CAMS and the Extended Evolutionary Synthesis
A Thermodynamically Motivated Coordination Formalism for Human Societies

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Abstract

This paper integrates the Complex Adaptive Model State (CAMS) framework with the Extended Evolutionary Synthesis (EES). Human societies are treated as far-from-equilibrium state-like coordination systems whose institutional architecture performs the work required for energy capture, entropy export, memory retention, and collective action. CAMS is not presented as direct calorimetric thermodynamics: it does not yet measure physical free energy, entropy production, or energy throughput in joules. Rather, it is proposed as a thermodynamically motivated coordination-theoretic formalism: a way of modelling the institutional substrate through which cultural inheritance is stabilised, strained, transformed, and sometimes lost.

The eight-node, four-metric CAMS architecture is proposed as a scale-covariant coarse-graining of large human societies and state-like systems, provisionally validated across longitudinal datasets spanning 1900–2025 and multiple civilisational types. We derive a two-dimensional diagnostic phase space—Cognitive Activation ($\overline{A} \times \overline{C}$) versus Effective Capacity ($\overline{V}$)—that partitions societal trajectories into regimes with divergent evolutionary implications. We distinguish long-run overreach indicators from proximate transition warnings, arguing that collapse prediction requires compound conditions involving the overreach ratio $\varepsilon(t)$, coherence degradation $\Lambda(t)$, rate dispersion $\omega(t)$, and resilience measures.

CAMS is not offered as a replacement for cultural-evolutionary theory, niche construction, institutional analysis, or cliodynamics. Rather, it supplies a meso-level coordination layer linking micro-institutional coupling to macro-historical phase transitions. All scoring protocols, datasets, and phase-space tools are available at neuralnations.org.

1 Introduction

The modern evolutionary synthesis—forged from Darwinian selection, Mendelian genetics, and population biology—was later extended by cultural evolution, niche construction, developmental bias, and extra-genetic inheritance into what is now termed the Extended Evolutionary Synthesis (EES) [2]. These frameworks successfully account for cumulative culture, social learning, ecological engineering, and the inheritance of constructed environments. Yet they do not yet provide a formal account of the *institutional substrate* through which large human societies retain memory, coordinate action, bear stress, and reproduce cultural order across generations.

Cultural inheritance does not float above material systems. It requires archives, priesthoods, schools, bureaucracies, legal orders, transport networks, armed institutions, labour systems, property regimes, and exchange mechanisms. These institutional structures require energy, maintenance, symbolic integration, and coordination. They decay when those requirements are not met. The question, therefore, is not whether culture evolves, but through what measurable institutional apparatus its evolution is stabilised, accelerated, constrained, or lost.

Paper 1 introduced the Complex Adaptive Model State (CAMS) as a formal model of societies as coordinated state-like systems [14]. Paper 2 argued that CAMS yields a natural taxonomy of such systems shaped by geography, path dependence, and recurrent coordination constraints [15]. This paper extends that work by positioning CAMS as a candidate coordination layer for the Extended Evolutionary Synthesis.

The claim is deliberately limited. CAMS is not, in its present form, a literal thermodynamic accounting system. It does not calculate energy throughput in joules or entropy production in physical units. It is instead a thermodynamically motivated coordination formalism. It models the institutional conditions under which energy capture, entropy export, memory retention, and collective action become possible. In this sense, CAMS supplies a bridge between cultural-evolutionary mechanisms and macro-historical phase transitions.

Human societies are not exceptions to physical law. They are among the most structurally intricate dissipative systems yet observed. But the appropriate first step is not to pretend that social variables are already physical energy variables. The appropriate first step is to formalise the coordination architecture through which human societies convert energy, information, memory, and labour into durable collective order.

2 Thermodynamic Motivation and Institutional Coordination

Every living system is a far-from-equilibrium dissipative structure [1]. It maintains order by importing usable energy and exporting disorder. This principle has been applied to ecosystems [3], economic systems [5], and historical complexity [4]. Lotka framed energy flows as evolutionary imperatives [6]; Odum developed energy-language for ecosystems; Tainter linked social complexity to declining returns on energetic investment; and later complexity theorists examined the non-linear evolution of economic and social systems.

These traditions establish the thermodynamic motivation for CAMS. However, they do not by themselves provide a scale-covariant institutional grammar. Ecosystem models often track energy flow but not symbolic abstraction. Collapse theories often identify energetic limits but do not formalise the internal coordination topology of the society under stress. Cultural-evolutionary models identify social learning and niche construction, but often leave the institutional substrate of long-run memory and coordination under-specified.

CAMS treats the institutional architecture of a society as its coordination apparatus. This apparatus is thermodynamically relevant because it regulates how a society captures energy, allocates resources, maintains memory, enforces order, distributes goods, mobilises labour, and sustains legitimacy. Its variables are not direct energy variables, but they describe the institutional conditions under which energetic and informational flows become socially usable.

2.1 The Eight-Node Coarse-Graining

The eight CAMS nodes are proposed as a regime-dependent coarse-grained basis for large human societies and state-like systems. They are:

- **Helm**: executive coordination, strategic direction, crisis response.
- **Shield**: defence, security, coercive order, boundary maintenance.
- **Lore**: legitimacy, meaning, symbolic integration, education, cosmology.
- **Stewards**: property, resource ownership, allocation, fiscal regimes.
- **Craft**: skills, production, technical competence, applied knowledge.
- **Hands**: labour, population, embodied social reproduction.

- **Archive**: institutional memory, records, law, precedent, bureaucracy.
- **Flow**: trade, logistics, distribution, exchange, network circulation.

These nodes are not proposed as an arbitrary social-science taxonomy. They are treated as a functional decomposition of recurrent coordination requirements. Where internal functional differentiation remains stable across multiple institutional cycles, an eight-node partition approaches the surveyable limit. In highly integrated, compressed, or coercively fused systems, fewer nodes may suffice; in highly differentiated systems, sub-nodes may be required.

The decomposition is therefore empirical rather than merely interpretive. It is warranted only where sub-node relations show persistent non-redundancy under pre-registered thresholds. In CAMS this constraint can be operationalised through network measures such as graph Laplacian algebraic connectivity. The eight-node grammar is thus a proposed coordination basis, not an axiom immune to revision.

2.2 Slow and Fast Coordination Loops

The empirically supported timescale partition is not simply "governing" versus "material", but reactive versus durable. Archive, Lore, and Stewards form the slow loop: they preserve institutional memory, legitimacy, property regimes, and long-horizon constraint structures. Helm, Shield, Flow, Hands, and Craft form the fast loop: they respond rapidly to crisis, mobilisation, logistics, labour disruption, productive reconfiguration, and executive shock.

Helm is strategically directional, but empirically fast-reactive. It moves with shocks rather than with archival or cultural memory. This distinction matters because societies often fail not when all nodes weaken simultaneously, but when slow-loop coherence and fast-loop reaction decouple. A society can preserve memory but lose execution; it can mobilise rapidly but lose legitimacy; it can trade efficiently while exhausting labour; it can retain symbolic identity while degrading material capacity.

2.3 Metrics and Canonical Node Value

The four CAMS metrics are Coherence (C), Capacity (K), Abstraction (A), and Stress (S). Each is scored on a bounded scale, usually 1–10, under a published scoring protocol.

- **Coherence** measures internal alignment, coupling, trust, and functional integration.
- **Capacity** measures demonstrated throughput, institutional knowledge, and operational competence.
- **Abstraction** measures symbolic complexity, representational depth, planning horizon, and institutional sophistication.
- **Stress** measures structural load, contradiction, disorder, or pressure.

The canonical node value is:

$$V_i(t) = C_i(t) + K_i(t) + \frac{1}{2}A_i(t) - S_i(t)$$

This is not literal free energy in the physical sense. It is a formal analogue: a local index of usable institutional order after stress costs are deducted. At system scale, aggregate node values, coherence indices, bond strength, and rate-dispersion measures function as order parameters, tracking whether the society remains synchronised or approaches transition.

2.4 Scale-Covariance and Measurement Limits

CAMS claims formal scale-covariance, not naive metric equivalence. The same state variables can be applied to a chiefdom, corporation, empire, or modern nation-state because each must solve recognisable coordination problems: direction, defence, legitimacy, memory, production, labour, resource allocation, and exchange.

This does not mean that a Coherence score of 7 in a small kin-based polity is materially identical to a Coherence score of 7 in an industrial democracy. The integer score is an ordinal estimate within a historically contextualised regime. Cross-scale comparison therefore requires calibration, transparency of evidence, sensitivity testing, and humility about measurement limits. CAMS claims functional comparability, not automatic equivalence of institutional magnitude.

This distinction is central. The formalism permits comparison across scales because the functions recur. The measurement layer must still respect historical context, institutional density, documentary reliability, and the energy base of the society being scored.

2.5 Thermodynamic Scope

CAMS does not presently measure physical free energy, entropy production, or energy throughput directly in joules. Its present formalism is coordination-theoretic rather than calorimetric. It models the institutional conditions under which energy capture, entropy export, memory retention, and coordinated action become possible.

The thermodynamic claim is therefore structural and operational, not yet energetic in the narrow physical sense. A future extension can anchor CAMS state variables to per-capita energy throughput, food-energy systems, embodied institutional energy, infrastructure maintenance costs, or Energy Returned on Energy Invested (EROEI). The present paper establishes the coordination layer required before such energetic accounting can be made comparative across societies.

3 Diagnostic Axes and Coordination Phase Space

The most analytically productive construction in CAMS is a two-dimensional diagnostic phase space spanned by Cognitive Activation and Effective Capacity:

$$\mathcal{A}(t) = \overline{A}(t) \times \overline{C}(t) \tag{1}$$

$$\mathcal{V}(t) = \overline{V}(t) = \overline{C}(t) + \overline{K}(t) + \frac{1}{2}\overline{A}(t) - \overline{S}(t) \tag{2}$$

where overbars denote means across the eight nodes.

$\mathcal{A}(t)$ measures the degree to which abstraction is coherently integrated. High abstraction without coherence may produce ideological elaboration, administrative complexity, or symbolic overreach without practical coordination. High coherence without abstraction may produce stable but limited coordination. The product $\overline{A} \times \overline{C}$ therefore measures not abstraction alone, but cognitively integrated abstraction.

$\mathcal{V}(t)$ measures effective institutional capacity after stress is deducted. It is not an energy measure, but a coordination-capacity measure. It tracks how much usable institutional order remains after the system's stress load has been accounted for.

Because $A_i, C_i, K_i, S_i \in [0, 10]$, and V_i is linear in these observables, the joint position of $\mathcal{A}$ and $\mathcal{V}$ partitions the observed state space into four diagnostically useful regimes relative to the reference-set means $\mu_{\mathcal{A}}$ and $\mu_{\mathcal{V}}$.

3.1 Four Diagnostic Regimes

Q1: High Activation, High Capacity

$$\mathcal{A} > \mu_{\mathcal{A}}, \qquad \mathcal{V} > \mu_{\mathcal{V}}$$

This is the regime of adaptive equilibrium. The society possesses both symbolic abstraction and the institutional capacity to implement it. Cultural evolution is rapid but bounded. Innovation, legitimacy, administration, and material throughput remain mutually reinforcing.

Q2: High Activation, Low Capacity

$$\mathcal{A} > \mu_{\mathcal{A}}, \qquad \mathcal{V} \leq \mu_{\mathcal{V}}$$

This is the regime of cognitive overreach. Abstraction exceeds the coordination base required to sustain it. Societies in this regime may display elaborate ideology, complex administration, ambitious strategy, or intense symbolic production while losing the institutional capacity to execute or integrate those abstractions.

Q3: Low Activation, Low Capacity

$$\mathcal{A} \leq \mu_{\mathcal{A}}, \qquad \mathcal{V} \leq \mu_{\mathcal{V}}$$

This is the regime of thermodynamic freeze, fragmentation, or terminal decline. The society lacks both symbolic processing power and effective capacity. Institutional memory may persist locally, but it no longer integrates the system. Afghanistan 1978–2025 and Māori South Island tribes 1865–1975 have been analysed in CAMS as examples of this regime [18]. In such cases, colonial disruption, external coercion, or geopolitical shock must be treated explicitly rather than read as endogenous failure.

Q4: Low Activation, High Capacity

$$\mathcal{A} \leq \mu_{\mathcal{A}}, \qquad \mathcal{V} > \mu_{\mathcal{V}}$$

This is a residual or under-activated capacity regime. It may describe systems with material or institutional capacity that remains symbolically compressed, weakly abstracted, or poorly integrated into higher-order coordination. Q4 cases appear rare in the current corpus, but this rarity must not be over-interpreted.

The two axes are not mathematically orthogonal. Both $\mathcal{A}$ and $\mathcal{V}$ contain positive dependence on coherence and abstraction, and this partial collinearity may suppress the frequency of Q4 cases. For that reason, Q4 should not be interpreted as historically rare until the empirical correlation between $\mathcal{A}$ and $\mathcal{V}$ is reported for the relevant corpus. In the present formulation, Q4 is best understood as a diagnostic residual category: systems with measurable capacity that remains under-activated, symbolically compressed, or weakly integrated.

3.2 Overreach Ratio and Transition Semantics

We define the overreach ratio as:

$$\varepsilon(t) = \frac{\overline{A}(t)}{\overline{C}(t)}$$

This index measures abstraction relative to integrative coherence. It should not be interpreted as a collapse trigger by itself. Rather, it marks the degree to which symbolic or administrative complexity exceeds the system's ability to maintain coherent integration.

Empirically, two regimes must be distinguished. Moderate or sustained elevation in $\varepsilon(t)$ is a long-run drift indicator: it suggests accumulating symbolic load and declining integrative efficiency, but it may persist for decades or even centuries if capacity, bond strength, external energy inputs, or imperial extraction remain sufficient. A proximate transition warning requires additional gating conditions, especially declining $\Lambda(t)$, falling resilience, rising rate dispersion $\omega(t)$, or widening stress shear across nodes.

Accordingly, $\varepsilon > 5$ is treated here as a provisional long-duration overreach marker, not as a standalone 4–15 year collapse signal. Shorter lead-time prediction requires a compound criterion combining $\varepsilon(t)$, $\Lambda(t)$, $\omega(t)$, bond strength, and resilience measures. This distinction prevents long-run drift indicators from being confused with proximate transition warnings.

3.3 Activation and Resilience Measures

Two derived indices sharpen the diagnostic resolution. The *Activation Index* is defined as:

$$\sigma_i(t) = \big(A_i(t) \cdot C_i(t)\big)\big(K_i(t) - S_i(t)\big)$$

This weights a node's cognitive output by its net capacity–stress margin. Unlike V_i, which treats all contributions additively, σ_i captures multiplicative fragility. A node may possess high abstraction and coherence, yet become negatively activated when $K_i - S_i < 0$. The boundary $K_i = S_i$ is therefore not a singularity in this formulation, but a phase boundary: the point at which symbolic-coherent activity ceases to produce net institutional headroom and begins to express strain.

Earlier exploratory CAMS notes used ratio-based activation measures. The multiplicative form above is preferred here because it avoids singular behaviour near $K_i = S_i$ while preserving the substantive interpretation of the capacity–stress boundary.

The *Resilience Ratio* is defined as:

$$\tau_i(t) = \frac{\sqrt{C_i(t) + K_i(t)}}{S_i(t) + A_i(t)}$$

This provides a scale-invariant measure of institutional headroom: the ability of a node to sustain stress and abstraction without losing operational coherence. Like all current CAMS indices, $\tau_i(t)$ is a coordination diagnostic, not a physical energy variable.

4 Relation to EES, Cliodynamics, and Cultural Evolution

The thermodynamic character of human societies has not been invisible; it has been observed but not fully formalised at the institutional coordination layer. Several adjacent literatures are directly relevant.

4.1 Extended Evolutionary Synthesis and Niche Construction

Niche construction theory argues that organisms modify their environments and thereby alter selection pressures for themselves and their descendants [8]. In humans, this

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The EES therefore already contains the conceptual opening CAMS requires. Cultural inheritance, developmental scaffolding, and institutional niche construction all imply that societies preserve adaptive information outside the genome. What remains under-formalised is the coordination apparatus through which that information is stored, strained, reproduced, and lost.

CAMS contributes at this point. It does not compete with niche construction or cultural evolution. Rather, it asks: what institutional functions must exist for constructed niches and cumulative culture to persist at scale? Its eight-node structure can be read as a coordination grammar for the social substrate of extra-genetic inheritance.

5.2 Cumulative Culture and Institutional Scaffolding

Boyd and Richerson, Henrich, Sterelny, Laland, Odling-Smee, and others have shown how social learning, cumulative culture, teaching, norm enforcement, and institutional scaffolding transformed human evolution [7, 9, 10, 2, 8]. CAMS is consistent with this tradition but shifts the level of analysis.

Instead of beginning with individual learners or population-level cultural traits, CAMS begins with the differentiated institutional meta-system. It models the Helm, Shield, Lore, Stewards, Craft, Hands, Archive, and Flow functions through which collective learning is retained and coordinated. This provides a meso-level bridge between micro-cultural mechanisms and macro-historical outcomes.

In this interpretation, CAMS is an institutional theory of cultural inheritance. Archive stores memory; Lore integrates meaning; Craft preserves technical skill; Flow circulates goods and information; Hands reproduce labour; Stewards regulate resources; Shield maintains boundaries; Helm coordinates direction. Cultural evolution requires all of these functions, though their relative weight varies by geography, scale, technology, and historical phase.

5.3 Cliodynamics and Seshat

CAMS also overlaps with cliodynamics, especially Turchin's work on structural-demographic theory and the Seshat Global History Databank [11, 12, 13]. Cliodynamics has demonstrated that long-run historical dynamics can be modelled quantitatively using variables such as elite overproduction, popular immiseration, state fiscal stress, warfare, social complexity, and institutional scale.

CAMS does not replace this programme. It proposes a complementary coordination layer. Instead of beginning with demographic pressure, elite competition, or warfare intensity, CAMS begins with the functional decomposition of the social meta-system into institutional nodes and measures the coherence, capacity, stress, and abstraction of each node through time.

The two approaches are potentially convergent. Seshat variables may provide external validation targets for CAMS scores. Structural-demographic stress may map onto CAMS stress, elite overproduction may load on Helm, Stewards, Lore, and Flow, while state fiscal crisis may appear as falling Capacity and rising Stress in Stewards, Archive, and Helm. Conversely, CAMS may help explain why similar demographic pressures produce different outcomes in different institutional topologies.

5.4 Why the Coordination Layer Remained Unformalised

Three constraints help explain why this layer remained difficult to formalise.

1. **Timescale mismatch.** Human lifespans are short relative to civilisational phase transitions. Individual observers experience systemic change as narrative drift—"the world is not what it used to be"—rather than as measurable trajectories in a phase space [19].

2. **Methodological individualism.** Much modern social science, especially in its rational-actor and agent-based traditions, has disaggregated collective behaviour into individual choice. While powerful for micro-prediction, these approaches can obscure the ensemble dynamics of institutional coupling.

3. **Modular civilisational bias.** The maritime, modular, high-Activity civilisational type, especially the Anglo-American form, has dominated recent global scientific discourse. Its particular coordination signature—high individual mobility, weak slow-loop coupling, and strong fast-loop adaptation—can therefore appear universal rather than one of several evolutionary strategies [15].

CAMS is designed to be neutral with respect to these biases. Its ensemble-scoring protocol and formal operators are, by construction, intended to be blind to the ideological priors of any single civilisational type. Whether this aspiration is achieved is an empirical question.

6 Empirical Robustness, Validation, and Limits

The CAMS framework is empirically grounded in longitudinal datasets spanning 1900–2025 for more than 20 societies, including liberal democracies, social democracies, theocratic republics, authoritarian states, corporations, and indigenous polities. These datasets remain provisional. They are best understood as proof-of-concept tests rather than completed validation.

6.1 Current Panel Results

Across independently scored CAMS datasets, the Stress–Capacity relation is consistently negative, with observed correlations ranging from weak-to-moderate ($\rho = -0.351$) to strong anti-correlation ($\rho = -0.797$). This is provisionally supportive, but not decisive.

Since current scores are produced from shared historical evidence streams, some anti-correlation may reflect scorer priors: societies perceived as stressed may also be scored as less capable. A stronger validation requires decoupled indicators, for example deriving Stress from social unrest, legitimacy crises, conflict, strike activity, elite fragmentation, or violence, while deriving Capacity from fiscal, administrative, infrastructural, industrial, or governance indicators. Until such tests are completed, the Stress–Capacity finding should be treated as a conditional regularity rather than an independently established law.

A full submission version of this paper should include a table reporting, for each dataset, the society, time window, number of observations, scoring source, Stress–Capacity correlation, phase-space classification, and whether the pre-registered criterion was satisfied. Without such a table, the empirical claim remains insufficiently auditable.

6.2 Retrospective Historical Alignment

Retrospective phase-space trajectories align with known historical inflections in several cases. The French Third Republic collapse in 1940, the Nazi seizure of power in 1933, the USA COVID shock in 2020, and the Māori reconstitution after 1975 all occupy the quadrants and attractor classes predicted by the formalism [20].

These alignments are encouraging, but they remain hindcasts. Retrospective fit is not prediction. The decisive test is whether the same operators detect stress accumulation, desynchronisation, or transition risk in systems not used to develop the framework.

The taxonomic clustering from Paper 2 recovers four major civilisational types—Continental, Maritime, Mountain, and Riverine—without geographic priors imposed on the clustering algorithm [15]. This result is non-trivial if replicated: the clustering is driven by the relative loading of the four metrics across the eight nodes, not by explicit geographic labels.

6.3 Inter-Rater Reliability and LLM Limits

Current CAMS scoring relies heavily on LLM-assisted ensemble scoring. Inter-rater reliability is high, with $ICC(2, k) = 0.973$ across the CAMNATIONS5 USA panel [21]. This is encouraging, but it should not be overstated. LLMs share overlapping training corpora, common historical narratives, and similar exposure to dominant interpretations. High inter-rater reliability among LLMs may therefore partly reflect inter-corpus convergence rather than genuinely independent judgment.

The next critical step is blind scoring by non-LLM institutional historians using the published protocol. A second step is out-of-sample testing on datasets not used in the original CAMS development cycle, including premodern polities, contemporary firms, and non-state institutional systems. A third step is decoupled validation, in which Stress, Capacity, Coherence, and Abstraction are estimated from independent evidence streams wherever possible.

6.4 Collinearity and Phase-Space Geometry

The activation–capacity phase space is diagnostically useful, but it is not an orthogonal decomposition of social reality. $\mathcal{A}(t)$ and $\mathcal{V}(t)$ share dependence on Coherence and Abstraction, and may therefore be correlated by construction. This matters especially for Q4, which may be suppressed by the geometry of the axes rather than by historical rarity.

A submission-ready version of this paper should report the empirical correlation between $\mathcal{A}(t)$ and $\mathcal{V}(t)$, preferably using both Pearson and Spearman coefficients across the pooled corpus and within major society types. If the axes are strongly correlated, the quadrant interpretation should be revised from a phase-space partition to a diagnostic projection. If the axes show moderate or weak correlation, the stronger phase-space interpretation becomes more defensible.

7 Falsifiability and Future Tests

CAMS is intended to be falsifiable. The following criteria define the next stage of empirical testing.

1. **Decoupled Stress–Capacity Test.** The Stress–Capacity anti-correlation must appear under decoupled scoring conditions, where Stress and Capacity are estimated from independently sourced evidence streams.

2. **Pre-Transition Desynchronisation Test.** Pre-transition desynchronisation, measured as declining $\Lambda(t)$, rising rate-dispersion $\omega(t)$, falling bond strength, or widening stress shear, must precede major collapses or regime transitions in out-of-sample cases.

3. **Compound Overreach Test.** Sustained $\varepsilon > 5$ must identify long-run overreach states, while proximate transitions must require additional gating conditions, including declining $\Lambda(t)$, rising $\omega(t)$, falling resilience $\tau_i(t)$, or weakening bond strength. The compound criterion, not ε alone, must discriminate terminal $Q2 \to Q3$ trajectories from recoverable $Q2 \to Q1$ rebounds.

4. **Scale-Covariance Test.** CAMS must recover comparable coordination signatures across systems of different scale—for example firms, polities, empires, and indigenous confederations—without pretending that equal integer scores imply equal institutional magnitude.

5. **Cliodynamic Convergence Test.** CAMS-derived stress, coherence, and capacity measures should correlate in theoretically expected ways with independent cliodynamic indicators, including structural-demographic stress, state fiscal strain, warfare intensity, elite competition, and social complexity.

6. **Geographic Clustering Test.** Civilisational clustering should be recoverable by independent researchers using the published scoring protocol and raw metric matrices, without geographic labels being supplied to the clustering algorithm.

These criteria are deliberately demanding. The framework should fail if it cannot survive independent scoring, decoupled validation, and out-of-sample testing.

8 Conclusion: A Coordination Layer for the Extended Synthesis

CAMS offers a thermodynamically motivated coordination layer for the Extended Evolutionary Synthesis. Human meta-systems are not exempt from the constraints that govern dissipative structures, but the present formalism does not yet claim direct energetic accounting. It models the institutional coordination conditions under which energy capture, entropy export, memory retention, and collective action become possible.

The eight-node, four-metric architecture, the activation–capacity projection, and the derived indices together provide a quantifiable language for the energetic and cognitive journey of large-scale human cooperation. What was once the domain of narrative intuition—"societies rise and fall," "civilisations collapse"—can now be restated as trajectories in a measurable coordination space, subject to falsification criteria and open to independent replication.

CAMS therefore offers the Extended Evolutionary Synthesis a candidate formalism for modelling human meta-systems as evolving, energy-processing, memory-bearing structures. Its present results are provisional. The decisive tests will be independent scoring, decoupled Stress and Capacity indicators, cross-scale calibration, cliodynamic convergence, and out-of-sample validation against historical systems not used in the framework's construction.

The datasets, scoring protocols, and phase-space visualisation tools are publicly available at neuralnations.org and github.com/KaliBond/wintermute. Researchers are invited to replicate, extend, and challenge these results.

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