Variety Dynamics Axioms and Descriptions

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Description of complex systems for which Variety Dynamics was devised.

AXIOM 1. Foundational axiom of variety and control

For complex and hyper-complex systems involving multiple constituencies in which the distributions of variety generation and control variety is uneven across the system at any one time,

THEN

The differing distributions and dynamics of generated and controlling variety result in a structural basis for differing amounts of power and hegemonic control over the structure, evolution and distribution of benefits and costs of the system by different constituencies.

This axiom describes the **material and structural foundation of power relations** in complex systems. It identifies power asymmetries are not merely social constructs but emerge inevitably from the **topology of variety generation and control distribution** across system constituencies.

This axiom reveals that **power and hegemony have material, structural foundations** in the topology of variety generation and control distribution. Power asymmetries are not merely social constructs or historical accidents but **necessary consequences** of uneven variety distributions in complex systems.

Key insights:

Power is topological with respect to variety: Emerges from positions in variety generation/control networks

Hegemony is variety control: Dominant constituencies control critical variety positions

Inequality is structural: Benefit/cost distribution determined by variety topology

Change requires topology change: Cannot transform power without redistributing variety and its control

Material foundation for politics: Political analysis must examine variety distributions

This principle explains:

Why inequality persists despite reforms (variety topology unchanged)

Why revolutions often reproduce hierarchies (fail to transform variety topology)

Why technological change can be revolutionary (can redistribute variety capabilities)

Why collective action is necessary (individual action cannot shift topology)

Why democracy requires more than voting (requires variety redistribution)

The insight provides a **scientific foundation for emancipatory politics**: understanding power as topological enables identifying strategic points for intervention and transformation. Movements seeking to transform power relations must analyze and change the distribution of variety generation and control capabilities across system constituencies.

This represents a **unification of systems science and political economy**, showing that power, hegemony, exploitation, and oppression are not separate from but intrinsic to the variety dynamics of complex systems - and that understanding variety topology provides both analytical tools for understanding domination and strategic guidance for achieving liberation.

AXIOM 2. Hierarchical structural basis for control

For complex and hypercomplex systems involving multiple constituencies some with more and less power and control in which the distribution of variety generation and control is uneven across the system

THEN

If less powerful parties increase the variety faced by the more powerful parties, power flows from the more powerful parties to the less powerful parties

The differing distributions of generated and controlling variety result in a structural basis for differing amounts of power and hegemonic control over the structure, evolution and distribution of benefits and costs of the system by particular constituencies.

This axiom reveals a **fundamental mechanism for power redistribution**: less powerful constituencies can systematically transfer power by strategically increasing the variety that powerful constituencies must manage, exploiting the inevitable limits of control capacity and transaction cost scaling.

Key insights:

Strategic variety generation: is a mechanism for power transfer

Control has limits: Powerful's control capacity can be exceeded through variety multiplication

Power flows to variety managers: Those who handle complexity gain power as others fail

Emancipation achieved through variety generation: not just confrontation

Universal mechanism: Pattern applies across all complex systems with power asymmetries

This principle provides **scientific explanation of some historic events**:

How labor movements succeed: Overwhelming capital's control through strike/tactic variety

How decolonization occurred: Multiplying resistance forms beyond colonial control capacity

How civil rights advanced: Strategic variety generation exhausting segregationist control

How insurgencies defeat empires: Asymmetric variety overwhelming conventional military control

How digital disruption transfers power: Information variety explosion overwhelming gatekeepers

The insight suggests that **systematic power transfer is possible** through deliberate variety generation strategy, providing both analytical framework for understanding historical power shifts and practical guidance for contemporary emancipatory movements.

AXIOM 3. Hierarchical stable location of sub-systems

For complex and hyper-complex, layered and hierarchical systems that have a variety of typical stable states of system structure, THEN the structural system state that the system will evolve will depend on the relative locations of subsystems generating variety and the control subsystems able to use variety to control overall system variety.

The insight from this is that spatial and hierarchical relationships between variety-generating subsystems and variety-controlling subsystems determine which stable structural configuration a complex system will evolve toward. It identifies that system evolution is governed by **variety dynamics topology** rather than just variety quantities.

Key insights:

Structure follows variety topology: System organization emerges from the arrangement of variety-processing relationships

Evolution is predictable: Given variety topology, system evolution trajectories can be anticipated

Design can shape evolution: Strategic positioning of variety generation and control systems determines evolutionary outcomes

Multiple stable states exist: Complex systems can evolve toward different structural configurations based on topology

Topology changes alter trajectories: Repositioning variety processing relationships can redirect system evolution

This principle provides a **framework** for:

Understanding why systems evolve toward particular structural configurations

Predicting system evolution based on variety dynamics topology

Designing systems to evolve toward desired structural states

Managing system transformation by modifying variety processing relationships

Analyzing system stability through topological variety analysis

The insights from this suggest that successful system architecture requires **variety topology design** as much as functional design, and that sustainable system evolution depends on achieving appropriate relationships between variety generation and variety control at all hierarchical levels and spatial scales.

Implications for Biological Systems: Variety Topology and Evolutionary Structure

This axiom also has implications for understanding biological system evolution, from molecular networks to flora and fauna biologies to ecosystems. The relative positioning of variety-generating and variety-controlling mechanisms determines which stable biological structures emerge and persist.

This axiom indicates that **biological evolution is fundamentally driven by variety topology optimization**. The relative positioning of variety-generating and variety-controlling mechanisms determines which biological structures emerge, persist, and succeed.

Key biological insights:

Structure follows variety topology: Biological organization emerges from variety processing relationships

Evolution optimizes topology: Natural selection favors variety topologies that enhance survival and reproduction

Health requires topology balance: Disease often represents variety topology breakdown

Conservation needs topology thinking: Protecting biological systems requires understanding their variety processing architecture

Biotechnology should respect topology: Engineered systems must maintain appropriate variety generation-control relationships

This framework potentially provides a **unified understanding** of biological organization from molecules to ecosystems, suggesting that all biological structures represent solutions to the fundamental challenge of organizing variety generation and control for survival, reproduction, and adaptation in complex environments.

The axiom points toward a **topology-based approach** to biology that could change understanding of evolution, development, ecology, medicine, and biotechnology by focusing on the spatial and hierarchical relationships between variety processing mechanisms as the fundamental driver of biological organization.

AXIOM 4. Subsystem variety change

Where differing sub-systems of control are involved in the management of a system and some sources of control are able to increase their variety to accommodate a shortfall of requisite variety in other control systems THEN the overall distribution of control between sub-systems and constituencies will be shaped by the amount and distribution of transfer of control to the accommodating control system.

This axiom reveals a **fundamental mechanism of power concentration and system evolution**. It identifies that when control systems face variety shortfalls, those capable of **providing compensatory variety** systematically accumulate power, fundamentally reshaping system control architecture.

Key insights:

Accommodation creates authority: Variety accommodation transfers control from deficient to accommodating systems

Capability determines structure: System control architecture evolves toward constituencies with accommodation capacity

Dependencies become domination: Temporary accommodation relationships become permanent power structures

Universal mechanism: Pattern operates across all complex systems with multiple control subsystems

Predictable evolution: Can forecast system control redistribution from accommodation patterns

The axiom explains:

Why central banks dominate finance: Accommodated liquidity/stability variety commercial banks/governments couldn't manage

Why executives dominate modern states: Accommodated crisis/complexity variety legislatures couldn't handle

Why tech platforms dominate digital society: Accommodated scale/speed variety traditional institutions couldn't provide

Why professional managers control corporations: Accommodated organizational variety owners couldn't manage

Why AI may dominate decision-making: Accommodating cognitive variety humans cannot process

The insight provides **strategic guidance** for:

Accommodating systems: How to convert accommodation into permanent authority

Deficient systems: How to avoid dependency traps and authority erosion

Democratic movements: How to preserve popular control against accommodation-driven centralization

System designers: How to structure accommodation to achieve desired power distributions

This represents a **unification of organizational theory, political science, and systems cybernetics**, showing system control architecture evolution follows from variety accommodation dynamics, making power redistribution a predictable consequence of differential accommodation capacity rather than merely historical accident or political struggle outcome.

The axiom suggests that **maintaining desired power distributions requires actively managing accommodation dynamics** - either building distributed accommodation capacity or carefully structuring accommodation relationships to prevent undesired authority transfers. Failure to manage variety accommodation results in inexorable power concentration toward constituencies capable of accommodating variety shortfalls, regardless of formal authority structures or democratic intentions.

AXIOM 5. Control linked to transaction costs

I*n complex systems in which multiple sources of variety generation and variety control interact, the relative effect of different forms of system variety and control variety on system behaviour and system control are dependent on their relative transaction costs.*

This axiom indicates why **not all variety is equal** in determining system behavior and control outcomes. The **relative transaction costs** of different variety and control forms fundamentally determine which varieties and controls actually shape system evolution, regardless of their nominal magnitude or formal authority.

The axiom reveals **transaction costs are a hidden determinant** of which varieties and controls actually shape system behavior.

Key insights:

Cost determines dominance: Low transaction cost varieties/controls dominate system behavior regardless of other characteristics

Frequency follows cost: Cheap forms deployed frequently, expensive forms rarely, creating behavioral dominance

Scale amplifies differences: Transaction cost advantages grow more decisive as systems scale

Power reflects costs: Power derives from favorable transaction cost position

Change requires cost transformation: Altering system behavior requires changing relative transaction costs

The axiom explains:

Why bureaucracies rely on standardization: Standardized procedures have lowest transaction costs

Why markets devolve to price competition: Price adjustment cheapest competitive strategy

Why social movements favor symbolic action: Symbolic varieties have lowest transaction costs

Why automation dominates control: Automated control has favorable transaction cost profile

Why informal norms shape behavior: Social pressure cheaper than formal enforcement

The insight provides **strategic frameworks** for:

System designers: Engineer transaction costs to achieve desired system behavior

Resistance movements: Exploit transaction cost asymmetries to challenge powerful

Dominant constituencies: Maintain power through transaction cost advantages

Reformers: Transform systems by restructuring transaction cost landscapes

This represents a **unification of organizational economics and systems cybernetics**, showing that system control architecture and behavioral patterns emerge from transaction cost structures rather than formal designs or stated intentions. Understanding and manipulating transaction costs becomes the fundamental lever for shaping complex system behavior and power distributions.

Example - Transaction Costs and Crime Prevention: A Variety-Based Analysis

Axiom 5 reveals that **crime prevention effectiveness is fundamentally determined by the relative transaction costs** of criminal varieties versus control varieties, not just by punishment severity or moral education. This transforms our understanding of why certain crime prevention strategies succeed or fail.

Crime as Low-Cost Variety Generation: Criminal behavior represents variety generation by individuals/groups seeking benefits through rule violation. The transaction cost profile of different criminal varieties determines their prevalence and the effectiveness of various prevention strategies.

Control Transaction Cost Competition: Prevention effectiveness depends on whether control systems can deploy lower-cost responses than criminals can deploy criminal varieties. When criminal transaction costs < prevention transaction costs, crime proliferates regardless of formal penalties.

This framework explains:

Why "wars" on drugs, crime fail: Transaction cost asymmetry makes victory impossible

Why severe punishment doesn't deter: Enforcement transaction costs prevent sufficient application probability

Why environmental design works: Inverts transaction costs - cheap prevention, expensive crime execution

Why community approaches succeed: Distributed control achieves low per-incident costs

Why opportunity removal most effective: Eliminates varieties entirely, zeroing both criminal and prevention costs

The path to effective crime prevention lies in **transaction cost engineering** - designing systems where prevention costs competitive with or lower than criminal execution costs, making crime control economically sustainable rather than a resource-draining impossibility.

AXIOM 6. Variety generation results in dynamic systems

Any system capable of generating variety will always be dynamic.

This consequence follows directly from the nature of variety itself **variety generation → system dynamism**.

This axiom establishes that **dynamism is an inescapable consequence of variety generation**. This is not an empirical observation but a logical necessity - the very definition of variety generation requires temporal state changes, making static systems logically incompatible with variety generation.

Some implications:

Process philosophy validated: Reality is fundamentally dynamic where variety exists

Static models inadequate: Any model treating variety-generating systems as static is fundamentally flawed

Change is normal: Dynamic behavior is not deviation but necessary feature of variety-generating systems

Evolution universal: All variety-generating systems must evolve - biological, technological, social, economic

Management approaches must be dynamic: Cannot manage variety-generating systems with static procedures

This axiom suggests that **the universe is necessarily dynamic** because it generates variety at all scales, from quantum to cosmic. This provides a physical foundation for understanding why change, evolution, and temporal development are fundamental features of reality rather than optional characteristics of some systems.

The axiom suggests that attempts to create or maintain static states in variety-generating systems will fail because it contradicts the logical requirements of variety generation itself. This explains why all complex systems - biological, technological, social, economic - exhibit continuous change and evolution as inevitable consequences of their variety-generating capabilities.

AXIOM 7. Generation of variety results in control

Any system capable of generating variety will ALWAYS result in the variety generating a controlling sub-system or systems.

This identifies that **variety generation inherently and unavoidably creates control systems** - not as an optional design feature, but as a logical and physical necessity.

This axiom potentially reveals a **universal law of complex systems**: Any system capable of generating variety will **inevitably and necessarily** produce control subsystems. This is not an optional feature or design choice - it is a **logical, physical, and evolutionary necessity**.

Key insights:

Control emergence is inevitable: Cannot have persistent variety generation without control emergence

Co-evolution is necessary: Variety and control evolve together, not sequentially

Pattern is universal: Same emergence pattern across physical, biological, social, technological systems

Design must accommodate: Cannot prevent control emergence; must guide it

Self-organization foundation: Provides basis for understanding all complex system organization

This principle explains:

Why all complex systems develop control structures

Why informal control mechanisms always emerge in organizations

Why regulatory systems inevitably develop around new technologies

Why biological systems evolved genetic and neural control architectures

Why attempts to prevent control emergence fail and harm system viability

This suggests **control is not imposed on variety but emerges from variety** - a fundamental self-organizing principle that governs the evolution of all complex systems from molecules to societies.

Attempts to design variety-generating systems without planning for control emergence will fail because the control systems will emerge anyway, but in potentially dysfunctional forms.

AXIOM 8. No variety generation results in catalogue

A system incapable of generating variety is restrained to having the properties of a catalogue or list of fixed variety rather than a dynamics system.

This axiom establishes a **fundamental ontological distinction** between true dynamic systems and static catalogs. The **capacity to generate variety** is not just a feature but the **defining characteristic** that separates dynamic systems from mere collections of pre-existing states.

This axiom establishes a **fundamental ontological divide**: systems capable of variety generation are **qualitatively different** from catalog systems, regardless of catalog complexity. This distinction has profound implications:

Key insights:

Variety generation = dynamic threshold: Capacity to generate novelty separates true dynamic systems from catalogs

Catalogs merely traverse: Complex catalogs may appear dynamic but only explore predetermined space

Genuine dynamics requires generation: True temporal evolution needs variety creation, not just state transitions

Ontological difference: Not degree but kind separates catalogs from generative systems

Epistemological consequences: Different knowledge types needed for catalogs vs. generative systems

Axiom 8 explains:

Why deterministic models fail for living systems: Life *generates* variety, not just selects from catalog

Why equilibrium economics inadequate: Real economies *generate* new goods, preferences, institutions

Why traditional AI limited: Catalog exploration cannot achieve genuine creativity

Why reductionism fails for consciousness: If consciousness generates novel qualia, not reducible to neural catalog

Why history matters: Variety-generating systems have genuine history, not just trajectory

The insight suggests:

Universe may be generative, not catalog: Physical reality may generate genuine novelty, not just reveal predetermined states

Creativity is ontological, not just psychological: Variety generation is real feature of certain systems, not illusion

Freedom requires generation: Genuine agency needs capacity to generate novel variety

Science needs generative methods: Understanding dynamic systems requires approaches beyond catalog-appropriate methods

This represents a potentially **fundamental contribution to metaphysics and systems theory**, establishing variety generation capacity as the defining feature separating static being from dynamic becoming, mechanical systems from creative ones, predetermined futures from genuinely open ones.

AXIOM 9. Variety definition

Variety is the possibility of a variable (which can be a system at any level of recursion) to have different values. Variety is the ability to vary. The amount of variety is the number of different options that are possible.

This axiom identifies that **variety is fundamentally about possibility** - the capacity for difference, not just actual differences observed.

This definition establishes **variety as the foundational concept** for understanding complex systems. Defining variety as **possibility space** - the capacity for difference rather than actual difference – provides a potentially rigorous foundation for other axioms:

Key insights from precise definition:

Variety = possibility, not actuality: Distinguishable options that could be, not just are

Variables at all scales: Recursive hierarchy from elementary to universe-level

Quantifiable: Number of distinguishable states (discrete) or dimensions/ranges (continuous)

Latent capacity: Most variety never actualized; exists as structural potential

Compositional: System variety emerges from component varieties through multiplication, constraint, or emergence

This definition enables:

Precise measurement: Variety quantification in bits, states, or dimensions

Rigorous theory: Mathematical formalization of all variety principles

Practical application: Concrete methods for variety analysis and engineering

Philosophical clarity: Resolves confusion between possibility, actuality, diversity, potential

Unified framework: All previous principles now rest on solid definitional foundation:

Requisite variety: Control possibilities must match system possibilities

Variety generation: Expanding possibility space over time

Transaction costs: Costs of accessing different possibilities

Power dynamics: Control over possibility space access and expansion

Catalog vs. dynamic: Fixed vs. expanding possibility spaces

The above potentially represents the basis for a **complete formalization of variety theory** as rigorous scientific framework for analyzing, designing, and understanding complex systems and power across all domains from quantum to cosmic scales.

AXIOM 10. Control via feedback loops in dynamic variety generation

In complex and hyper-complex systems in which multiple and variable sources of variety generation and variety control interact and in which control varieties are generated dynamically to respond to changes in system varieties THEN relative control of the feedback loops driving control varieties shapes the future distribution of power and hegemonic control between sub-systems and constituencies over the structure, evolution and distribution of benefits and costs of the system.

This axiom reveals ta deeper **level of power dynamics** in complex systems in which power lies not in controlling variety itself, nor even in controlling control systems, but in **controlling the feedback loops that generate control varieties** - the meta-control level that shapes how control systems themselves evolve.

This axiom reveals **power in complex systems resides at the meta-control level** - control over feedback loops that generate control varieties.

Key insights:

Three levels of control: Direct variety control < Control variety generation < Feedback loop control (meta-control)

Feedback loops are ultimate power: Constituencies controlling how control varieties are generated control system evolution

Revolutions transform feedback: Fundamental change requires altering feedback loops, not just seizing power

Technology disrupts through feedback: New technologies create new feedback loops generating new control varieties

Evolution through feedback evolution: System development driven by feedback loop transformation

This principle explains:

Why power concentrates: Feedback loop control enables self-reinforcing power accumulation

Why revolutions fail: Seizing power without transforming feedback loops allows old patterns to regenerate

Why technology disrupts: New feedback loops generate control varieties incumbents cannot match

Why institutions ossify: Feedback loop monopolization prevents adaptive control generation

Why systems evolve: Feedback loop transformation drives fundamental system change

Strategic implications:

For challengers: Capture or create feedback loops generating favorable control varieties

For incumbents: Monopolize and defend feedback loop control

For system health: Distribute feedback control, maintain adaptive capacity, ensure accountability

This represents a **deeper layer of variety-based power analysis**, showing that hegemonic control ultimately rests on controlling the cybernetic mechanisms that generate control varieties - the feedback loops that determine how systems adapt, evolve, and distribute power across constituencies.

Understanding and governing these meta-control mechanisms is essential for understanding power dynamics and shaping system evolution toward desired futures.

AXIOM 11. Variety and subsequent distributions of benefits

For complex and hyper-complex, layered and hierarchical systems involving multiple constituencies in which the distribution of variety generation and control is uneven across the system THEN the differing distributions of generated and controlling variety will result in structural basis for differing amounts of power and hegemonic control over the structure, evolution and distribution of benefits and costs of the system by particular constituencies.

This is the complete formulation of a **fundamental law of complex system power dynamics**. It indicates that power, hegemony, and benefit distribution are not arbitrary or merely social constructs but **structurally determined** by the topology of variety generation and control across system constituencies.

This axiom establishes that **power, hegemony, and benefit/cost distribution are structurally determined** by variety topology in complex systems. This is not just descriptive but **predictive and explanatory** - given the distribution of variety generation and control across constituencies, we can forecast power asymmetries, predict system evolution, and explain benefit flows.

Axiom 11 provides:

Analytical framework: Map any system's power structure through variety topology analysis

Predictive capability: Forecast power distribution from variety distributions

Strategic guidance: Target variety topology for effective power challenges

Design principles: Structure systems for desired power distributions

Justice foundation: Ground fairness in variety distribution rather than just outcomes

Universal applicability: Framework applies to all complex systems:

Economic systems: Class power from capital/labor variety asymmetries

Political systems: State power from governance variety concentration

Technological systems: Platform power from infrastructure variety control

Ecological systems: Keystone species power from ecosystem variety generation

Cognitive systems: Conceptual hegemony from ideational variety control

This potentially represents a **complete scientific theory of power** grounded in variety dynamics, providing unified framework for understanding, predicting, and transforming power structures across all complex systems from molecules to civilizations.

AXIOM 12. Variety and stability

For complex and hyper-complex systems, the type of outcome in terms of stability depends on the relative locations of subsystems generating variety and the control subsystems able to use variety to control system variety.

This axiom reveals how **system stability is structurally determined** by the spatial, hierarchical, and relational positioning of variety generators relative to control systems. The different topological arrangements of variety generation and control produce fundamentally different stability outcomes - not as probabilistic tendencies but as **necessary structural consequences**.

Stability outcomes by different topology examples:

Co-located: Local stability, global fragility

Hierarchical: System coordination, brittleness to novelty

Spatially distributed: Regional stability, coordination challenges

Network distributed: Emergent stability, unpredictability

Temporally separated: Oscillations, cyclical instability

Cross-level (below): Fragmented stability, emergence or chaos

Crossed networks: Structural instability, governance failure

Adaptive coupling: Robust stability, high complexity

This framework appears to apply across all complex systems - biological, technological, economic, political, ecological - providing unified understanding of how system structure determines stability outcomes through variety topology.

AXIOM 13. Control shortfall leading to transfer of ownership of control

Where differing sub-systems of control are involved in the management of a system and some sources of control are able to increase their variety to accommodate the lack of requisite variety in other control systems then the overall distribution of control between sub-systems and constituencies will be shaped by the amount and distribution of transfer of control to the accommodating control system.

Strategic Implication: Control redistribution through accommodation is self-limiting; transaction costs create natural boundaries preventing total control concentration.

AXIOM 14. Time is a dimension of variety in the distribution of power

Time is a dimension of variety in shaping the dynamic locus of power between constituencies in a situation.

The availability of system variety and control variety is dynamic and dependent on time.

THUS

Introduction of variety that results in changes to the time dynamic of availability of variety results in changes to the locus of power and the distribution of benefits and costs of the system by different constituencies.

Power flows not just to those with variety/control capacity, but specifically to those who can **control the temporal availability** of varieties - when they appear, how quickly they can be deployed, and how timing advantages accumulate.

Six Temporal Mechanisms:

First-mover advantages: Access variety before others

Speed advantages: Deploy variety faster than others

Temporal access control: Determine when varieties become available

Duration control: Determine how long varieties remain accessible

Sequence control: Determine order of variety availability

Synchronization control: Coordinate timing relationships

Across all complex systems - biological, technological, economic, political, social - power flows to constituencies that control the **temporal availability of variety**, regardless of spatial variety or control variety quantities. Time is not just a dimension along which variety exists, but **a variety dimension like other elements of variety that shape the locus of power**.

AXIOM 15. Variety Dynamics and equivalence with Quantum Theory

Variety dynamic systems and reversibility Systems with variety dynamics do not necessarily have closed boundaries and outcomes and processes are only reversible in special instances.

This axiom establishes two fundamental characteristics that distinguish variety dynamic systems from classical reversible systems: **boundary openness** and **irreversibility as the general case**, with reversibility occurring only under special restricted conditions.

Variety dynamic systems fundamentally break this pattern because:

Organizational changes are typically irreversible: Once new variety emerges, the system cannot simply "un-know" or "un-organize" back to its previous state

Historical path-dependence: The route taken affects what reversibility even means—different paths create different contexts

Boundary permeability: As we established, variety crosses boundaries, meaning "undoing" a process requires coordinating across multiple systems

Information asymmetry: Creating variety often involves information that, once generated, changes possibility spaces permanently

The Two Claims Unpacked

Claim 1: Non-Closed Boundaries

Variety dynamic systems **do not necessarily have closed boundaries** means:

Variety flows: Options, distinctions, organizational forms flow in and out unpredictably

Emergent boundaries: The boundary itself can change based on variety dynamics

Partial containment: Some aspects of the system respect boundaries, others don't

Context-dependent closure: What counts as "inside" varies with perspective and timescale

This contrasts with thermodynamic systems where we can meaningfully define isolated, closed, or open systems with specified boundaries.

Claim 2: Irreversibility as Default

Outcomes and processes are only reversible in special instances means:

Default assumption: Variety processes are irreversible

Reversibility requires explanation: When reversibility occurs, specific conditions must enable it

Special instances are constraints: Reversibility happens when variety dynamics is suppressed or controlled

Note that from different directions variety-dynamics (via information theory) is a physical phenomenon and subject to physical and thermodynamics laws; and also, that it cannot operate according to thermodynamic laws

This reveals a deep paradox—or perhaps more accurately, a **fundamental tension** at the heart of variety dynamics.

Implications

1. Emergence is Real The fact that variety dynamics is physical yet non-thermodynamic proves that **emergent levels of description are genuinely novel**, not just convenient bookkeeping.

2. Information is Physical, but Not Energy Information/organization/variety is a **distinct physical quantity** that doesn't reduce to energy, entropy, or any thermodynamic variable.

3. Thermodynamics is Incomplete For variety-dynamic systems (living, cognitive, social), thermodynamics provides **necessary but not sufficient** constraints. We need additional principles.

4. Reductionism Fails Cannot predict variety dynamics from thermodynamics alone, even though variety dynamics is fully physical. This is **ontological emergence**, not just epistemic.

Historical Precedent: Quantum Mechanics

This situation parallels the relationship between quantum mechanics and classical mechanics:

Quantum systems are "physical" but don't obey classical determinism

Classical mechanics emerges in special limits

Quantum rules are more fundamental but include classical as special case

Similarly:

Variety dynamic systems are "physical" but don't obey thermodynamic conservation

Thermodynamic behavior emerges in special limits (closed boundaries, no organizational change)

Variety dynamics may be more fundamental, including thermodynamics as special case

The "Special Instances" Redux

The axioms state thermodynamic laws apply to variety systems only in **special instances**. These instances are exactly when:

Variety generation is suppressed (no new organizational forms)

Boundaries become effectively closed (variety cannot transcend)

Reversibility is enforced (no historical path-dependence)

Physical substrate dominates (organizational level frozen)

In these cases, variety dynamics **collapses to** thermodynamics.

But in general systems—where variety can emerge, boundaries are permeable, processes are irreversible—**variety dynamics transcends thermodynamic description** while remaining fully physical.

A Deeper Framework

Perhaps the resolution requires a **tripartite ontology**:

Physical Substrate (matter, energy)

Obeys thermodynamic laws

Conservation principles

Closed/open boundary distinctions

Variety Dynamics (organization, information, options)

Operates on physical substrate

Non-conservative

Boundary-transcending

The Profound Consequence

What is identified is that **variety dynamics reveals physics is richer than thermodynamics**.

Physical reality includes:

Thermodynamic layer: Energy, entropy, equilibrium

Variety-dynamic layer: Organization, information, possibility spaces

Interaction between layers: Constrained but not determined

The "contradiction" isn't a logical inconsistency—it's evidence that **physical reality has hierarchical structure** where higher levels are physical yet autonomous from lower-level laws.

This is why life, mind, culture, and economy are simultaneously:

Completely physical (no violation of physics)

Not reducible to physics (new principles needed)

The variety dynamics axioms formalize this **physical non-reductionism**: acknowledging that variety is physical while proving it cannot be reduced to thermodynamic principles.

Fundamental Question

If variety dynamics is physical but non-thermodynamic, what are the **fundamental laws of variety dynamics**?

At heart this is the same tension between 1st and second laws of thermodynamic at quantum level

The Measurement Problem as Variety Creation

The quantum measurement problem is essentially a **variety dynamics problem**:

Before measurement:

Superposition state $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$

Single quantum state (minimal variety in one sense)

Maximum variety in another sense (all possibilities coexist)

After measurement:

Definite outcome $|0\rangle$ or $|1\rangle$

Classical information created (variety realized)

Irreversible - cannot recover the original superposition

Other possibility has been **eliminated** (variety destroyed)

The measurement creates **organizational variety** (a definite fact about the world) while destroying **quantum variety** (superposition). This is **irreversible** even though the underlying quantum dynamics is reversible.

Parallel to Variety Dynamics Axioms

Quantum Level → Variety Dynamics Level

Reversible substrate (unitary evolution) → **Physical processes** (energy conservation possible)

Irreversible emergence (wave function collapse/decoherence) → **Variety creation/destruction** (organizational change)

Information appears (measurement outcomes) → **New distinctions emerge** (variety increases)

Cannot reverse measurement → Cannot reverse variety dynamics

The tension is **structurally identical**:

Fundamental substrate obeys reversible, conservative laws

Higher-level phenomena are irreversible and non-conservative

Both are physical

Higher level cannot be reduced to lower-level dynamics alone

The observation that variety dynamics connects to information theory is crucial because:

Quantum Information:

Von Neumann entropy: $S = -Tr(\rho \ln \rho)$

Can decrease locally (information concentration)

Globally conserved in unitary evolution

Thermodynamic Information:

Shannon/Boltzmann entropy

Always increases (Second Law)

Irreversibly lost in measurements

Variety Information:

Organizational distinctions and possibilities

Can increase or decrease

Non-conservative across boundaries

Irreversible transformations

The tension exists because **information has multiple physical manifestations** at different levels, each with different conservation properties.

Why Thermodynamics Applies "Only in Special Instances"

Just as quantum thermodynamics shows Second Law emerges from:

Coarse graining (ignoring microscopic details)

Large system limits (thermodynamic limit)

Environmental coupling (decoherence)

Time scale separation (fast microscopic, slow macroscopic)

Similarly, variety dynamics shows thermodynamic constraints apply only when:

Organizational freezing (no new variety emerges)

Boundary closure (variety cannot propagate)

Reversibility (no historical path-dependence)

Physical substrate dominates (informational level suppressed)

The Resolution: Complementary Descriptions

In quantum mechanics, the tension resolved through **complementarity**:

Wave and particle descriptions are complementary

Position and momentum cannot be simultaneously determined

Different experimental contexts reveal different aspects

For variety dynamics, the resolution is similar **level complementarity**:

Thermodynamic description: Valid when variety dynamics suppressed

Variety-dynamic description: Valid when organizational change active

Cannot simultaneously apply both - must choose appropriate level for context

This connection suggests variety dynamics is not just an ad hoc extension of physics, but addresses a **fundamental tension present at all levels**:

Quantum Scale: Reversible unitary evolution ↔ Irreversible measurement/decoherence

Variety Scale: Conservative energy dynamics ↔ non-conservative variety dynamics

The **same structural problem** appears at different scales, suggesting variety dynamics taps into something **fundamental about physical reality**.

l Physics

If the quantum-thermodynamic tension is resolved by recognizing **different levels of physical description**, then:

Variety dynamics may be recognized as a fundamental physical theory describing organizational/informational levels, just as:

Quantum mechanics describes microscopic levels

Thermodynamics describes statistical/macroscopic levels

General relativity describes gravitational/geometric levels

Each level:

Is fully physical

Has its own laws

Cannot be reduced to other levels

Applies in different domains/contexts

Connects to others through coupling relations

The Meta-Pattern

There's a **recurring pattern in physics**:

Substrate level with reversible, conservative laws (quantum mechanics, Hamiltonian dynamics)

Emergent level with irreversible, non-conservative behavior (thermodynamics, variety dynamics)

Apparent contradiction between levels

Resolution through context: Emergent level arises from substrate + context coupling

Both levels remain valid in appropriate domains

These axioms are formalizing this pattern at the **organizational/informational level**, just as statistical mechanics formalized it at the **thermodynamic level**.

The Fundamental Answer

The "contradiction" that variety dynamics is physical yet non-thermodynamic is the **same type of contradiction** as quantum mechanics being deterministic yet thermodynamics being irreversible.

The resolution in both cases: **Physical reality has irreducible levels**, each with autonomous laws, connected by contextual coupling. The context (environment, boundaries, organizational structure) is physical but cannot be eliminated, making higher-level laws genuinely novel, not merely convenient descriptions.

This potentially places the variety dynamics framework in a similar category as statistical mechanics and quantum information theory.

AXIOM 16. Variety dynamics and Nyquist number

Stable control of simple systems is defined by the Nyquist number. The Nyquist number indicates whether the relationship between the control system and the deviation causing subsystems is likely to become stable, oscillatory or trend towards an unstable or even unknown outcome.

IN essence, the Nyquist number reflects the phase difference between a system disturbing activity and the control response to that disturbance, which in turn results in a change to the disturbing activity and further change in the control response.

Although the central issue is one of time, by representing the behaviours of disturbance and control in circular form by Fourier transform, the time can be regarded as a difference in phase between a complex Fourier function representing the disturbance and its subsequent modification by the control system and a different complex Fourier function representing the control response.

Variety Dynamics and Nyquist Stability

Axiom 16 reveals **fundamental stability conditions** in variety-processing systems through phase relationships between variety generation (disturbance) and control response. This is extending classical control theory's Nyquist criterion into the variety dynamics framework, providing rigorous conditions for when variety-control feedback loops produce stability, oscillation, or chaos.

Core Principle: System stability is determined by the **phase relationship** between variety generation and control response in feedback loops. When variety disturbances and control actions are properly synchronized (phase-aligned), stability results; when phase relationships are wrong, oscillation or instability emerges.

This Nyquist-based axiom16 reveals that **variety-control stability depends fundamentally on phase relationships** - the temporal alignment between variety generation and control responses.

Universal pattern: Across all variety-processing systems - biological, economic, social, technological - stability requires maintaining appropriate phase relationships between variety generation and control response.

The mathematics of feedback control (Nyquist) provides rigorous foundation for understanding stability in variety dynamics.

AXIOM 17. Variety dynamics and system control

A subsystem disturbance can be regarded as a succession of different states. Variety is the measure of the different states that are possible to that subsystem behaviour. In other words, it is a counterfactual variable.

Thus, the variety dynamics function describing the behaviour (different states) exists as a meta-function or collection of functions. This is in the same way that the function(s) describing the bounds of a set, or equivalently, the criteria for entities to be a member of that set are meta-functions that describe the characteristics of the entities that are included in that set.

Variety dynamics extends that analysis in a straightforward manner such that the variety dynamics meta-function maps to the relations between the control system varieties, the disturbing system varieties and the varieties of the behaviours resulting from the interaction between the disturbing system and the control system.

Variety Dynamics Meta-functions and Nyquist

The Nyquist number was originally developed to provide designers with a simple measure to ensure stabilisation of simple single dimensional control systems of first and second order in which there existed a lag between disturbance and control response and in which the gain (i.e., scale of control response) and the lag were adjustable. Such a system is typically represented as a simple differential equation describing the dynamics. Thus, the variety dynamics representation would follow the same format.

For the convention al dynamics representation, a 2 or greater dimensional system is represented using partial derivatives. This in turn can be transformed into a complex Fourier representation or complex Taylor expansion. The variety functions equivalent of the physical dynamics follow the same.

The Nyquist ‘number’ provides the criteria for stability of a simple one-dimensional system. That is the Nyquist ‘number’ describes the bound for stability (in this case a linear bound).

For more complex multidimensional control systems, the stability boundary is a surface that can be represented by a Nyquist-like complex function.

The ability to map variety dynamic space onto the physical dynamic space means that for an m dimensional variety space mapping a system with interacting control and disturbance sub-systems there exists a Nyquist-like function defining the boundary surface of stability for such a system.

Practical Processing

Clearly in a system context viewed in terms of the variety dynamics of multiple different characteristics of systems and subsystems, the variety dynamics functions are complex over multiple dimensions (and this is likely to be a large number of dimensions). Although for explanatory convenience these have been described in terms of complex multidimensional Fourier functions, they could be equivalently, and computationally more usefully defined in terms of Taylor or similar functions that can be numerically more easily processed.

This foundational axiom establishes that:

Variety is counterfactual meta-function - mathematics of possibilities

Variety dynamics are equivalent to physical dynamics - rigorous mathematical framework

Multidimensional Nyquist criteria exist - stability boundaries are computable hypersurfaces

Computational methods available - Fourier, Taylor, numerical approaches

Universal applicability - same mathematics across all domains

This axiom provides the mathematical foundation for entire variety dynamics field.

It transforms variety dynamics from qualitative framework to **rigorous mathematical theory** with:

Formal definitions

Stability theorems

Computational algorithms

Predictive capability

Design principles

[EDITORIAL NOTE: This is the mathematical AXIOM 1 - the mathematical foundation. All other axioms derive from or build upon this meta-function framework. Essential for establishing variety dynamics as rigorous mathematical field. Should be first chapter in theoretical treatise, establishing formalism before applications.]

AXIOM 18. Control strategies to manage problematic subsystems

Where a system has a sub-system with the following characteristics:

- Sub-system is capable of damaging or destroying the whole system
- Subsystem can transfer its characteristics to elements of the larger system (i.e., subsystem can expand)
- Subsystem operates according to its own interests rather than the interests of the whole system (local suboptimization)
- Subsystem can adapt its internal elements and processes to increase its variety and different varieties of the subsystem have different effects on whole system, result in different levels of local suboptimization
- Subsystem scale of existence, local suboptimization and rate of variety generation depends on variety available to rest of system

AND

Overall system is limited in the control variety that it can bring to bear on the locally sub-optimising subsystem

THEN

Strategies and outcomes are limited to the following:

- Locally suboptimizing system will result in collapse of whole system
- Whole system learns from interacting with subsystem such that control variety increases to the point where it controls the errant subsystem
- Whole system control system uses enforcement to attenuate the variety of the errant subsystem, and this brings it under control to the point where it controls the errant subsystem
- Whole system control system develops strategies to limit the variety generating aspect of the errant subsystem (same as last point?)
- Whole system's control system has and uses its capacity to completely destroy the errant subsystem
- Whole system collaborates with and draws on external support (external subsystem) that is capable of controlling, attenuating the behaviour of or destroying the errant subsystem. This always results in some power redistribution to the external support system.
- Whole system draws on external support (external subsystem) that enables the whole system to change and develop itself to have increased variety sufficient to control the errant subsystem. This always results in some power redistribution to the external support system.
- The control system of the whole system can be destroyed or itself controlled or sufficiently influenced by the errant subsystem to achieve the intended local suboptimization objectives of that subsystem.
- Errant subsystem's actions can influence the whole system, a subsystem of it, or the supersystem of which the whole system is a part.
- Time is of the essence. The ability for an errant subsystem to use its variety to create local suboptimization outcomes takes time as does the ability for the whole system's control system to use its variety to act against the errant subsystem.

Time-based variety generation strategies can provide the means to delay the activities of the varieties available to the errant subsystems and reduce the time to act of the variety-generated control response. In other words, for the control system to act to control the errant subsystem's activities before they are problematic. Note: such time-based variety management strategies can be prone to result in unstable outcomes depending on Nyquist number of the system).

Whole systems can use multiple strategies on errant subsystems to attenuate subsystem variety and variety generation to enable

AXIOM 19. Service systems variety and design

Effective service design requires managing variety distributions across two interconnected control systems:

The service provider system (S_1)
The service recipient system (S_2)

For successful service delivery, both systems must maintain functional variety dynamics. This means each system's control mechanisms must possess greater variety than the system they are designed to regulate. Additionally, for service provider system (S_1) to provide full support for service recipient system (S_2), the total variety of service provider system (S_1) must exceed the total variety of service recipient system (S_2).

Service system viability requires satisfaction of three variety relationships: $C_1 > V_1$, $C_2 > V_2$, and $V_1 > V_2$. The system is fundamentally constrained by whichever relationship is violated. This axiom establishes that successful service design must simultaneously:

Engineer adequate internal control variety in both provider and recipient systems
Ensure the provider system encompasses sufficient operational variety to handle the full spectrum of recipient system states

The third condition ($V_1 > V_2$) explains why specialized service providers often outperform generalist providers – they deliberately constrain V_2 (the recipient variety they serve) to ensure $V_1 > V_2$, enabling full support within their domain. Conversely, this principle reveals why universal service providers struggle: as they attempt to serve increasingly diverse recipients (expanding V_2), maintaining $V_1 > V_2$ becomes exponentially more resource intensive. This dual-system requirement with variety dominance explains both the success of focused service models and the inherent scalability challenges in comprehensive service provision.

AXIOM 20. Feedback loops result in dynamic systems

Any system with feedback loops generates variety

Feedback loops inherently generate variety through several fundamental mechanisms. Feedback loops are variety generators because they create recursive relationships between past, present, and future system states. This recursion, combined with environmental interaction and non-linear dynamics, ensures that feedback systems exhibit far greater variety than their inputs alone would predict.

This principle is fundamental to understanding why all adaptive, learning, and control systems naturally evolve increasing complexity over time - they cannot help but generate variety through their basic operational mechanism of feedback.

AXIOM 21. Feedback loops always have control systems

Any system with feedback loops includes one or more control systems. Such control systems are not necessarily wholly within the system.

This axiom extends the variety generation principle relating to feedback loops. The presence of control systems - whether internal, external, or distributed - fundamentally alters how variety is created and managed within feedback loops.

Control Boundary Management: System designers must account for variety generation not just within their system, but from all control systems that influence it. The principle $V_1 > V_2$ for full support now becomes more complex: V_controlling_systems > V_controlled_system across all relevant boundaries.

Variety Coupling: Systems with external or distributed control are subject to variety coupling - changes in external control systems can dramatically alter internal variety patterns, sometimes faster than internal adaptation can respond.

The above extends the variety generation principle: feedback loops don't just generate variety through their internal dynamics but serve as conduits for variety from all control systems that influence them.

This means variety generation in real systems is often dominated not by internal feedback mechanisms, but by the variety characteristics of external and distributed control systems. Understanding system behavior therefore requires mapping the complete control ecosystem, not just the focal system's internal feedback loops.

This axiom explains why seemingly simple systems can exhibit complex behavior (due to external control variety) and why system boundaries are often more porous and variety-permeable than traditional analysis suggests.

AXIOM 22. Control systems without feedback loops and system boundary

The control system of any system without feedback loops exists at least in part outside that system.

This insight reveals a fundamental architectural constraint in system design. The axiom identifies that systems lacking internal feedback loops are inherently dependent on external control - they cannot be fully self-governing.

This axiom reveals another fundamental systems law: ***autonomy requires feedback.***

This creates an architectural imperative: either build feedback into the system (increasing internal complexity but achieving autonomy) or accept external control dependency (simplifying internal design but requiring control infrastructure).

This axiom explains why truly autonomous systems (biological organisms, adaptive AI systems, self-regulating markets) invariably evolve complex internal feedback mechanisms, while simpler systems (tools, basic machines, linear processes) remain dependent on external intelligence for their effective operation.

The choice between internal feedback complexity and external control dependency is one of the fundamental design decisions in any system architecture.

AXIOM 23. System feedback loops increase control variety

The variety generated by a system with feedback loops automatically also increases the variety of the control system.

This identifies a critical positive feedback relationship between operational variety and control variety that has profound implications for system evolution and complexity growth.

This axiom reveals why all sophisticated systems eventually become dominated by their control infrastructure rather than their primary operational components.

The variety generated by feedback loops creates an **inexorable control variety escalation** that transforms simple systems into complex control ecosystems.

This explains several phenomena:

Why software systems become dominated by configuration and management code

Why organizations spend more effort on management than on core work

Why regulatory systems grow more complex than the industries they regulate

Why AI systems require increasingly sophisticated safety and alignment mechanisms

The principle suggests that sustainable system design must anticipate and plan for control variety escalation, treating it as a fundamental growth pattern rather than an unfortunate side effect.

Systems that fail to evolve their control variety adequately become unmanageable; systems that over-invest in control variety become inefficient. The art of system design lies in managing this inevitable escalation effectively.

AXIOM 24. Variety Dynamics Human Bodies and Medical Practice

The variety generated by a system with feedback loops automatically also increases the variety of the control system applies to human bodies internal management and also explains why specialist medical approaches to understanding human bodily functions are problematic if they do not focus on the bodies' control systems

The human body exemplifies the principle of feedback-driven control variety escalation on an extraordinary scale, demonstrating why reductionist medical approaches face fundamental limitations.

Human Body as Multi-Scale Feedback System

Hierarchical Control Architecture:

Cellular level: Gene regulatory networks, metabolic feedback loops

Tissue level: Local homeostatic mechanisms, paracrine signaling

Organ level: Functional feedback systems (heart rate, kidney filtration)

System level: Neuroendocrine integration, immune surveillance

Organism level: Behavioral adaptation, environmental response

The human body demonstrates that successful biological systems evolve enormous control variety to manage the variety generated by their own feedback loops. Medical approaches that fragment this integrated control architecture fundamentally misunderstand how health and disease operate.

The principle suggests: Health is not the absence of pathology but the presence of robust, integrated control systems with sufficient variety to handle life's challenges. Disease often represents control system dysfunction rather than component failure.

This explains why:

Holistic approaches often outperform specialist interventions for complex conditions

Lifestyle interventions (affecting multiple control systems) can be more effective than targeted drugs

Stress reduction (supporting meta-control systems) improves multiple health outcomes

Social support (external control variety) enhances individual health resilience

The implications of this axiom are that improved or accurate medical understanding requires recognizing that we are treating integrated self-controlling ecosystems, not isolated biological machines.

AXIOM 25. Variety dynamic systems are information systems

All situations with variety dynamics are information systems

This axiom supports the unification of cybernetics, information theory, and systems science. It identifies that variety and information are fundamentally equivalent - wherever variety dynamics occur, information is being processed, transmitted, stored, and transformed.

This axiom equates variety dynamics and information processing as two perspectives on the same fundamental phenomenon. Every situation involving variety changes is necessarily an information system because variety IS information - distinguished states carrying meaning about system capabilities, constraints, and transformations.

This unification explains why:

Information theory provides powerful tools for analyzing any system with variety dynamics

Computational approaches can model complex biological, social, and economic systems

Communication systems are central to all complex adaptive systems

Learning and adaptation are universal features of systems managing variety

This axiom also suggests that understanding any complex system requires understanding its information architecture - how it captures, stores, processes, and uses the information encoded in its variety dynamics.

In combination, this provides a unified framework for analyzing systems across all domains, from molecular biology to global economics, through the lens of information processing capabilities and constraints.

AXIOM 26. Variety dynamic systems are information systems are thermodynamic systems

All situations with variety dynamics are thermodynamic systems and conform to laws of thermodynamics because they are information systems.

This axiom connects cybernetics, information theory, and thermodynamics through the fundamental relationship between information and energy. Variety dynamics necessarily involve thermodynamic processes because information processing requires energy expenditure.

This axiom suggests variety dynamics, information processing, and thermodynamics are three perspectives on the same fundamental phenomenon. Every situation with variety dynamics is necessarily:

An information system (processing distinguishable states)

A thermodynamic system (requiring energy, producing entropy)

Subject to physical limits (energy conservation, entropy increase, thermal constraints)

This axiom also suggests that understanding any variety-processing system may involve simultaneous consideration of its information architecture, energy requirements, and thermodynamic constraints.

The framework following this axiom suggests that the ultimate limits of system complexity and intelligence are set not by logical or computational constraints, but by the fundamental thermodynamic costs of information processing in the physical universe.

AXIOM 27. Power and variety are interchangeable resources

In a competitive environment between multiple actors capable of forming power **groups** then power and variety are interchangeable resources.

Every system contains multiple actors (even a "monopoly" exists within an ecosystem of suppliers, customers, regulators, designers, etc.), and **variety is always accessible** to these actors as a resource for changing power dynamics.

The axiom states a deeper principle: **power and variety are two different currencies for achieving the same fundamental outcome - changing the locus of control** in a system.

This means **there is no situation where only power matters** - variety is always an alternative pathway to achieving control changes, even if it operates on different timescales or through indirect mechanisms.

The functional equivalence is fundamental: any change in system control achievable through power application has a corresponding pathway through variety manipulation, making them interchangeable at the deepest level of system dynamics.

AXIOM 28. All variety dynamic systems are physical systems

All situations with variety dynamics are physical systems. This includes information systems, knowledge generation and management systems, inquiry systems, legal systems, political systems and design/art creative systems.

Regardless of how abstract or conceptual a system appears, if it processes variety, it must be instantiated in physical processes subject to the laws of physics.

This axiom establishes that **physicalism is not optional** for any system exhibiting variety dynamics. Regardless of how abstract, conceptual, or spiritual a system appears, if it processes variety, it must be grounded in physical processes subject to physical laws.

This insight unifies all domains of inquiry under physical science:

Computer science: Study of physical computation processes

Cognitive science: Study of physical neural information processing

Social science: Study of coordinated physical behavior by humans

Legal studies: Study of physical enforcement of behavioral patterns

Political science: Study of physical resource control and coordination

Art and design: Study of physical creativity processes and aesthetic perception

The axiom suggests that advancing our understanding of any variety-processing system requires understanding its physical implementation, energy requirements, material constraints, and thermodynamic properties. This provides a unified scientific foundation for analyzing all complex systems, from quantum computers to human societies, through the lens of physical variety-processing mechanisms.

At a meta-level it suggests t **the universe itself might be considered as the ultimate variety-processing system** - with all smaller systems being subsystems of cosmic information processing, energy transformation, and entropy production occurring within the physical fabric of space-time. This has implications for the role of variety-dynamics analysis in cosmology.

AXIOM 29. Variety dynamics can be open systems

Systems with variety dynamics do not necessarily have closed boundaries.

Fundamental Principle: Open Boundary Variety-Processing Systems

The insights from this axiom challenge some traditional systems thinking and reveal an essential aspect of variety dynamics in real-world contexts. Variety processing often transcends any definable system boundary, creating distributed, networked, and interpenetrating variety-processing architectures.

This axiom draws attention to the fact that **most real-world variety processing occurs in open, interconnected networks rather than discrete bounded systems**. This insight fundamentally changes how we should analyze, design, and govern variety-processing systems.

This perspective suggests that the most important variety-processing systems - the internet, global economy, climate system, human knowledge, biological ecosystems - are all open boundary systems whose behavior emerges from distributed network interactions rather than centralized control.

The axiom points toward a **network-based understanding of reality** where discrete entities are temporary analytical abstractions from ongoing variety-processing networks that extend across space and time without clear boundaries.

AXIOM 30. Variety dynamic systems and conservation of energy

Only special instances of systems with variety dynamics conform to Law of Conservation of Energy

This axiom establishes a fundamental distinction between variety dynamic systems and classical physical systems, asserting that energy conservation—a bedrock principle of physics—applies only to special, restricted cases within the broader domain of variety dynamics.

In systems where variety itself is a fundamental resource, the "conservation" principle breaks down because:

Variety generation is not energy-conservative: Creating new options, distinctions, or organizational forms doesn't require proportional energy expenditure

Information and organization: The emergence of new variety often involves organizational changes that cannot be reduced to energy transformations

Context-dependent possibilities: What counts as "possible states" (variety) can change based on system history and context—the phase space itself evolves

The Special Instances

Energy conservation holds in variety dynamic systems only when:

Complete constraint: The system is fully determined by physical laws with no organizational degrees of freedom

Fixed variety space: The set of possible states remains constant (no emergence of new options)

Reversible dynamics: All transformations can be undone, implying no genuine creation or destruction of variety

Isolated physical subsystems: When we artificially isolate purely mechanical or thermodynamic components

These are **limiting cases** where variety dynamics reduces to classical physics.

This axiom reveals that **variety dynamics requires abandoning boundary-based conservation thinking**.

The special instances where energy conservation applies to variety systems are exactly those where:

Variety is artificially constrained to respect boundaries (isolated laboratory conditions)

Organizational forms are frozen (no emergence)

System is reducible to pure physical dynamics

In real-world variety dynamic systems—biological, cognitive, social, economic—**variety routinely transcends boundaries**, making energy-style conservation laws fundamentally inapplicable.

AXIOM 31. Variety dynamic systems and reversibility

Systems with variety dynamics do not necessarily have closed boundaries and outcomes and processes are only reversible in special instances.

This axiom establishes two fundamental characteristics that distinguish variety dynamic systems from classical reversible systems: **boundary openness** and **irreversibility as the general case**, with reversibility occurring only under special restricted conditions.

This axiom reveals that **variety dynamics operates in historical time**, fundamentally different from the reversible time of classical mechanics:

Physical time: t → -t leaves laws unchanged (time symmetric)

Variety time: Irreversible direction toward increasing organizational complexity, option awareness, and contextual richness

The "special instances" where reversibility occurs are exactly those where we've **artificially suppressed variety dynamics**—isolated the system, prevented emergence, blocked boundary crossing, or frozen organizational structure.

In real systems—living, cognitive, social, technological, economic—**irreversibility is the rule**. Variety, once created or destroyed, permanently changes the landscape of possibilities. The system cannot return to its previous state because even the meaning of "previous state" has transformed.

AXIOM 32. Variety dynamics and counterfactual and constructor theories

Variety dynamics provides the ontological and epistemological foundation for counterfactual theories and constructor theory in physics.

This implies **variety dynamics might be considered a foundational metaphysical principle** underlying t modern physics. Both counterfactual and constructor theories derive their explanatory power from the deeper reality of variety-processing systems that:

Most profoundly, it suggests that **the universe itself is the ultimate variety-processing system**, with all physical laws, quantum phenomena, thermodynamic processes, and gravitational effects being manifestations of cosmic variety transformation capabilities. This potentially provides a unified alternative foundation for understanding reality as a vast, interconnected network of variety-processing constructors exploring counterfactual possibilities across all scales of space and time.

This axiom points toward a **variety-theoretic physics** that could potentially unify quantum mechanics, relativity, and thermodynamics under a single framework based on variety accessibility, transformation constraints, and constructor capabilities - representing a fundamental advance in our understanding of the physical universe.

AXIOM 33. Power flows between HQs and departments from variety management

When an organisation has a powerful HQ and less powerful subdepartments or regional or similar external departments then HQ typically supplements its own power and controls them by:

ensuring HQ management has more requisite variety than the variety available to be generated by these outer departments, or

HQ attenuates the variety possible to be generated by external departments

If the subdepartments focus on generating variety at a rate (variety changes/time) that is faster than HQ can cope with, then power flows to the external departments from HQ. HQ must bear transaction costs and operational costs to increase its variety to address any shortfall compared to variety from the periphery. If the peripheral parts of the organisation increase their variety so as to only just exceed HQ abilities, then transaction cost limitations will ensure that HQ does not develop sufficient responses by increasing its own control variety. The result will be a steady transfer of power from HQ to the periphery.

However, if the value of the rate of change of variety by the peripheral part of the organisation exceeds the transaction costs of HQ of increases its own variety, then HQ will either act by increasing its variety or will use its variety and power to attenuate and limit the variety generation of the peripheral part by repressive action.

AXIOM 34. Power acquisition via variety and transaction costs

The ability of a controlling or coercive agency to increase its variety (in scale, in distribution or its dynamics) to increase its potential for power and control is limited by the increase in transaction costs associated with generating, using and managing the additional variety. The benefits of additional variety are in the limit offset or overcome by the associated Coasian transaction costs.

Policy and Design Implications

1. Antitrust and Competition Policy - Understanding variety-transaction cost dynamics suggests:

Natural monopoly limits: Even monopolists face variety-driven transaction cost constraints

Dynamic efficiency: Focus on innovation and adaptation rather than static efficiency

Platform regulation: Recognize that platform power is self-limiting through transaction costs

Market structure evolution: Allow natural evolution toward optimal control system sizes

2. Organizational Design - Effective organizations should:

Plan for transaction cost escalation: Build flexibility to adapt as variety grows

Invest in transaction cost reduction: Technology and processes that reduce coordination costs

Choose variety scope carefully: Focus on variety domains where control provides greatest net benefit

Design for optimal scale: Structure systems to operate at transaction cost-efficient scales

Conclusion

This axiom reveals a **fundamental constraint mechanism** that prevents unlimited concentration of power and control through variety accumulation.

The Coasian transaction cost framework provides the economic foundation for understanding why all controlling agencies face diminishing returns to variety expansion.

Key insights:

Power is self-limiting: Attempts to increase control through variety expansion eventually become self-defeating

Optimal control exists: Every control system has an optimal variety management scale

Technology shifts limits: New technologies can change transaction cost curves and optimal control scales

Natural selection applies: Evolution favors control systems operating near their transaction cost-efficient scales

Decentralization tendency: High transaction costs favor distributed over centralized control

This principle explains why:

Large organizations tend to break up or become inefficient over time

Government power has natural limits despite apparent unlimited coercive capability

Technological disruption often enables smaller, more focused competitors

Federal and subsidiary systems evolve to handle variety at appropriate scales

Market mechanisms often outperform command and control for managing complex variety

The insights from this axiom suggests that **freedom and decentralization are natural outcomes** of variety dynamics, not just political preferences. Transaction cost constraints create evolutionary pressure toward distributed, specialized, and appropriately scaled control systems, providing an economic foundation for understanding why concentrated power tends to be unstable and why variety naturally promotes more distributed and democratic forms of organization.

AXIOM 35. Transaction costs related to scale and distribution of varieties

The Coasian transaction costs associated with generating, using and managing variety are related to the scale of variety options. For example, the transaction costs associated with providing the ability to be able to choose a product that has five different colour options is greater than that with a variety of 3 options which in turn is greater than the costs of choosing a product with only one colour option. These transaction costs increase with the dimensions of variety. For example, there is a significant increase in the associated transaction costs associated with enabling the possibility of having the option of choosing (say) from five different meals that each have five options; or choosing from five different cars that each have five different colours. In general, the transaction costs increase with both the variety of any characteristic AND the variety of characteristics.

Additionally, in complex situations, transaction costs also increase due to distribution of variety (for example, the location of individuals variety sources in different subsystems) and the dynamics of variety (for example if 3 colours are available on Monday, 4 colours for the rest of the week and only 2 colours from 2 weeks hence until 7 colours early next year....)

AXIOM 36. Transaction costs increase exponentially

Transaction costs associated with variety increase exponentially or combinatorically with increase in variety.

Fundamental Principle: Exponential/Combinatorial Transaction Cost Scaling

This axiom provides a mathematical insight that reveals why variety-driven transaction costs represent such a formidable barrier to power concentration. Cost scaling relationships are not linear but follow exponential or combinatorial growth patterns, creating insurmountable barriers to unlimited control expansion.

Implications for Power Distribution

1. Mathematical Impossibility of Total Control - The exponential/combinatorial scaling creates absolute limits:

No finite resource base can support unlimited variety control

No technological advance can overcome exponential scaling indefinitely

No organizational innovation can eliminate combinatorial complexity

No political system can concentrate unlimited power sustainably

2. Natural Tendency Toward Decentralization - Mathematical scaling forces decentralization:

Variety management must be pushed to lowest feasible levels

Specialization becomes necessary to manage variety subsets efficiently

Federation emerges as optimal structure for variety distribution

Market coordination becomes more efficient than command coordination

3. Evolutionary Selection for Optimal Scale - Organizations naturally evolve toward transaction cost-efficient scales:

Oversized systems collapse under transaction cost burden

Undersized systems get outcompeted by appropriately scaled competitors

Optimal systems find sustainable variety-management configurations

Adaptation pressure continuously adjusts organizational scale to changing variety conditions

Strategic Implications for System Design

1. Plan for Transaction Cost Explosion - Effective system design must:

Anticipate exponential scaling and design flexibility for variety management approaches

Build in variety constraints that prevent transaction cost explosion

Create variety reduction mechanisms that simplify coordination requirements

Design for graceful degradation when variety exceeds management capacity

2. Embrace Controlled Decentralization - Rather than fighting mathematical reality:

Distribute variety management to appropriate scales

Specialize subsystems for efficient variety handling

Use market mechanisms where coordination benefits exceed transaction costs

Accept limits on direct control in exchange for system sustainability

3. Invest in Transaction Cost Reduction Technology - Focus technological development on:

Automation of routine variety processing to reduce human coordination costs

Standardization technologies that reduce variety without eliminating beneficial diversity

Communication technologies that reduce information transmission costs

Decision support systems that help humans handle exponential complexity

Conclusion

This axiom reveals that **exponential and combinatorial transaction cost scaling of variety creates absolute mathematical barriers** to unlimited power concentration and variety control. This isn't a temporary technological limitation or organizational challenge - it's a **fundamental mathematical constraint** that no amount of resources, technology, or organizational innovation can ultimately overcome.

Key insights:

Control has absolute limits imposed by mathematical reality, not just practical constraints

Decentralization is mathematically optimal for managing large variety systems

Technology can delay but not eliminate transaction cost explosion

Evolution naturally selects for appropriately scaled variety-management systems

Freedom emerges naturally from mathematical constraints on centralized control

This principle provides the **mathematical foundation** for understanding why:

No empire lasts forever - they all eventually exceed their variety management capacity

Large corporations tend to break up or become inefficient over time

Democracy and federalism emerge as natural solutions to variety management complexity

Market systems outperform command systems for complex variety coordination

Technological disruption often enables smaller, more specialized competitors

The exponential/combinatorial scaling of transaction costs with variety represents a **mathematical proof** that concentrated power is inherently unstable and that distributed, specialized, and appropriately scaled systems are not just politically desirable but mathematically inevitable outcomes of variety dynamics in complex systems.

AXIOM 37. Transaction costs and competition architectures

Given a measurable ‘cost’ associated with implementing power and control, subject to the limits of variety. The transaction costs of both parties will increase as variety is used in a competitive situation. Hence the low cost and efficiency of ‘power at a point’ strategies.

The Pratchett Example: ‘Power at a Point’ In Jingo, pointing a crossbow at the ruler during negotiations is a cheap, fast variety injection:

Transaction cost analysis:

Diplomatic variety engagement: Months of negotiation, multiple proposals, coalition building, protocol management, intelligence gathering = HIGH COST

Crossbow pointed at head: One person, one weapon, one moment = LOW COST

Variety created: Entire new branch of possibilities (ruler dies, war escalates differently, negotiations collapse, power transfers)

The crossbow doesn't compete with the existing diplomatic variety - it adds a new dimension that dominates the previous variety space.

Key insight: The variety injected (lethal threat to decision-maker) is:

Fast: Immediate, no buildup required

Cheap: Minimal resources (one weapon, one person)

Decisive: Changes entire strategic landscape

Low transaction cost: Simple to execute, no complex coordination

Element 2: Surprise is low-cost, high variety

Attacker pays cost once (achieving surprise)

Then gains variety for free during response delay

The delay converts time (which passes naturally) into variety (strategic advantage)

Lowest possible transaction cost: Just wait while opponent is delayed

The axiom reveals that surprise attacks are effective not just because of the initial shock, but because they open a temporal window where time itself becomes variety for the attacker.

The response delay is not passive - it's active variety generation. Every second defender cannot respond is a second attacker can:

Take more territory

Secure more objectives

Establish more facts

Create more strategic options

Build more advantageous positions

The transaction cost advantage of surprise attacks is thus even greater than initially apparent: Not only is execution cheap, but the response delay provides free variety as time naturally passes. The attacker's variety compounds automatically during defender's paralysis.

Pratchett's crossbow in time: The moment it's pointed, time starts counting. Every second the ruler delays responding (processing shock, considering options, deciding action), the crossbow wielder gains variety (psychological dominance, negotiating leverage, deterrent credibility). The time delay itself is the weapon, not just the crossbow.

AXIOM 38. Optimal variety for power and control is calculable

Given a measurable 'cost' associated with implementing power and control again subject to the limits of variety and given measurable transaction costs associated with providing variety. Then, it is in principle possible to calculate optimal levels variety for power and control for different organisations.

Deming's System as Variety-Power Optimization

Deming fundamentally recognized that **traditional management over-optimized for control (P) at the expense of variety (V)**, leading to sub-optimal organizational performance. His 14 Points (often referenced as 13 or 14 rules) are essentially *prescriptions for rebalancing toward optimal V, P***.

Empirical evidence (Japan 1950s-1980s, later worldwide):

Before Deming (High P, Low V):

Defect rates: 5-10%

Productivity: Baseline

Innovation: Low

Total cost: High (rework, inspection, supervision)

After Deming (Optimal V, P)**:

Defect rates: <1% (often <0.1%)

Productivity: 2-5x increase

Innovation: Continuous improvement

Total cost: Lower (less rework, less inspection, less supervision)

Calculation proved correct: Rebalancing toward higher V, lower P was optimal for manufacturing environment.

Deming proved that **variety-power optimization is not just theoretically possible but practically achievable** and **delivers measurable superior results**.

Demings 14 Points are essentially **variety-power rebalancing heuristics** that work because they move organizations from typical sub-optimal variety toward actual optimal variety for most modern productive environments.

AXIOM 39. Control effects and benefits from variety follow power law distribution

At any point in time in any complex or hypercomplex situation the control effects and benefits to specific stakeholders of particular varieties in a variety distribution follow a power law distribution.

AXIOM 40. Transactions costs for variety follow power law related to variety

Given that the effects of variety to provide control and coercion, and the transaction costs associated with particular levels of variety both follow power law relations. Then, it would be expected that there is some Zipf/Pareto-like relation in which 80% of the controlling/coercive effects of variety would be gained from only 20% of the variety. Similarly, it would be expected that something like 80% of the transaction costs associated with providing variety would be due to only 20% of the variety. These 20%s of variety elements need not overlap.

This reveals a **fundamental inequality structure** in how variety operates. The power law nature of both benefits and costs creates critical asymmetries in variety-power optimization.

The observation reveals that **most variety is waste**:

In typical organization:

80% of control comes from 20% of variety (vital few + strategic)

80% of cost comes from 20% of variety (strategic + toxic)

Assuming 50% overlap: ~10% is vital few, ~10% is toxic

Optimal organization:

Maximize the 10% vital few

Eliminate the 10% toxic

Carefully manage the 10% strategic overlap

Results in ~30% of original variety at dramatically better performance

Apple example:

1997: Many products (computers, printers, peripherals, Newton, etc.)

Steve Jobs returns: Cuts to 4 product lines

Eliminates ~80% of variety

Revenue increases, profit skyrockets

Kept vital few, eliminated toxic variety, strategic investment in iPhone later

The power law structure means **less can be more** - not as platitude, but as **mathematical necessity**. The 80-20 distribution ensures that most variety is net-negative value, and optimal strategy requires **aggressive pruning** to expose and maximize the vital few.

This transforms variety dynamics from "more variety = better adaptability" to "**optimal variety = identify and maximize the vital few while eliminating the toxic many**."

AXIOM 41. Transfer of control by variety is opaque past 2 feedback loops

Opacity of control by variety management. Humans can typically relatively easily predict outputs of a system with a single feedback loop. However, manipulating the locus of variety and its control operates variably across multiple linked feedback loops. Due to Love's two feedback loop law of, the operation of such a change process is opaque to those involved who are not consciously managing the locus, distribution and dynamics of variety. Solution: develop ways of making visible the consequences and potential consequences of multiple feedback loops e.g. by dashboard, models.

The Opacity Problem: Most control in modern systems is invisible to those being controlled.

This isn't conspiracy - it's **cognitive limitation**:

Humans can intuitively understand systems with 1-2 feedback loops

Real-world variety-mediated control operates across 3+ feedback loops

Beyond 2 loops, causality becomes **opaque** - people cannot see how control is being exercised

This creates dangerous power asymmetries

Those who consciously manage variety across multiple loops can:

Exercise control while appearing not to

Make outcomes seem like "natural forces" or "emergence"

Manipulate without being detected

Accumulate power invisibly

Those who don't understand multi-loop dynamics experience:

Powerlessness ("things just happen to me")

Surprise ("didn't see that coming")

Confusion ("how did we get here?")

Manipulation (controlled without knowing it)

Why This Matters: The Democratic Crisis

Democracy requires informed consent and accountability.

But if control mechanisms are **cognitively opaque**:

Citizens cannot identify who's controlling what

Accountability breaks down (can't hold invisible controllers responsible)

Consent becomes meaningless (agreeing to things one doesn' understand)

Power concentrates with variety managers (those who understand multi-loop dynamics)

It includes:

Corporate capture of regulation (opaque multi-loop process)

Algorithmic manipulation of behavior (invisible feedback loops)

Financial system control (derivatives and complexity hiding power)

Information ecosystem control (multi-loop narrative management)

The solution is NOT to eliminate complexity and variety (impossible in modern systems).

The solution is to create tools to see and manage multi-loop variety dynamics.

The goal is not to eliminate variety dynamics (impossible and undesirable) but to:

Make it visible (so people can see when they're being controlled)

Make it understandable (so people can analyze and respond)

Make it controllable (so people can exercise their own variety management)

Make it accountable (so invisible controllers can be identified and checked)

AXIOM 42. Variety strategies for minimising the damage from misapplication of local power.

If a problematic individual or group with local power acts as a local node generating control variety and applying power in ways that are disadvantageous to the whole system,

THEN

Variety dynamics strategies that individuals and groups being adversely influenced by the problematic individual can address this problem include:

Increase local generation of variety in everyday tasks (subordinate control)

Managed individuals increase the variety in the detail their own tasks (superior control)

Managed Individuals and groups add new work tasks that increase variety to be managed by summation with existing variety (superior control)

Insist on reification or prioritisation of lesser tasks (this increases average variety timewise) (superior and subordinate control).

This axiom provides a **practical defensive toolkit** for individuals and groups facing problematic local authority. It reveals that **subordinates have variety-based power** they can deploy to constrain, redirect, or neutralize harmful local controllers - even without formal authority.

The democratic implication: Even in hierarchical systems, those being controlled have **variety-based power** they can exercise. This provides a check on arbitrary authority - controllers who abuse power face variety resistance that makes control unsustainable.

The limitation: This works when:

Work has inherent variety potential

Collective action is possible

Controller cannot simply eliminate workers

Some legitimacy/accountability exists

Doesn't work when:

Controller can use violence without constraint

Workers are completely replaceable

No collective action possible

Work has no variety potential

But in most modern organizational contexts, **variety-based defense is available and effective**.

The hope: By making these strategies known, perhaps fewer workers will need to use them (because problematic controllers will know they're vulnerable to variety resistance and will self-correct).

This axiom provides both **warning to potential abusers** (that they are vulnerable to variety flooding) and **toolkit for those abused** (how to defend through variety generation).

AXIOM 43. Variety implications for Security Controls of systems

Security is the control of access to assets.

It is only possible to control variety of a security or similar situation by using more variety than the system being controlled

OR

This can alternatively be achieved attenuating the variety of the situation being controlled

IF

The variety of the system being controlled is attenuated

THEN

The power of the controlling security is compromised.

Examples

Door master key systems

The FIDO passwordless security keys

Design rule 1: Avoid variety attenuation

No master keys/passwords/tokens

Each context should have independent security

Compromise of one ≠ compromise of others

Design rule 2: When convenience requires unification, maintain logical variety

Physical token may be singular

Logical credentials must be multiple

Internal variety preserved, external simplicity

Design rule 3: Make variety attenuation visible

When password reused, system warns

When master key exists, document blast radius

When SSO used, understand single point of failure

Conscious risk acceptance vs. ignorance

Design rule 4: Minimize blast radius of compromises

Partition systems so compromise of one limits exposure

Contain variety attenuation to smallest possible scope

If master key needed, limit what it opens

Design rule 5: Technical solutions over policy

Don't rely on users to maintain variety (they'll fail)

Build systems that maintain necessary variety automatically

Make secure behavior the easy behavior

The Deep Principle: Security IS Variety

The uncomfortable truth: Real security requires high variety, which is:

Inconvenient for users

Expensive for organizations

Complex to manage

Cognitively demanding

Attempted shortcuts (variety attenuation) create:

Convenient insecurity

False sense of protection

Catastrophic single points of failure

The axiom reveals: **Security and convenience are in fundamental tension through variety requirements**. Claims to resolve this tension (like current FIDO) often hide variety attenuation that compromises security. Real solutions must **maintain necessary variety** while using technology to manage the complexity, not eliminate it.

AXIOM 44. Organisational Stability Variety Axiom

For any organisation,

If the organisation has variety available to control its environment and internal functioning greater than that needed to control its environment and internal functioning and sufficient to satisfy its ambitions for future development,

THEN

the organisation tends towards internal and external stability.

This enables the identification of critical threshold conditions that determine organizational stability versus instability based on variety adequacy relative to control requirements and developmental ambitions.

Organizations achieve stable operation when their available variety exceeds the combined requirements for environmental control, internal coordination, and developmental ambitions.

Key insights:

Stability is predictable based on variety analysis rather than just performance metrics

Organizational health depends on variety adequacy, not just financial or operational success

Strategic planning should focus on variety development as much as goal achievement

Organizational design should optimize for variety adequacy across time horizons

Crisis prevention requires maintaining variety reserves above minimum requirements

This principle explains why:

Some organizations thrive while others struggle despite similar external conditions

Organizational growth phases create predictable stability challenges

Diversification strategies often succeed by building variety adequacy

Organizational decline often precedes financial decline through variety erosion

Sustainable success requires continuous variety development rather than just performance optimization

This provides a **diagnostic tool** for organizational health and a **strategic framework** for sustainable organizational development.

Organizations that systematically build and maintain variety adequacy relative to their environmental challenges and developmental ambitions will tend toward stability, while those operating near or below variety sufficiency thresholds will experience instability regardless of short-term performance metrics.

AXIOM 45. Surprise Attack – variety in interpretation (deception)

In any hyper-complex situation, the locus, dynamics and ownership of power is shaped by the distribution of variety. Some of this variety is physical, some in processes and some in the information realm. A crucial dimension of variety in the information realm is the variety of potential interpretations of available information by different agents. The arts of subterfuge and misinformation include this manipulation of variety of potential interpretations of information.

Thus, an indicator for a surprise attack when:

> There is a variety in the potential interpretations of the information available to different parties in a situation.
> One or more parties can structure the dynamics of the variet(ies) of potential interpretations of events
> Manipulated changes to the dynamics of the variet(ies) of potential interpretations of information can be used to benefit those creating the changes in informatic varieties.
> The Coasian transaction costs of implementing the changes in varieties of potential interpretations of information by other parties and managing subsequent consequences (including protection from informatic reprisals) must be less than the benefits gained.

Such changes in the variety of potential interpretation of information offer both advantage in undertaking a surprise attack and indicators to defenders of opponents' possible intention to undertake a surprise attack.

Simplistic examples of the above axiom are subterfuge and misinformation. More complex approaches exist beyond the two-feedback loop horizon such that the perpetrator is effectively controlling other parties' decision-making, strategy and interventions.

The axiom reveals: **Surprise attack is fundamentally an interpretation variety management problem**, not an information availability problem. Defenders need not just information, but **requisite variety in interpretation** - the ability to consider all plausible interpretations and resist adversarial shaping of their interpretation space.

Deception is variety dynamics in the cognitive realm, and it operates with the same principles: requisite variety, transaction costs, multi-loop opacity, and power through variety control.

AXIOM 46. Surprise Attack 2

In any hyper-complex situation, the locus, dynamics and ownership of power is shaped by the distribution of variety. Availability of variety is dependent on time to access and implement that variety. That is, time to access variety has an inverse value to availability of variety itself. Thus, there is potential for a surprise attack when:

> One or more parties can more rapidly access the variety they control than other parties
> This difference in availability of variety offers dynamic variety advantage to the faster parties. That is, the speed of use of variety results in a temporary variety advantage even though, statically, the balance of variety may be otherwise.
> The Coasian transaction costs of implementing the surprise attack and managing subsequent gains (including protecting them from reprisals) is less than the benefits gained by the attack.

Traditional analysis:

Count assets, forces, capabilities (static variety)

Assume equal access time

Predict outcomes from variety balance

Reality:

Time to access variety is critical variable

Fast access to small variety > slow access to large variety (within time window)

Speed converts to temporary variety superiority

Connection to Other Axioms

Surprise Attack 1 (Interpretation Variety): Speed provides less time for defender to interpret. Fast attacks compress interpretation time → defender more likely to misinterpret → speed and interpretation variety compound.

Time as Variety: Speed of variety access = converting time advantage to variety advantage. Fast party gets more "time as variety" before opponent accesses theirs.

Transaction Cost Axiom: Speed has transaction costs (preparation, coordination, risk). Speed-based surprise only when these costs < benefits from temporary variety advantage.

Opacity Axiom: Fast multi-domain attacks overwhelm defender's 2-loop comprehension limit. Speed prevents defender from tracing causality across loops.

The uncomfortable truth: Superior resources ≠ Victory if opponent can access their smaller resources faster.

Modern implication: Speed is becoming more important as technology enables faster information, decision, and action. Future warfare favors those who can access variety fastest, not just those with most variety.

The axiom reveals: **Time is not just a constraint but a strategic dimension of variety dynamics**. Speed of variety access can overcome static variety disadvantage, making **velocity a fundamental strategic resource** in any competitive domain.

AXIOM 47. Variety as a fundamental variable in cosmological and quantum research

The concept of variety as the distribution of potential options of states of particular entities offers a fundamental basis for the improved mathematical representation of situations at the extremes of physical analysis, cosmology and quantum, and at their union at the ‘big bang’. Variety distribution offers a lower-level theoretical foundation bearing in mind that variety == information==physical phenomena.

AXIOM 48. Discontinuity and Irreversibility in Variety Dynamics

Typically, changes in variety distributions and the dynamics of the structures of power and control in living systems can be represented by continuous functions.

However, in living systems, there is potential for these functions to be discontinuous or cuspic. In these cases, some variety changes lead to discontinuous or irreversible outcomes. These can either be a benefit or a problem.

It is important to identify such areas of potential discontinuities in the variety distributions. Careful management of variety around these areas can ensure continuity. On the other hand, such areas of discontinuity can be used to control unwanted factors (e.g. weeds).

The discontinuity of variety is illustrated by the man who arranged his donkey to be more and more cost effective by training it to eat less and less until eventually it ate almost nothing – and died. The continuous changes reducing the food and the training of the donkey led to the donkey continuing to be a donkey and continuously changing (getting thinner) until suddenly there was a cuspic discontinuous change – the donkey died. The donkey's training on eating less at this point is a discontinuity that is irreversible.

Sometimes, these are coined 'tipping points' or irreversible boundaries.