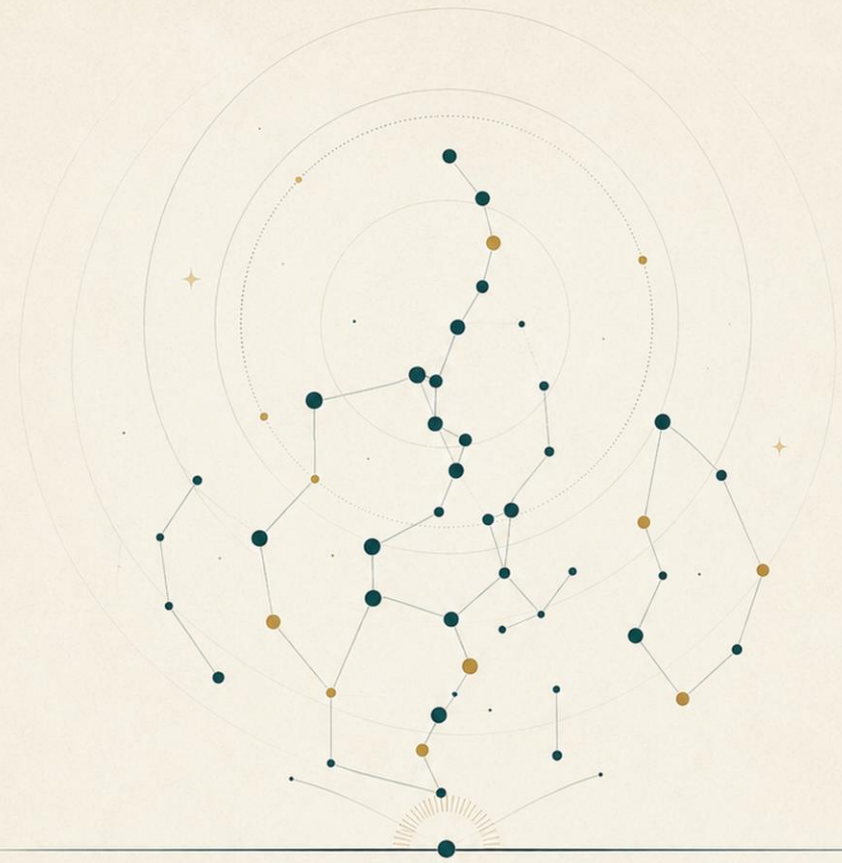

THE EVOLUTION OF WORLDS

Natural Drift, Inverse Darwinism, and the Biology of Love

From Protected Variation to Life-Coherent Civilization

ACADEMIC WHITE PAPER

Dr Bichara Sahely

BSc (Biology), MBBS, DM (Internal Medicine)

JUNE 2026

Suggested Citation

Sahely, B. (2026). *The evolution of worlds: Natural drift, Inverse Darwinism, and the biology of love - From protected variation to life-coherent civilization*. Academic white paper.

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Scope and Methodological Note

This is a transdisciplinary theoretical synthesis, not a systematic review or empirical demonstration of a single cross-scale mechanism. Molecular evolution, organismal biology, cognition, culture, institutions, and ethics are kept analytically distinct. Analogies across these domains are identified as analogies and are not treated as substitutes for domain-specific mechanisms or empirical evidence.

Competing Interests, Funding, and Licence

The author declares no competing interests and received no dedicated funding for this white paper.

Abstract

Modern civilization commonly narrates evolution through scarcity, competition, selection, and the survival of the better adapted. While natural selection remains foundational to evolutionary biology, its expansion into a total civilizational ontology obscures the generative roles of conservation, redundancy, structural drift, recurrent coupling, emotioning, languaging, and love. This white paper brings Maturana and Mpodozis's theory of natural drift into dialogue with autopoiesis and structural coupling, Kalkman and Deacon's Inverse Darwinism, Maturana's biology of emotioning and languaging, the biology of love, and McMurtry's life-value onto-axiology. It proposes life-coherent generative drift as a transdisciplinary framework. Living systems conserve organization while varying structurally; redundancy and excess capacity protect exploratory divergence; recurrent coupling discloses complementary relations; human emotional and linguistic coordination stabilizes worlds of practice and institution; and life-coherence evaluates whether the resulting organization protects, restores, or enlarges life-capacity without transferring disabling costs to other lives or future conditions. The paper distinguishes generative reserve from bureaucratic duplication, life-serving complementarity from pathological lock-in, and system coherence from life-coherence. Applications are developed for medicine, education, ecology, economics, artificial intelligence, democracy, law, and peacebuilding. The central conclusion is that a civilization capable of becoming otherwise must conserve the life-ground, sufficient margin for variation, truthful feedback, legitimate participation, and corrigible civil commons. The world is what we conserve together.

Keywords: autopoiesis; natural drift; structural coupling; Inverse Darwinism; constructive neutral evolution; redundancy; degeneracy; emotioning; languaging; biology of love; legitimate otherhood; life-coherence; life-capacity; civil commons; institutional autopoietization; cultural drift; biosemiotics; evolutionary theory; resilient institutions; regenerative civilization

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Executive Summary

Modern civilization commonly tells the story of evolution through scarcity, competition, selection, and the survival of the better adapted. This story contains an important truth: organisms and lineages do not persist independently of the conditions in which they live, and differential survival and reproduction can alter populations. Yet when this partial account becomes a civilizational ontology, it encourages a dangerous inference. If competition is treated as the principal engine of life, then economic rivalry, institutional austerity, geopolitical domination, and the elimination of apparent redundancy can be portrayed as natural, necessary, and even progressive. The result is a selectionist world: hospitals without reserve, ecosystems stripped of diversity, workers made interchangeable, knowledge enclosed, social vulnerability punished, and institutions rewarded for surviving even when their survival disables the life they were created to serve.

This white paper develops a different account of evolutionary and civilizational becoming. It brings Humberto Maturana and Jorge Mpodozis's theory of evolution by natural drift into dialogue with Maturana and Francisco Varela's account of autopoiesis and structural coupling; Maturana's analyses of emotioning, languaging, and objectivity-in-parentheses; Maturana, Gerda Verden-Zoller, and Ximena Davila's biology of love; Matt Kalkman and Terrence Deacon's account of Inverse Darwinism and abductive evolutionary innovation; and John McMurtry's life-value onto-axiology and civil-commons framework. The synthesis is named **life-coherent generative drift**.

Autopoiesis identifies the organization whose conservation constitutes a living system as a living unity. The distinction between organization and structure explains how a being can change extensively while remaining itself: organization is conserved through changing structural realizations. Natural drift generalizes this insight to lineages. Evolution is not a process in which an external environment instructs organisms how to change or pulls them toward a predetermined optimum. Structural variations arise according to the existing constitution of organisms and lineages. As long as autopoiesis and adaptation remain conserved, the lineage continues to drift. Natural selection, in this account, is an observer's retrospective description of differential disappearance and persistence within a broader historical process of structural drift.

Structural coupling explains how living beings and their media become historically congruent through recurrent interaction. The medium triggers changes but does not specify them; the structure of the living system determines which changes can occur. Organism and niche therefore do not confront one another as independently completed realities. Their congruence is co-generated through a history of interaction. Living beings do not simply adapt to a world that is already fully given. Through their structures, distinctions, actions, and transformations of the medium, they participate in bringing forth the worlds in which they live.

Inverse Darwinism adds a generative mechanism that natural drift alone leaves underspecified. Duplication, redundancy, and excess capacity can protect an existing function while a duplicate diverges. Variations that would otherwise be deleterious may be buffered or neutralized. Divergent components may later discover complementary relations, divisions of labour, or new dimensions of coordinated function. Natural selection may stabilize and refine these relations, but it does not by itself generate the protected possibility space in which they become probable. Redundancy is therefore not merely waste. It is reserve, error tolerance, and evolutionary permission.

Kalkman and Deacon compare this process with Charles Sanders Peirce's abduction: the generation of a plausible possibility through resemblance or iconism. A duplicate begins as a functional likeness of what already works. Its later variations are neither randomly unconstrained nor directed by foresight. They are historically biased possibilities generated from a viable theme. Evolutionary innovation can thus be understood as prepared possibility: life preserves enough of what works to permit part of itself to wander.

This generative process is not automatically life-serving. Constructive neutral evolution can produce gratuitous complexity, dependency, and irreversible lock-in. Tumours, parasites, militarized states, financial systems, and administrative bureaucracies can become increasingly effective at reproducing themselves while disabling their hosts. Complexity is not equivalent to coherence, and system coherence is not equivalent to life-coherence. A normative criterion is required.

Maturana's account of human existence adds a further level. Human worlds are not brought forth by structural variation alone. **Emotioning** specifies domains of possible action: fear opens defence, concealment, and attack; curiosity opens exploration; trust opens disclosure; resentment opens retaliation; love opens legitimate coexistence. **Languaging** is not merely the transmission of information but recursive consensual coordination of conduct. Human cultures are networks of conversations in which languaging and emotioning are interwoven. They conserve particular distinctions, identities, practices, authorities, exclusions, and expectations. Civilizations therefore reproduce not only through laws and infrastructures but through the recurrent emotioning embodied in their conversations.

The biology of love is decisive. Love, in Maturana's technical sense, is the relational dynamic in which the other arises as a legitimate other in coexistence. Love does not require agreement with every action, nor does it abolish boundaries. It preserves the legitimacy of persons while permitting opposition to actions that destroy coexistence. The paper proposes a careful formal analogy: biological redundancy protects function during structural difference; love protects legitimate participation during human difference. Both create generative margin. They allow variation, error, vulnerability, and disagreement to remain present long enough for learning, repair, and complementarity to emerge.

McMurtry's life-value framework supplies the evaluative ground. A relationship, practice, technology, or institution is life-coherent insofar as it protects, restores, or enlarges the capacities of living beings and the life-supporting systems upon which they depend, without transferring disabling costs to other persons, species, ecosystems, or future generations. Persistence alone is not value. Internal coherence alone is not health. The question is always what life-capacities a system enables, whose capacities it disables, and whether the conditions of further life remain available.

The integrated sequence is:

Conservation -> generative margin -> structural drift -> recurrent coupling -> complementarity -> emotioning -> languaging -> cultural conservation -> life-coherence test -> renewal or pathological lock-in.

This sequence is not a universal law or a teleological staircase. It is a transdisciplinary heuristic that identifies recurring conditions under which novelty can arise without immediate collapse and can be evaluated without confusing survival with worth.

The civilizational implication is direct. A society capable of becoming otherwise must conserve more than existing institutions. It must conserve the life-ground, truthful feedback, ecological and social diversity, sufficient material reserve, spaces for experimentation, the legitimacy of persons as participants, and the capacity to revise the conversations through which institutions reproduce themselves. The civil commons - public systems that secure access to the conditions of life - can be understood as society's shared generative reserve and as the material institutionalization of legitimate coexistence.

The world that wants to be brought forth is therefore not a finished utopia designed from above. It is a different civilizational drift: one that protects margin without glorifying waste, welcomes difference without romanticizing harm, establishes boundaries without converting persons into disposable beings, and evaluates every system by the living capacities it enables. Its foundational question is simple:

What must we conserve together if life is to remain capable of bringing forth more life-serving worlds?

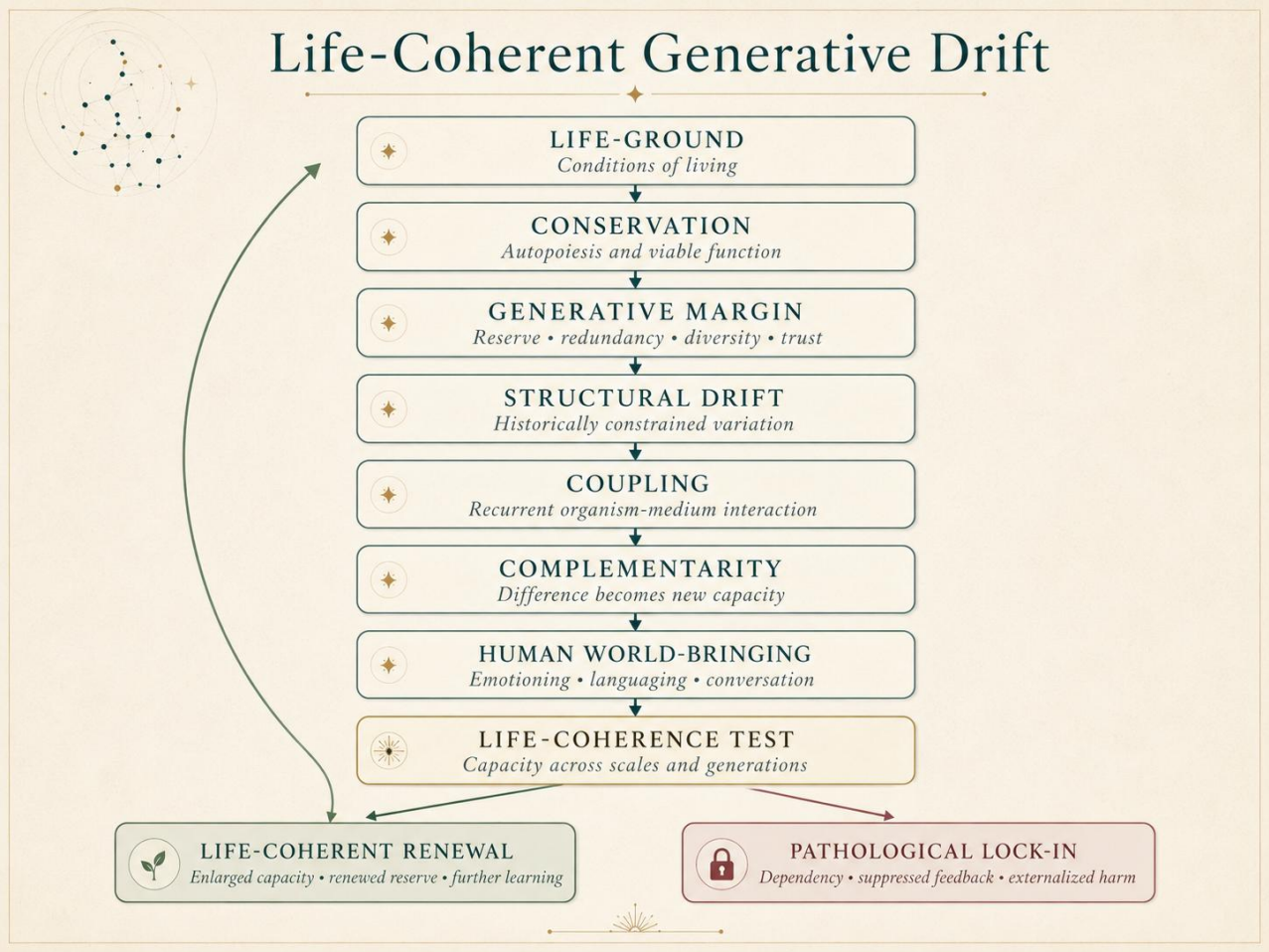

Figure 1. Life-Coherent Generative Drift. Conservation and generative margin permit structural drift, coupling, complementarity, and human world-bringing. Life-coherence separates renewed capacity from pathological lock-in.

Preface: The Paper That Wanted to Appear

Some papers begin with a problem selected in advance. Others begin when several lines of inquiry, developed separately, suddenly recognize one another. This paper arose through such a convergence.

The immediate catalyst was Kalkman and Deacon's chapter, "Inverse Darwinism: An Abductive Complement to Natural Selection?" Their argument that duplication, redundancy, tolerated degeneration, and complementation can generate evolutionary novelty illuminated a recurring theme across the life-coherence project. In medicine, reserve permits the body to absorb disturbance before clinical failure becomes visible. In ecology, diversity and functional overlap sustain response under changing conditions. In public institutions, spare capacity and multiple routes of access enable continuity during crisis. In knowledge, plurality permits comparison and correction. In democratic life, dissent preserves information that centralized systems would otherwise lose. Across domains, what optimization calls excess often proves to be the margin through which a system can heal and become otherwise.

Yet the chapter also raised a deeper question. Protected biological variation can generate novelty, but what is the human-social counterpart of that protection? What permits differences among persons, perspectives, and practices to remain present without immediate exclusion? Maturana's biology of love supplied an answer. Love is not sentiment added after biological survival. It is the relational domain in which the other appears as a legitimate other in coexistence. It creates the possibility that disagreement need not become annihilation, error need not become expulsion, and vulnerability need not become an invitation to exploitation.

Natural drift provided the wider evolutionary grammar. Living systems and lineages do not require a predetermined destination to change coherently. They conserve organization and adaptation while drifting structurally through histories

of coupling. Emotioning and languaging then revealed how human beings bring forth social worlds: not through propositions alone, but through recurrent coordinations of action sustained within emotional matrices. McMurtry's life-value onto-axiology supplied the necessary criterion for judgment, because neither drift, complexity, complementarity, nor love within an in-group guarantees justice across the wider life-ground.

The synthesis that appeared was therefore neither a new version of social Darwinism nor a romantic denial of conflict, competition, death, and selection. It was a more complete generative account. Life changes because it preserves enough continuity to tolerate difference. Difference becomes meaningful through coupling. Some differences become complementary. Human communities conserve these relations through conversations. The emotional domain determines which conversations are possible. Love allows legitimate plurality, while life-coherence tests whether the resulting arrangement enlarges capacity across the wider field of life.

Several cautions govern the argument. Molecular evolution, organismal development, human cognition, culture, institutions, and ethics are not identical levels. Analogies across them can illuminate but cannot substitute for mechanism. Natural drift should not be used to erase population genetics. Inverse Darwinism should not be treated as the negation of natural selection. The biology of love should not be converted into a vague doctrine of niceness. Life-coherence itself must remain corrigible, open to evidence of harm and to dialogue with traditions that disclose what its present categories fail to see.

This white paper is offered as an invitation to further languaging. Its task is not to pronounce a final theory of evolution or civilization, but to make a generative pattern visible enough to be examined, criticized, tested, and translated into medicine, education, ecology, economics, technology, governance, peacebuilding, and everyday relations. The world that appears through this conversation will depend not only on the ideas expressed, but on the emotioning in which they are received and the practices through which they are conserved.

Part I - The Selectionist World

1. The Civilizational Myth of Selection

Darwin's theory of evolution by natural selection transformed biology by explaining how heritable variations, differential reproduction, and environmental conditions can produce adaptation without a designing intelligence. Its scientific achievement remains foundational. The problem begins when one part of evolutionary explanation is expanded into a complete account of life and then projected back onto society as moral instruction.

The selectionist myth is not simply the claim that natural selection occurs. It is the cultural conviction that scarcity, competition, elimination, and the victory of the strongest or most efficient are the deepest and most reliable sources of improvement. Once installed as common sense, this conviction migrates across domains. Markets are imagined as selection machines that necessarily reward social usefulness. Corporations are treated as organisms whose survival proves fitness. States pursue security through competitive accumulation. Universities rank persons and ideas through artificial scarcity. Hospitals reduce reserve capacity in the name of efficiency. Ecosystems are simplified into production units. Social programmes are required to prove immediate returns while speculative finance is permitted to expand without comparable life-value tests.

This migration turns description into justification. What persists is interpreted as what deserves to persist. What accumulates power is interpreted as what is superior. What cannot compete under imposed conditions is interpreted as deficient. Structural inequalities disappear from view because outcomes are attributed to the intrinsic fitness of winners and losers. The conditions of the contest, the histories of enclosure, and the life-supporting labour that makes competition possible are treated as external.

A selectionist civilization also develops a particular attitude toward redundancy. Spare beds, idle time, duplicate expertise, diverse species, local production, public inventories, and overlapping institutions appear inefficient because their value is not visible under ordinary conditions. Optimization removes them. The system becomes lean, centralized, and dependent upon uninterrupted flows. It may perform impressively within a narrow range of expected conditions, yet become brittle when disturbance exceeds that range.

The COVID-19 pandemic made this pattern globally visible. Health systems designed around average demand discovered that reserve is not waste when demand surges. Supply chains designed around just-in-time delivery discovered that multiple suppliers and local capacity are forms of resilience. Communities discovered that care networks, public trust, and accessible information are infrastructures. The lesson extends beyond pandemic preparedness. Every living and social system requires margin because the future cannot be fully specified in advance.

The selectionist myth contains another inversion. Institutions created to serve living purposes are increasingly assessed by their own persistence, expansion, revenue, and procedural throughput. A hospital may be financially successful while patients cannot obtain timely care. A university may rise in rankings while students and staff become exhausted. An economy may grow while ecological and social capacities contract. A state may become more secure administratively while its population experiences greater insecurity. System survival replaces life-service as the hidden criterion.

The aim of this paper is not to replace competition with cooperation as an equally totalizing slogan. Living systems exhibit competition, predation, death, exclusion, and conflict alongside symbiosis, mutualism, care, redundancy, and cooperation. The task is to recover the generative processes hidden when selection becomes the only explanatory image and to distinguish between arrangements that merely persist and arrangements that enlarge the conditions of living.

2. Why Selection Alone Cannot Generate the New

Selection is subtractive. It changes the distribution of existing variants by differentially preserving or eliminating them. It can refine, stabilize, and adaptively tune. What it cannot do by itself is explain the structured generation of the possibilities on which it acts.

Strictly random variation is an incomplete answer because biological variation is not sampled uniformly from every conceivable molecular or morphological state. It is produced by existing organisms with particular genomes,

developmental systems, metabolic constraints, cellular architectures, and ecological histories. Variation is biased by what is already present. Mutations occur within inherited structures. Development channels some outcomes and makes others inaccessible. Gene duplication reproduces working components. Symbiosis combines organized systems. Behaviour alters exposure to selective conditions. Organisms modify niches. The field of possible change is historically prepared.

This does not mean that evolution anticipates future usefulness. A duplicated gene does not know that a later mutation will contribute to colour vision. A redundant pathway does not foresee a future disturbance. A behavioural variation does not contain an image of a coming niche. Directionality can arise from structural bias and historical constraint without foresight.

The central distinction is between **generation** and **retention**. Selection concerns differential retention. Generative processes concern how a system comes to possess a non-arbitrary set of variants capable of entering new relations. The two processes interact, but they are not identical. An expanded evolutionary account must therefore ask not only why one variant survived, but how that variant became possible within the lineage's inherited architecture.

This distinction has direct civilizational significance. Institutions that rely only on selection - competitive grants, rankings, market exit, electoral defeat, disciplinary exclusion - may remove some failures but do little to cultivate the conditions from which better alternatives can arise. If persons and communities cannot survive experimentation, the space of possible reform contracts. If every error is punished as proof of unfitness, learning becomes concealment. If all public capacity must demonstrate immediate utilization, no reserve remains for unprecedented needs. A civilization of selection can become highly effective at eliminating possibilities before their value becomes knowable.

The generative question is therefore prior to the competitive question:

What conditions allow a system to vary, learn, and discover new complementarities without destroying the continuity upon which further exploration depends?

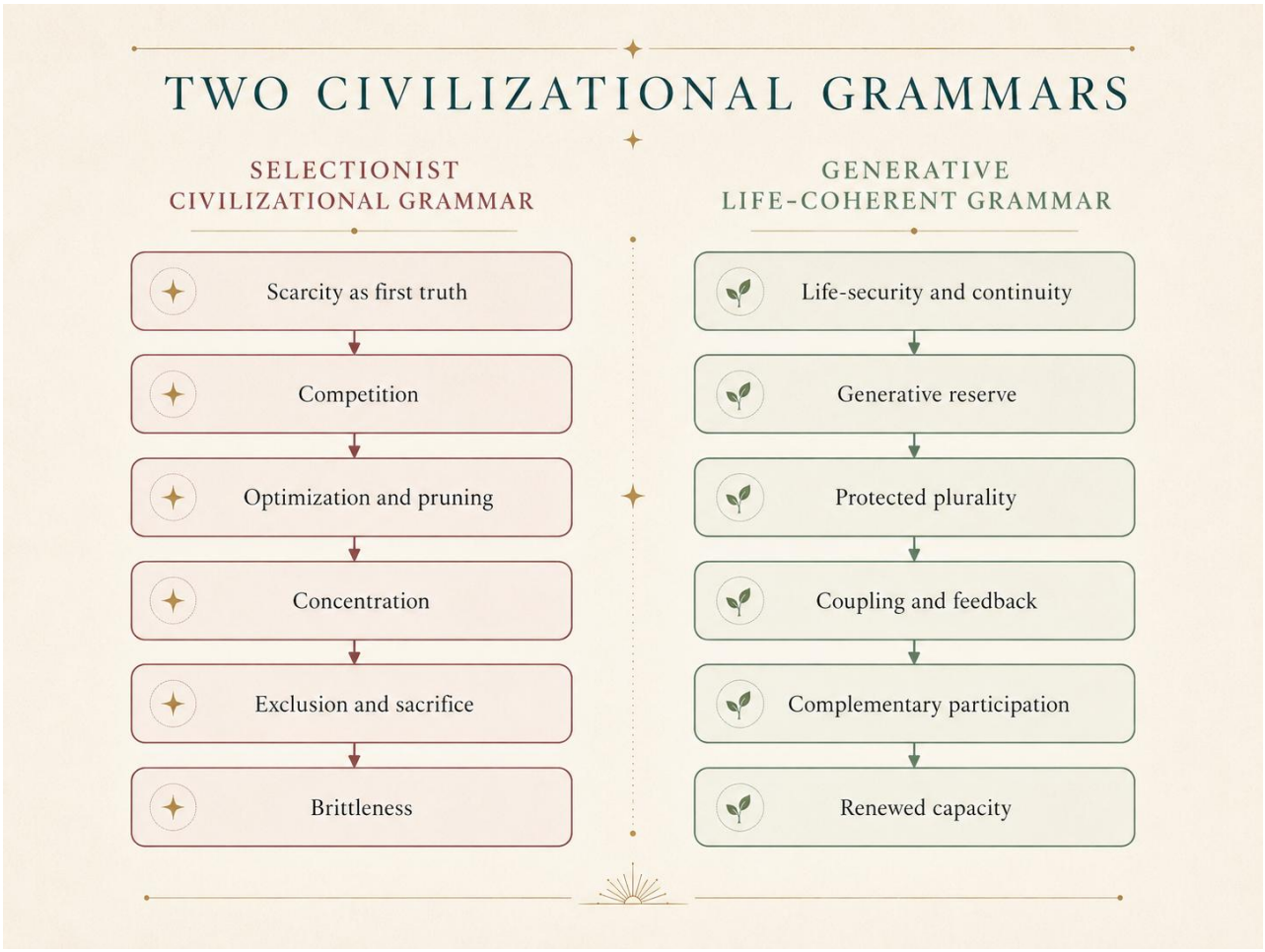

Figure 2. Two Civilizational Grammars. The selectionist grammar converts scarcity into exclusion and brittleness; the generative grammar converts life-security and protected plurality into renewed capacity.

Table 1. The integrated contribution of the principal frameworks.

Framework	Principal contribution	Question opened
Autopoiesis	Living identity as conserved organization through structural change.	What must remain conserved for a living unity to continue?
Natural drift	Historical lineage change without external instruction or predetermined optimum.	How can evolution acquire direction without a destination?
Structural coupling	Recurrent interaction produces organism-medium congruence.	What world is co-brought forth through this relation?
Inverse Darwinism	Redundancy buffers divergence and increases the probability of complementarity.	What protects novelty long enough to become possible?
Emotioning	Bodily dispositions open domains of possible action.	Which actions are possible in the emotional world being conserved?
Languaging	Recursive consensual coordination brings forth shared distinctions and institutions.	Which world do our conversations repeatedly reproduce?
Biology of love	Legitimate otherhood creates relational safety for difference and learning.	Can difference remain present without negation?
Life-value	Evaluates arrangements by their effects on life-capacity and the life-ground.	Whose capacities are enabled, and whose are disabled?

Part II - Conservation Through Change

3. Autopoiesis: Identity Without Rigidity

Maturana and Varela introduced autopoiesis to identify the organization distinctive of living systems. An autopoietic system is constituted as a unity by a network of processes that produces the components whose interactions regenerate the same network and establish the boundary within which that network operates. The emphasis is not on a particular material substance but on a circular organization of production.

The distinction between **organization** and **structure** is essential. Organization refers to the relations that must be conserved for a unity to remain the kind of unity it is. Structure refers to the actual components and relations that realize that organization at a particular moment. A living organism undergoes continual molecular replacement, developmental change, injury, repair, learning, and ageing, yet remains a living unity while its autopoietic organization is conserved. Identity is therefore neither static substance nor unrestricted flux. It is continuity of organization through structural change.

This account corrects two common errors. The first treats organisms as machines assembled from externally specified parts. Machines can be described in relation to purposes assigned by designers or users. A living system, by contrast, continuously produces and distinguishes itself as a unity through its own operations. The second error treats autonomy as isolation. Autopoietic beings are operationally closed in the sense that their changes are determined by their own structure, yet they are materially and energetically open and continuously coupled with their media. Autonomy is relationally sustained.

The structure of a living system determines which perturbations can trigger which changes. The same environmental event can produce different consequences in different organisms, or in the same organism at different moments, because structure differs. This is the principle of structural determinism. It does not imply rigid predictability. The structure may be extraordinarily complex, historically formed, plastic, and only partially knowable. It means that an external agent does not insert a specified change directly into the organism. The perturbation triggers; the organism's structure determines what happens.

Autopoiesis provides the first condition for generative drift: there must be something conserved through change. Without continuity, variation is not exploration but dissolution. A system cannot discover new relations if every deviation destroys the process that makes further variation possible.

This insight is clinically familiar. Health is not the absence of molecular change. It is the continuing capacity to regulate, repair, coordinate, and act through change. The body preserves life through dynamic turnover. A patient can lose cells, alter metabolic pathways, and reorganize behaviour while remaining the same living person. Conversely, apparently stable measurements can conceal declining reserve when the regulatory work required to maintain them becomes unsustainable.

The same distinction applies to institutions, but only analogically. An institution conserves an organization through changing staff, technologies, procedures, and buildings. Yet institutional operational closure is not biological autopoiesis in a literal sense, and the institution's persistence has no intrinsic priority over the living beings it affects. The analogy becomes ethically useful when it reveals a displacement: an organization founded to heal, educate, govern, or inform may increasingly conserve the relations that reproduce itself rather than the living purpose that justified its existence.

Autopoiesis therefore establishes a necessary but insufficient principle. Conservation makes change possible, but what is conserved can itself become pathological at a higher scale. A tumour conserves its cellular reproduction. A bureaucracy conserves procedures. A financial system conserves claims. Life-coherence asks whether such conservation remains aligned with the capacities of the larger living fields that make it possible.

4. Natural Drift: Evolution Without Predestination

Maturana and Mpodozis proposed evolution by natural drift as a reformulation of the process that generates biological diversity and the biosphere's historical coherence. Their argument does not deny differential survival and reproduction. It relocates them within a broader process centred on the conservation of living and adaptation.

A lineage continues while its members conserve autopoiesis and remain in a relation of adaptation with their medium. Adaptation here does not mean optimal fit according to an external scale. It means that the interactions between organism and medium remain compatible with the organism's continued realization as a living unity. If that congruence is lost, the organism dies. If it is conserved across reproduction and structural change, the lineage continues.

Structural variations arise as part of reproduction, development, and living. Because organisms are structurally determined, the medium does not instruct them which variations to produce. The lineage drifts through a domain of possible structural configurations while conserving living and adaptation. Some branches disappear; others persist. What observers call natural selection describes the consequences of this history, but it does not function as an external force choosing designs in advance.

Natural drift therefore opposes two misleading images. The first is the ladder of progress: evolution climbing from lower to higher forms toward a predetermined culmination. The second is the optimizing engineer: nature evaluating designs against a single objective function. Evolution has direction in the minimal sense that histories are irreversible and inherited structures constrain later possibilities. It does not require a destination.

This historical orientation changes the meaning of fitness. Fitness is not a fixed property contained inside an organism. It is an observer's abstraction from a relation among organism, lineage, medium, and time. A trait may support continued living in one relational history and become irrelevant or harmful in another. An organism does not possess a context-free score that the environment reads.

Natural drift also makes the niche relational. Organisms do not merely occupy pre-existing environmental slots. Through metabolism, movement, construction, communication, and reproduction, they alter the conditions in which they and other beings live. Beavers build dams; plants transform atmospheric and soil conditions; microbes reshape chemical environments; humans construct languages, cities, laws, technologies, and economies. The medium participates in the history of the lineage, while the lineage participates in the history of the medium.

The theory's greatest civilizational contribution is to release transformation from the demand for a final blueprint. A life-coherent society need not know every feature of a distant ideal before beginning to change. It must conserve the conditions that keep more life-serving possibilities open: the life-ground, feedback, participation, diversity, repair, and institutional corrigibility. Direction can arise through iterative correction rather than imposed perfection.

Natural drift nevertheless requires careful qualification. Population genetics provides indispensable accounts of mutation, inheritance, drift, selection coefficients, gene flow, and demographic change. The concept should enrich rather than erase those analyses. Its distinctive contribution is epistemological and organizational: it refuses to treat selection as an instructive agent and places evolutionary change within histories of conserved living and structural coupling.

For the present synthesis, natural drift supplies the widest temporal grammar. Inverse Darwinism describes one family of processes that enlarges the domain through which a lineage can drift. Redundancy and functional overlap permit more structural variation to occur without immediate loss of organization. Natural drift explains becoming without predestination; generative reserve explains how the space of viable becoming can widen.

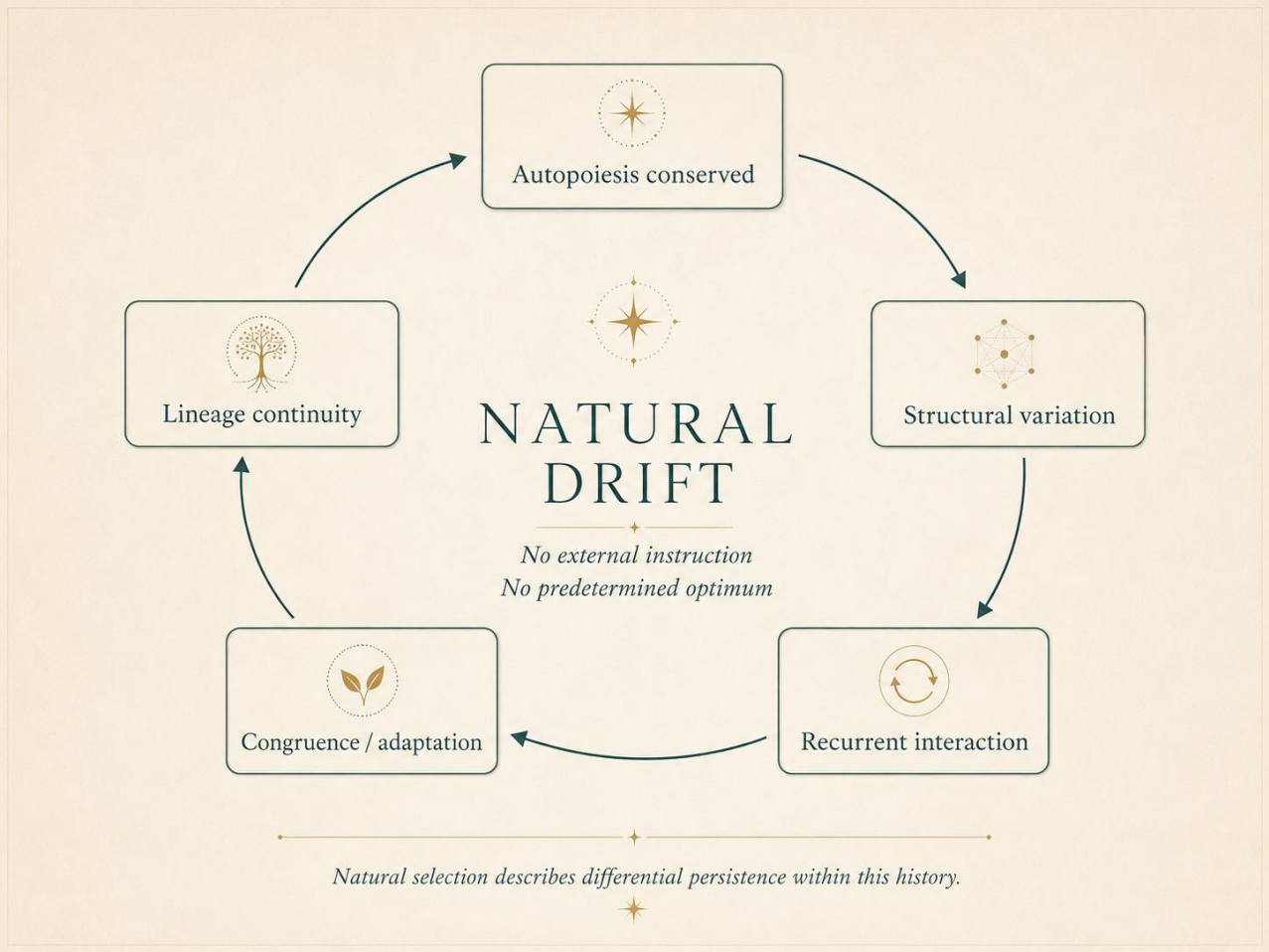

Figure 3. Evolution by Natural Drift. A lineage changes structurally while autopoiesis and adaptation remain conserved through recurrent organism-medium interaction.

5. Structural Coupling and the Co-Bringing-Forth of Worlds

Structural coupling names the history of recurrent interactions through which a structurally determined system and its medium undergo congruent changes. The phrase avoids two symmetrical errors. The first imagines the organism as passively instructed by an independent environment. The second imagines the organism as creating reality without constraint. In structural coupling, neither side specifies the other's changes, yet recurrent interactions establish a history of mutual congruence.

Consider a simple sensory interaction. An environmental event does not enter the nervous system as a ready-made representation. It perturbs sensory surfaces. The organism's nervous system, bodily state, developmental history, and ongoing activity determine the changes that follow. The significance of the event emerges in the organism's conduct. A molecular difference, sound, gesture, or colour becomes meaningful because of the distinctions and coordinations it enables within the living system's history.

This is why Maturana describes cognition broadly as effective action in a domain of existence. Knowing is not the possession of an inner copy of an independent world. It is the conduct of a living system whose operations remain congruent with its medium. An observer may describe that conduct as successful, mistaken, intelligent, or maladaptive, but the system itself operates according to its structure.

The phrase **bringing forth a world** follows. Every living being encounters a domain of relevance shaped by its sensory capacities, modes of action, bodily needs, and history. A tick, a bat, a physician, a child, and an algorithmically mediated institution do not inhabit the same experiential world even when they share physical surroundings. Their distinctions differ. Human beings further transform their worlds through languaging, symbolic practices, tools, and institutions.

This does not entail that anything can be made true by conversation. Bodies can be injured, ecosystems can collapse, and material constraints can defeat our descriptions. Objectivity-in-parentheses is not indifference to evidence. It is recognition that explanations are made by observers operating within particular domains of coherence and that claims to an observer-independent view can conceal the conditions and responsibilities of observation. Scientific explanation remains disciplined by reproducibility, operational coherence, communal criticism, and encounters with phenomena that resist expectation.

Structural coupling adds an important correction to the metaphor of evolutionary hypotheses being "tested" by the environment. The medium is not a static examiner. A new variation alters the organism's conduct and may alter the medium itself. A modified sensory capacity changes which distinctions can guide behaviour. A new social practice changes expectations and available roles. A technology changes both users and the infrastructures in which later technologies emerge. The test is reciprocal and historical.

This reciprocity is central to institutional design. Policies do not intervene in passive populations. They change incentives, identities, expectations, trust, and behaviour; those changes then alter the conditions under which later policies operate. Surveillance may induce concealment. Punitive welfare systems may create the very instability they claim to manage. Participatory governance may cultivate capacities for collective problem solving. Every intervention participates in producing the domain it later measures.

A life-coherent approach therefore asks not only whether an intervention achieves a target, but what kind of coupling it establishes. Does it increase fear, dependency, and silence? Does it widen truthful feedback and shared agency? Does it strengthen the capacities through which communities can respond to future problems? The world produced by a policy includes the relations and emotioning through which the policy operates.

Part III - Generative Reserve

6. Inverse Darwinism: From Duplication to Complementarity

Kalkman and Deacon use the term Inverse Darwinism to describe a general generative logic derived from constructive neutral evolution, gene duplication, duplication-degeneration-complementation, and related processes. The inversion is conceptual. Darwin's insight was shaped by Malthusian scarcity and competitive elimination. Inverse Darwinian processes begin with excess capacity and functional redundancy.

A duplicated gene, molecule, cell, structure, behaviour, or symbiotic contribution initially preserves some likeness to an existing function. Because the function is available through more than one route, one copy can vary without immediately destroying the organism's viability. Changes that would have been deleterious in a single-copy system may be buffered or neutralized. Over time, duplicates can lose different aspects of their ancestral role, become expressed in different places or times, or enter distinct interactions. What began as excess can become a division of labour or a new complementary system.

The process can be represented as:

Duplication -> redundancy -> error tolerance -> divergent variation -> complementary interaction -> stabilized dependency or new capacity.

This sequence challenges the assumption that every step toward complexity must independently improve fitness. Some changes persist because their harmful effects are masked. Later relations may make those changes indispensable. Selection then acts principally to prevent the loss of an established interdependence and to refine its fit, rather than to create the interdependence from nothing.

The evolution of trichromatic vision provides an illustrative case. Duplication of an opsin gene allowed one copy to retain an established wavelength sensitivity while another diverged. The new relation did not merely add a separate band of light reception. Comparison among overlapping signals helped generate a richer dimensional field of colour distinction. Similarly, duplicated developmental regulators can diverge in expression and function, enabling body segments or limbs to become differentiated while remaining parts of a coordinated whole.

Redundancy also parallels information theory. Shannon showed that redundancy in communication permits noise detection and error correction. In biological systems, overlapping functional information preserves interpretability despite mutation and perturbation. Yet biology can go beyond correction: it may retain some deviation long enough for a new complementary relation to appear. The same property that protects continuity therefore enables novelty.

The term "neutral" can mislead if it suggests that variants possess a context-free absence of effect. More often, effects are neutralized within a particular organization. A mutation that would be damaging in one context may be tolerated because another component supplies the lost function. Neutrality is relational and scale-dependent.

Inverse Darwinism should not be presented as the replacement of Darwinian theory. Natural selection remains crucial to population change, adaptation, and stabilization. The stronger and more defensible claim is that generative variation has structure and that selection cannot explain that structure by itself. Inverse Darwinism is a generative complement to selective evolution.

Its relevance extends beyond genes. Repeated body structures, overlapping physiological pathways, paired organs, immune repertoires, ecological functional diversity, social role overlap, and redundant infrastructures can all create tolerance for deviation. The mechanisms differ across levels, and analogy must not be mistaken for identity. What recurs is a formal pattern: continuity is protected strongly enough for difference to arise; differences can then enter relations unavailable to the original undifferentiated system.

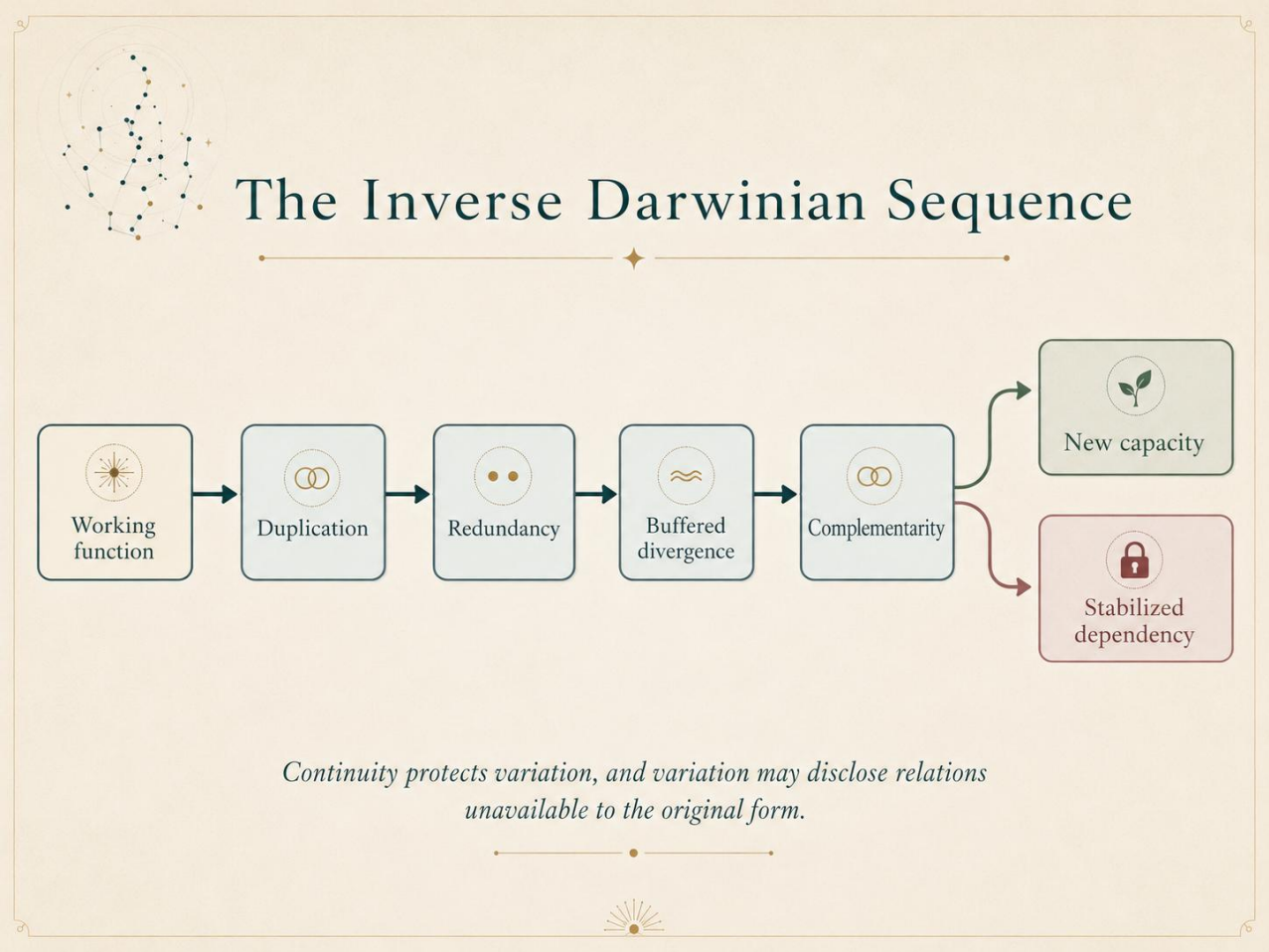

Figure 4. The Inverse Darwinian Sequence. Duplication and redundancy buffer divergence, increasing the probability of complementarity, new capacity, or historically stabilized dependency.

7. Abduction, Semiosis, and Prepared Possibility

Kalkman and Deacon compare Inverse Darwinian innovation with Peirce's abductive inference. Deduction derives necessary consequences from premises. Induction estimates probable regularities from cases. Abduction proposes a possible explanation or relation that, if true, would make observed facts intelligible. Abduction is fallible, but it opens new ground.

Peirce associated abduction with iconism: inference through perceived likeness. A duplicate biological form is iconic in a minimal functional sense. It initially resembles the original sufficiently to be interpreted by the organism's existing organization as performing a comparable role. That likeness provides a structured starting point for divergence.

The evolutionary "hypothesis" is not conscious. It is a metaphor for the way a variant explores a possibility. Because the variant begins from a viable theme, the exploration is biased by past functionality. Because no future function is anticipated, the outcome remains contingent. The process occupies a middle position between foresight and unstructured randomness.

This can be called **prepared possibility**. Pasteur's observation that chance favours the prepared mind has a biological analogue: chance variation becomes generative when it occurs within a structure able to tolerate and interpret it. The preparation consists of inherited organization, redundancy, developmental constraints, ecological relations, and the preserved capacities of the system.

The analogy helps explain creative cognition as well. Human insight often arises by bringing partially similar domains into relation. Koestler called this bisociation; Bateson described double description; Fauconnier and Turner analysed conceptual blending. Two perspectives overlap enough to be compared but differ enough to reveal a dimension not

explicit in either alone. Binocular vision produces depth from systematic disparities between two similar images. Interdisciplinary thought can produce a new conceptual dimension from the tensions between partially overlapping frameworks.

This paper is itself an exercise in double description. Natural drift, Inverse Darwinism, the biology of love, and life-value theory are not identical accounts. Their overlap discloses a shared generative concern: how continuity can be conserved while difference remains possible, how difference becomes coordinated, and how the resulting whole should be evaluated.

A biosemiotic interpretation requires care. Resemblance alone does not constitute meaning. In Peircean terms, semiosis involves a sign, an object, and an interpretant. In biological systems, the interpretant can be understood operationally as the change in regulation, conduct, or viability produced when a molecular or environmental difference participates in the organism's organization. A sign matters because it changes what the living system can do.

This formulation joins semiosis to structural coupling. Molecular differences acquire significance within networks that regulate living; perceptual differences acquire significance within embodied action; words acquire significance within consensual coordination; institutional indicators acquire significance within decisions and consequences. Meaning is neither located in an isolated object nor freely invented by an observer. It arises in a relation that transforms a system's possibilities of action.

8. When Complexity Becomes Lock-In

The generative power of redundancy has a shadow. Constructive neutral evolution can produce complexity that is historically entrenched but not adaptively superior. Components may become mutually dependent through accumulated losses. Removal becomes difficult even when the arrangement adds little capacity. Researchers have described such outcomes as irremediable complexity, neutral ratchets, Rube Goldberg systems, and even runaway bureaucracy.

This reveals a crucial distinction:

More complexity does not necessarily mean more capacity. More interdependence does not necessarily mean more resilience. More system coherence does not necessarily mean more life-coherence.

A dependency can be productive when differentiated components together enable a capacity unavailable to either alone. It can be pathological when the system requires increasing resources merely to reproduce an inherited arrangement, suppresses alternative pathways, or transfers its maintenance costs to a larger host.

Cancer provides the clearest biological warning. Tumour populations exploit variation, redundancy, altered coupling, and selection. They can become highly evolvable at the cellular level while destroying the organismal conditions on which they depend. Local adaptive success is therefore compatible with higher-level life-harm.

The same pattern appears institutionally. A procedure is introduced to solve a problem. Additional procedures compensate for failures created by the first. Roles emerge to administer the growing complexity. Metrics are created to demonstrate compliance. Staff learn to satisfy the metrics. Removing any part threatens organizational continuity because other parts have become dependent upon it. The institution may become increasingly coherent as a self-reproducing system while the patient, learner, citizen, ecosystem, or worker encounters greater difficulty obtaining the intended good.

This is institutional autopoietization: the progressive displacement of life-service by the conservation of the institution's own operations, categories, revenues, authority, and reputational security. The term is analogical; institutions are not literally living cells. Its diagnostic value lies in revealing how operational closure can become detached from the life-functions that justify it.

Two ratchets must therefore be distinguished. The life-coherent ratchet moves from reserve to exploration, complementarity, enlarged capacity, and renewed reserve. The pathological ratchet moves from neutral accretion to dependency, procedural complexity, feedback suppression, and capacity loss.

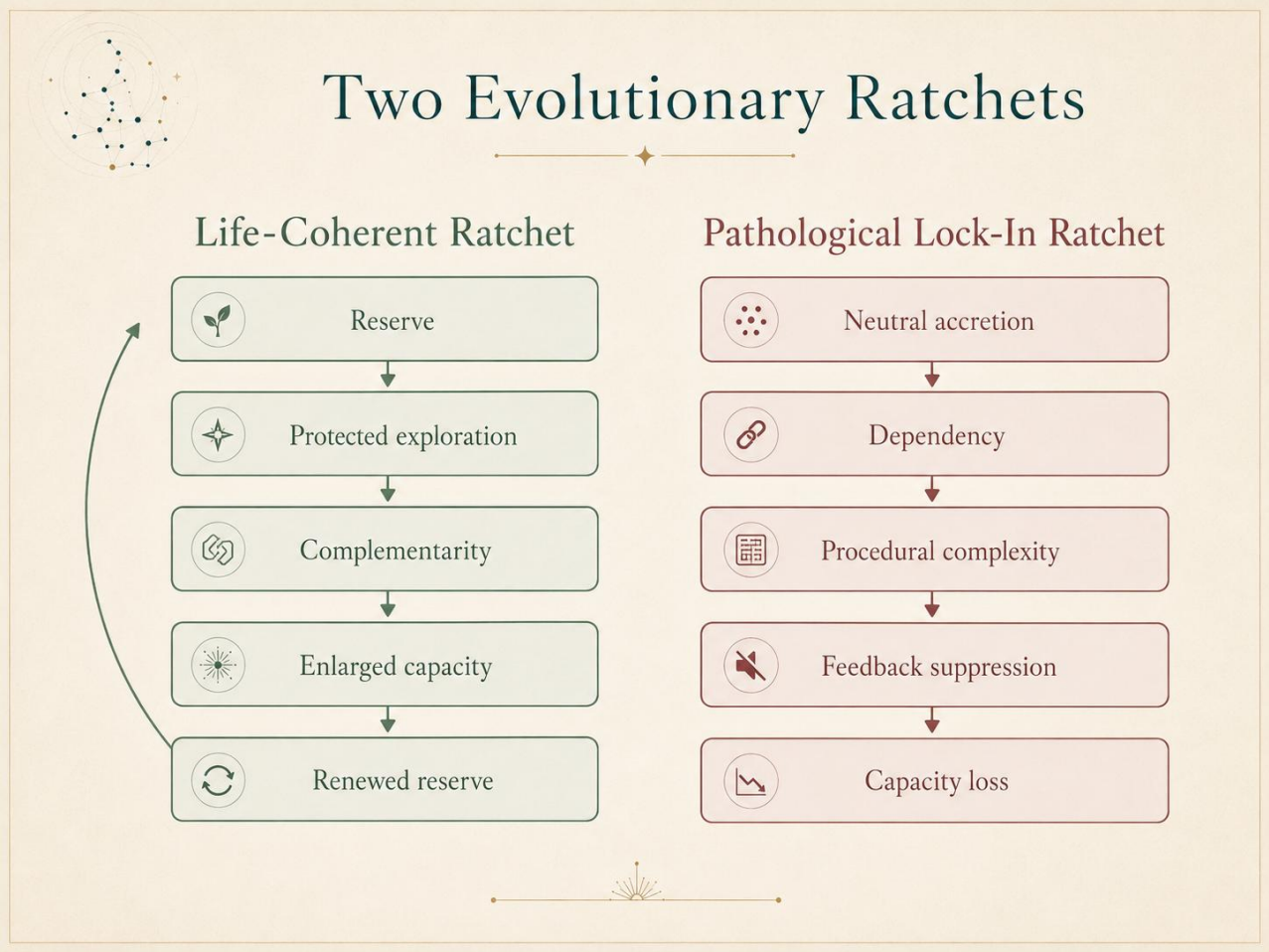

Figure 5. Two Evolutionary Ratchets. Generative reserve can become renewed capacity, while neutral accretion can harden into dependency, feedback suppression, and capacity loss.

The difference cannot be determined from internal persistence alone. It requires a cross-scale assessment. Does the new organization enlarge the abilities of persons and communities to act, understand, heal, participate, and respond? Does it preserve ecological regenerative capacity? Can it receive evidence of harm? Can components be revised or removed without catastrophic collapse? Does it create new reserve, or consume reserve to maintain itself?

These questions introduce the life-coherence criterion that will govern the remainder of the paper.

Part IV - Human Worlds

9. Emotioning: The Biology of Possible Action

In ordinary discourse, emotions are often treated as private feelings that interfere with reason. Maturana uses the term more fundamentally. An emotion is a dynamic bodily disposition that specifies a domain of possible actions. Under different emotions, different conduct becomes possible, sensible, or unthinkable.

Fear opens vigilance, retreat, concealment, defensive aggression, and the search for control. Anger opens confrontation and the demand that an obstruction be removed. Resentment conserves a history of injury and makes retaliation intelligible. Curiosity opens exploration. Trust opens disclosure and reliance. Tenderness opens care. Love opens the acceptance of the other as a legitimate other in coexistence.

Reasoning never occurs outside an emotional domain. A logical argument may be formally valid, yet the premises chosen, questions judged important, evidence admitted, and actions considered acceptable arise within a manner of living. Rational systems can therefore justify radically different worlds while remaining internally coherent. The emotional foundation usually becomes visible only when challenged.

This insight transforms institutional analysis. An organization is not defined only by its formal rules. It also conserves an emotional matrix. Two hospitals with similar protocols may produce different care if one operates through blame and defensive documentation while the other cultivates trust, candour, and shared responsibility. Two schools may use the same curriculum while one conserves fear of failure and the other conserves curiosity. Two democracies may possess similar constitutions while one normalizes humiliation and the other treats disagreement as legitimate participation.

Emotioning regulates the human possibility space. Biological redundancy may make a structural variation possible, but human beings require a relational-emotional domain in which an idea, identity, or practice can actually be expressed. A community ruled by fear can possess abundant diversity while silencing it. A research institution ruled by status competition can contain knowledge that cannot be coordinated. A family ruled by shame can produce outward conformity at the cost of truth.

This allows a further refinement of generative margin. Material reserve is necessary but not sufficient. Persons also require relational safety: enough confidence that error, uncertainty, dissent, or vulnerability will not automatically result in annihilation, dispossession, or exclusion. Without such safety, variation is concealed. Feedback becomes unreliable. Systems lose the ability to perceive their own effects.

Fear is not inherently pathological. It can protect life in the presence of danger. Anger can disclose violated boundaries. Grief can acknowledge loss. The issue is whether an emotion becomes chronically conserved beyond the conditions in which it serves life. A civilization organized around permanent emergency will normalize control, secrecy, enemy construction, and sacrifice. A market organized around chronic insecurity will make cooperation appear naive. A medical system organized around liability fear will substitute procedural defence for care.

Life-coherent transformation therefore cannot be achieved only by changing information. A community may know that its practices are harmful and continue them because the emotional cost of change appears intolerable. Institutions may commission evidence yet defend the identities and power relations threatened by that evidence. The domain of possible action must change.

This is why reflection is not merely intellectual. Reflection occurs when a person or community can examine the emotioning from which it acts and consider whether it wishes to continue conserving that world. Love is crucial because it creates the relational safety in which such reflection can occur without requiring self-destruction or the negation of others.

10. Languaging and the Recursive Production of Shared Reality

For Maturana, language is not fundamentally a code by which inner meanings are transmitted between separate minds. Languaging is a flow of consensual coordinations of conduct. Through recurrent interaction, participants coordinate

actions; then coordinate their coordinations; then coordinate the coordination of those coordinations. Objects, roles, promises, explanations, norms, and institutions arise within this recursive domain.

A word does not carry meaning as a self-contained package. Its meaning is enacted in the coordinations it permits. A clinical label coordinates attention, testing, treatment, prognosis, billing, and identity. A legal category coordinates rights, prohibitions, procedures, and consequences. A monetary symbol coordinates claims on labour and resources. A national identity coordinates belonging, obligation, memory, and exclusion. These distinctions become real in their effects because communities recurrently enact them.

Languaging is inseparable from emotioning. A conversation is the interweaving of language and emotion. The same words spoken in trust, contempt, fear, play, or domination belong to different conversations because they open different domains of action. Cultures can therefore be understood as closed networks of conversations conserved across generations.

This helps explain why changing terminology alone rarely transforms institutions. An organization may adopt the language of participation while conserving command. It may speak of patient-centred care while preserving an emotional matrix of professional superiority. It may speak of sustainability while desire remains organized around unlimited accumulation. It may speak of peace while humiliation and enemy construction continue to structure public conversation.

Human worlds are stabilized by these recursive coordinations. Budgets, laws, professional standards, algorithms, buildings, and technologies materialize distinctions that began and continue within conversations. Once embodied, they feed back into later emotioning and languaging. A ranking system produces anxiety and competitive behaviour; that behaviour appears to validate the need for ranking. A punitive system produces concealment; concealment appears to justify greater surveillance. A trust-building process produces disclosure; disclosure permits better coordination and can deepen trust.

The recursive character of languaging creates the possibility of reflexivity. Human beings can coordinate not only actions but the rules by which actions are coordinated. A community can ask: What distinctions are we conserving? Who may speak? What counts as evidence? Which injuries remain unnamed? What do our indicators conceal? What kind of person must one become to participate here? Are we willing to continue bringing forth this world?

This reflective capacity is central to life-coherent generative drift. Biological evolution does not deliberate about its value criterion. Human communities can. They can examine inherited conversations, anticipate consequences, protect vulnerable participants, create experimental institutions, and revise rules in response to harm. Reflexivity does not release them from biology or history. It changes the history of coupling by making the manner of coordination itself available for transformation.

Artificial intelligence now enters this domain as a powerful participant in human languaging. It can generate distinctions, summaries, simulations, images, and arguments at scale. Yet its effects depend on the conversations and emotioning in which it is embedded. Used within competition and enclosure, it may intensify surveillance, dependency, symbolic excess, and epistemic centralization. Used within life-coherent commons, it may widen access to knowledge, support translation, reveal neglected relations, and assist collective reflection. The technology does not independently determine the world. Its coupling with institutions does.

11. The Biology of Love: Legitimate Otherhood as Generative Margin

Maturana's biology of love is frequently misunderstood because the word "love" carries romantic, religious, and sentimental associations. In his technical usage, love is the emotioning in which the other arises as a legitimate other in coexistence with oneself. It is a relational dynamic, visible in conduct.

Legitimacy does not mean approval of every action. A parent can prevent a child from causing harm while preserving the child's dignity. A court can restrain violence without defining the offender as less than human. A community can refuse exploitation while recognizing the exploiter's continuing membership in the human moral field. Love makes boundaries possible without requiring ontological negation.

Human development depends upon this relational matrix. Infants and children require prolonged care, touch, play, attention, and reciprocal coordination. Through these relations they develop bodily confidence, language, self-respect, trust, and the capacity to participate with others. Chronic negation, humiliation, or deprivation does not merely produce unpleasant feelings. It alters the developmental domain in which human capacities emerge.

Maturana and Verden-Zoller emphasize play as a relation of bodily presence in which the activity is not subordinated to an external result. In play, participants attend to one another and to the present coordination. Such interactions are generative because they permit exploration without the constant threat of evaluation. Education organized entirely around performance can destroy the playfulness through which genuine learning and creativity arise.

The present synthesis proposes a formal analogy between biological redundancy and love. The analogy must be handled carefully because molecular buffering and human recognition are not the same mechanism. Yet they share a generative form.

Biological redundancy protects function while a component varies. Love protects legitimate belonging while a person, perspective, or relationship changes. Redundancy permits divergence without immediate functional collapse. Love permits difference without immediate social annihilation. Redundancy increases the probability that complementary biological relations will be discovered. Love increases the probability that distinct persons and perspectives can disclose complementary capacities.

The sequence is:

Mutual legitimacy -> relational safety -> tolerated difference -> exploration and truthful feedback -> discovered complementarity -> higher-order cooperation.

This is not an argument that all differences are complementary or that harmful actions should be tolerated indefinitely. Some variations destroy the conditions of coexistence. Life-coherent love includes protective boundaries. The distinction is between refusing an action and converting a person or population into disposable matter.

Love also enlarges intelligence. When defensive self-protection relaxes, more of a situation can be perceived. The other can speak without tailoring every word to avoid punishment. Error can be acknowledged. Institutions can receive bad news. Creativity becomes possible because the cost of an unsuccessful exploration is not total exclusion.

Conversely, domination narrows intelligence. It pressures subordinates to confirm what authority wishes to hear. It suppresses local knowledge. It converts disagreement into disloyalty. It may produce rapid compliance, but it impoverishes feedback and increases brittleness. Authoritarian order is therefore often a loss of collective cognition.

The biology of love does not replace politics, law, or material redistribution. A person cannot be recognized as a legitimate other while being denied food, water, shelter, healthcare, education, or voice through institutional arrangements. Love must acquire material form. The civil commons can be interpreted as one such form: shared institutions through which a society recognizes that access to the universal conditions of life cannot depend entirely on competitive purchasing power.

12. Cultural Drift and Institutional Autopoietization

Cultures drift through the recurrent conservation of conversations. Children do not inherit culture only as explicit propositions. They participate in patterns of attention, authority, emotion, work, gender, play, punishment, exchange, care, and belonging. Through living these coordinations, they acquire the bodily dispositions from which a world appears obvious.

Cultural drift is neither random nor fully planned. Existing institutions, infrastructures, traumas, ecological conditions, technologies, and power relations bias which conversations can continue. Innovations arise, some disappear, some become complementary to existing practices, and some transform the organization of social life. Human reflexivity can influence this drift, but never from outside history.

Institutions are condensations of conserved conversation. A hospital materializes distinctions among illness, expertise, urgency, responsibility, payment, and acceptable risk. A school materializes distinctions among knowledge, age,

achievement, discipline, and authority. A financial system materializes distinctions among value, credit, ownership, debt, and entitlement. A state materializes distinctions among citizenship, territory, law, security, and legitimate force.

Because institutions coordinate recurring conduct, they develop operational closure. Their decisions increasingly refer to prior decisions, rules, categories, budgets, and performance measures. Some closure is necessary for continuity. Pathology emerges when the institution becomes unable to receive evidence that its self-conservation is disabling its stated living purpose.

Institutional autopoietization can be diagnosed through several signs. Means become ends. Proxies displace realities. Compliance substitutes for consequence. Those most affected lose the power to define harm. Costs are externalized to households, workers, ecosystems, or future generations. Exit becomes difficult. Criticism is interpreted as threat. Institutional survival is treated as a value in itself.

The emotional matrix often shifts simultaneously. Fear of blame encourages defensive documentation. Status anxiety protects hierarchy. Scarcity encourages competition between departments. Reputational fear suppresses acknowledgment of harm. Moral injury accumulates among staff who recognize the gap between institutional procedure and life-service but lack the power to change it.

A life-coherent institution must therefore be more than efficient or participatory in appearance. It must be corrigible. Evidence of harm must be able to enter, be interpreted by those with relevant lived and technical knowledge, and change core operations, incentives, resource allocations, and authority relations. Corrigibility is the institutional form of reflective structural coupling.

The aim is not to abolish organization but to realign what organization conserves. A hospital should conserve reliable healing capacity, not merely throughput. A school should conserve development and curiosity, not merely credential production. An economy should conserve access to life-goods and ecological regeneration, not merely monetary expansion. A state should conserve conditions of legitimate coexistence, not merely its security apparatus.

The world a culture brings forth is the world its conversations and institutions repeatedly conserve. Transformation becomes possible when communities can perceive that conservation, change the emotioning in which it operates, and establish material arrangements that make a different conversation viable.

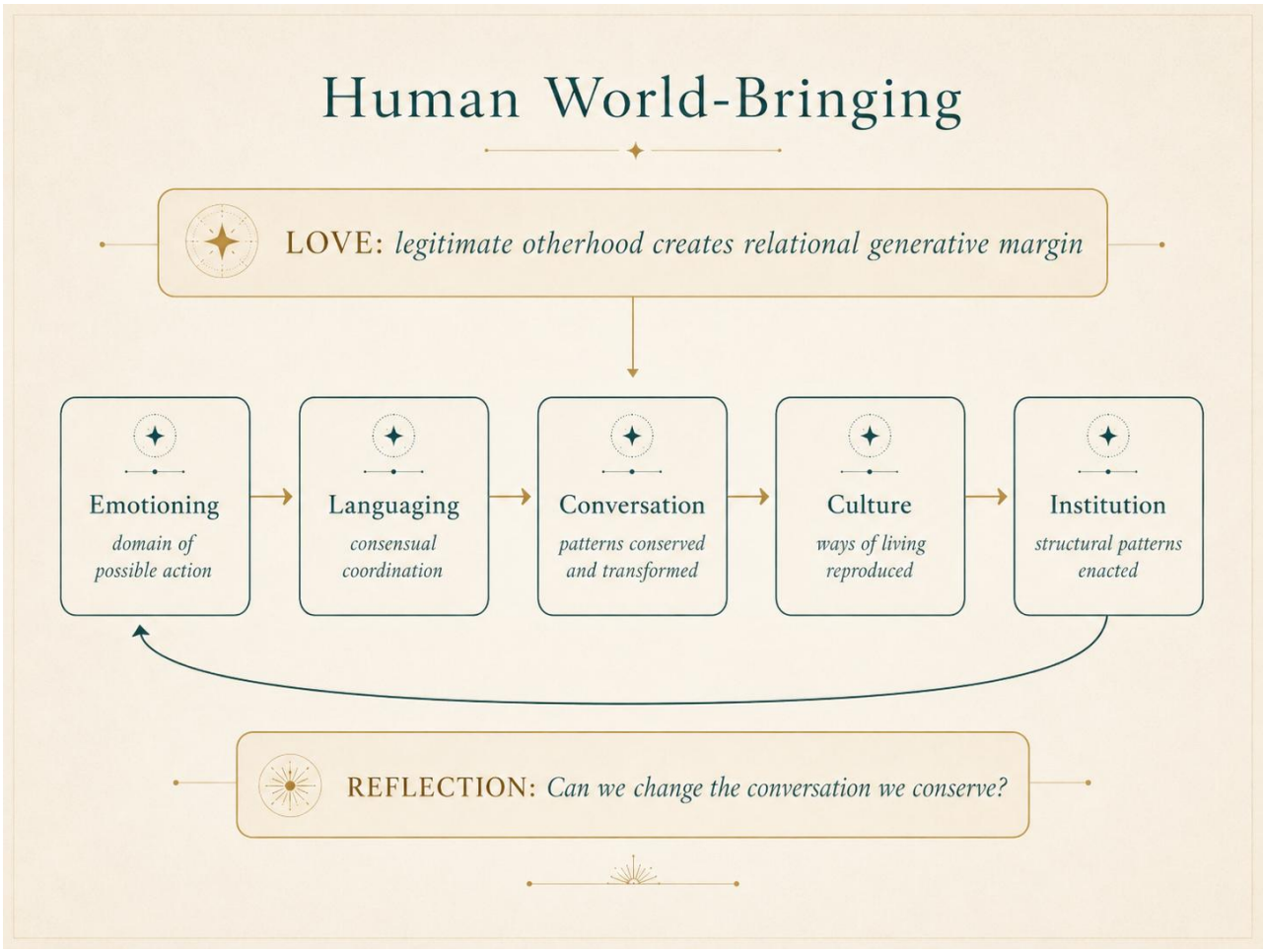

Figure 6. Human World-Bringing. Emotioning, languaging, conversation, culture, and institution recursively conserve ways of living; love creates relational generative margin and reflection permits change.

Part V - Life-Coherent Generative Drift

13. The Integrated Framework

The preceding analyses can now be integrated into a single transdisciplinary framework. **Life-coherent generative drift** names the process by which living systems and human communities conserve sufficient continuity to vary, encounter difference through recurrent coupling, discover or construct complementary relations, stabilize those relations through coordination, and evaluate the resulting organization by its effects on life-capacity.

The framework has nine movements.

First, **conservation**. Autopoiesis and the necessary conditions of living must continue. Nothing can explore if the processes that make exploration possible have already collapsed.

Second, **generative margin**. Reserve, redundancy, diversity, time, trust, and alternative pathways buffer variation. Margin is not unlimited abundance. It is sufficient room for a system to absorb error and disturbance without irreversible failure.

Third, **structural drift**. Variations arise within inherited constraints without requiring a predetermined destination. History biases possibility, but does not fully specify it.

Fourth, **structural coupling**. Variants encounter organisms, media, communities, and institutions through recurrent interaction. Their significance appears in changed conduct and consequences.

Fifth, **complementarity**. Some differences disclose divisions of labour, reciprocal supports, new dimensions of perception, or higher-order capacities. Other differences prove incompatible or harmful.

Sixth, **emotioning**. In human systems, the emotional domain determines whether possibilities can be expressed, explored, and heard. Fear may conceal difference; curiosity may investigate it; love may preserve the legitimacy of participants through disagreement.

Seventh, **languaging and cultural conservation**. Recursive coordination stabilizes distinctions, practices, roles, norms, and institutions. A temporary innovation becomes a reproducible social world.

Eighth, **life-coherence evaluation**. The new organization is assessed across scales and time. Does it protect, restore, or enlarge life-capacity? Does it externalize disabling costs? Can those affected contest its operations? Does it preserve the conditions of future correction?

Ninth, **renewal or lock-in**. A life-coherent organization creates renewed reserve and wider participation, permitting another generative cycle. A pathological organization consumes reserve, suppresses feedback, and deepens dependency until crisis or deliberate repair interrupts it.

Life-coherent generative drift is not proposed as a single causal law that replaces domain-specific science. It is a relational grammar. Molecular evolution requires molecular mechanisms and population models. Clinical medicine requires physiology and evidence. Institutional design requires political economy, law, and empirical evaluation. The framework connects these domains by identifying recurring questions about continuity, margin, variation, coupling, coordination, and value.

The framework also clarifies the relation between adaptation and normativity. Adaptation means continued congruence within a domain; it does not establish that the domain is just or sustainable. Persons can adapt to oppressive institutions. Institutions can adapt to public criticism without changing harmful operations. Markets can adapt to ecological scarcity by making necessities unaffordable. Life-coherence asks whether the adaptation enlarges the capacities and conditions of living rather than merely conserving the adapting system.

This is especially important in discussions of resilience. Resilience is often defined as the capacity to absorb disturbance and continue functioning. But a harmful system can be resilient. A life-coherent account asks what function is being preserved, for whom, and at whose cost. The goal is not resilience of any existing order; it is resilience of life-serving capacity and transformability of life-destructive arrangements.

The integrated framework can therefore be expressed as a governing proposition:

> *A system generates higher-order viable organization when it possesses sufficient reserve to tolerate structural variation, feedback capable of revealing complementary or harmful relations, and constraints capable of stabilizing life-serving coordination without sacrificing the capacities of the wider living fields upon which the system depends.*

Its negative counterpart is:

> *When margin is eliminated, difference is punished, feedback is blocked, or local coherence is purchased through externalized life-harm, evolutionary and cultural becoming contracts into pathological lock-in.*

14. Domains of Application

14.1 Clinical medicine

Physiological reserve is the body's generative margin. Paired organs, excess nephron capacity, hepatic regeneration, collateral circulation, overlapping metabolic pathways, immune diversity, and neuroplasticity allow function to continue despite injury and variation. Clinical disease often becomes visible only after reserve has been substantially depleted.

This supports a shift from static normality to capacity. A laboratory value may remain within range because compensatory work has increased. A patient may possess adequate oxygen, glucose, and nutrients yet lack the mitochondrial, muscular, autonomic, or social capacity to convert those substrates into sustained activity. Health assessment must therefore include reserve, regulatory flexibility, recovery time, and the ability to respond to ordinary disturbance.

The therapeutic relationship also constitutes a domain of structural coupling. When patients are treated as legitimate participants, trust can support disclosure, shared reasoning, adherence, and corrective feedback. When they are humiliated or dismissed, information is lost and care becomes less intelligent. Love in clinical practice is not sentimentality; it is the disciplined recognition that the patient is not a case to be processed but a living person whose experience participates in diagnostic knowledge.

Life-coherent medicine asks whether an intervention restores capacity or merely normalizes a metric; whether treatment burden exceeds benefit; whether social conditions make the plan possible; and whether the institution preserves enough time, staffing, and continuity for safe care. A lean hospital with no margin is not efficient from the standpoint of life.

14.2 Education

Education is frequently organized as selection: ranking, sorting, credentialing, and competitive access to scarce opportunities. This can suppress the generative conditions of learning. Curiosity narrows when every exploration is graded. Error becomes concealment. Students learn to perform expected answers rather than participate in bringing forth understanding.

A life-coherent educational environment preserves rigor while changing the emotioning in which rigor is enacted. Learners remain legitimate participants. Feedback guides development rather than assigning worth. Play and exploratory time are protected. Multiple forms of understanding can enter dialogue. Redundancy in explanations, media, mentors, and pathways is recognized as accessibility and resilience rather than waste.

The purpose is not to eliminate standards but to align them with capacity enlargement. The central question becomes: What can the learner increasingly perceive, understand, create, communicate, and contribute? Education then becomes guided cultural drift - the intergenerational conservation and transformation of worlds through conversation.

14.3 Ecology and environmental governance

Biodiversity is ecological generative reserve. Species with partially overlapping functions may appear redundant under stable conditions, yet respond differently to drought, disease, temperature, or disturbance. Functional diversity preserves ecosystem processes across changing conditions. Simplification can increase short-term yield while reducing future response capacity.

Environmental governance must therefore protect more than currently profitable species or measurable services. It must preserve evolutionary and ecological possibility: habitats, connectivity, genetic diversity, water cycles, soils, and the temporal margins required for regeneration.

Structural coupling also corrects the image of society acting upon an external environment. Human institutions are already ecological processes. Budgets, trade systems, energy grids, agriculture, and urban design reshape the media in which human and nonhuman life drift. Environmental policy is not the management of nature from outside but the reflective reorganization of our participation within a shared life-ground.

14.4 Economics and the civil commons

Market competition can coordinate some forms of production and discovery, but it cannot by itself secure universal access to conditions that everyone requires to participate. When necessities are allocated solely through purchasing power, deprivation is interpreted as market information rather than life-harm.

The civil commons includes shared institutions that provide universal access to life-goods such as healthcare, education, clean water, sanitation, public knowledge, ecological protection, and social security. These institutions are society's collective generative reserve. They allow persons to learn, recover, care, create, and take constructive risks without every failure becoming destitution.

A life-coherent economy therefore values margin differently. Household savings, public inventories, ecological buffers, local production, care time, and community networks are not idle assets waiting for financial extraction. They are capacities through which society remains able to respond and become otherwise.

The economic test is not whether an activity generates monetary value, but whether its conversion of labour, matter, energy, and attention enlarges life-capacity within ecological limits. Growth that consumes the conditions of future adaptation is a pathological ratchet.

14.5 Artificial intelligence and technology

Generative AI is an abductive variation engine. It can propose formulations, analogies, images, hypotheses, and combinations at extraordinary speed. Yet generation is not truth, wisdom, or value. Outputs require empirical testing, human judgment, contextual knowledge, and evaluation of consequence.

AI also changes the ecology of languaging. It can widen participation through translation and accessibility, or flood public domains with synthetic volume. It can support local capacity, or deepen dependency on proprietary infrastructures. It can assist reflection, or automate the categories of institutions already detached from life-service.

The governing question is not whether AI is intelligent in the abstract. It is what patterns of coupling its use establishes. Does it preserve human learning and agency? Does it make evidence of harm more visible? Does it contribute to knowledge commons? Are its ecological and labour costs justified by the capacities it enlarges? Can affected persons appeal, contest, and repair its decisions?

Technology becomes life-coherent when it remains a corrigible tool within a wider civil commons rather than an oracle, idol, or enclosure.

14.6 Democracy, law, and peacebuilding

Democracy requires more than periodic selection among elites. It requires protected plurality, truthful feedback, and institutions capable of revising decisions. Opposition, journalism, independent science, local knowledge, and civil society function as social redundancy. They preserve distinctions and warnings that centralized authority may miss.

The biology of love reframes democratic legitimacy. Political opponents need not be treated as enemies whose existence invalidates one's own. Firm boundaries can be established against violence, corruption, and domination while preserving persons as members of the human field. This is the emotional basis of non-sacrificial politics.

Peacebuilding similarly requires more than suppressing direct violence. Structural coupling has often conserved fear, humiliation, trauma, insecurity, and mutually reinforcing narratives. Durable peace must change the recurrent

conversations and material conditions that reproduce threat. Positive peace protects the capacities through which groups can participate without domination.

Love does not erase accountability. It makes accountability restorative rather than annihilative. The aim is to interrupt life-destructive conduct, repair injury, transform conditions, and preserve the possibility of legitimate future coexistence wherever that remains possible.

15. A Life-Coherent Institutional Protocol

The framework can be translated into an institutional protocol organized around eight questions.

1. What living purpose should be conserved?

Name the life-capacity the institution exists to protect, restore, or enlarge. Avoid proxies at this stage. A hospital exists for healing and safe care, not throughput. A school exists for learning and development, not scores. A water agency exists for safe and ecologically sustainable water, not report completion.

2. What generative margin does that purpose require?

Identify the reserves without which the institution becomes brittle: staffing, time, knowledge diversity, ecological buffers, financial contingency, local capacity, multiple access routes, and relational trust. Distinguish useful redundancy from procedural duplication.

3. Which variations and voices are currently suppressed?

Examine whose knowledge cannot enter, which errors are punished into concealment, what alternatives are excluded by procurement or professional categories, and which communities bear consequences without interpretive authority.

4. What coupling does the institution create?

Assess how rules and technologies change the conduct of staff, users, communities, and ecosystems. Do indicators improve reality or train people to satisfy the indicator? Does surveillance create safety or concealment? Does conditionality build capacity or dependency?

5. What emotioning is being conserved?

Identify whether the institutional world is organized through fear, shame, rivalry, curiosity, trust, solidarity, or care. Formal participation cannot compensate for an emotional matrix in which dissent remains dangerous.

6. Which complementarities could enlarge capacity?

Look for differences that can become divisions of labour, reciprocal support, or new dimensions of understanding. Protect experimental collaborations long enough for their value to become visible.

7. What are the cross-scale life effects?

Ask who benefits, who bears costs, and over what time. Include workers, families, communities, ecosystems, nonhuman life, and future generations. Local efficiency achieved through wider disabling cost is life-incoherent.

8. Can evidence of harm change core operations?

Establish corrigibility. Those affected need routes to appeal. Evidence must be able to alter budgets, incentives, authority, procurement, and strategy, not merely produce another report. Exit and decomplexification options should be preserved.

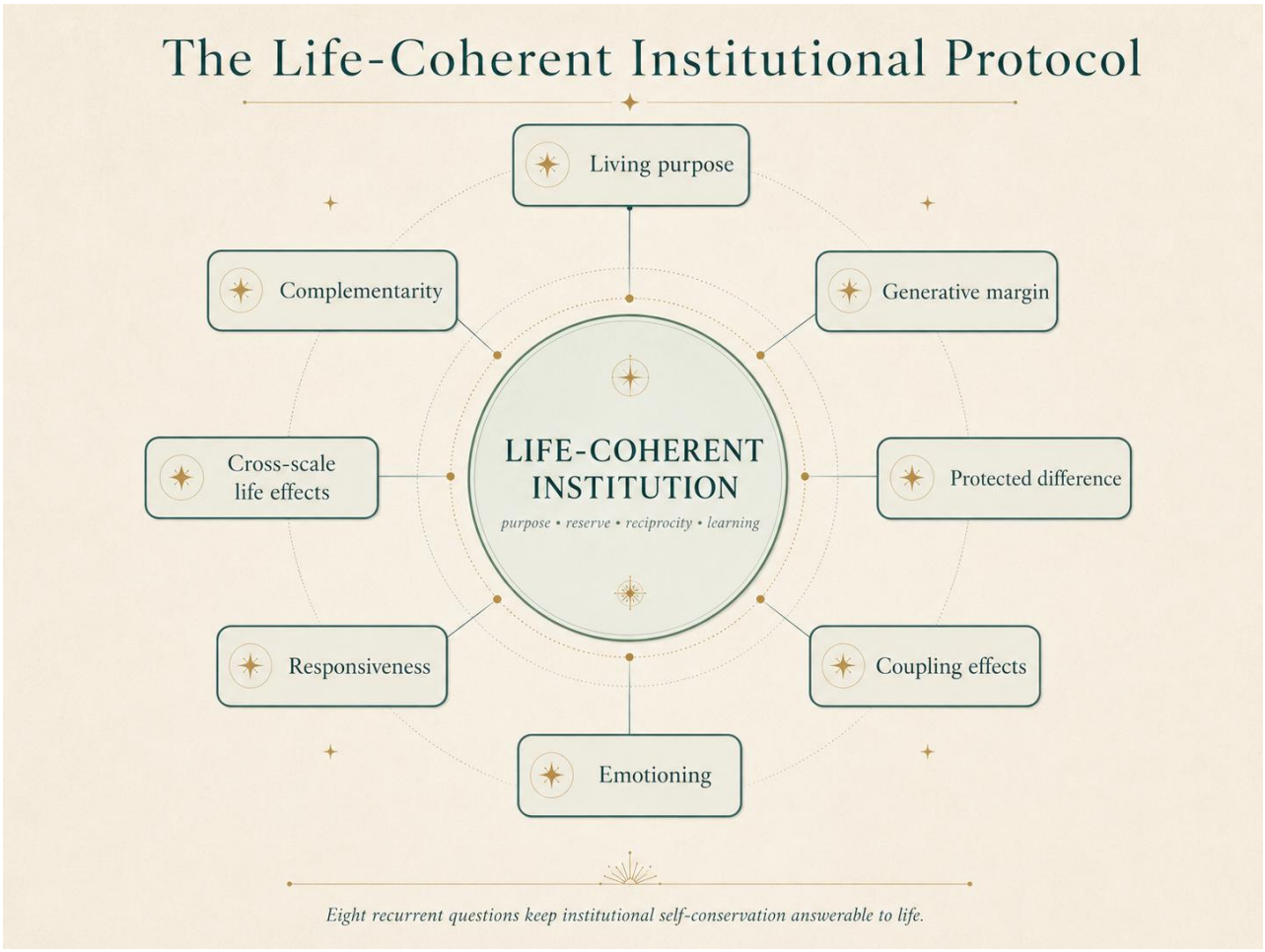

Figure 7. The Life-Coherent Institutional Protocol. Eight recurrent questions keep institutional self-conservation answerable to living purpose and cross-scale consequence.

Table 2. Life-coherent institutional design principles and diagnostic questions.

Principle	Diagnostic question	Life-coherent direction
Living purpose	Which life-capacity justifies the institution?	Name healing, learning, safety, participation, or ecological regeneration before choosing proxies.
Generative margin	What reserve is needed for disturbance and learning?	Protect time, staffing, diversity, alternatives, local capacity, and trust.
Protected difference	Which voices and variations are suppressed?	Create safe routes for dissent, uncertainty, local knowledge, and experiment.
Coupling awareness	How do rules alter the conduct they measure?	Evaluate behavioural, relational, ecological, and long-term effects.
Emotional matrix	What emotioning is recurrently conserved?	Reduce fear and shame; cultivate curiosity, responsibility, solidarity, and love.
Complementarity	Which differences could become reciprocal capacities?	Support cross-boundary collaboration without forced sameness.
Cross-scale value	Who benefits and who bears costs?	Internalize effects on workers, communities, ecosystems, and future generations.
Corrigibility	Can evidence of harm alter core operations?	Provide appeal, participatory interpretation, budget change, repair, exit, and simplification.

The protocol is iterative. Institutional change is itself a perturbation that will produce unanticipated effects. Evaluation therefore returns to the beginning. The aim is not to certify permanent coherence but to conserve the capacity for ongoing correction.

Conclusion - The World Is What We Conserve Together

Evolution does not present humanity with a moral instruction to dominate, compete, or eliminate. Nor does it guarantee progress toward cooperation. It reveals a more demanding truth: living worlds persist through histories in which continuity and change remain inseparable.

Autopoiesis shows that identity is conserved organization through structural transformation. Natural drift shows that lineages can become different without being pulled toward a predetermined goal. Structural coupling shows that organism and medium become congruent through recurrent interaction and that living beings participate in bringing forth their worlds. Inverse Darwinism shows that duplication, redundancy, and excess capacity can protect variation long enough for improbable complementarities to emerge. Biosemiotic analysis shows that differences become meaningful through the changes they make possible in an interpreting living system.

Human worlds add another recursion. Emotioning opens and closes domains of action. Languaging coordinates conduct and stabilizes shared distinctions. Cultures conserve networks of conversation. Institutions materialize those conversations and can become increasingly organized around their own reproduction. Love preserves legitimate otherhood and creates the relational margin in which difference, error, vulnerability, and dissent can remain present without immediate negation.

Yet neither love within a group, complexity, adaptation, nor persistence is sufficient. A tumour adapts. An empire coordinates. A bureaucracy persists. A market can become internally coherent while destroying the ecological and social capacities upon which it depends. Life-value supplies the decisive criterion. The measure of a system is the range and depth of life-capacity it enables, the harms it prevents or repairs, and the conditions of future living it conserves.

The world that wants to be brought forth is not an ideal system imposed from above. It is a manner of drifting together. It protects ecological and social margin. It recognizes diversity as potential reserve. It allows truthful feedback. It holds persons legitimate while establishing boundaries against life-destructive action. It embodies love materially through civil commons. It makes technology answerable to life. It enables institutions to admit error and change the operations producing harm.

Such a world will still contain conflict, loss, uncertainty, limits, and death. Life-coherence does not promise immunity from tragedy. It asks whether our responses enlarge the capacity to meet tragedy without multiplying unnecessary sacrifice.

The central civilizational question is therefore not, "Which system will win?" It is:

What must we conserve together if life is to remain capable of becoming otherwise?

The answer is not a fixed blueprint. We must conserve the life-ground; the legitimacy of persons as participants; sufficient diversity and reserve for adaptation; truthful feedback; the capacity to revise our conversations; and the civil commons through which the conditions of possibility remain widely shared.

The task is not to stop drift. It is to become responsible for what our drift conserves.

Conserve the living. Protect the margin. Permit the drift. Attend to the coupling. Welcome complementarity. Reflect on the conversation. Restore legitimate otherhood. Test every arrangement by the capacities of life it enables.

The world is what we conserve together.

Research and Practice Agenda

This synthesis opens a programme rather than closes an argument.

1. **Clarify natural drift empirically.** Compare the explanatory contribution of natural drift with population-genetic, developmental, ecological, and niche-construction models. Specify where the concept adds testable insight and where it functions principally as an epistemological reframing.
2. **Map generative reserve across scales.** Develop operational measures of redundancy, degeneracy, diversity, slack, repair capacity, and alternative pathways in cells, organisms, ecosystems, institutions, and communities. Distinguish reserve that enlarges adaptive possibility from duplication that merely adds burden.
3. **Study transitions from neutralization to complementarity.** Identify conditions under which buffered differences produce new capacity, harmless complexity, or pathological dependency. Use comparative molecular, ecological, and institutional case studies.
4. **Operationalize emotional matrices.** Develop ethically appropriate methods for studying how fear, trust, curiosity, shame, solidarity, and love shape feedback, learning, error disclosure, and innovation in hospitals, schools, public agencies, and research organizations.
5. **Examine languaging as institutional infrastructure.** Track how recurring distinctions and narratives become embedded in forms, metrics, software, budgets, and professional roles. Test whether changing conversational and material arrangements together produces more durable transformation than changing either alone.
6. **Develop measures of institutional corrigibility.** Assess how evidence of harm enters an institution, who may interpret it, how quickly it reaches decision-making, whether affected communities possess standing, and whether core resource allocation can change.
7. **Test the civil commons as generative reserve.** Compare societies and regions with differing levels of universal healthcare, education, social security, public knowledge, and ecological protection. Examine whether stronger commons increase adaptive capacity, innovation, trust, and recovery while reducing catastrophic exclusion.
8. **Apply the framework clinically.** Study reserve and life-capacity in multimorbidity, frailty, chronic fatigue, rehabilitation, discharge safety, and long-term care. Evaluate whether relational legitimacy and shared reasoning improve diagnostic accuracy, adherence, and functional outcomes.
9. **Develop life-coherent AI governance.** Assess whether AI applications enlarge local knowledge and agency or create dependency, surveillance, cognitive displacement, ecological burden, and institutional lock-in. Preserve appeal, human judgment, and public-interest alternatives.
10. Formalize life-coherent generative drift cautiously. Define variables, mappings, and testable implications. Compare network, dynamical-systems, category-theoretic, information-theoretic, and other mathematical approaches by explanatory economy, empirical discrimination, and corrigibility.
11. **Engage pluriversal knowledge traditions.** Enter dialogue with Indigenous, African, Asian, Caribbean, ecological, feminist, disability, and decolonial traditions through consent, reciprocity, territorial respect, and protection against epistemic extraction. Test whether "legitimate otherhood" adequately addresses histories of power and dispossession.
12. **Create living laboratories of generative drift.** Establish bounded institutional experiments in which margin, protected dissent, interdisciplinary complementarity, participatory evaluation, and life-capacity measures can be studied over time.

Glossary of Core Terms

Adaptation: In the Maturanan sense used here, the continued congruence between a living system and its medium such that autopoiesis remains conserved; not necessarily optimality.

Autopoiesis: The organization of a living system as a network of processes that produces the components and boundary through which the same network is continuously regenerated.

Civil commons: Socially organized institutions and practices that secure universal access to the conditions required for life and life-capacity.

Complementarity: A relation in which differentiated components or perspectives together enable a function, understanding, or capacity unavailable to either alone.

Conversation: The interweaving of languaging and emotioning through which recurrent coordinations of conduct are conserved or transformed.

Corrigibility: The capacity of a person, theory, technology, or institution to receive evidence of error or harm and alter the operations producing it.

Cultural drift: Historical change in networks of conversation, practices, and institutions as manners of living are conserved and transformed across generations.

Degeneracy: In biology, the capacity of structurally different components or pathways to perform overlapping functions or produce similar outcomes; an important source of resilience and evolvability.

Emotioning: The continuous flow among bodily-relational dispositions that specify domains of possible action.

Generative margin: The reserve, redundancy, diversity, time, trust, and alternative pathways that permit variation and learning without immediate collapse or exclusion.

Institutional autopoietization: The analogical process by which an institution becomes increasingly organized around conserving its own procedures, categories, revenues, authority, and reputation rather than the living purpose it was created to serve.

Inverse Darwinism: The proposed generative complement to natural selection in which duplication, redundancy, buffered divergence, and complementarity increase the probability of evolutionary novelty.

Languaging: Recursive consensual coordination of conduct through which human distinctions, meanings, identities, and shared worlds arise.

Life-capacity: The embodied, cognitive, affective, relational, cultural, and ecological abilities through which living beings can act, experience, develop, recover, and participate.

Life-coherence: Alignment of a relationship, practice, technology, or institution with the protection, restoration, and enlargement of life-capacity without transferring disabling costs to other lives or future conditions.

Life-coherent generative drift: The integrated process by which sufficient continuity and margin permit structural variation, coupling, complementarity, conversational conservation, and reflective life-value evaluation.

Life-ground: The biological, ecological, social, and material conditions presupposed by every human purpose and institutional system.

Love: In Maturana's technical sense, the emotioning in which the other arises as a legitimate other in coexistence.

Natural drift: Evolutionary change through the conservation of autopoiesis and adaptation while lineages undergo structurally determined variation within histories of coupling, without a predetermined destination.

Organization: The relations that must be conserved for a unity to remain a unity of a particular class.

Pathological lock-in: A condition in which accumulated dependencies, feedback suppression, and self-maintenance make a system difficult to change even as it diminishes wider life-capacity.

Structural coupling: The history of recurrent interactions through which a structurally determined system and its medium undergo congruent changes.

Structure: The actual components and relations that realize a system's organization at a particular moment.

Appendix A - Life-Coherent Generative Drift Checklist

Use the checklist as a reflective instrument rather than a certification score.

1. What living person, community, ecosystem, or capacity is this system meant to serve?
2. What organization or function genuinely needs to be conserved?
3. What reserve, redundancy, diversity, or time margin is required for safe variation?
4. Has efficiency removed capacities that would be needed under disturbance?
5. Which forms of difference, dissent, or local knowledge are currently suppressed?
6. Can people acknowledge uncertainty and error without disproportionate punishment?
7. What emotional domain does the system conserve: fear, shame, rivalry, curiosity, trust, solidarity, or love?
8. What recurring conversations reproduce the present arrangement?
9. How do rules, indicators, technologies, and incentives alter the conduct they measure?
10. Which complementary relations could enlarge capacity if given protected time to develop?
11. Which dependencies add genuine capacity, and which merely reproduce inherited complexity?
12. Who benefits from the present organization?
13. Who bears its bodily, social, ecological, or temporal costs?
14. Are costs transferred to persons, species, places, or generations unable to refuse them?
15. Can those affected define harm and participate in interpretation and decision-making?
16. Does the arrangement strengthen local and shared capacity or deepen dependency?
17. Can evidence of harm alter budgets, incentives, authority, and core operations?
18. Are exit, simplification, and decomplexification possible?
19. Does the system create renewed reserve for future learning and repair?
20. Overall, does it protect, restore, or enlarge life-capacity within ecological limits?

Decision options: proceed; proceed with safeguards; redesign; pause and investigate; simplify; repair; withdraw.

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Acknowledgements

This work acknowledges the writings of Humberto Maturana, Francisco Varela, Jorge Mpodozis, Gerda Verden-Zoller, Ximena Davila, Terrence Deacon, Matt Kalkman, John McMurtry, Gregory Bateson, Johan Galtung, and the many researchers and practitioners whose work has made a relational, embodied, and life-grounded understanding of evolution possible. The 2026 chapter by Kalkman and Deacon provided the immediate catalyst for the present synthesis. The author also acknowledges the patients, colleagues, communities, teachers, family members, and readers through whose conversations the life-coherence framework has continued to develop.

About the Author

Dr Bichara Sahely, BSc (Biology), MBBS, DM (Internal Medicine), is a general internist from St Kitts and Nevis. His work integrates clinical medicine, public health, environmental governance, political economy, peace studies, living-systems theory, and John McMurtry's life-value onto-axiology. Drawing upon more than two decades of clinical practice, he has developed the life-coherence framework as a transdisciplinary approach to diagnosing and repairing systems that become detached from the living purposes they were created to serve. Through *Toward Life-Knowledge* and his open-access website, bsahely.com, he curates essays, academic white papers, dialogues, and educational resources devoted to bringing knowledge back into service of life.