# Relational Holon Theory
## How It Works, and What It Means

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## Abstract

Relational Holon Theory is a new trans-disciplinary foundation and framework for science based on the causal pattern of natural wholeness. It was introduced in 2011 and updated in 2017 to provide a four-cause coupled modeling framework for simple and complex systems alike. It is the first theory to explain the four types of living systems in terms of their strategic organization, and to provide a scientific definition of sustainability. The theory suggests causes of and remedies for the current post-truth information crisis.

## Introduction

Relational Holon Theory (RHT or R-theory) is a coupled modeling framework and General Systems meta-theory, published in 2011 by Dr. John Kineman, from a synthesis of Robert Rosen's "Relational Biology". Since then, the theory has been refined and tested in numerous contexts. It is based on a rigorous re-interpretation of Aristotle's causalities, viewing them as a complete cycle of four causes that identify a whole system (holon). This schema is proposed as a more complete view than the current mainstream treatment of causality as hierarchical, which fractions holon symmetry and implies higher cause teleology. The cycle agrees with the ancient Vedic worldview of causal reality as a cycle reflecting "cosmic order" (Rta). Misinterpretation of the four causes has led to confusion and dismissal of causal views in mainstream academia, reinforcing a false idea of material foundations. The causal cycle is presented as a mathematical object in category theory, which has both graphical and algebraic forms. The graphical form provides an intuitive and robust way to expand current science to explain complex and holistic phenomena, whereas the algebraic form facilitates mathematical proofs. Successful RHT models explain the origin and essence of life, 'predict' the four fundamental life types known empirically in taxonomy (three organism types plus proto-life) and offer a viable approach to the mind-body relation (the "hard problem'), taking systemic identity (the cycle itself) as a foundation for transcendent consciousness and soul.

Because RHT represents a new foundation for modeling reality, there are a number of 'threshold' concepts – foundational ideas – that can block initial understanding and acceptance. Examining

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these roadblocks can help bridge between mainstream dualism and this view, which does not contradict present models but expands their context. Experience has shown that once these basic concepts are understood, automatic "red flags" can be set aside, and people are able to grasp the theory's general validity and explanatory power. This new causal realism allows us to analyze nature in terms of whole autopoietic units that account for existence in addition to behavior, thus supporting parsimonious and robust models of complex natural phenomena including life. This is in contrast with statistical and other heuristic simulation approaches that have become popular in modern times, as surrogates for true modeling of causes.

## Threshold Concepts

Let's begin with the threshold concepts that can facilitate understanding this new framework. This will prepare the foundation for thinking in terms of whole systems.

**Causality means explanation**. Traditionally there are four parsimonious ways of explaining "why". These ways of knowing and explaining are ancient and were well-known 5,000 years ago in pre-Vedic philosophy. Aristotle re-considered this causal framework, preserving some aspects of holism but also reflecting new dualistic thoughts that began to dominate Indo-European civilization since 1500BC, during a thousand year period when the Vedic civilization was being forced to disperse from the Saraswati basin due to climate change (Danino, 2010; Mcintosh, 2001; Rajaram, 2006). But as modern science developed in Western dualism, causality itself has fallen out of favor due to misinterpretation of final cause as something mystical, unknowable, or theological.[1] Formal cause was harder to dismiss after relativity and quantum discoveries, but to not implicate its precursor, final cause, most theories try to reduce formal cause to efficient processes as well. This preserves the "machine metaphor" of nature and prevents exploration of true complexity. Since efficient entailments alone cannot explain higher cause potentiality – the organization of a system – the whole idea of causality was questioned. Thus, the idea of a-causal behavior has become popular, but what that really means is the lack of efficient and material explanations and unwillingness to consider contextual (top-down) causes. The consequence of expanding the causal view is that we gain an ability to model complexity in ways that are otherwise impossible.

**Final cause** is not an external intervention into nature, it is natural as part of a causal cycle (**Fig. 1**). It "closes the loop" of causation (Rosen, 1993) and is best thought of as "anticipation" (Rosen, 1985). "*An anticipatory system is one which contains a subsystem which can serve as a predictive model of the world. In such systems, the output of the model (embodying a prediction about the future) is the stimulus to present action. Anticipatory systems are ubiquitous in biological and social systems; despite this, there exists no formal theory of such systems, because they appear to violate familiar notions of causality. Yet a theory of such systems is of the utmost importance for*

[1] Note that despite the apparent non-theological view presented here, there is no contradiction with the idea of God as an infinite contextual influence. As argued in many of his works and summarized in (Rosen, 1991), he pointed out that if a system has a closed to efficient cause relation with itself, that is it has a self-model, the encoding and decoding relations of that modelling relation lie outside of both system and model. Consequently, the description can never be completely, implying an infinite regress of context. The result is that there is no largest mechanistic (i.e., exact) system description: Reality is infinitely causal, but unknowable in the limit.

*understanding behavior, and for providing a basis for any technology involving forecasting*" (Rosen, 1978).

Mechanistic science assumes a hierarchy of causes with external predicates, thus removing final cause from what science can study. In this view there is a "beginning" and an "end" to reality (beginning with an unknowable origin or deity and ending in dissolution or heat death). Relational holism assumes a holarchy of four causes with internal origins at every level of wholeness. In this view there is no beginning or end, existence is implied in the eternal and unbounded cycle itself (and thus one cannot escape incompleteness of explanation).

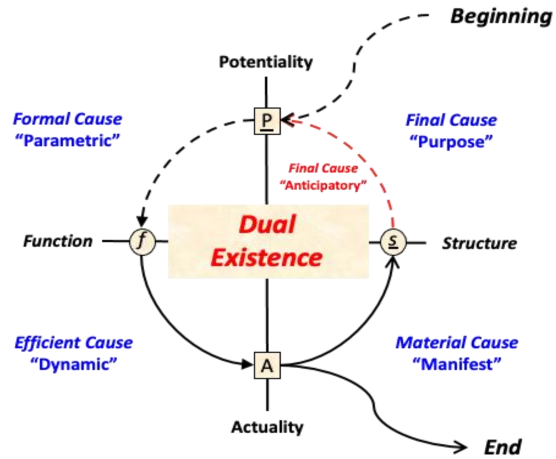


*Figure 1: Hierarchical causation vs. four cause closure.*

**Cyclical causality is fundamentally complex**, providing a more complete and parsimonious foundation for science than we have had to date; explaining both mechanistic simplicity (external models or 'laws'), such as Newtonian motion, and non-mechanistic complexity (internal, self-produced models), such as life and the conscious mind-body relation. Four-cause cycles (**Fig. 2**) allow us to identify both closed and open "modeling relations" (Kineman, 2007; Rosen, 1990) between potentiality and actuality (Aristotle's terms). Whole units of causality (holons) are important because they represent sustainable relations and processes in nature; the true 'building blocks'.

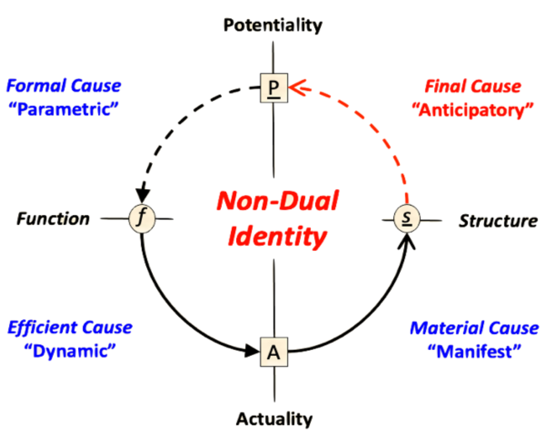


*Figure 2: The Relational Holon.*

Final cause closure is non-teleological in this framework because it is entailed in nature, but it does act to pre-condition the future based on models of past action (event information), as in the Eastern concept of Karmic destiny. This relation is assumed to be the foundation of all existence, but mind-like causes are not only human, they encompass all natural laws and dynamical attractors, and even non-local entanglement. Humans are more sophisticated reflections of this natural relation as a result of evolution. The concept of "universal mind" or cosmic order (known as "Rta" in Vedic philosophy) is thus taken as real in these terms, but it is knowable only as principles of relation, not specific pre-destined outcomes.

This modeling relation is logically "impredicative", meaning it can't be predicated on other systems (and can't be generally formalized) but can have mutual influences and formalizations that apply to specific systems, such as quantum systems and, as developed in the theory, organismic life (Kineman, 2018). This gives it the "part-whole" dichotomy of holons as imagined by Arthur Koestler (Koestler, 1969) and places autopoiesis (Maturana & Varela, 1980) at the foundation of reality, explaining evolutionary life and sustainability.

**Relational holons imply a network holarchy**. Because four cause relations can be internal or external, they implicate a universal holarchy, reflecting Leonardo da Vinci's statement that "everything is connected to everything else", a concept that has been largely misunderstood as to how everything is connected. The relation between the higher and lower causal categories (analogous to mind and body) is impredicative, as stated above, but does translate patterns from one category to another. This is in the nature of "structure preserving" functors in category theory, which are essentially information relations. Rosen labeled them "encoding" and "decoding" in his modeling relation diagram. If holons are the fundamental building blocks of nature, then information relations are the 'glue' holding everything together. It is indeed a "participatory universe" as the physicist J. A. Wheeler said (Wheeler, 1981), but more than that it is an anticipatory universe in which participation is through two way information transformations in modeling relations.

**This worldview is justified by parsimony**, meaning it incorporates the least set of necessary and sufficient assumptions. This contrasts with current mainstream assumptions which become increasingly non-parsimonious as we attempt to explain complex phenomena by the addition of simple systems. In fact, the schema meets all six fundamental criteria for scientific worldviews, except that testing is on-going (Kineman, 2019). The schema is being applied to our current post-truth crisis and development of "truthful" Artificial Intelligence, based on holon architecture as a universal symmetry for causal alignment.

## The Four-Cause Cycle

- **Final Cause – Anticipation:** By interpreting the final cause as anticipation, we emphasize the role of past conditions forming potential realization of future states. Such potentials inform and guide current processes (e.g., natural law, in the most reduced case).

- **Formal Cause – Parameterization:** Linking formal cause to parameterization allows for a contextual interpretation of how dynamics are formed or 'attracted' by organizational patterns under varying conditions. This reflects an understanding that dynamical behavior is context-dependent, as we see in relativity, quantum measurement, and other complex and semi-complex phenomena. In mathematical terms the parameters of a system establish its boundary conditions and organizational structure, such as scale, energy conservation, natural transformations, etc. These are boundaries on the dynamics that do not determine dynamical laws but condition them to behave in an organized way based on the anticipatory model. For example, when a carpenter uses a saw, it cuts according to the formal constraints known by the carpenter, whereas the physical dynamics of the saw apply everywhere.

- **Efficient Cause – Dynamics:** Describing the efficient cause as the dynamics that realize attractors via natural functions highlights the processes through which potentiality manifests its effects in predictable ways, once the exact functions are determined. This aligns with the dynamic systems theory where the trajectory towards attractors (stable states) is shaped by the interactions and functions defined by the system's rules and conditions.

- **Material Cause – Manifestation:** Viewing material cause as the manifestation of measurable dynamic events places emphasis on the tangible, observable outcomes of the other causes, grounding the model in empirical reality. In the most general case, the process of manifestation defines spacetime structure itself.

- **Cyclical Iteration – Wholeness:** The cycle of four causes repeating deductively in the order above, is creative; that is, given one quadrant the next is instantiated. The reverse order is inductive reasoning: given one quadrant, what established it? All temporal state differences in the measurable world are thus manifestations of context. There are no permanent or established states in this view, but cyclically regenerated states that conform to contextual organization. Thus, modifying the context of dynamical systems will alter their behaviors in ways that are not predictable by dynamics. The holarchical architecture of this causal schema ensures that all dynamics are conditioned by both internal relations (in the case of living systems) and external relations extending universally. The case of classical reduction is easily explained as the case of having established a stable external relational context (external models) as a result of efficient realizations. In the absence of causal boundaries at meso-scale (where neither quantum nor relativistic effects are significant), frequent interactions establish and maintain a general classical 'law-like' context. Where causal boundaries exist (quantum systems, relativistic systems, and organisms) behavior is more self-entailed and thus less generally defined. Self-determining behavior ('free will') thus applies to internalized relational contexts (building and using internal models).

## Modeling Relations

Modeling Relations are ubiquitous in mathematics, where one formal system models another. The key to understanding relational complexity is to realize that modeling relations are also ubiquitous in any description of nature, and while we assume that nature is in some way whole, we must also recognize this dualism that accounts for diversity. Thus, we have a fundamental complementarity between what can be observed or measured and what can only be inferred or in some cases directly experienced – two categories by which nature is known to exist. The problem of science then becomes discovering how these two categories are related. This is the basis for applying mathematical models, which are also in the formal domain, to describe nature's measurable domain and thus to infer nature's models. But nature also has functions in its formal domain, whether that be approximated by us as law-like, stochastic, or otherwise, and it has some functions that mathematics cannot formalize. We know this because humans are capable of performing such functions (Reason, 2019). Therefore, scientific models are reductive in one way or another – they reduce the modeling relation to something that can be formalized and then we attempt to build back an understanding of natural complexity from those reduced models.

The problem in mainstream science is the way we build back complexity, by adding reductive physical processes instead of coupling them with contextual models that cannot be represented in the same way (i.e., reduced). The problem is addressed in many arbitrary ways, for example in quantum theory and other fields. Perhaps the closest to the schema described here is "relational cosmology" (Rovelli, 1996), but it has not become a general philosophy nor has it been generalized as attempted here. If we couple inductive and deductive models in a modeling relation, we preserve the essence of natural complexity to the best of our ability, while allowing empirical determination of the relations (which is being done in some theories, but without a universal schema). While mathematics can only simulate natural systems, and thus cannot get a complete model, humans are natural and capable of performing impredicative functions. Thus, it is possible to do science while retaining a meta-understanding of how nature is organized. Rosen depicted this principle in terms of the modeling relation, expanded here (**Fig. 3**) to show both contextual and dynamical model entailments, related to each other in a modeling relation.

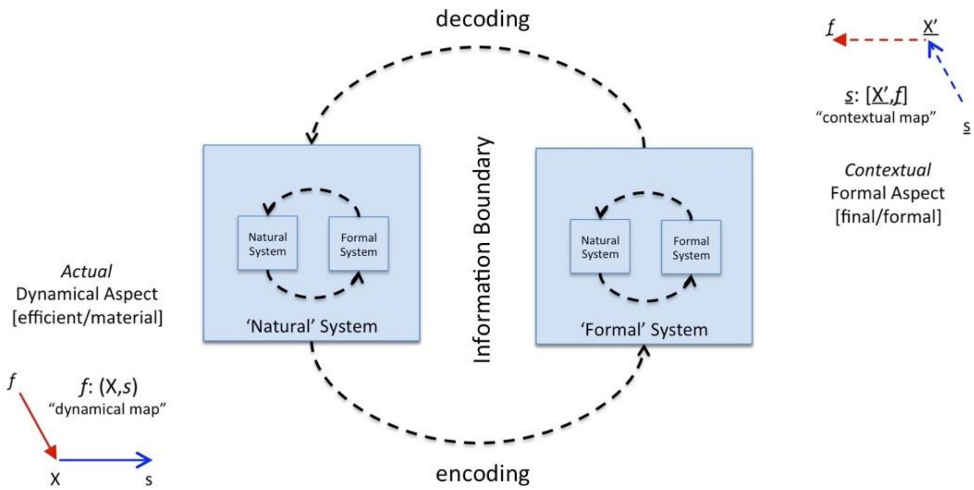


*Figure 3: Modeling Relation Expanded to Show Coupling of Causal Entailments by Information Relations. [X = natural system, X' = contextual system, f = efficient cause function, s = material cause structure].*

It should be clear by now that the modeling relation is a whole cycle of causality – a holon – where the "potentiality" is shown on the right in Fig. 3 as a "formal" system, and the "actuality" is shown on the left as a "natural" system. Internal modeling relations are formalizable, and the general entailment structure is shown for both categories (the two-cause entailments on each side, characterizing the "dynamical map" and "contextual map"). The diagram also shows nesting of modeling relations, thus implicating both external and internal relations in keeping with the idea mentioned earlier, that there can be no complete ("largest") system description, nor would there be a smallest system description (particle) – the schema is scale invariant and nature then appears to be infinitely scaled in this view.

Also, we should note that the causal entailments shown are inverses of each other. As such, they cannot serve as surrogates but can only be coupled. When coupled by effective information (encoding and decoding), they describe a causal whole. The properties of such whole units become extremely interesting and important in today's world as we deal more and more with complex systems.

## Life Itself

What is life? If you look at textbook definitions and popular explanations you will find that life is not defined in terms of what it IS, but in terms of what it DOES. In other words, we have only considered it as a dynamical system. Indeed, life seems to behave differently than machines, but the difference has been hard to pin down. Rosen was focused on discovering what life IS and to answer that question he reasoned that the explanation must be in terms of rich causality and the most general meta-mathematics, category theory, is needed to understand it. We can see that intuitively, by recognizing how we answer "why" questions – we say "be-cause". We may give a causal explanation, but we rarely include all four kinds of cause as above. We don't give the whole answer but something that seems relevant to the conversation, and we switch between giving a physical answer and a psychological one (giving one where the other is expected is often a source of humor, levity, dismissal, etc.). Modern science does the same: We cite a fractional cause (one of the four) as if that is most important. But in general terms it is no more important than the others (Aristotle is quoted as saying an explanation that does not give all four reasons, is no explanation at all). Thus, it is the balance of causes that prevails and is sustainable in nature. Of what use is dynamics if there are no states? What use are both without contextual meaning and generative potentials? No part of the causal cycle can happen without what the other quadrants represent, whether those relations be generally distributed in the environment or localized in an organism.

Armed with such insights, Rosen took two theory tracks toward explaining life itself – modeling relations and causal closure. Rosen demonstrated the necessity of a commuting relation between the two categories as the essence of modeling relations (and goal of science). A natural system decodes or realizes a model and a formal system encodes or exemplifies behavior in models. Clearly, there can be no modeling relation without both categories. But to give that a causal explanation, as in Fig. 3 above, Rosen began by looking at efficient entailments alone (the directed graph of efficient and material causes).

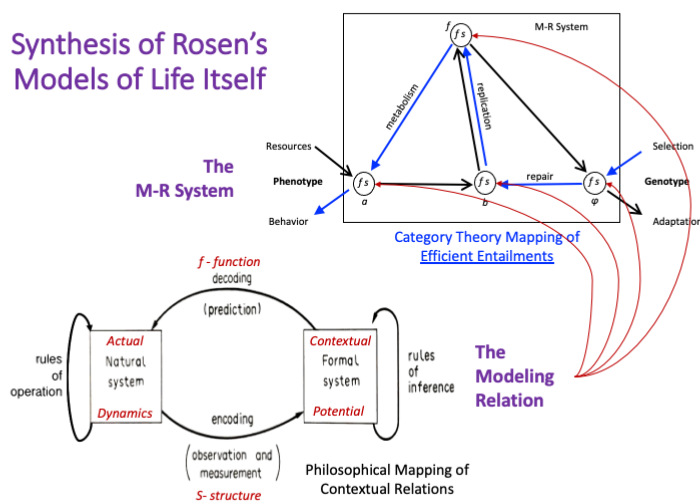


*Figure 4: Rosen's Two Theory Tracks to Explain Life Itself.*

Rosen reasoned that organisms have a minimum set of functions that are necessary for life: *Metabolism*, *Replication* of metabolism, and *Repair* of metabolism using the replication code. Of course, organisms also have necessary relations with their environments, as shown in **Fig. 4** in an "extended" M-R system diagram, including environmental relations (phenotype behavior and genotype selection), but Rosen's original diagram left those relations out to focus only on what defines an organism within its own organization. He found that these three critical functions operate in a mutually supporting way – they form an internal closed loop of efficient causation aside from external relations. He called this organization a "Metabolism-Repair" or "M-R" system (considering replication part of the repair process). It represents an autopoietic (self-producing) whole. This might not be considered so surprising, since these organic functions are well known, except that such closure is logically impossible without additional causality – the higher causes. In other words, it cannot exist strictly as a mechanism, flying in the face of many theoretical programs. This implies the revolutionary idea that nature itself cannot be strictly mechanistic either, or else life could not exist. Thus he dismissed the "machine metaphor" (Rosen, 1991).

Mechanistic science is built on efficient entailments, where dynamical functions determine resulting material states. The physicist Erwin Schrodinger wrote that we know the mathematics for how functions determine states, but the key to understanding life is the inverse of that, where a state implicates a function (Rosen, 1999; Schrodinger, 1967). That is the inductive entailment shown on the contextual side in Fig. 3.

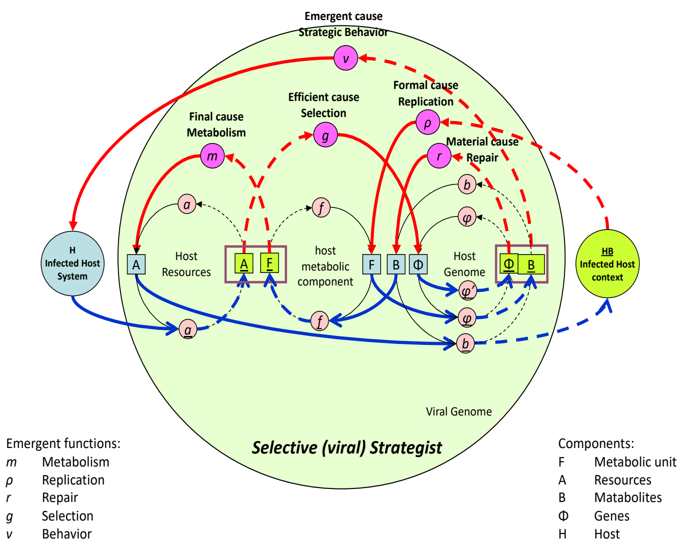


*Figure 5: Contextual mapping of Protobiota, the selective strategist.*

In **Fig. 5**, the missing causality is hidden in the nodes of the M-R system diagram, but on inspection one can see a material arrow is transformed at each node into an efficient arrow, precisely the transformation that takes place as "encoding" in the modeling relation: the encoding of model-based functions from events, which is the final or "functional" entailment (Louie, 2013).

As a result, there are continuous pathways through the M-R diagram in each direction, one being a sequence of functions, and the other a sequence of states which then allows the organism to produce behavior on which it can be selected.

Traditional science has no description for the inverse (functional) entailment: it asserts empirically that material configurations *have* functions but not how they get them. The point is that in complex systems, which in an absolute sense are all systems, those functions depend on contextual relations encoded from prior states as internal models – a transformation from states to functions. So, it is this hidden causality in the M-R system that allows it to exist as a logical structure and as a model of life.

A synthesis of these two theory tracks (Kineman, 2011) resulted in a detailed mapping of the M-R system's hidden contextual entailments. That mapping predicted four parsimonious types of M-R system, of which three are efficiently closed organisms corresponding organizationally and strategically to the three organism types determined from taxonomy: Metabolic (*Ekaryota*), Reparative (*Archaea*), and Replicative (*Bacteria*). The fourth type corresponds to the environmental selection function in the extended M-R diagram, which on the surface would seem to be a null strategy since strategic types are *for* selection. But on further reflection, that turns out to be possible if it occurs within a host (Kineman, 2017, 2018).

This is a 'self-selector' type that co-opts host functions to complete a virtual organism in the host but is not itself an organism. It was accordingly labeled "Protobiota" after similar recognition in the taxonomic community. Viruses are the most extreme example because generically they do not contain any M-R functions but passively co-opt (select) those functions from a host, causing it, in turn, to be passively selected to forming a virtual organism in the host. That virtual organism is a hybrid of host and virus instruction sets (**Fig. 6**). The four contextual maps (only Protobiota is shown here – see references for the others) begin with the basic component holons in the M-R system and then map the emergent functions from Rosen's M-R diagram. Because emergent functions are produced by perturbing existing component contexts and pairwise combination of existing contexts is the most parsimonious perturbation assumption, the result is four archetype possibilities.

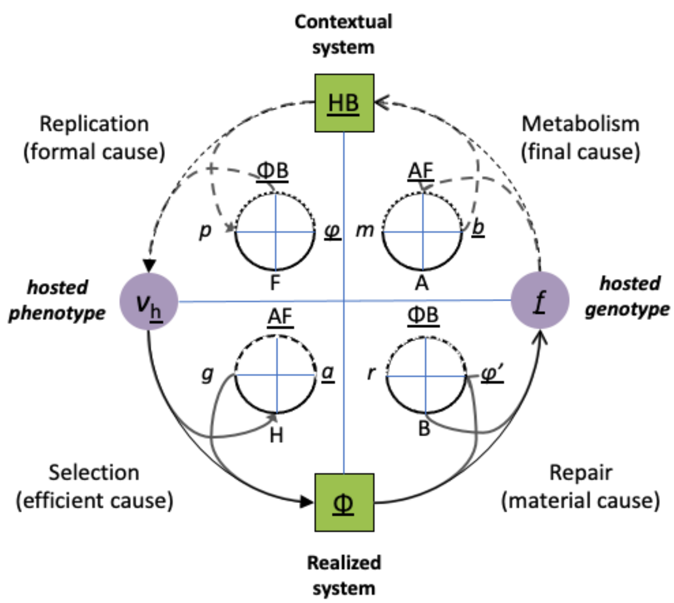

*Figure 6: Holon view of Protobiota.*

A holon view of the same systems can be produced, focusing on M-R function generating cycles as internal holons (no longer showing the complete component holons) and aligning them with the four causal types to define a "5$^{th}$ order" organism holon as shown here also for Protobiota (**Fig. 6**). Preserving causal and functional order, that alignment has four relative orientations defining the life types causally as well as functionally. We thus obtain four kinds of M-R system holons (when the selective context is considered), which are strategic living system archetypes. The selective type also explains partial types in addition to viruses, such as internal organs, and suggests a developmental pathway for the origin of organismic life from matter at the beginning of adaptive evolution. Agreement of this schema with the many four-part schemas from Vedic and other ancient ontologies was discovered from other research, but is so profound that for many reasons it must be noted as a significant precedent (Kineman, 2017).

## Information Integrity as the Key to Sustainability

Given the forgoing, it should be clear that sustainable whole systems depend on ***information integrity***. This can be seen best in the opposite case of the virus, which as such, has essentially zero information integrity (why it mutates so easily). Information, in this theory, is not the code or coded material itself, i.e., not the RNA or DNA fragment or its pattern. It is the process by which that pattern informs other systems; "a difference that makes a difference", which, in regard to evolution, involves both organism and environment since they are inseparable (Bateson, 2015).

Even though it is an RNA or DNA fragment containing sometimes sophisticated instructions that a host can implement, a virus cannot perform any active functions on its own, including the act of informing other systems. Bateson argued that the unit of evolutionary selection is the organism-environment relation. In this case it is primarily the organism-host relation (the holon presented above), whereas the host then has its own selective relation with its environment. Viruses are essentially strands of genetic code that become replicated in a host to form a virtual organism that disappears outside the host. Evolution of the virus (aside from environmental mutations) thus takes place in the host. In contrast, the other three organism types are self-sustaining in the environment due to adaptive information transformations.

The focus here is on the *Protobiota* type because it is most relevant to the crises we face today politically and socially. Whereas the *Eukaryota* type represents perhaps the highest form of biological organization with self-sustaining internal balance of causes, the Protobiota represents the opposite end of the spectrum. For example, we can note that the mutually selecting relation between *Protobiota* and a host benefits from the destruction of the host's identity information, allowing the virus to escape immune responses and passively co-opt host functions that replicate it.

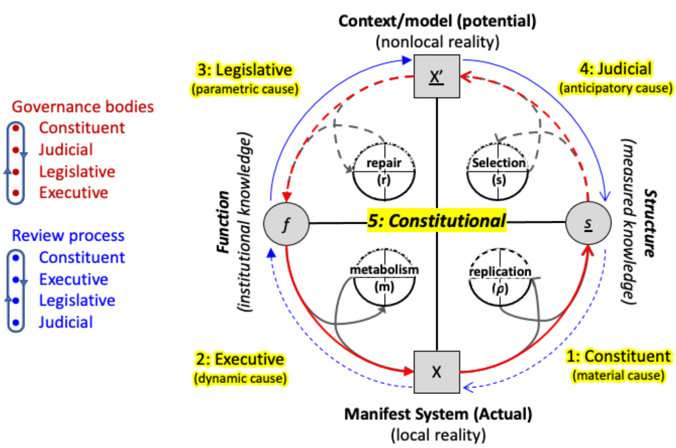


*Figure 7: Holon balance of powers (causes) in governance.*

The analogy with current post-truth paradigms that have arisen in political, social, scientific, and governance sectors should now be clear, as information, information systems, and systemic checks and balances are degraded, and ungrounded populism finds suitable hosts. In particular democratic governance systems depend on this same holon cycle of causes, or "powers" (**Fig. 7**). While it is not the case that human cultural agents of change are viruses, sophisticated life types including humans can mimic this parasitic or regenerative strategy. This may not be purposeful and is unlikely to be on the part of the agent but may be on the part of the host. Regeneration will still occur, but in the absence of a plan for it, it will be determined by larger systemic trends or host designs. This cycle of regeneration is well studied in the theory of "Panarchy", which describes cyclical regeneration that applies to both ecological and human systems (Gunderson & Holling, 2002). The viral strategic type explains the beginning phase of renewal in which such systems are dismembered or in the case of the origin of life, never existed at a stage when sustainable, commuting information relations had not yet become self-entailed organisms, but could nevertheless form from passive associations of the required functions in the environment.

While the true Protobiota cannot mimic other strategic types because it does not have the causal flexibility, the other types can mimic Protobiota. Thus, both Eukaryotes and Prokaryotes can have parasitic strategies they employ, which, until evolutionary balance is achieved again, tend to damage or break down a system. Panarchy implies that how systems reorganize, and in what form, is determined by greater contexts than anything the viral agent represents. In the case of mega-trends in human civilization, reorganization tends to follow a recognized four-stage pattern of descent from holonic balance, to physical dominance, to chaos, to symbolic dominance (our current age), then a return to holonic balance (Kineman, 2017). But in the initial stage, the strategy lacks its own balance of M-R functions and depends primarily on organized hosts that have their own agendas.

## Conclusion

This has been a brief tour of the basics of Relational Holon Theory. Greater depth can be found in the references cited. This synopsis has a very strong message for the evolution of civilization in current times. Both the cause of current trends and correction of the causal balance depends almost entirely on information integrity, without which a complex system must degrade to primitive processes.

Regeneration depends on extant information contexts at the time. Merely encouraging dissolution without a plan for regeneration leaves a system open to many possible paradigms. A viral agent, even a sophisticated mimic, generally depends on hosts and larger contexts for regeneration and has no viable plan at the outset. But the single most beneficial intervention that can be done during such dissolution is to preserve information integrity. 3,500 years ago, civilization in the Saraswati basin faced a similar crisis from climate change. The Yogi's and sages of the time understood that their sophisticated culture could only be preserved and rebuilt elsewhere if they preserved their knowledge ("Veda" in Sanskrit).

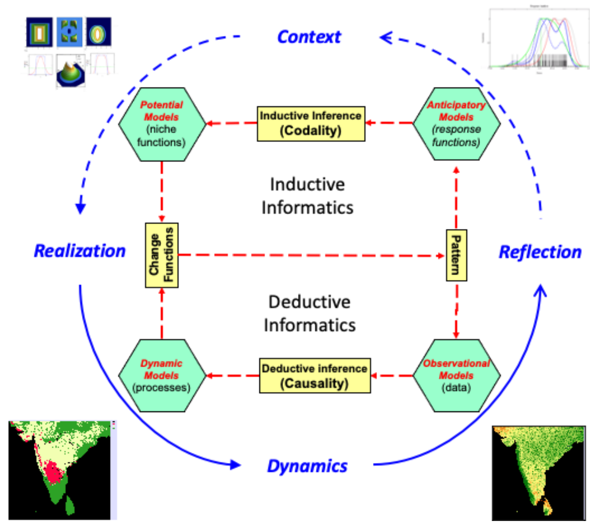


*Figure 8: Holon causality can be applied in the architecture of Artificial Intelligence systems to achieve greater alignment with nature's sustainable symmetry.*

It was at this time that Priests were trained to embody aspects of the Veda and the great spiritual folklore of India was transcribed from oral tradition to writing in poetic forms that would be hard to alter.

The vast knowledge we have today is at risk of being lost to another dark age. But we have the opportunity, as a result of recent theoretical and technological advances, to train artificial systems in aspects of that knowledge, and to create an unalterable archive of knowledge using holon principles.

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