A Layman's View of Complexity

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Abstract

This paper introduces a framework to demystify complexity, bridging thermodynamics with socioeconomy. The present verbose transdisciplinary "fog" is challenged by synthesizing complexity in a core operational formula — "***C*** = ***evg***" (*endless variety generation*) — as a simple starting point to understand it.
With the second principle of thermodynamics as the underlying physical engine, it is also shown that complex systems — and life itself — are not "teleological", but just "efficient ways of increasing entropy".

Keywords: knowledge modeling, layman view, power laws, unexpected innovation.

Introduction

In describing and dealing with complexity, the sheer contributions of the many disciplines involved have built a large body of knowledge as well as "a thick fog", which results in cluttering a possible layman's view of the concept.[1] This paper is meant for those who'd like, in compact terms, to know what it might be all about.

We prefer clear, albeit approximate, indications to intricate, all-encompassing descriptions. Therefore, in order to navigate an infinite landscape — *everything is connected with everything else...* — we start from how our brains build reality: the evolutionary architecture of learning.

[1] "Layman's view" does not mean "simplistic reduction". It is just an exercise in functional clarity for the pragmatic outsider: engineer, operative manager, thinker who refuses to buy into the secular priesthood of hyper-specialized academy.

Epistemological foundations

The architecture of learning (knowledge modeling)

Learning / knowledge building / mind changing starts with a structure (a model, even unconscious, or a working hypothesis), into which gathered data are duly placed. This dynamic operates in three different modes:

- *Additive learning*: incoming data are smoothly placed into the existing framework. This incremental knowledge mirrors the "*Zen tea cup*": sooner or later it will need to be emptied in order to be filled up differently or anew. Filling it up "again equally" would be pointless.

- *Paradigm shift*: when incoming data are in serious disagreement with the structure at hand, the latter is redefined or changed; knowledge needs to be capable of changing shape and its internal structure to entail conceptual revolutions.

- *Learning to Learn* ("the method" of Edgar Morin): eventually, the learning process becomes conscious, continuous, open. Knowledge becomes flexible, adaptable, willing to endlessly revolutionize itself. True adult learning is not about adding new knowledge elements, but about discarding old assumptions and superstitions.

The evolution of consciousness

This modeling development starts in early infancy. A baby is born with an unconscious model connecting self and mother in an undivided unity. Challenged by sensory inputs, the child progressively builds a separate representation of the self versus the world: *the child* creates the "self" out of an interconnected world; *the adult* starts from the "self" to meet the world, evolving toward true adult adaptation

The role of language

Can a finite human mind truly explore complexity, in its declared "interconnection of everything with everything else"? It is like running after a mythical tortoise; ...however a very fast, ever-accelerating one.

Luckily enough, we have our Achilles, the hero capable of carrying us on his shoulders while chasing the tortoise at mental warp speed: *language* does appear to be capable of representing anything humans may conceive.

By exploiting the sheer compression power of language, we shrink the vastness of complexity into a dense, unexpectedly simple three-word formula:

C = ***e v g***

Complexity comes from / "is" endless variety generation.

Complexity does not simply generate novel variations within existing domains: it blindly drives the "emergence" (technical term) of *entirely new ontological / conceptual categories*: beyond ever novel variety of behaviors, properties, forms / structures, functions, collective dynamics, we also face something that has never been thought about or classified before. We do not just face unknown variables: we also face unknown axes in the phase space — think about life, intelligence, consciousness — opened "*just for **evg**'s sake*".

Achilles overcomes the tortoise: we can now possibly "grasp" what complexity is: a generative force ...and frenzy.

The physical engine

The thermodynamic's mandate (complexity as efficient entropy generation)

The blind generation of variety is not a casual poetic occurrence, nor is it a mystical design. It's a strict physical obligation from the *second principle of thermodynamics*.

The universe is bound to produce entropy, racing toward thermal death. Crucially, *disorder and complexity are correlated expressions of the same phenomenon*. Complex systems — from a primal fractal broth to biological organisms to global networks of people and technology — are open infrastructures designed to degrade energy gradients as rapidly as possible.

The Benard's cells

In your kitchen, with a pot of water on a stove, you can experience what shallow logic would tell you "impossible": diffusion of (thermal) disorder which *self-organize order in its flow* in order to diffuse faster. *Magic enough?*

From the heat source to the pot, to water and air / vapour, a thermal flow is clearly happening. Well, in proper conditions, convection (movement of matter to diffuse heat) in the liquid phase (water) self organize into hexagonal cells to make convection faster.

Life is similar, just orders of magnitude more complex, ...and with other emergences beyond "ordering".

Overall, the universe accelerates its decay by igniting a magnificent firework display of behavioral, structural, functional, dynamical varieties. Self-organization, complexity and emergences are the dynamic tools that disorder uses to diffuse faster. The universe does so with chaotic dynamics which relentlessly "search" the phase space for "points of activation" of autocatalytic cycles ensuing in emergences.

Taxonomies

Five thinking paradigms

- *Linear*: finding the laws which link effects to causes.

- *Systemic*: mapping feedback loops, states, and equilibrium conditions.

- *Complex*: positive feedback almost everywhere, with non-linearities as the rule and strange attractors as islands of bounded instabilities as well as "searching spaces" for autocatalytic cycles by chaos.

- "*Synthetic*": the only guard we have against complexity-related difficulties, by discarding silo / reductionist views through a joint team effort allowing to reach a shared, higher-level perspective.

- *Simple* (of mystics and enlightened people): meditating, reaching awareness / enlightenment, seeing things as an interconnected whole.

Three structural archetypes

- *Designed*: closed, predictable systems with a defined perimeter, built to perform specific functions with adequate reliability, or open, structurally reconfigurable networks growing via node aggregation and novel links.

- *Evolved*: autopoietic, open systems / networks / environments, focused on survival and homeostasis.

- *Mixed*: socio-technical clusters where human interventions and spontaneous evolution clash continuously.

Socioeconomic practice

Management and artificial friction

When faced with external complexity, traditional management makes a systemic error: it increases *internal complication* (silos, cumbersome control structures, organizational fads).

To understand this error in thermodynamic terms, we must distinguish between two domains: *external complexity* and *internal complication*. External complexity is an inevitable, environmental given. Healthy open organizations survive by dealing with

the external complexity and delivering utility to the environment, ...meanwhile generating entropy outside themselves.

However, institutional bureaucracy turns this dynamic inward. Internal complication acts as an artificial friction. When an organization generates high entropy inside its own perimeter, it actively harms itself. It bottlenecks information and energy flow. By wasting energy on internal control rather than external output, the system runs worse and achieves less, acting as a thermodynamic parasite that impairs survival.

Complex thinking

To dismantle this mechanical illusion, we must ground our perspective in the operational reality of crisis management, as captured by Rasmus Dahlberg:

> "*When agents in an organisation accept at least some notion of complexity, they tend to reduce the amount of planning, substituting this with preparing for the unexpected. In practise, this could be done by shifting focus from schedules and plans (representing a 'mechanistic' approach that tries to predict the future through analysis) to core values, long-term goals, do's and don'ts, human relations and so on. Even a minor insight in complexity helps this transition in agents' worldview.*"

Complexity thinking is the art of maintaining the tension between pretending we know something, and knowing we know nothing for sure. It requires us to spend a little more time thinking, and a little less time working. Agents must be freed from rigid schedules to expand their capability for organic self-organization.

The case for free infrastructures

A mixed social system gains maximum robustness when its core infrastructure elements — banking, telecommunications, motorways, water supply — are treated as open, non-profit utilities.

- *The attrition of pricing*: charging micro-fees for transactions, toll gates, or basic communication represents a useless systemic complication. The operational cost of collecting, tracking, and validating these petty payments is a structural friction.

- *Removing the friction*: eliminating tolls and fees completely unburdens the system. It removes the artificial friction, allowing the necessary environmental conditions for self-organization and resilient economic behaviors to emerge organically. Instead of deploying complex toll technologies, motorways should be free, placing ambulances, tow trucks and Police cars at every gate, ready to intervene. We do not need better accounting of the flow; we need a more robust infrastructure to survive the long-tailed shocks of complexity.

Systemic risk

The collapse of global financial structures stems from using Gaussian distributions to model highly interconnected systems. Interdependence generates power laws with much longer tails. In these systems, extreme events are "statistical inevitabilities". Risk management cannot rely on mathematical predictions of probability. We must actively pivot toward managing *exposure* (the structural severity of the outcome) rather than probability.

Unshackling innovation

The current paradigm of scientific funding — epitomized by the hyper-regulated, bureaucratic machinery of institutions like the European Union — is an absurd misunderstanding of how variety is generated and the nature of innovation:

- *The illusion of pre-codification*: meticulously pre-codifying in every minute detail the innovation categories, subcategories and sub-subcategories is a pointless obsession which assumes that innovation is something linear / predictable. It is not. *True* innovation is radically *unexpected*; it is an emergent variety driven by the bottom-up generation of the researchers themselves. Bureaucratic auditing is the true obstacle that chokes human intelligence.

- *The rule of three sages*: to restore the evolutionary flow, institutional frameworks should leave 40% of the research budget unassigned to any pre-defined category. This budget should be placed directly in the hands of three trusted, high-level "sages" with a strict, minimalist mandate: bypass and unlock the funding bottleneck for *the unexpected, the outlier, the unclassifiable*.

  The sages do not act as a central planning committee; the generative noise and creative variety come entirely from the researchers proposing the innovations. Within recognized human limitations, the three sages simply act as an emergency valve to support the "unthought" that traditional bureaucracy pretends to predict but inevitably strangles.

- *Refocusing control*: trying to enforce strict preventive ethical controls on the act of research itself is a logical folly. In modern technoscience, exploration and application are tightly coupled. Control must pivot to a mandate of extreme systemic liability ("skin in the game"). Systemic and legislative control must be shifted entirely downstream: on the economic and military applications of research. Researchers and economic backers must face total, un-bailable asymmetric liability for any catastrophic phase transitions their applications

trigger downstream / applications must be legally bound to pay for their systemic damages.

Conclusion

Epistemology dictates that the laws of (entropy and) complexity shape our world. We cannot control an ontologically unpredictable whole through mechanistic planning. Humanity's only viable strategy is to transition from rigid optimization to structural flexibility. By dismantling the pickiness of bureaucratic funding, eliminating artificial pricing frictions, and shifting control from the freedom of thought to the accountability of application, we will possibly allow our mixed systems to breathe, adapt, and survive.

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