

Whom Does the Abstraction Serve?

By Paul R. Leonard

Human civilization runs on abstractions. Language, law, medicine, technology, education, finance, and science are tools we have engineered to coordinate action and navigate physical reality.

While these fields appear different on the surface, many of their foundational organizing principles share a common, often unexamined assumption—an assumption that can and should be questioned.

Legacy assumptions—those that once seemed true—can persist long after evidence has shifted, orbiting a calcified narrative mass that accumulates over time. In some cases the assumptions still hold. In others they no longer do. The difficulty is recognizing which is which when the abstraction has become infrastructure.

What follows is a short series of statements that describe baseline operating parameters in several critical domains. As you read each one, pause briefly and ask a straightforward question based on your own understanding of how the world works:

Do you largely agree or disagree with these statements?

I. Science & Measurement

“The physical world, in all its complexity and historical depth, is best understood by identifying, isolating, and measuring its smallest constituent particles and states.”

Let’s say it in a slightly different way:

The universe is unimaginably complex. The only reliable way to make progress is to break it into its smallest measurable pieces—particles, states, constants—and build precise models from those isolatable units. Luckily, particle counts, energy levels, reaction rates, and equilibrium constants can be measured, standardized, published, and funded, giving institutions a concrete ledger of scientific progress even when the living, time-dependent behavior of the system is set aside.

Largely agree, or largely disagree?

II. Medicine

“Toxicity is an acceptable, managed variable required to achieve a measurable therapeutic index in the treatment of human disease.”

Does the adjusted narrative change your vote?:

Bodies get sick. In many cases the practical response is to interrupt or suppress the visible manifestations of disease with interventions that themselves carry side effects. The therapeutic index is carefully calculated so that the chemical or procedural action is strong enough to move the chosen markers—lab values, tumor size, symptom scores—while the collateral effects are monitored and managed. Luckily, those markers can be precisely measured, billed, and charted. They supply a concrete, capitalizable record that the condition is being managed, even when the underlying processes that generated the symptoms remain largely unaddressed.

Largely agree, or largely disagree?

III. Tech Infrastructure & Cybersecurity

“Digital information, intelligence, authority, and correction must operate within a unified, centralized topology to ensure network security and system-wide integrity.”

I’d love to hear from tech professionals on this:

The volume and speed of modern cyber threats are real. Individual users and local devices cannot be expected to defend themselves alone. Centralized monitoring and rapid response appear essential. Luckily, server response times, uptime percentages, and firewall throughput can be measured, capitalized, and reported, giving operators a concrete ledger that security is being maintained.

IV. Sports Science & Athletic Training

“Repetitive, progressive overload of isolated muscle groups is the foundational requirement for predictable athletic adaptation and performance gains.”

If you can measure it, you can achieve it:

If an athlete needs to run faster, jump higher, or reduce injury risk, the specific muscles responsible for those actions must be strengthened. Isolated gym machinery and progressive loading protocols make the process measurable and repeatable. Luckily, pounds on a barbell, muscle circumference, and peak torque can be tracked and standardized, giving coaches a clear ledger of adaptation.

V. Agriculture & Food Systems

“Soil is a physical substrate that must be systematically supplemented with standardized chemical inputs to guarantee predictable, uniform crop yields at scale.”

What about when phrased like this?:

Modern agriculture must feed large populations with consistent output. Chemical inputs help plants resist pests and disease and deliver uniform yields. Luckily, bushels per acre and standardized nitrogen-phosphorus-potassium ratios can be measured, financialized, and applied at scale, allowing yields to be contracted and traded on global markets.

VI. Macroeconomics

“Manipulating aggregate monetary variables such as interest rates and money supply from a central authority is the primary mechanism required to maintain stable, long-term economic equilibrium.”

Statistics don’t lie. What if we said:

Markets are volatile. Unchecked panic can produce severe contractions. An independent central authority that adjusts interest rates and liquidity is widely accepted as a necessary stabilizer. Luckily, interest rates, Gross Domestic Product, and the Consumer Price Index can be measured, modeled, and adjusted, giving policymakers a concrete set of levers with which to claim stewardship of the larger economy.

VII. Energy Generation

“Usable energy at scale is obtained by driving mass far from equilibrium—primarily through nuclear or extreme thermal processes—and recovering a fraction of the resulting heat across the largest practical temperature difference.”

‘Follow the science’ can mean different things:

We know that matter contains vast amounts of ordered energy. To unlock it at the scale modern society requires, we deliberately push that matter far from its stable state—most powerfully by splitting atoms, but also by burning fuels. The ordered energy appears for only the briefest moment before most of it turns into heat and spreads into the surroundings.

Fortunately, we have a clear way to score how well we are doing: we measure the temperature difference between the hottest part of the process and the coolest. The bigger that difference, the higher the theoretical efficiency. So the entire system is engineered to make that gap as wide as materials will allow. Heat is used to create pressure that briefly forces some of the energy into a more ordered form (moving a turbine, for example) before the rest is lost again as waste heat.

Materials science and energy engineering therefore focuses on substances that can survive higher and higher temperatures and pressures. That gives engineers a concrete, measurable, and fundable mark of progress—even though the original ordered energy has already been largely converted to heat, and even though that heat must still be turned into electricity before any usable power appears.

Were your responses consistent across the seven categories? Did the plain-language follow-ons change how the formal claims landed? The exercise is not a test; it is an observation about how easily a measurable, authority-backed metric can make an abstraction feel both necessary and legitimate.

To understand why these statements share a common blueprint, we look upstream to the primary tool human beings use to navigate the universe: the abstraction.

An abstraction is a simplified representation of reality.

Everyday conversational shorthand—"There are two types of people in the world: givers and takers"—compresses complex social dynamics into rapid heuristics. The statements are not universally true, yet they remain useful. Without such compression, a finite mind would be overwhelmed by the detail of physical and social reality.

Abstractions—language, money, software, scientific models, institutional metrics—allow finite humans to act across time, space, and complexity. They are necessary tools. Abstractions help mitigate human finitude-- that's why they were invented in the first place.

The difficulty arises when an abstraction becomes so deeply embedded that we forget it is a representation. We treat the shorthand as an absolute law. We mistake the frozen map, no matter how complex it might be, for the living territory in physical reality. When we optimize entirely for a static, measurable snapshot because it is easier to finance, regulate, publish, or control, we risk attenuating the real-time feedback loops that keep living systems adaptive.

This distinction becomes sharper in the age of artificial intelligence.

AI Symmetry vs Human Asymmetry

I've written about this before. Artificial intelligence is a powerful equilibrium engine. It approaches knowledge through static abstraction and pattern recognition—smoothing data, resolving contradictions, and seeking steady-state descriptions. It treats the world, in important respects, as a library of state-based characteristics to be optimized.

Human intelligence is a non-equilibrium process. We are open systems through which energy, information, and consequence flow. We do not only match patterns; we perturb them. Because we are alive, we are asymmetric. We navigate friction, revise rules when abstractions cease to serve, and maintain structure away from maximum entropy.

If institutions and technical systems are governed exclusively by static equilibrium models, adaptive capacity can be outsourced to systems structurally oriented toward the frozen snapshot. A more useful path is to design abstractions that respect the non-equilibrium character of living processes and to keep human agency in the position of primary perturbation rather than permanent dependency.

The Equilibrium Abstractions — Structural Consequences

Once the justifying metrics are visible, the systemic results become clearer.

Science & Measurement

When the preferred abstractions are those that isolate and stabilize the smallest measurable units, non-equilibrium dynamics—time-dependent circulation, relaxation pathways, threshold behavior—tend to be translated into equilibrium frames or treated as secondary. In fact, it is altogether fair to say that the overwhelming majority of equilibrium chemistry and condensed matter physics occurs within or is indexed to the ground-state manifold, yet thermodynamic work is only ever performed away from equilibrium. Static measurability enables capitalization, publication, and regulation; what cannot easily be rendered as a stable metric risks remaining outside the formal ledger of progress.

Medicine

Static biomarkers and symptom scores become the primary success criteria. An open, self-regulating organism can be converted into a managed condition whose improvement is scored against movement in the chosen markers—lab values, tumor size, symptom inventories—rather than against resolution of the underlying processes that produce those markers. Toxicity is accepted as a manageable cost of achieving the measurable change. The result is a system optimized for the snapshot of control rather than for restoration of adaptive capacity.

Tech Infrastructure

Information, intelligence, authority, and correction are forced into the same centralized topology. Local environmental feedback is delayed or ignored as downstream. Administrative legibility and central visibility are equated with security, while the capacity for timely local correction is reduced.

Sports Science

The body is treated as a set of isolatable mechanical levers. Continuous force-distribution networks and the non-linear demands of live environments receive less design attention. Structures optimized for controlled metrics can prove brittle under variable real-world loads over time.

Agriculture

Soil is treated primarily as an inert substrate requiring external chemical inputs. The complex, non-

equilibrium networks of the rhizosphere—where plants and microbial communities exchange chemical and informational signals that regulate immunity, nutrient uptake, and resilience—are bypassed or degraded. Success is scored by uniform yield metrics (bushels per acre, standardized NPK ratios) that can be contracted and traded at scale. The result is ongoing supplementation in place of autonomous ecological function, and a progressive decoupling of yield from the nutritional and biological qualities the plant would otherwise deliver to human physiology.

Macroeconomics

Complex, reflexive human exchange is rendered legible through a small number of aggregate variables. Local knowledge and non-linear feedback become secondary. Temporary improvements in the measured indices can be mistaken for durable systemic health.

Energy Generation

Usable energy at scale is organized around an equilibrium efficiency metric: the temperature difference between a hot source and a cold sink. The larger the difference, the higher the theoretical efficiency, so the system is engineered to maximize that variable within the limits of materials that can survive the extremes. Because success is defined by this Carnot frame, the large residual losses are treated as unavoidable. Recover what the metric permits; accept the rest-- optimize for the single, static measurement. What remains largely unexamined is that energy release is itself a non-equilibrium process whose ordered phase is fleeting. Approaches that might reorganize where and when dissipation occurs—rather than optimizing solely for a static, wider thermal gap—are sidelined by the metric, and by the multi-decade capital and regulatory cycles built around it.

In each case the same pattern operates: a living or open process is translated into a static, measurable, capitalizable or regulable snapshot. The snapshot then becomes the primary object of optimization, marketing, and governance. Whom does the abstraction serve?

Time itself reinforces the pattern. Capital investment and regulatory approval in domains such as energy generation routinely operate on multi-year to multi-decade cycles. Once large commitments have been made under a given set of assumptions and metrics, both investors and regulators have strong incentives to keep those assumptions stable long enough for returns to be realized and rules to remain coherent. The same dynamic appears in medicine, where decades of clinical practice, regulatory frameworks, liability structures, and pharmaceutical investment have grown around the premise that managed toxicity is an acceptable and measurable price of therapeutic effect.

Abstractions were originally created by humans to mitigate finitude—to let finite minds act across time, complexity, and uncertainty. When the capital and regulatory cycles that protect an abstraction become as long as, or longer than, a generational lifetime, the persistent narrative typically prevails. Innovations that could operate on substantially shorter cycles, or that work from different first

principles, are not merely technically disruptive; they are temporally disruptive to the structures that have grown around the prevailing abstractions. This dynamic appears, in varying degrees, across all of the domains above and in many others.

The Metacognitive Twist

The diagnostic offered here is itself an abstraction—a simplified map intended to make a recurring pattern visible. Abstractions are necessary. The task is not to eliminate them but to change our relationship to them so they remain tools rather than unnoticed constraints.

Once the pattern is recognized, similar snapshot abstractions appear in ordinary settings: the rigid industrial workday that treats cognitive energy as uniform hourly blocks; the three-digit credit score that compresses complex financial and social behavior into a single integer; calorie-counting models that treat metabolism as a simple closed furnace; grading systems that reduce divergent learning processes to linear rankings. Optimization for the measurable snapshot can quietly displace attention to the living process the snapshot was meant to represent.

In some cases the pattern is harder to see because it is actively constructed in the present. Contemporary public narratives sometimes pair high-visibility athletic platforms with emotionally resonant medical causes. Measurable charitable actions—donations triggered by on-field events, personal stories of patients—create strong positive association. The underlying therapeutic premise, that the body's existing multi-mode, feedback-regulated defenses are best supplemented or replaced by external intervention, receives the benefit of that association and becomes more difficult to examine on its own terms. So we ask, whom does the abstraction serve?

Once the pattern is visible, the practical question becomes how to keep abstractions in service of the beings who created them rather than the reverse.

What Can Be Done

Abstractions are human creations intended to mitigate finitude. Humans themselves are non-equilibrium beings whose macro-scale behavior tends, when opportunity is perceived, toward the preservation or expansion of viable option space. It follows that the abstractions we build are best organized for responsiveness over time rather than for permanent closure. An abstraction that cannot be revised when conditions change has ceased to serve its original purpose and has become a constraint. The orientations below are practical expressions of that requirement.

Seeing the pattern is useful only if it changes design practice. Three orientations follow:

1. Prefer flux metrics over pure state metrics

Measure rates of adaptation, recovery, and information or energy throughput under stress, not only

static levels. Optimize for maneuverability and return to functional range rather than for the appearance of permanent equilibrium.

2. Keep information, authority, and correction topographically aligned

When designing technical systems, organizations, or interventions, ensure that the components closest to the relevant environment retain the capacity to sense, constrain, and correct in meaningful time. Routing every local problem through a distant center introduces delay and fragility.

3. Maintain contestability

An abstraction that becomes prohibitively expensive to leave or revise has ceased to be a tool and has become infrastructure that dictates conditions. Preserve alternative paths. Use the representation that serves the present purpose while retaining the ability to revise or replace it when it no longer does.

Operational ways of characterizing non-equilibrium behavior already exist in certain technical domains —indicators of relaxation dynamics, threshold behavior, and sustained internal energy circulation among them. The larger design task is to treat such indicators not as isolated laboratory curiosities but as elements of architectures in which physical process, information flow, and authority remain deliberately coupled.

By aligning abstractions more closely with the non-equilibrium character of living systems, we reduce the tendency to build brittle structures optimized for legibility alone. We create more room for human agency to remain the primary source of purposeful perturbation rather than a permanent dependent of the tools it has built.

Acknowledgments of Lineage

The core observations in this essay are not new. They synthesize insights developed across the twentieth century in thermodynamics, cybernetics, philosophy, and political economy. The contribution here is simply to show how those insights illuminate recurring constraints across contemporary domains, and to suggest practical orientations for design.

Relevant lineages include:

- **The fallacy of misplaced concreteness** — Alfred North Whitehead’s warning, later condensed by Alfred Korzybski as “the map is not the territory.”
- **The tyranny of the metric** — Goodhart’s Law (and Marilyn Strathern’s formulation): when a measure becomes a target, it ceases to be a good measure.
- **Non-equilibrium steady states** — Erwin Schrödinger’s *What is Life?* and Ilya Prigogine’s work on dissipative structures and systems maintained far from equilibrium.

- **The limits of centralization** — Friedrich Hayek's "The Use of Knowledge in Society" and James C. Scott's analysis in *Seeing Like a State* of how centralized legibility flattens local knowledge and adaptive capacity.
- **Tool captivity** — Ivan Illich's argument in *Tools for Conviviality* that tools can mutate from instruments of human purpose into infrastructures that dictate the conditions of action.

We do not lack the intellectual lineage required to recognize these patterns. Whitehead and Korzybski, Goodhart, Schrödinger and Prigogine, Hayek and Scott, Illich—each mapped a part of the same territory. What has been missing is the willingness to treat their insights as operational design criteria rather than as academic observations.

When the capital and regulatory cycles that protect an abstraction stretch to the length of a human lifetime or beyond, the persistent narrative tends to prevail even after better descriptions become available. The same dynamic appears, in different forms, across science, energy, medicine, infrastructure, agriculture, and the management of collective economic life. In each case a living process is translated into a static, measurable snapshot, and the snapshot becomes the primary object of optimization, capitalization, and control.

The practical task is therefore not merely to critique the abstractions we have inherited, but to build new ones that remain responsive over time. Abstractions exist to mitigate human finitude. Because humans are non-equilibrium beings whose larger tendency is to preserve or expand viable option space when the opportunity is perceived, the tools we create are best organized for revision rather than permanent closure. Flux metrics, local alignment of information and authority, and genuine contestability are concrete expressions of that requirement.

The remaining work is technical and institutional: to design measurement practices, material architectures, information topologies, and governance arrangements that respect physical and social reality as living process, and that keep human purpose and local corrective capacity in their proper places. The map is not the territory. The useful map is the one that can still be redrawn.

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#Abstractions #NonEquilibrium #SystemsThinking #HumanAgency #Thermoeconomics

About the Author

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His broader work examines seemingly disparate problems through a thermoeconomic lens, seeking structural relationships among energy, surplus, human agency, institutional behavior, and technological development.

Leonard is also the author of *Big Quantum Nerd*, a publication exploring structural clarity through thermoeconomics and non-equilibrium systems.

His work draws on applied experience across physics, energy, materials, complex systems, and organizational problem-solving, with an emphasis on identifying structural solutions that expand human maneuverability rather than merely optimizing existing constraints.