Contradiction-Preserving Cross-Project Synthesis.

The term is deliberately narrower than continuous synthesis because living evidence approaches already demonstrate continuous updating of scientific evidence (Elliott et al., 2017).

The DRA-specific proposition concerns synthesis across projects that retain independent scientific governance.

Portfolio-level synthesis should make visible convergent findings, divergent findings, negative results, null results, context-dependent findings, methodological limitations, and unresolved uncertainty.

Its purpose is not to create artificial consensus.

Where findings conflict, synthesis should examine whether divergence can be associated with theoretical assumptions, methods, measurement, sample characteristics, institutional context, time horizon, or genuine unresolved uncertainty.

Contradiction therefore becomes an object of scientific analysis rather than a coordination failure.

5.6 DRA-F5 - Evidence-Driven Federated Portfolio Renewal

The fifth function is Evidence-Driven Federated Portfolio Renewal.

This requirement goes beyond general research-priority setting.

Portfolio-level synthesis must explicitly modify at least one component of the subsequent research cycle, such as research questions, evidentiary priorities, coverage of populations or contexts, methodological needs, or portfolio composition.

The next cycle should therefore be demonstrably informed by the previous portfolio's evidence.

research outputs -> cross-project synthesis -> revised evidence architecture -> reconfigured subsequent federated portfolio

5.7 Cumulative Strategic Knowledge

The principal proposed scientific outcome is Cumulative Strategic Knowledge (CSK).

a progressively structured body of evidence generated by critically connecting autonomous research contributions while explicitly accounting for convergence, contradiction, contextual variation, methodological limitation and remaining uncertainty around a shared strategic problem space.

CSK is proposed here as an analytical construct. It is not presented as an established or validated measurement scale.

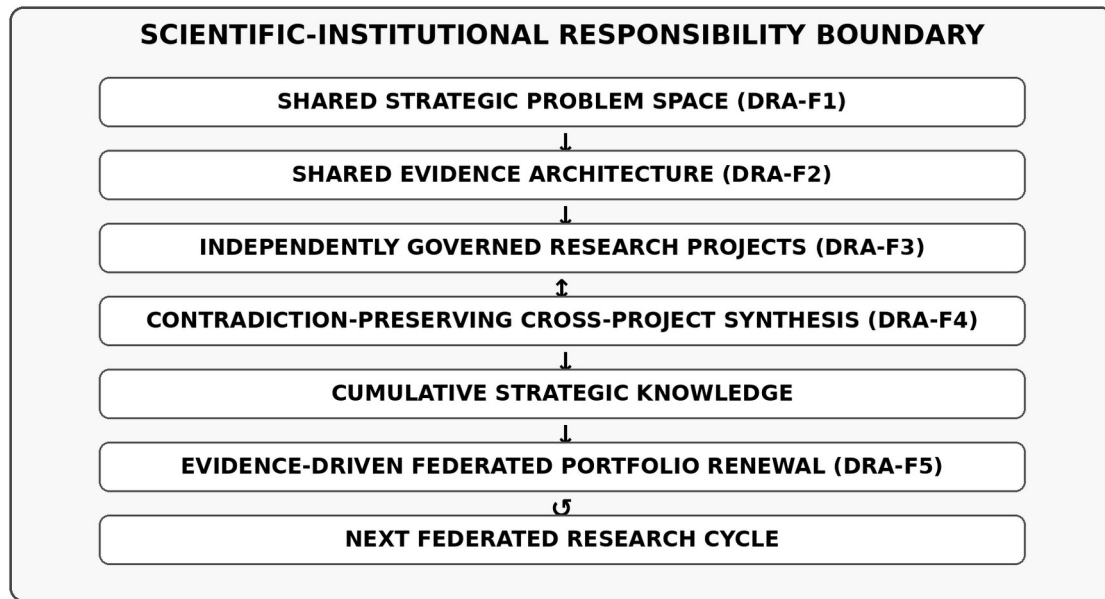
Figure 1. Directed Research Architecture (DRA v2.0): Core Research-Governance Cycle

Figure 1. The model connects independently governed research projects through a shared evidence architecture and contradiction-preserving cross-project synthesis. Portfolio-level synthesis contributes to Cumulative Strategic Knowledge and informs the subsequent federated research cycle. The Scientific-Institutional Responsibility Boundary applies across the architecture. The figure represents a proposed conceptual model and does not imply empirically established causal effects.

Table 1. Core Functions and Operational Criteria of the Directed Research Architecture

DRA Core Function	Purpose	Corresponding Operational Criterion
DRA-F1 - Shared Strategic Problem Space	Establishes a common but scientifically revisable problem space around which otherwise independent research projects can contribute.	C1 - Shared Strategic Problem Criterion: Projects explicitly contribute to a common strategic problem space.
DRA-F2 - Shared Evidence Architecture	Maintains traceability among existing evidence, gaps, research questions, projects, methods, findings, limitations and contradictions.	Supports C3-C6 by providing the common evidentiary infrastructure required for federation, synthesis and renewal.
DRA-F3 - Independently Governed Research Portfolio	Connects projects while preserving substantive scientific autonomy over theory, methodology, interpretation and publication.	C2 - Independent Scientific Governance Criterion and C3 - Federated Portfolio Criterion.
DRA-F4 - Contradiction-Preserving Cross-Project Synthesis	Compares evidence across project boundaries while retaining null, negative, divergent and context-dependent findings.	C4 - Cross-Project Synthesis Criterion and C5 - Divergence Preservation Criterion.
DRA-F5 - Evidence-Driven Federated Portfolio Renewal	Uses portfolio-level synthesis to alter questions, evidentiary priorities or composition of a subsequent research cycle.	C6 - Evidence-Driven Portfolio Renewal Criterion.

Note. The criteria specify observable conditions for identifying a DRA-compatible research arrangement. They are proposed operational criteria and should not be interpreted as a validated measurement scale or as a scoring system for ranking alternative research frameworks.

Core distinction. Integration concerns how heterogeneous knowledge is brought together. Federation concerns how independently governed knowledge-producing units are connected without requiring their scientific governance to be unified. The DRA proposes that integration may occur through federation while theoretical, methodological, interpretative and publication autonomy remain substantively decentralised.

5.9 Operational criteria C1-C6

C1 - Shared Strategic Problem Criterion. Projects contribute explicitly to a common strategic problem space.

C2 - Independent Scientific Governance Criterion. Projects retain substantive theoretical, methodological, interpretative and publication autonomy.

C3 - Federated Portfolio Criterion. Projects participate in a shared evidence architecture without being reduced to centrally governed work packages.

C4 - Cross-Project Synthesis Criterion. Evidence is systematically compared across project boundaries.

C5 - Divergence Preservation Criterion. Null, negative, contradictory and context-dependent findings remain visible and analytically usable.

C6 - Evidence-Driven Portfolio Renewal Criterion. Portfolio-level synthesis explicitly changes the questions, evidentiary priorities or composition of a subsequent research cycle.

These criteria give empirical content to the proposed concept of research federation.

6. Conceptual Propositions and Empirical Testability

6.1 P1 - Federation and cross-project integration

P1. Portfolios combining independent scientific governance with a shared evidence architecture will exhibit greater cross-project knowledge integration than collections of independently conducted but evidentially unconnected research projects.

The proposition distinguishes research federation from simple coexistence. Its empirical test requires comparison between projects linked through shared evidentiary structures and projects addressing related questions without such structures.

6.2 P2 - Scientific autonomy

P2. The positive relationship between portfolio federation and cumulative strategic knowledge will be stronger where theoretical, methodological, interpretative and publication autonomy are preserved.

Autonomy is therefore treated as a testable condition rather than only as a normative principle.

6.3 P3 - Cross-project synthesis

P3. Contradiction-preserving cross-project synthesis mediates the relationship between portfolio federation and cumulative strategic knowledge.

The hypothesised pathway is: Federated Portfolio -> Cross-Project Synthesis -> Cumulative Strategic Knowledge. If cumulative knowledge develops equally well in the absence of such synthesis, this mechanism would require revision.

6.4 P4 - Methodological diversity

P4. Methodological diversity contributes positively to cumulative strategic knowledge when project differences are traceable and subjected to structured cross-project synthesis.

Methodological heterogeneity is not assumed to be inherently beneficial. Where traceability and synthesis are weak, diversity may instead increase fragmentation.

6.5 P5 - Divergent evidence

P5. Portfolios that preserve and analyse null, negative, contradictory and context-dependent findings will generate more robust cumulative strategic knowledge than portfolios in which synthesis preferentially retains convergent findings.

This proposition makes divergence preservation an empirically assessable property of the architecture.

6.6 P6 - Traceability

P6. Higher levels of portfolio-level research traceability within a shared evidence architecture will improve the interpretability of cross-project synthesis.

Possible future indicators include traceability of synthesis claims to constituent studies; visibility of project assumptions; documentation of methodological differences; and explicit connections between evidence gaps and project outputs.

6.7 P7 - Responsibility differentiation

P7. Explicit differentiation between strategic agenda-setting, scientific production, cross-project synthesis and institutional decision-making will be positively associated with scientific autonomy and evidence integrity.

The proposition operationalises the Scientific-Institutional Responsibility Boundary developed in Section 7.

6.8 P8 - Federated portfolio renewal

P8. Portfolios in which synthesis explicitly reconfigures the questions, evidentiary priorities or composition of the subsequent independently governed portfolio will exhibit greater cumulative knowledge development across successive cycles than portfolios whose research agenda remains substantially fixed.

Testing this proposition requires longitudinal data across more than one research cycle.

6.9 Falsification conditions

The DRA would be weakened if future empirical evidence demonstrated that:

- a shared evidence architecture does not improve cross-project integration;
- independent scientific governance is unrelated to evidence integrity or cumulative knowledge;
- cross-project synthesis provides no identifiable additional value;
- preserving divergent findings does not improve interpretability or robustness;
- portfolio renewal does not improve cumulative learning;
- or alternative research arrangements achieve comparable results with substantially lower coordination costs.

These outcomes must remain scientifically admissible.

6.10 Status of P1-P8

The propositions above are not findings.

They are hypothesised relationships derived from the proposed architecture.

They therefore require prospective empirical testing.

7. Governance, Integrity and the Scientific-Institutional Responsibility Boundary

7.1 Governance as a scientific condition

Governance is not treated as an administrative layer external to the DRA.

It is part of the research architecture because strategic research may involve actors who define problems, finance projects, provide access to data, participate in synthesis, publish results, or make decisions based on the evidence.

Concentration of these functions can affect scientific autonomy and evidentiary integrity.

Existing science-policy research demonstrates that scientific and institutional actors cannot simply be separated into isolated domains (van den Hove, 2007). Co-production literature similarly emphasises relationships among knowledge, institutions, governance and power (Wyborn et al., 2019).

The DRA therefore does not seek institutional isolation. It seeks responsibility differentiation.

7.2 Canonical definition

Scientific-Institutional Responsibility Boundary

defined as:

a governance arrangement that permits interaction, exchange and coordination between scientific and institutional actors while maintaining explicit responsibility boundaries for strategic agenda-setting, scientific production, cross-project synthesis and institutional decision-making.

Its governing principle is:

interaction without epistemic subordination.

7.3 Strategic agenda-setting responsibility

Institutions may legitimately identify strategic problems requiring scientific investigation.

They may contribute operational information, institutional context, policy constraints, risk information, and practical knowledge.

Such contributions can inform the Shared Strategic Problem Space.

However, institutional participation in problem identification should not automatically confer authority over scientific theory, research methods, data interpretation, or scientific conclusions.

7.4 Scientific production responsibility

The constituent research project remains responsible for theory, methodology, data analysis, interpretation, and scientific conclusions.

The architecture therefore distinguishes institutional relevance from scientific determination.

A finding may legitimately contradict the expectations of the institution that initiated or financed the research.

7.5 Synthesis responsibility

Cross-project synthesis constitutes a separate epistemic responsibility.

Even where individual projects remain scientifically autonomous, portfolio-level synthesis may introduce bias by excluding null results, privileging preferred methodologies, removing contextual qualifications, or underrepresenting contradictory findings.

The synthesis process should therefore document which projects were considered, which findings were included, which disagreements were identified, which methodological differences affected interpretation, and which uncertainties remain unresolved.

7.6 Institutional decision responsibility

Research findings may inform institutional decisions but do not mechanically determine them.

Institutional decisions may legitimately incorporate legal obligations, budgets, implementation capacity, ethical considerations, social priorities, political mandates, and risk tolerance.

scientific conclusion != institutional decision

Researchers remain responsible for evidentiary claims. Decision-makers remain responsible for institutional choices.

7.7 Conflict-of-interest transparency

Strategically oriented research may involve conflicts of interest.

Relevant relationships may include funding, institutional employment, advisory roles, editorial roles, research-network participation, or prior advocacy.

Such relationships do not automatically invalidate research.

However, they should be disclosed where they are reasonably capable of influencing scientific judgement.

Where appropriate, safeguards may include independent review, editorial recusal, transparent funding declarations, and separation between project evaluation and project authorship.

7.8 Research integrity

The DRA is intended to remain compatible with established research-integrity principles.

The European Code of Conduct for Research Integrity identifies reliability, honesty, respect and accountability as fundamental principles of good research practice (ALLEA, 2023).

The DRA does not replace these standards.

Its more specific question concerns how such principles should operate when multiple autonomous research projects are strategically federated.

7.9 Publication independence

A DRA-compatible governance arrangement should protect the scientific visibility of legitimate findings regardless of whether they support institutional expectations.

In principle, negative findings, null findings, contradictory findings, and findings questioning the original strategic framing should remain publishable subject to ordinary ethical, legal and methodological requirements.

Institutional relevance should not determine scientific admissibility.

7.10 DIM Review and self-validation

DIM Review may provide one institutional environment in which aspects of the proposed architecture are piloted and exposed to independent scientific evaluation.

DIM Review is not presented as evidence of the effectiveness or validation of the DRA.

Where future research directly evaluates the DRA, independent methodological review should be used where feasible.

Editorial and research-coordination roles should also remain distinguishable.

8. Cumulative Strategic Knowledge

8.1 From research accumulation to cumulative knowledge

The principal scientific outcome proposed by the DRA is not publication volume, project count, network size or citation frequency.

A research system may generate increasing numbers of studies while remaining epistemically fragmented.

The DRA therefore distinguishes research accumulation from cumulative knowledge development.

Research accumulation refers to the production of additional studies, datasets, reports or publications.

Cumulative knowledge requires explicit relationships among those outputs.

These relationships include comparison, integration, identification of contradiction, contextual interpretation, methodological qualification, and use of unresolved uncertainty to generate subsequent inquiry.

Existing scholarship already recognises the importance of cumulative learning and transparent evidence structures. Dunning (2016) argues that experiments alone are insufficient for cumulative learning and highlights the importance of transparency and replication. Living-evidence approaches similarly demonstrate that evidence bases can be updated continuously as new research becomes available (Elliott et al., 2017).

The DRA therefore does not claim novelty for cumulability itself.

Its narrower concern is cumulative knowledge across independently governed research projects.

8.2 Canonical definition of Cumulative Strategic Knowledge

The DRA proposes Cumulative Strategic Knowledge (CSK) as:

a progressively structured body of evidence generated by critically connecting autonomous research contributions while explicitly accounting for convergence, contradiction, contextual variation, methodological limitation and remaining uncertainty around a shared strategic problem space.

CSK is proposed here as an analytical construct. It is not presented as an established or validated measurement scale.

8.3 Aggregation, integration and cumulability

Three levels should be distinguished.

Aggregation: research outputs are placed together ($A + B + C$). No analytical relationship among them is required.

Integration: relationships among findings are examined ($A \leftrightarrow B \leftrightarrow C$). This may involve convergence, divergence, methodological comparison, or contextual differentiation.

Cumulability: integrated evidence changes subsequent inquiry ($A \leftrightarrow B \leftrightarrow C \rightarrow$ revised uncertainty $\rightarrow$ new research questions $\rightarrow$ subsequent portfolio).

Cumulability therefore has a temporal dimension. It cannot be fully established through a single research cycle.

8.4 Contradiction as scientific information

The DRA does not equate cumulative knowledge with increasing agreement.

Consider three studies examining a common intervention. One reports a positive association. A second reports no measurable association. A third reports a positive association only under certain institutional conditions.

A superficial synthesis may classify these results as inconsistent.

A stronger synthesis asks whether divergence can be explained by different populations, different measures, implementation conditions, time horizons, institutional context, theoretical assumptions, or methodological design.

Where divergence can be explained, contradiction becomes conditional knowledge.

Where it cannot, the unresolved contradiction itself becomes a more precisely defined research problem.

divergence may contribute to cumulative knowledge when it becomes analytically intelligible.

8.5 Four provisional dimensions of CSK

CSK1 - Integration. The degree to which findings from different projects are explicitly related rather than merely reported separately.

CSK2 - Divergence Explicitness. The degree to which contradictory, null, negative and context-dependent findings remain visible and analytically interpreted.

CSK3 - Gap Evolution. The degree to which evidence gaps become resolved, narrowed, reformulated, or more precisely bounded over time.

CSK4 - Research Generativity. The degree to which synthesis produces new and more precise research questions for the subsequent portfolio.

These dimensions require future empirical validation.

8.6 Evidence comparability

Federated projects may produce evidence with different levels of comparability.

The DRA should distinguish directly comparable evidence; partially comparable evidence; and non-comparable but complementary evidence.

This distinction is important because heterogeneity may arise from different constructs, measurement systems, time periods, territorial scales, units of analysis, or epistemological traditions.

Federation should therefore not manufacture comparability where scientific comparability does not exist.

8.7 Shared evidence architecture as scientific memory

The Shared Evidence Architecture provides a persistent record of questions, gaps, projects, methods, contexts, findings, limitations, contradictions, and unresolved uncertainties.

Its function is therefore more than archival.

It provides an evolving portfolio-level scientific memory.

This memory should allow subsequent research cycles to begin from an explicit representation of what previous projects actually established and failed to establish.

8.8 CSK and institutional use

Cumulative Strategic Knowledge must remain analytically distinct from policy adoption or organisational implementation.

A portfolio may produce a strong evidence base that institutional actors do not use.

Conversely, an institution may adopt a policy despite weak scientific evidence.

CSK quality != policy uptake

policy uptake != scientific validity

Institutional use belongs to a separate extension of the architecture, not to the definition of CSK itself.

9. Comparative Positioning of the DRA

9.1 Purpose of comparison

The purpose of comparative positioning is not to rank existing frameworks.

Different approaches address different scientific and organisational problems.

The relevant question is whether the proposed DRA combines established mechanisms in a configuration sufficiently distinct to justify independent investigation.

9.2 Science of Team Science

Science of Team Science primarily examines researchers, teams and collaborative processes (Hall et al., 2018).

The DRA may contain team-based projects, but its principal unit of analysis is the federated portfolio of independently governed research projects.

Thus, Team Science concerns collaboration within teams, whereas DRA concerns evidentiary coordination across independently governed projects. The two approaches are compatible.

9.3 Interdisciplinary and transdisciplinary research

Interdisciplinary and transdisciplinary approaches focus primarily on integration across disciplinary or societal boundaries.

The DRA does not require every participating project to be interdisciplinary.

A discipline-specific study may contribute to the same federated portfolio as interdisciplinary research, provided that both connect to the shared evidence architecture.

Thus, disciplinary integration and research federation are analytically distinct dimensions.

9.4 Convergence research

Convergence research constitutes one of the closest comparators.

Recent scholarship demonstrates that convergence projects can integrate multiple forms of expertise around complex societal problems and can use adaptive mechanisms for knowledge integration and boundary coordination (Misra et al., 2024; Punjabi et al., 2026).

The DRA therefore does not claim novelty for problem orientation, adaptive coordination, cross-boundary interaction, or knowledge integration.

Its proposed distinction concerns the scientific governance of constituent projects.

The DRA asks whether these integrative functions can operate across projects that remain independently governed rather than forming components of one common convergence enterprise.

9.5 Knowledge Integration

Knowledge-integration frameworks address how heterogeneous knowledge becomes connected and interpretable.

The DRA incorporates this objective but introduces an additional governance question: Can the units producing that knowledge remain independently governed?

Thus, knowledge integration concerns relations among knowledge contributions; research federation concerns governance relations among the projects producing those contributions.

9.6 Research Portfolio Management

Research portfolio approaches already treat projects collectively and may address complementarity, resource allocation, interdependencies and strategic objectives (Linton & Vonortas, 2015; Canton, 2025).

The DRA therefore does not claim the portfolio concept as novel.

Its proposed extension is to treat the portfolio as a persistent evidence architecture in addition to a management structure.

9.7 Evidence and Gap Maps

Evidence and Gap Maps already support identification of available evidence, knowledge gaps and research priorities (Snilstveit et al., 2016).

Accordingly, evidence-gap mapping is an inherited mechanism within DRA.

The proposed difference is that the evidence map remains dynamically connected to active research projects, contradictions and subsequent portfolio renewal.

9.8 Living evidence

Living systematic reviews demonstrate that scientific evidence can be continuously updated as new studies become available (Elliott et al., 2017).

The DRA therefore does not claim continuous updating as a novel mechanism.

Its specific proposition concerns cross-project synthesis among independently governed projects plus divergence preservation plus subsequent portfolio reconfiguration.

9.9 Adaptive management and learning systems

Adaptive management and Learning Health Systems demonstrate that evidence, feedback and subsequent action can be organised iteratively (Rist et al., 2013; Friedman et al., 2015; Gillson et al., 2019).

Thus, recursive learning is not unique to DRA.

The DRA's narrower proposition is that synthesis should reconfigure a subsequent federated research portfolio whose constituent projects remain independently governed.

9.10 Programme Theory and Evaluation

Programme theory provides a useful basis for making mechanisms explicit and testable (Brousselle & Champagne, 2011).

The DRA can itself be treated as a programme theory in future empirical work.

However, programme theory generally evaluates how an intervention is expected to generate outcomes.

The DRA instead focuses on governance relations among multiple knowledge-producing projects.

9.11 Science-Policy Interfaces

Science-policy interface literature shows that research and decision-making interact in complex, non-linear ways (van den Hove, 2007; Greenhalgh & Wieringa, 2011).

The DRA therefore rejects a simple research -> decision model.

Its proposed Scientific-Institutional Responsibility Boundary instead seeks to differentiate authority while allowing continued interaction.

9.12 Organisational Learning

Organisational-learning literature addresses how institutions acquire, interpret and use knowledge (Rashman et al., 2009).

The DRA deliberately keeps organisational learning outside its scientific core.

A DRA portfolio may generate cumulative knowledge even if an institution later fails to use it.

9.13 Comparative synthesis

Framework	Primary focus	Proposed DRA distinction
Team Science	Scientific teams and collaborative processes	Portfolio-level evidentiary coordination across independently governed projects.
Interdisciplinary research	Integration across disciplinary boundaries	Interdisciplinarity is not required for every participating project.
Convergence research	Problem-driven integration and adaptive coordination	Tests whether integrative functions can operate across independently governed projects.
Knowledge Integration	Relations among heterogeneous knowledge contributions	Adds governance relations among the projects producing those contributions.
Research Portfolio Management	Collective management of multiple projects	Treats the portfolio as a persistent evidence architecture.
Evidence & Gap Maps	Evidence and gap identification	Links the evidence structure dynamically to active projects, contradictions and portfolio renewal.
Living Evidence	Continuous updating of evidence	Adds contradiction-preserving cross-project synthesis and portfolio renewal.
Adaptive/Learning Systems	Feedback and iterative adaptation	Reconfigures a subsequent independently governed research portfolio.
Programme Theory	Explicit mechanisms and testability	Makes the architecture itself an object of empirical testing.

Science-Policy Interface	Interaction between evidence and decision-making	Introduces explicit responsibility differentiation.
Organisational Learning	Institutional acquisition and use of knowledge	Located outside the DRA scientific core.

Note. This comparison is descriptive and should not be interpreted as an evaluative ranking of frameworks.

9.14 Canonical originality claim

The proposed contribution of the Directed Research Architecture does not lie in problem-oriented research, interdisciplinary collaboration, portfolio management, evidence-gap mapping, knowledge integration, continuous evidence synthesis, adaptive learning, programme evaluation or research-priority setting considered separately. Its potential contribution lies in configuring these mechanisms around a federated portfolio of independently governed research projects that share an evidence architecture, preserve divergent evidence and use portfolio-level synthesis to reconfigure subsequent research priorities or portfolio composition.

Whether this configuration is sufficiently distinct from existing research-governance arrangements, and whether it produces measurable scientific advantages, remain empirical questions.

10. Operationalisation and Pilot Implementation

10.1 Purpose

The purpose of operationalisation is to translate the conceptual architecture into observable research procedures.

An initial pilot should therefore test feasibility and mechanism plausibility rather than attempt to demonstrate public-policy effectiveness.

10.2 Shared strategic problem space

A pilot begins with a strategically relevant problem space rather than a predetermined set of research titles.

The initial formulation should identify the domain, the principal uncertainties, existing evidence, relevant contexts, and why multiple research projects may be required.

The framing must remain scientifically revisable.

10.3 Initial shared evidence architecture

Before new projects enter the portfolio, the pilot should establish a baseline evidence structure containing, where feasible, existing evidence, evidence gaps, known contradictions, relevant datasets, contextual limitations, and unresolved research questions.

The purpose is to create a traceable scientific baseline.

10.4 Project Evidence Record

Each participating project should have a Project Evidence Record documenting project identifier, research title, principal investigator, institution, country or context, research question, problem-space link, evidence gap addressed, theoretical framework, research design, unit of analysis, data source, limitations, ethical requirements, funding, conflict-of-interest information, and publication status.

The record should support synthesis without becoming unnecessary bureaucracy.

10.5 Assessing independent scientific governance

Independent governance should be assessed across four domains: theoretical autonomy; methodological autonomy; interpretative autonomy; publication autonomy.

A project should not be classified as independently governed merely because separate researchers perform centrally assigned tasks.

10.6 Shared standards

Common metadata or reporting standards may be used where they improve comparability.

The operational principle is:

standardise what is scientifically necessary for comparability; preserve autonomy where standardisation is unnecessary.

10.7 Synthesis cycle

A bounded pilot should include explicit portfolio-level synthesis.

The synthesis should evaluate convergence, divergence, methodological dependence, contextual variation, and residual uncertainty.

Its output should update the Shared Evidence Architecture.

10.8 Contradiction Register

A Contradiction Register may record projects involved, conflicting findings, methods, contexts, possible explanations, and unresolved questions.

This instrument is proposed as a practical implementation mechanism and is not presented as a validated tool.

10.9 Evidence-gap evolution

Evidence gaps may be tracked through provisional statuses such as open; under investigation; partially clarified; conditionally clarified; reformulated; provisionally resolved.

The objective is to observe whether the research portfolio changes the structure of uncertainty over time.

10.10 Portfolio renewal

At the end of a cycle, synthesis should inform a documented portfolio-renewal process.

Questions should include: Which research questions remain necessary? Which should be reformulated? Which contradictions require targeted investigation? Which contexts remain underrepresented? Which methodological weaknesses require correction? Which new questions emerged?

The subsequent portfolio should therefore be traceably related to the previous synthesis.

10.11 Bounded initial pilot

A deliberately limited pilot could, for example, involve one strategic problem space; approximately six to twelve projects; two or more disciplines; two or more institutional settings; a baseline evidence architecture; one or two formal synthesis points; and one documented portfolio-renewal decision.

These figures are illustrative and should not be interpreted as an empirically established optimum.

10.12 DIM Review

DIM Review may provide one institutional environment for pilot development, methodological discussion and publication of synthesis work.

portfolio participation should not require publication in DIM Review, and publication decisions should not depend on portfolio participation.

Editorial and research-governance functions should remain distinguishable.

10.13 International implementation

International implementation should preserve contextual differences.

A common strategic problem does not imply identical questions, methods, legal contexts, datasets, or institutional structures.

comparability without artificial uniformity.

11. Limitations, Risks and Research Agenda

11.1 Conceptual distinctiveness

The distinctiveness of DRA remains provisional.

Future review may identify an existing research-governance framework that already combines most or all of the proposed mechanisms.

If so, DRA should be repositioned as an extension, adaptation, or domain-specific reformulation.

11.2 No demonstrated effectiveness

The present article does not demonstrate that DRA improves research quality, reduces duplication, improves synthesis, reduces cost, improves policy, or improves institutional performance.

Its current status remains:

proposed, operationally specified and empirically testable.

11.3 Coordination cost

Federation may impose significant transaction costs, including metadata production, synthesis, governance, documentation, and meetings.

Future evaluation should therefore examine scientific benefit relative to coordination burden.

11.4 Autonomy-comparability tension

Greater autonomy may reduce comparability.

Greater standardisation may increase comparability but constrain autonomy.

The optimal balance, if one exists, remains an empirical question.

11.5 Synthesis authority

Synthesis may itself create epistemic concentration.

Future studies should therefore examine who controls synthesis, how disagreements are represented, whether minority interpretations remain visible, and how methodological preferences influence portfolio-level conclusions.

11.6 International inequality

Federation may reproduce inequalities in funding, language, data access, institutional prestige, publication capacity, and methodological resources.

Future evaluation should examine not only geographic participation but epistemic influence.

11.7 Measurement limitations

Key constructs currently lack validated scales, including Independent Scientific Governance, Federation Intensity, Cross-Project Synthesis Quality, Cumulative Strategic Knowledge, and Portfolio Renewal Quality.

Measurement development is therefore a prerequisite for stronger quantitative claims.

11.8 Temporal limitation

Evidence-driven portfolio renewal is inherently longitudinal.

A single cycle can test feasibility but not mature cumulative learning.

11.9 Domain dependence

The architecture may function differently across scientific domains.

Transferability should therefore be investigated rather than assumed.

11.10 Research agenda

7. Phase 1 - External conceptual review
8. Phase 2 - Measurement development
9. Phase 3 - Bounded feasibility pilot
10. Phase 4 - Mechanism testing
11. Phase 5 - Comparative evaluation
12. Phase 6 - International replication
13. Phase 7 - Institutional Extension

This sequence is intended to prevent premature expansion before the scientific core is evaluated.

12. Discussion

The DRA proposes a shift from collaboration within a common scientific enterprise toward governance across independently governed research projects.

Its key proposition is not that autonomy and coordination are inherently compatible, but that they may be made compatible through evidence interfaces that do not centralise scientific judgement.

The architecture therefore occupies an intermediate position between fragmented independence and centralised integration.

Its proposed organising principle is:

coordinated evidence interfaces with decentralised scientific judgement.

For strategic planning, this architecture may be useful where a complex problem requires multiple scientific contributions but no single centrally governed study can capture the entire problem.

For knowledge management, it introduces an upstream distinction between availability of knowledge and structure of knowledge.

An organisation may possess substantial information while lacking a coherent representation of what is established, what is contested, what varies by context, and what requires further investigation.

The architecture also treats contradiction as analytically productive rather than merely problematic.

This may be particularly relevant in international research, where differences among institutions, countries and methods can reveal conditional rather than universal relationships.

The most important recursive feature concerns portfolio renewal.

The relevant question is observable:

Did portfolio-level synthesis actually alter the subsequent research portfolio?

If not, the architecture has not achieved recursive renewal in the DRA sense.

For DIM Review, the framework also clarifies distinctions among publishing, research coordination, international networking, committee participation, and institutional partnership.

These roles should remain separable.

The DRA's proposed contribution should therefore be described as configurational and research-governance oriented.

Its scientific value depends on future empirical testing rather than conceptual elegance alone.

13. Conclusion

This article examined a specific research-governance problem: how multiple scientific projects addressing a shared strategic problem might contribute to cumulative knowledge without being absorbed into a single centrally governed scientific programme.

Existing scholarship already provides sophisticated approaches to scientific collaboration, interdisciplinary and convergence research, knowledge integration, research portfolios, evidence synthesis, evidence-gap mapping, adaptive learning, programme evaluation, and science-policy interaction.

The proposed Directed Research Architecture does not claim novelty for these mechanisms individually.

Its potential contribution lies in their configuration around a federated portfolio of independently governed research projects.

Within the proposed architecture, projects participate in a shared strategic problem space, a shared evidence architecture, and cross-project synthesis while retaining substantive autonomy over theory, method, interpretation, and publication.

The architecture further requires that negative findings, null findings, contradictory findings, and context-dependent findings remain available for portfolio-level synthesis.

The resulting evidence is then expected to inform the questions, evidentiary priorities or composition of a subsequent federated research portfolio.

The DRA Core therefore consists of five functions: DRA-F1 - Shared Strategic Problem Space; DRA-F2 - Shared Evidence Architecture; DRA-F3 - Independently Governed Research Portfolio; DRA-F4 - Contradiction-Preserving Cross-Project Synthesis; and DRA-F5 - Evidence-Driven Federated Portfolio Renewal.

Its principal proposed scientific outcome is Cumulative Strategic Knowledge.

The present article does not demonstrate that this architecture is effective or superior to existing research arrangements.

Its current status is:

a theoretically informed, operationally specified and empirically testable research-governance architecture.

The immediate priority is therefore not large-scale deployment but independent evaluation.

A bounded pilot should determine whether independent scientific governance can be preserved; shared evidence architecture can be maintained; cross-project synthesis is feasible; divergent evidence remains visible; and synthesis actually modifies subsequent research activity.

The central proposition advanced by the article is intentionally limited:

Scientific projects addressing a common strategic problem may not require unified scientific governance in order to contribute to a cumulative research programme. They may instead be federated through shared evidence structures that preserve scientific autonomy while enabling cross-project synthesis and recursive portfolio renewal.

Whether this proposition withstands empirical testing will determine the scientific value of the Directed Research Architecture.

Final Declarations

Conflict of Interest Statement

The author is the Founder and Editor-in-Chief of DIM Review, which is discussed in this article as a possible institutional environment for future pilot development of the proposed Directed Research Architecture. This role is disclosed as a potential institutional conflict of interest. DIM Review is not presented as evidence of the effectiveness or validation of the DRA.

Funding Statement

This research received no external funding.

Data Availability Statement

No original empirical dataset was generated for this conceptual study. The literature and documentary sources used to develop the framework are identified in the reference list.

Author Contribution Statement

Jamel Doura: Conceptualization, framework development, methodology, investigation, analysis, writing-original draft, writing-review and editing.

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