THE COHERENCE INDEX: A PRE-CONCEPT FRAMEWORK FOR MEASURING SYSTEMIC ALIGNMENT

Concept • Method • Pilot • Impact

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Author's chronology note: The geometric-mean formulation within a coherence index was conceived in April 2025 and first applied within the RCI framework on 20–21 October 2025. This publication records that chronology and separates the conceptual seed from enabling methods.

Abstract

The global economy lacks a metric capable of expressing the systemic coherence required for regenerative performance. This pre-concept paper introduces the Coherence Index, a geometric-mean-based construct designed to measure balanced alignment across four interdependent domains: **Informational, Biophysical, Human, and Economic.** Unlike additive indices, a geometric approach encodes complementarity and interdependence, preventing strong performance in one area from compensating for structural weakness elsewhere. We propose the conceptual form:

$C = (I \times B \times H \times E)^{(1/4)}$,

where $I, B, H, E \in [0,1]$ are normalised sub-indices. The formulation ensures that coherence reflects the 'weakest-link' behaviour characteristic of complex adaptive systems. This paper fixes authorship, structure, and conceptual lineage while deliberately withholding implementation details. The forthcoming **Regenerative Coherence Index (RCI)** will extend this foundation through adaptive weighting, dynamic feedback, validation methods, and applied case studies.

1. Introduction — The Case for a Coherence Metric

Conventional indicators—GDP, ROI, ESG scores, and carbon inventories—describe important aspects of performance but fail to capture the alignment of the system as a whole. GDP can rise while ecological resilience collapses; a firm may increase ROI while exhausting natural capital; social trust may decay even as innovation accelerates. Such contradictions emerge because these metrics are **fragmented**. They track isolated domains but ignore the coupled, non-linear, and multi-domain dynamics on which real-world resilience depends.

Coherence, by contrast, refers to the degree of aligned order that enables systems to circulate information effectively, regulate energy and resources, sustain relationships, and regenerate over time. When one domain is optimised at the expense of others, the whole system becomes brittle: ecological overshoot, misinformation cascades, economic short-termism, and psychosocial dysregulation all emerge from structural incoherence.

This pre-concept paper introduces the **Coherence Index** as a minimal, integrative metric intended to capture such alignment. It treats coherence as **multiplicative**, not additive: if one structural pillar fails, the entire system's capacity to regenerate is constrained. The goal is not an operational tool at this stage, but a rigorous conceptual seed that timestamps the intellectual architecture in advance of full RCI development.

Practically, an eventual coherence-oriented dashboard could complement existing metrics by (i) revealing weakest-link constraints, (ii) aligning incentives toward balanced improvements across

domains, and (iii) offering a compact scalar signal suitable for cross-sectional comparisons and longitudinal trajectories. The geometric mean is the mathematical backbone that makes these properties explicit.

2. Background and Context

Though used across many disciplines, the concept of coherence is fragmented:

- In **physics**, coherence describes phase alignment and the emergence of ordered wave behaviour.
- In **information theory**, it relates to mutual information and the capacity for signals to reduce uncertainty.
- In **public policy**, coherence reflects alignment between sectoral objectives and governance mechanisms.
- In **physiology**, psychophysiological coherence refers to harmonised autonomic patterns associated with resilience and prosocial behaviour.

Despite their differences, these all concern the quality of relationships among system components.

We synthesise these into four interdependent domains:

Informational coherence,

signal clarity, mutual intelligibility, reliable feedback, and reduced entropy.

Biophysical coherence,

resource use and material flows within ecological limits; regenerative energy and nutrient cycling.

Human coherence,

psychophysiological regulation, psychological resilience, relational integrity, and trust.

Economic coherence ,

capital allocation, governance, incentives, and value creation aligned with regenerative principles.

The Coherence Index consolidates these into a single structural signal. It does not aim to replace domain-specific metrics but to articulate the systemic health that emerges from their interaction. In subsequent work (RCI), these domains can accommodate context-specific indicators and thresholds (e.g., science-based targets, trust indices, or openness metrics), provided they are normalised and auditable.

3. Conceptual Proposal — A Geometric-Mean Model

We define the Coherence Index as:

$$C = (I \times B \times H \times E)^{(1/4)},$$

where each domain is normalised to [0,1].

The index reaches 1 only when all domains are maximised and declines rapidly when any domain approaches 0.

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Rationale for the geometric mean:

- Penalises **imbalance**, reflecting the complementarity of systemic domains.
- Encodes **joint necessity**: no domain should compensate for deficits elsewhere.
- Mirrors **complex-systems failure modes** where the weakest link constrains performance.
- Aligns with the **post-2010 Human Development Index (HDI)**, which adopted a geometric aggregator to reduce substitutability.

Relation to prior work (HDI): The Coherence Index adopts the geometric-mean aggregation principle but diverges from HDI's focus on human development. It broadens the lens to include informational dynamics, biophysical constraints, and inter-domain feedback behaviour, and is explicitly designed to support regenerative and boundary-aware extensions within the RCI.

Table 1 — Selected Composite Indices

Framework	Aim	Aggregation	Domains	Substitutabilit	Notes

Coherence Index (this paper)	Systemic alignment	Geometric mean	I, B, H, E	Very low	Conceptual seed; non-enabling
RCI™ — UK TM Application No. UK00004292767	Regenerative performance	Geometric mean + dynamics	I, B, H, E (+ feedbacks)	Non-substitutable	Methods under development
HDI	Human development	Geometric mean	Health, Education, Income	Reduced	No ecological thresholds
GPI	Beyond-GDP welfare	Additive	Economic + social + env.	High	Cost-adjusted GDP
SPI	Social performance	Composite	Social domains	Moderate	Social outcomes independent of GDP

Table 2 — Boundary and Accounting Frameworks

Framework	Aim	Structure	Domains	Substitutability	Notes
Planetary Boundaries	Ecological stability	Thresholds	Earth-system processes	None	No socio-economic integration
Doughnut Economics	Safe & just space	Dashboard	Social + ecological	None	Conceptual model
SEEA	Env-econ accounting	Accounts	Natural assets	N/A	Statistical framework
ESG Ratings	Firm-level risk	Weighted additive	E, S, G	High	Methodological variability

5. Philosophical and Regenerative Implications

Regeneration is not merely the replenishment of stocks; it is the preservation of relational qualities that allow systems to thrive. Coherence provides the structural conditions for regeneration by reducing (i) energy dissipation (waste), (ii) informational noise (misalignment), (iii) psychosocial fragmentation (stress, distrust), and (iv) ecological degradation (overshoot). A

coherent system aligns means with ends, short-term actions with long-term viability, and local incentives with global commons. The Coherence Index clarifies this by expressing system health as the concurrent improvement of all domains. It resists silver-bullet thinking and foregrounds relational integrity.

6. Outlook and Next Steps

This pre-concept formalises the problem, the philosophical grounding, and the geometric-mean logic underlying the Coherence Index. The forthcoming Regenerative Coherence Index (RCI) will:

1. Operationalise each domain with candidate indicators, normalisation pathways, and sensitivity tests.
2. Introduce dynamic behaviour, including temporal coherence, adaptive weighting, and resilience measures.
3. Develop computational prototypes and early case studies.
4. Provide clear, open methods for validation, uncertainty analysis, and governance considerations.

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