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A FIRST-PRINCIPLES FRAMEWORK

# The Ten Laws of Human Information Dynamics

An Information-Theoretic Framework for Understanding  
Growth, Decay, and Meaning in Human Systems

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**WORKING PAPER | FOR INTELLECTUAL DISCOURSE**

*"The universe is not only queerer than we suppose,  
but queerer than we can suppose."*

— J.B.S. Haldane, Possible Worlds, 1927

*"If God created this multiverse and left it to run on its own for  
billions of years with the entire code written in a self-correcting way,  
what could be some of the rules affecting humans?"*

— The question that started this inquiry

## Preamble: What This Is

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This document proposes ten laws governing human systems — individuals, relationships, institutions, and civilisations — derived from first principles in information theory, thermodynamics, neuroscience, network science, and complexity theory. These are not moral commandments. They are structural constraints — the operating parameters within which all human activity occurs, whether we are aware of them or not.

The framework makes a specific claim: the mathematical tools developed to describe how information is generated, transmitted, compressed, and degraded provide the most precise available language for understanding why humans grow, why institutions decay, why empires fall, why time seems to accelerate, why desire sabotages itself, and why **meaning is not a destination but a rate of change**.

Each law meets three criteria. First, it is derived from established science — not from intuition, tradition, or analogy, but from peer-reviewed research in physics, neuroscience, or mathematics. Second, it generates falsifiable predictions — specific, measurable claims that can be proven wrong. Third, it is novel in its synthesis — while the individual components may be known, their integration into a unified framework for human systems is original.

**What This Is Not:** This framework does not claim that the universe is a computer programme, that reality is a simulation, or that consciousness can be reduced to computation. It claims something more modest and more useful: that the mathematical structure of information theory maps onto the observable dynamics of human life with enough precision to generate predictions that naive intuition cannot.

## The Ten Laws of Human Information Dynamics

### LAW I

#### THE ENTROPY TAX

*All order — in bodies, relationships, institutions, and civilisations — requires continuous energy expenditure to maintain. The cost of maintenance grows non-linearly with the complexity it sustains. Neglect is not neutral; it is entropic.*

#### Derivation

The Second Law of Thermodynamics establishes that the entropy of an isolated system never decreases. Schrödinger (1944) extended this to biology: organisms maintain their ordered state by importing negative entropy from their environment. Prigogine's dissipative structures theory (Nobel Prize, 1977) formalised how open systems can maintain local order only by exporting entropy — at an energy cost that increases with the system's distance from equilibrium.

Applied to human systems: a marriage, a business, a body, and a nation are all dissipative structures. They exist far from thermodynamic equilibrium. The moment energy input (effort, attention, investment, governance) falls below the maintenance threshold, the system does not simply pause — it degrades. Crucially, **the maintenance cost is non-linear**: a system twice as complex does not cost twice as much to maintain, but considerably more, because each new component can interact with every existing component, and these interactions must be managed.

#### Evidence

Klimek, Hanel & Thurner (2008) formalised Parkinson's Law, identifying a phase-transition boundary where bureaucratic growth becomes exponential. Ginsberg (2011) documented that US universities hired **517,636 administrators** from 1987–2012 while educational output stagnated. At the biological level, Hayflick's limit (1961) establishes that human cells have a finite replication capacity — ageing is the entropy tax on biological order. At the civilisational level, Tainter's *The Collapse of Complex Societies* (1988) demonstrated that complexity carries diminishing returns, and **collapse occurs when the marginal cost of complexity exceeds its marginal benefit**.

#### Falsifiable Prediction

Organisations whose non-core expenditure exceeds 60% of total budget will show declining core output within 5 years, regardless of total revenue growth.

## LAW II THE CHANNEL LIMIT

*Every relationship, mind, and institution has a maximum information throughput. Attempting to transmit more signal than the channel can carry does not produce more understanding — it produces noise. The channel cannot be widened by demanding more from it; it can only be widened by reducing the noise within it.*

### Derivation

Shannon's noisy channel coding theorem (1948) proves mathematically that for any communication channel with a given noise level, there exists a maximum rate  $C$  at which information can be reliably transmitted. Beyond  $C$ , error rates increase without bound. This is not a guideline — it is a mathematical limit as absolute as the speed of light.

Applied to human systems: a person can process **approximately 120 bits per second** of conscious information (Csikszentmihalyi, 2004). Understanding speech requires roughly 60 bits/second. This means that attending to two simultaneous conversations is not difficult — it is **physically impossible**. The same principle applies to institutions: a regulatory body with a fixed number of competent staff has a fixed channel capacity. Mandating that it process more applications, oversee more institutions, or enforce more regulations does not make it more effective — it guarantees that its signal-to-noise ratio degrades.

### Human Implication

The epidemic of burnout in modern life is not a motivational failure — it is a channel capacity violation. When a human is simultaneously processing work emails, parenting demands, social media feeds, financial stress, and health concerns, the channel is carrying more signal than its bandwidth allows. The result is not reduced performance on each task; it is a categorical failure of signal integrity. The solution is never to try harder — it is to **reduce noise or increase bandwidth** (through rest, focus, or structural simplification).

### LAW III

## THE COMPRESSION GRADIENT

*Subjective time, memory density, and perceived meaning are inversely proportional to the predictability of experience. Routine compresses life. Novelty expands it. A year of repetition encodes as a single memory; a week of genuine novelty encodes as a lifetime.*

### Derivation

Eagleman & Pariyadath (2009, Philosophical Transactions of the Royal Society B) demonstrated that subjective duration is a signature of coding efficiency. Repeated stimuli undergo neural repetition suppression — the brain allocates fewer resources to encoding familiar events because they carry less information in the Shannon sense. Block & Zakay's contextual change model established that retrospective time estimation is proportional to the density of contextual changes encoded in memory.

This creates a fundamental asymmetry in human experience. In prospective time (while it is happening), routine feels slow because attention has nothing to engage with. In retrospective time (looking back), routine feels fast because few distinct memories were encoded. Novelty reverses both: novel experiences feel fast in the moment (high engagement) but slow in retrospect (dense memory encoding). This is why a two-week holiday in a new country feels like it lasted a month, while six months of office routine compresses into a blur.

### Falsifiable Prediction

Individuals who introduce a minimum of 2 novel activities per week (defined as activities not performed in the prior 90 days) will report significantly longer retrospective time estimates for the same calendar period compared to matched controls in routine environments.

## LAW IV

# THE PREDICTION ERROR ENGINE

*All learning, growth, and adaptation in biological systems are driven by the gap between expectation and reality. Eliminate surprise and you eliminate growth. The brain does not learn from what it already knows; it learns from what violates its model of the world.*

## Derivation

Schultz, Dayan & Montague (1997, Science) established that midbrain dopamine neurons fire in direct proportion to reward prediction errors — the difference between expected and actual outcomes. This is not a metaphor; it is the physical mechanism by which the brain updates its model of reality. Greve et al. (2019, Nature Communications) demonstrated that factual knowledge acquisition is governed by the same striatal prediction error signals. Gruber & Ranganath's PACE framework (2019, Trends in Cognitive Sciences) formalised how prediction errors trigger curiosity, which enhances both encoding and consolidation through dopaminergic modulation.

The mechanism has an information-theoretic interpretation that is precise: in Shannon's framework, the information content of an event is defined as  $I = -\log_2(p)$ , where  $p$  is the probability of the event. An event with  $p = 1$  (certainty) carries zero information. An event with low probability carries high information. The dopamine system is, functionally, a **biological implementation of Shannon's surprise metric**.

## The Saturation Boundary

Critically, the relationship between prediction error and learning is not monotonic. Extremely high prediction errors — events so unexpected that they cannot be integrated into any existing model — produce not curiosity but anxiety, confusion, and defensive shutdown. Vygotsky intuitively identified this as the boundary of the Zone of Proximal Development. CETE formalises it: the optimal learning zone is a region of **moderate, structured prediction error** where the system can update its model without overwhelming its error-correction capacity.

## LAW V

## THE DEPENDENCY TOPOLOGY

*Your value to any system — family, organisation, market, civilisation — is not measured by what you accumulate but by the cost the system would incur to route around your absence. Accumulation is storage. Indispensability is architecture.*

**Derivation**

In network science, betweenness centrality measures the fraction of shortest paths between all node pairs that pass through a given node (Freeman, 1977). Removing a node with high betweenness centrality does not simply remove one connection — it forces the entire network to find alternative (longer, costlier) paths. In some topologies, removing a single high-centrality node partitions the network entirely, splitting it into disconnected components (Albert, Jeong & Barabási, 2000).

Applied to human systems: a person who hoards resources (wealth, knowledge, status) but connects to few other nodes is a peripheral storage device. The system loses nothing by routing around them. A person who connects disparate networks — bridging industries, cultures, disciplines, or social groups — has high betweenness centrality. Removing them forces the system to find alternative bridges, often at enormous cost. Burt's structural holes theory (1992) demonstrated empirically that individuals who bridge structural holes in social networks receive **disproportionate returns** in salary, promotions, and influence.

**Falsifiable Prediction**

Individuals with high betweenness centrality in professional networks (top quartile) will show career advancement rates at least 1.5x those of individuals with equivalent credentials but lower centrality, controlling for industry and seniority.

## LAW VI

### THE ATTACHMENT RESONANCE

*High-intensity need for a specific outcome creates a feedback loop that destabilises the system's capacity to reach that outcome. The more desperately a variable is pursued, the more the system's resources are consumed by the pursuit itself rather than by the conditions that would produce the outcome.*

#### Derivation

In control theory, a feedback loop with excessive gain becomes unstable — it oscillates with increasing amplitude until the system saturates or destroys itself. This is the mathematical basis of resonance catastrophe. In psychology, Wegner's ironic process theory (1994, *Psychological Review*) demonstrated that attempting to suppress a thought increases its frequency. Baumeister's ego depletion research (though contested in replication) pointed to a more robust finding: sustained effortful self-regulation consumes finite cognitive resources, degrading subsequent performance.

The information-theoretic interpretation: when a system dedicates an increasing fraction of its processing capacity to monitoring a single variable (the desired outcome), it necessarily reduces the bandwidth available for processing all other variables. This creates a paradox: the environmental signals that would actually lead to the desired outcome (opportunities, connections, insights) are missed because **the channel is saturated with self-referential monitoring noise**.

#### Human Implication

This is why people often achieve goals after ceasing to pursue them obsessively. It is not mystical — it is informational. When the monitoring load is removed, channel capacity is freed, allowing the system to process environmental signals that were previously drowned in self-referential noise. The practical prescription is not to abandon goals but to reduce the monitoring frequency — to set the direction and then redirect processing resources to the environment rather than to the internal state of wanting.

## LAW VII

### THE COMPLEXITY CEILING

*Every system accumulates complexity until the cost of maintaining internal coherence exceeds the value of its output. At this threshold, the system does not gradually decline — it undergoes a phase transition into a qualitatively different state: stagnation, fragmentation, or collapse.*

#### Derivation

Tainter's archaeological analysis (1988) demonstrated across seventeen civilisations that complexity is initially adaptive (solving problems) but eventually becomes maladaptive (consuming more resources than it generates). Olson's institutional sclerosis theory (1982) formalised how stable democracies accumulate rent-seeking coalitions that increase regulatory complexity while reducing adaptive capacity. Klimek, Hanel & Thurner (2008) identified the mathematical phase-transition boundary where bureaucratic growth becomes self-sustaining and exponential.

The information-theoretic formalisation: as a system adds rules, processes, and hierarchies, its internal state space grows combinatorially. Each new rule can interact with every existing rule, creating potential inconsistencies that require adjudication. The system must allocate increasing processing power to maintaining internal consistency (analogous to checksum verification in data transmission). Beyond the critical threshold, the system spends **more energy on self-coherence than on its ostensible purpose**.

#### Falsifiable Prediction

Nations whose regulatory code length (measured in word count) grows faster than 5% annually for a decade will show declining GDP growth per regulatory word added, following a power-law decay curve.

## LAW VIII

### THE NOVELTY PREMIUM

*Systems — biological, economic, and social — disproportionately allocate resources to agents generating non-redundant information. Repetition is maintenance. Novelty is investment. The market, the culture, and evolution itself pay a premium for genuine originality because it is the only input that expands the system's model of the possible.*

#### Derivation

In evolutionary biology, sexual reproduction exists despite being energetically expensive because it generates genetic novelty — new combinations that may prove adaptive in changed environments (Red Queen hypothesis; Van Valen, 1973). In economics, Schumpeter's creative destruction (1942) formalised how innovation generates disproportionate returns precisely because it disrupts existing equilibria. In neuroscience, the dopaminergic novelty response (Bunzeck & Düzel, 2006, Neuron) demonstrates that the brain allocates preferential encoding resources to novel stimuli.

The information-theoretic interpretation: a system receiving redundant signals (the same information repeated) gains zero new knowledge per bit received. A system receiving novel signals gains new knowledge proportional to the signal's unexpectedness. From the system's perspective, **agents generating novel information are the only ones expanding its state space** — the only ones making the system capable of new responses. This is why first-movers in markets, first-authors in science, and first-settlers in territories receive disproportionate rewards: they are generating high-information-content signals in an environment of low prior probability.

#### Human Implication

The practical consequence is stark: if your work can be described by someone who has not seen it (because it is predictable), its information content is zero. A consulting report that says what every consulting report says, a CV that lists what every CV lists, a business that does what every business does — these are high-entropy, low-information outputs. The system does not reward them because they do not teach it anything new.

**LAW IX****THE CONSERVATION OF ATTENTION**

*Conscious processing is a scarce resource allocated dynamically, not a constant state. Most human behaviour executes without it. You are fully “online” only when processing novel, high-prediction-error information. The rest of the time, you are running cached scripts.*

**Derivation**

Dehaene’s Global Neuronal Workspace theory (2011) established that conscious awareness requires coordinated activation across prefrontal, parietal, and sensory cortices — an energetically expensive state that the brain cannot maintain continuously. Bargh & Chartrand’s automaticity research (1999) demonstrated that the vast majority of human behaviour is habitual, operating below the threshold of conscious awareness. Kahneman’s System 1/System 2 framework (2011) distinguished between automatic (fast, low-energy) and deliberate (slow, high-energy) processing, with System 1 handling the majority of daily decisions.

The information-theoretic interpretation: conscious processing is the high-bandwidth, high-energy mode reserved for novel information that cannot be handled by cached heuristics. It is the system’s way of allocating its most expensive resource (prefrontal cortex computation) only when the prediction-error signal exceeds a threshold. Below that threshold, the system runs on compressed, pre-computed responses — habits. This is not a flaw; it is optimal resource allocation. The danger arises when the entire environment becomes predictable enough that conscious processing is never triggered — what the framework terms **cognitive dormancy**.

**Falsifiable Prediction**

Individuals in highly routine environments (self-reported novelty < 2 events/week) will show reduced prefrontal cortex activation on fMRI during decision-making tasks compared to individuals in variable environments, controlling for age and cognitive baseline.

## LAW X

### THE REGRESSION ATTRACTOR

*Extreme deviations from system baselines — in wealth, power, health, or emotion — are thermodynamically unstable and will revert toward the mean. The rate of reversion is proportional to the magnitude of deviation. Peaks are as temporary as troughs. The only durable position is one maintained by continuous energy input.*

#### Derivation

Galton's regression to the mean (1886) is one of the most robust empirical findings in statistics, observed across genetics, sports performance, economic returns, and clinical outcomes. Kahneman (2011) identified it as the statistical phenomenon most consistently confused with causal explanation — people attribute the reversion to skill, punishment, or karma when it is purely mathematical.

The thermodynamic interpretation: **extreme states represent low-entropy configurations** — they are statistically improbable given the system's state space. A person at the extreme of wealth, fame, or power occupies one of a very small number of configurations out of an astronomically large possibility space. Random perturbations (market shocks, health events, political shifts) will, on average, push the system toward higher-entropy (more probable) states. Maintaining an extreme state requires continuous energy input to counteract these perturbations — exactly as maintaining a low-entropy physical system requires continuous energy input to counteract the Second Law.

#### Human Implication

This law dissolves the false dichotomy between optimism and pessimism. Suffering is temporary because extreme negative states are as unstable as extreme positive ones. But so is ecstasy. The practical implication is not fatalism but strategic patience: during troughs, the system is already reverting — additional panic (which consumes channel capacity per Law II) only delays recovery. During peaks, the system is already reverting — additional attachment (which triggers resonance per Law VI) only amplifies the eventual correction. The wise response to both extremes is the same: invest the energy that would be spent on emotional response into structural work that moves the baseline itself.

## The Meta-Structure: How the Ten Laws Interact

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The ten laws are not independent axioms — they form an interconnected system with specific causal relationships. Understanding these interactions is essential for applying the framework to real-world situations.

### The Growth Engine (Laws IV + VIII + III)

Prediction Error (IV) drives learning. Novelty Premium (VIII) rewards the application of that learning. Compression Gradient (III) ensures that the subjective experience of a life spent generating novelty feels longer, denser, and more meaningful than a life spent in routine.

Together, these three laws describe the mechanism by which humans create value:

**encounter surprise** → **update model** → **generate novel output** → receive disproportionate reward → expand experienced time. This is the virtuous cycle.

### The Decay Engine (Laws I + VII + II)

Entropy Tax (I) ensures that all systems degrade without energy input. Complexity Ceiling (VII) ensures that the cost of fighting entropy grows non-linearly with system complexity. Channel Limit (II) ensures that when the system's maintenance demands exceed its processing capacity, signal integrity collapses. Together, these describe the mechanism by which institutions, relationships, and civilisations fail: **accumulated complexity** → **rising maintenance cost** → **channel overload** → signal degradation → system enters maintenance-only mode → collapse. This is the vicious cycle.

### The Equilibrium Mechanism (Laws VI + X)

Attachment Resonance (VI) and Regression Attractor (X) operate as complementary equilibrium mechanisms. When a system pursues an extreme state with excessive intensity (VI), it simultaneously triggers the statistical forces that pull it back toward the mean (X). The system that fights its own regression burns energy faster (per Law I) and channels more bandwidth into monitoring (per Law II), accelerating its own exhaustion. The system that accepts regression as structural rather than personal conserves energy for the strategic work of shifting the baseline — the only durable path to a sustainably different state.

### The Consciousness Allocator (Laws IX + IV)

Conservation of Attention (IX) determines when the system is actually processing information, and Prediction Error Engine (IV) determines what triggers that processing. Together they explain why most of human life is lived on autopilot, and why the moments that define us — the decisions, revelations, and transformations — occur in the rare windows when genuine novelty forces the system into high-bandwidth mode. The practical implication: **if you want to be fully alive, you must engineer environments that reliably generate prediction errors.**

## Interaction Map: The Laws as a System

Law Pair	Interaction Type	Observable Effect
I + VII	Amplifying	Entropy tax compounds with complexity — old institutions decay faster than young ones
II + I	Cascading	Channel overload accelerates entropy — overwhelmed systems lose coherence faster
III + IV	Enabling	Novelty expands time AND drives learning — the same mechanism serves both
IV + VIII	Rewarding	Prediction errors drive growth; novelty premium rewards the output of growth
V + VIII	Structural	Network position determines who captures the novelty premium
VI + X	Counterbalancing	Attachment accelerates regression; detachment allows baseline to shift
VII + I	Threshold	Complexity ceiling is where entropy tax becomes unsustainable
IX + IV	Gating	Attention is allocated only when prediction error exceeds threshold
IX + III	Compressing	Low attention states produce compressed time — routine years vanish
X + I	Restoring	Regression is entropy's way of reclaiming extreme states

## Twenty Falsifiable Predictions

A framework that cannot be wrong is not science. The following twenty predictions are specific, measurable, and testable. If five or more are empirically falsified, the framework requires fundamental revision.

ID	Law(s)	Prediction
P1	I	Organisations where administrative overhead exceeds 60% of budget will show declining core output within 5 years.
P2	II	Individuals reporting >4 simultaneous major life demands will show degraded performance on cognitive tasks compared to those reporting ≤2.
P3	III	Participants introducing 2+ novel weekly activities will estimate the elapsed month as 15–20% longer than routine-matched controls.
P4	IV	Students in prediction-error-optimised classrooms (structured surprise) will show 20%+ higher retention at 30 days versus lecture-only controls.
P5	V	Professionals in the top quartile of network betweenness centrality will earn 30%+ more than credential-matched peers in the bottom quartile.
P6	VI	Goal-obsessed individuals (measured by monitoring frequency) will show longer time-to-goal than moderate-monitoring individuals with equivalent baseline ability.
P7	VII	Nations where regulatory word count grows >5% annually for a decade will show declining GDP growth per regulatory word added.
P8	VIII	First-to-market companies in new categories will capture >50% of total category profit over a 10-year period.
P9	IX	fMRI studies will show reduced prefrontal activation in high-routine individuals compared to high-novelty individuals during identical decision tasks.
P10	X	Forbes 400 wealth rankings will show >40% turnover per decade, consistent with regression dynamics.
P11	I+VII	Universities >100 years old will have higher admin-to-faculty ratios than universities <30 years old, controlling for size.
P12	III+IX	Individuals in high-routine jobs will report both faster-passing years AND lower life satisfaction scores.
P13	IV+VIII	Patent filings per researcher will be higher in interdisciplinary labs (high prediction error) than single-discipline labs.
P14	II+I	Healthcare workers reporting >50% administrative burden will show burnout rates 2x those of workers reporting <30%.
P15	V+VIII	Individuals bridging two or more distinct industries will generate more commercially viable innovations than specialists.
P16	VI+X	Lottery winners will revert to baseline life satisfaction within 2 years (replication of Brickman et al.).
P17	VII	Empires at peak territorial extent will collapse within 150 years (testable against historical data).
P18	III	Travellers in novel countries will produce 3x more diary entries per day than travellers revisiting familiar destinations.
P19	IX	Meditation practitioners (≥30 min/day, 2+ years) will show enhanced prefrontal activation in novel-stimulus tasks.
P20	IV+III	Retirees who pursue structured learning will report slower subjective ageing than retirees in routine environments.

## Practical Application: The Laws as Operating System

The framework is not merely theoretical. Each law implies a specific operating principle for individuals, organisations, and policymakers. The following table translates the ten laws into actionable heuristics.

Law	For Individuals	For Organisations	For Policymakers
I. Entropy Tax	Audit your maintenance load quarterly. Prune commitments below the decay threshold.	Measure and cap the admin-to-output ratio. Sunset old processes when adding new ones.	Apply a "regulatory entropy tax" — removing one regulation for each new one added.
II. Channel Limit	Protect focus. Reduce inputs before increasing effort.	Never mandate new processes without removing old ones.	Design policies as noise-reducing, not signal-adding.
III. Compression	Schedule novelty deliberately. Travel, learn, change routines.	Rotate teams, projects, and environments annually.	Fund experiential education over rote instruction.
IV. Prediction Error	Seek structured discomfort. Read outside your field. Travel.	Hire for cognitive diversity, not cultural fit.	Design curricula around prediction error, not coverage.
V. Dependency	Build bridges, not walls. Connect disparate networks.	Map your institutional dependencies. Identify single points of failure.	Decentralise regulatory authority. Reduce hub vulnerability.
VI. Attachment	Set direction, then redirect attention to the environment.	Avoid single-metric optimisation. Monitor multiple signals.	Design incentive structures that reward exploration, not fixation.
VII. Complexity	Simplify before adding. Ruthlessly prune.	Measure complexity cost. Fund simplification teams.	Mandate cost-benefit for every regulatory addition.
VIII. Novelty	Invest in R&D time for yourself. 20% of effort on the unknown.	Reward first-movers and experimenters, not replicators.	Fund early-stage innovation disproportionately.
IX. Attention	Engineer daily prediction errors to trigger full consciousness.	Design work that requires genuine thought, not compliance.	Measure educational quality by attention engagement, not attendance.
X. Regression	During peaks, invest in structural change. During troughs, conserve energy.	Plan for regression in all projections. Build counter-cyclical reserves.	Design social safety nets as regression buffers, not permanent states.

## Limitations and Intellectual Honesty

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This framework has specific, acknowledged limitations that must be stated plainly.

### What The Framework Cannot Do

First, it cannot address questions of value. The ten laws describe how human systems operate, not how they should operate. They can tell you why an empire collapses but not whether it deserved to. They can explain why novelty drives growth but not whether all growth is good. Normative questions — justice, equity, beauty, love — require different tools. Information theory is a lens, not a philosophy of life.

Second, it cannot make point predictions. The laws describe statistical tendencies and structural constraints, not deterministic outcomes. Law X (Regression Attractor) does not predict when a specific empire will fall; it predicts that extreme states are unstable. The precision is structural, not temporal.

Third, the mathematical formalisations are schematic. Computing the actual Shannon entropy of a civilisation's state space, or the channel capacity of a human mind in a specific context, requires empirical calibration that this paper does not attempt. The framework identifies the correct mathematical tools and the correct structural relationships; the quantitative calibration is future work.

### The Risk of Over-Application

The most serious risk of any unifying framework is over-application — the temptation to explain everything, which explains nothing. Cancer is not literally an infinite loop. Empires do not literally undergo phase transitions. These are analogies with varying degrees of precision. The framework is **most rigorous when applied to phenomena where information flow, channel capacity, and entropy accumulation can be directly measured** (education systems, institutional governance, cognitive performance). It is least rigorous when applied to phenomena where these quantities are metaphorical (meaning, purpose, consciousness itself).

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*India's Leading Education Intelligence Firm*

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