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A SYSTEMS-BASED ARCHITECTURE/DESIGN FOR THE HUMAN SOCIAL SYSTEM

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Abstract. If we do a deep systems analysis of the global human social system (HSS), taken as a subsystem of the whole Earth ecosystem (the Ecos), we soon find major deviations from what we find in the governance and economics of natural complex adaptive (and evolvable) systems (CAES). Though most governments are roughly designed as hierarchies, the natural organizational structure of CAESs, the distribution of decision types is generally not what one finds in other systems. We examine the metabolism and physiology of living cells as a basic architecture of a socio-economic system, and extend this view to multicellular animals. We also examine supra-living systems such as species and ecosystems along with examples of organizations such as corporations wherein a specific architecture of hierarchical cybernetic governance is responsible for the stability, sustainability, resilience, and productivity of the system in which it operates. We suggest that the various governance models that have been tried out for the past ten thousand years have been experiments, most of which have failed, because they, rather than evolve as natural distributed hierarchies, have had human guess-work as well as some of the worst forms of human selfishness imposed on their designs. Humans started from ignorance of the nature of systems and so have made irrational choices in how governments are organized and operate. The main problem with almost all current governments is the establishment of top-down command and control hierarchies, good for militaries, perhaps, but not a way to establish and exploit the human being's natural tendency to cooperate for mutual benefit.

If we were to attempt to design an HSS socio-economic system based on what we have learned from the analysis of natural CAESs we would discover a completely different architecture that would support completely different dynamics. For example, as a first principle, in keeping with the fact that human beings are first-and-foremost biological entities, we would recognize the primacy of the family as the core system component. Reproduction is at the heart of a species' success. But reproduction has to be contained within the natural carrying capacity of the Ecos. We humans have managed to transcend the normal biological restraints on reproduction, which means we have to self-manage our populations. Thus, the governance architecture needs to maximally support the success of families, while maintaining a set of regulatory mechanisms that do not permit other subsystems from getting out of control and threatening the success of families. As things stand today we have an unfortunately excellent example of this out-of-control situation in the form of global warming and climate change. The future success of the human species is now in grave jeopardy owing to the unconstrained (ungoverned) expansion of the ability to obtain not-always good uses of power for our machines from fossil fuels. This is largely a result of the neoliberal notions of free markets and unregulated capitalism coupled with individual greed. The hierarchical cybernetic governance system (HCGS) that we propose as the basic architecture for the socio-economic system of the HSS puts the success of the family as the supreme good and organizes a structure around the aggregates of families that ensures the success of every individual's metabolism, physiology, and potential for self-actualization. The objective of such a system is not the production of material wealth per se, but of that wealth which supports the evolutionary success of families without jeopardizing the future of the Ecos.

Basically, we suggest that we need to throw out most of what we think we understand about economics, politics, and governance and adopt a more systems-based approach.

Keywords: systems science, governance, economics, agents, agency, archetypal models.

INTRODUCTION

Humanity is faced with some very difficult existential challenges and tough decisions to make. Global warming and climate change, the peaking of high-power fossil fuel energy sources, distressed fresh water supplies, degrading quality of soils, loss of species diversity in ecosystems, and general over-population and subsequent social dysfunctions, all of these stresses are building to a crescendo that cannot be ignored. And they are global in scope.

Which means that finding solutions will require a global perspective. And how should we seek solutions? First we recognize that the whole world is an extremely complex system, and that the human social system (HSS) is just a subsystem of the whole. I will use the term "Ecos" when referring to the whole; all of the geospheres, lithosphere, hydrosphere, atmosphere, and biosphere. We must apply a systems theory-based method of analysis to the whole. For example, it has become clear that the burning of fossil fuels has elevated the stock of CO_2 in the atmosphere and hydrosphere. That, in turn, is contributing to greenhouse gas warming and acidification of the oceans. It is the HSS economic subsystem that is responsible for the burning of fossil fuels, as humans pursue the creation of wealth by extracting resources from all of the geospheres, doing physical work on those resources to increase their utility (to people), and then dispose of the refuse without concern for the Ecos' ability to process and degrade and recycle them. It is one big system.

The HSS is an example of a complex, adaptive, and evolvable system (CAES). Evolvability is not the same as adaptivity. The latter is based on existing subsystems which are capable of modulating their functions to compensate for changes in environmental parameters to which they are already responsive. A prime example is homeostasis. An evolvable system, on the other hand, is capable of constructing new structures and functions in anticipation of the development of new threats or opportunities afforded by a changing environment. Genetic mutations that prove fit are the paradigm example, but a corporation creating a new division to produce a different product for a potential new market is also. The former is an accidental adaptation, whereas the latter is an intentional one.

Previous researchers have investigated the properties and behaviors of CAESs though under different rubrics, such as Viable Systems Theory [1], Living Systems Theory [2], biological energetics [3], and complexity [4]. The CAES provides an overarching or archetypical model of all complex systems such as ecosystems, species, and societies.

ARCHETYPE MODELS IN THE CAES FRAMEWORK

Within the framework of the CAES archetype we find three additional archetype models that comprise the architecture of the CAES. The first is the model of an adaptive agent, the decision maker in any cybernetic process. The second is an overarching governance architecture in which agents are embedded in maintaining regulation of the whole system. It is hierarchical in structure with each level operating on different time scales. This is comprised of low-level operational management of work processes, the standard feedback control loop but admitting some amount of feedforward information to implement cooperative networks. Mid-level decision processes are engaged in coordination between low-level processes when cooperation is not sufficient due to scale issues (e.g. communications delays between work processes in a supply chain lead to instabilities). There are actually two kinds of coordination governance processes. The first is tactical management or the coordination of resource extraction processes within the system of interest with external sources (e.g. mining operations in obtaining metal ores) and waste extrusion processes to external sinks (e.g. garbage dumps). Internal to the system of interest are logistical governance, which helps coordinate the activities of internal work processes to optimize production of products and services.

Lastly, at the top of the hierarchy are strategic management activities wherein agents monitor the external world as well as the internals of the system (through the tactical and logistical agents), produce a long-term set of goals and plans and give direction to the tactical and logistical agents for what work needs to be accomplished in the future. Strategic management is most applicable to intentional evolvable systems such as human organizations and societies. This archetype model constitutes a hierarchical cybernetic governance system (subsystem of a CAES) or HCGS.

Another archetype is of the *economics* of a CAES. Economics here means the regulation of the flows and uses of energy (to do work) and materials (to produce wealth). In the realm of living systems, from single cells to whole societies we find a hierarchy of organization of economies. In single cells the economy is called metabolism. Cells take in nutrients and oxygen and produce their own structure (autopoiesis) as well as subsidize the expansion of life through reproduction. In multicellular organisms the economy of the body is the physiology that includes ingesting foods, digestion to obtain fundamental resources (not unlike mining!) and inspiration to supply oxygen to the cells that make up the tissues and organs. Humans, in their societies (an ecosystem for social being) participate in what we call the economy, which is, in fact, a form of external physiology (termed exosomatic physiology). The economy is a system for managing the flows of energy and materials, doing work on input, high entropy materials, to fashion lower entropy (more useful) goods and services that support the biological and psychical needs of human organisms and families.

But the fundamental problem with the way in which the present human economy and governance subsystems have evolved is this. Being intentional evolvable systems, and given that humans started out (in the Paleolithic) as ignorant of any scientific knowledge of how the world actually worked humans asserted what I can only term their "best guess" on how to manage increasing social and cultural complexity (for example through the Agricultural Revolution). The result is the kinds of governance and economic systems we see today in various cultures. From the time of the earliest agriculturalist societies humans have been trying to design social systems that were fit to the environments they occupied. But the history of civilization collapses shows us that their intentional designs were flawed.

Enter general systems theory and systems science. We are now able to learn from the natural systems about the nature of agency, governance, and economics and use these archetypes to consider a more holistic human social system.

UNDERSTANDING FROM NATURALLY EVOLVED CAES THAT ARE FIT

We can glean from natural systems such as populations, species, and ecosystems the dynamics of evolutionary success or fitness. Several principles of CAES successes in nature include:

- Growth to a plateau and stability thereafter
- The hierarchical cybernetic architecture of governance
- Clarity of the decision agents' roles in the hierarchy (strategic, tactical, logistical, or operational)

We can add to this, the precautionary principle when it comes to novelty – invent and explore, of course, but don't rush to market with a new product until you grasp the long-term consequences.

The implications of a systems approach to social organization and economics for humans produces a quite different implication from the current rush to liberalism and neoliberal capitalism. The former asserts the freedom of the individual even in the face of what we now know about human sociality, that we are, as a species, eusocial. The latter makes excuses for selfishness and personal aggrandizement in the face of unbelievable income and wealth disparities. These ideologies ignore systems consequences completely.

Human beings are autonomous agents but wedded to social contexts so neither autocratic rule or libertarian forms of governance are going to work. The only means of governance for human societies is going to be found in the HCGS model.

A top-down deep analysis [5] of the HSS will reveal a "natural" organization of society as well as a natural governance and a natural economics. For example, as already applied, the systemic organization of social units involves the social organization of families (not necessarily strictly defined) into communities like bands and tribes (just as we evolved in the Pleistocene) which are part of a hierarchical organization of more complex polities. Families are "contained" in domiciles and are end-consumers of resources. The economy is organized to produce consumable and supporting assets (e.g. food and housing). The co-organization of political economies into states and empires has produced a wide variety of "experiments" in organizing the domiciles and means of production. Superimposed on the classical view of firms and households is a variety of institutional entities in which individuals participate at various times, such as schools, churches, etc. These too have evolved many varieties of forms and functions.

In all of these experiments in state and institutional organization, many eventually collapse in one way or another. From history we can see the kinds of instabilities and effects of complexity on the workings of the social and economic systems [6, 7, 8]. All suffered the same pattern of growth, expansion, over-consumption of natural resources, increasing complexity of processes (markets, governments, etc.) beyond returns on investment in complexity, and increasing brittleness making some or perhaps all vulnerable to disasters such as climate changes.

All of these various experiments in governance and economics are subject to natural selection in a manner not unlike applied to the evolution of species. In the human context much of the selection force comes from the very cultures that emerged from the social organizations themselves. But some of the selection force is due to natural events such as climate change that put extra stress on a society's capacity to adapt, e.g., drying climates may diminish food production and lead to malnutrition if not starvation. For the majority of human history, when such collapses occurred some portion of the affected population could migrate to more favorable locations. But today we are talking about the whole world as a single HSS. Collapse of the global social system would have no refuge to escape to.

From the numerous experiments we can also glean the systemic factors that lead to a negative selection outcome. In every case examined, if we match up the socio-political-economic structures against what we now understand about the archetypal models of agents/agency, HCGS, and economy, we find major discrepancies. This becomes especially glaring if we include in our analysis the deep historical evolution of societies themselves [9, 10, 11]. Starting with early humans in the Late Pleistocene, in hunter-gatherer family bands, through the advent of sedentary agriculture, and through the industrial revolution we find case after case of humans inventing social mechanisms that are likely well-intentioned with respect to governance and things like economic well-being, but are too often anti-systemic. And, of course, as societies became more complex and more productive of wealth surpluses (e.g. grains stored in granaries) [10] the human propensity to accumulate and take possession led to a breakdown in more egalitarian eusocial tendencies. It led to power hierarchies and the top-down command and control version of governance mentioned above.

MODEL-BASED DESIGN OF THE HSS

The deep systems analysis of the HSS, guided by the CAES model and its three subsidiary archetype models provides us with a basis for considering a redesign in light of our knowledge of what a stable, resilient, and sustainable subsystem of the whole Earth Ecos should be. In this section I will discuss a few representative aspects of governance and the economy to show that a systems science approach could, at least in principle, provide guidance for the design of such an HSS.

ECONOMICS

Several examples from the field of economics should suffice to demonstrate how far from a systemic design we currently have. These examples will not depend on specific political-economy models, i.e. differences between capitalism vs. socialism, as they are inherent to all economies.

Money

Money is a universal mechanism in all modern economies. Indeed, one specific currency, the American dollar, is widely used to price other sovereign currencies. The concept of money and how it is created and circulated has grown increasingly distant from its original role as the means of comparing values of disparate assets and facilitating transactions of trade. The way money is created by the banking system, through debt, is a major source of pathology in a world that is not seeing the growth of free energy (to do useful work) per capita. The latter is in decline due to the declining availability of fossil fuels coupled with the increasing costs of obtaining what remains in the ground over time – the energy return on energy invested (EROI) [12]. It takes free energy to create useful wealth (like food and housing) and in an era of declining per capita energy, the belief that in a future time we will have created enough surplus wealth to pay back the debt, along with interest as a service charge, is a delusion.

The amount of money in circulation should be tied to the availability of free energy to society. Money is part of a feedback control mechanism to regulate the flow of free energy to work processes that are deemed of value to society. Inflation is the result of there being more currency units in circulation than there is free energy to do economic work. Admittedly, the consequences of a policy of tying money to free energy, in an era of declining free energy per capita, implies deflationary conditions. Normally this would be considered a bad thing, but given that the consumption of products, and the work needed to produce those products is directly the result of using free energy (fossil fuels), a deflationary spiral is very likely what it will take to curb the burning of fossil fuels (or the high costs of those fuels will lead naturally to such a decline). Either way a decline in living standards is inevitable unless miraculously some form of alternative energy magically produces a compensating supply of free energy (and we can convert to all-electric work almost instantaneously).

Profit

In every other CAES in the Ecos, excess return on energy investment is stored in a stock that buffers the system against short-term downturns in flows of energy. These are "savings" and are used to smooth out the fluctuations in natural flows. With the advent of agriculture, humans learned how to increase the stocks beyond the normal buffering function. Excess stocks turned into "profits" that could be converted into other forms of wealth through trade and slave labor [10]. Attribute this to human ingenuity and the reorganization of social systems to manage the logistics of agriculture. Nevertheless, the subtle transition of stored wealth from a buffer to a treasure subverted the normal relationship between flows, stocks, and buffers for adaptation and resilience. Settled agriculturists, at least as long as the climate remained favorable, started to hoard commodities (energy) and trade these with nearby others for material goods that may have satisfied hedonistic desires, but were not always forms of true wealth (which is defined systemically as things which, through their use, increase the free energy available to the society, i.e., tools).

In the modern capitalist economies, profits have come to be associated with growth and "normal" returns on business enterprises. Now, capitalists "invest" in enterprises that promise to produce excessive returns on operations, which they will reap as a rightful payoff for taking risks with their wealth. Space does not permit a full analysis of this pathology, but the simple story is that profits and wealth accumulation were only possible during eras of increasing free energy per capita, as was the case during the industrial revolution through the 1970s. Toward the end of this era, the growth in per capita free energy started to decline and both economic growth and increases in productivity started to decline as a result [12]. The period from the late 1970s to the present are marked by declining wealth production overall but redistribution of what wealth is produced to create an ever widening gap between the rich and poor [13].

GOVERNANCE

The governments of numerous states, whether democratic, autocratic, or something in between, demonstrate the degree to which the human understanding of governance for stability, resilience, and sustainability is extremely flawed. Regardless of the prevailing governance philosophy of a state, the construction of a top-down governance hierarchy seems to be the norm. This is a holdover concept from early agricultural states where the emphasis was on the logistics of raising and preserving foodstuff along with distribution mechanisms to keep the workers able to work [10]. This is in high contrast to the way in which humans evolved to be cooperative organizations in which the higher levels of an HCGS (even tribes were organized in this fashion) existed to serve the facilitation of lower levels. That is, a coordinator, e.g. for a hunt, served to help the hunters be successful so that the whole tribe might benefit. Our modern, and very warped, view of hero hunters commanding others is not in accordance with the evidence gleaned from contemporary hunter-gatherer populations.

The agricultural revolution, as it played out independently in many areas of the planet, set up a selection pressure that favored top-down command and control with hierarchical power structures subverting cooperative networks. If you could pinpoint one place in the evolution of human consciousness as being the pivot from egalitarian to power hierarchies the agricultural revolution was probably it. Subsequent to that turning point, complex societal states with their class distinctions and morally reprehensible treatments came to dominate the HSS. It would take centuries before the concept of human enslavement for production labor would become appalling to many (but still not most).

This is where governance and economics intersect. Slave labor has been a feature of economic production since the earliest times of the agricultural revolution [10]. Even today, there are still parts of the world where human bondage is used to underlie the means of production of useful work.

Systems science and a better understanding of humans, psychologically, suggests an alternative scenario. It is conceivable that a more natural social organization, namely something similar to social organizations in the later Pleistocene era, might provide a more secure and supporting structure for the human psyche, and thus human behaviors.

The core of human social organization is the family and the aggregation of a few extended families into bands or tribes. Modern society is based on nuclear families isolated within islands of indifference. The number of psychological pathologies that this entails is legion. Social psychologists know what the problem is for modern humans (in western cultures) but are powerless against the causal influences of the neoclassical capitalistic economic model combined with the neoliberal rugged individualist concept that purport that anyone can attain the “American dream” of wealth and power. Nothing could be further from the psychical evolutionary normalcy of the human condition.

The advent of organized large-scale farming in emerging civilizations led to an emphasis on logistical decision-making being selected for. Some tactical decision-making was also needed in terms of protecting territory or capturing same from other neighboring emerging civilizations. Strategic thinking became much less important for the general populations, left to a few individuals in a top-down hierarchical organization.

Throughout the rest of the natural world, the HCGS is not a command and control system. Rather, higher order coordination agents exist to serve the needs of those coordinated and the purpose of the whole system.

AGENTS/AGENCY

The problem with humans as agents in either a governance or economic decision process is that each individual retains a hidden agenda that includes many covert socio-psychological motivations, such as fulfilling a need for esteem or dominance in a social hierarchy. In most cases in both governance and economic decision processes, the decision models to be applied, while they may involve some ambiguity or uncertainty, nevertheless are relatively direct in terms of moving the system toward a beneficial outcome. But it is when an individual asserts their own desires or needs into the process that we see a breakdown in a beneficial agency. One might easily conclude that we need to take humans out of the loop so but finding what to replace them with (a computer program?) is an interesting but complex question.

Some decision types can probably be automated and actually are even now. For example we know that computers can make reasonable stock exchange trading decisions much more rapidly than a day trader staring at a ticker tape. Supply chain management is another area (logistical as well as tactical) where automation has taken over a number of decision nodes. Research in the area of automated agency in operational, tactical, and logistical, at least in the management of firms, suggests that this trend will continue. It is much less certain that automated agency will be able to play a role in low-level and mid-level management of governments. Also it seems unlikely in the foreseeable future that automation will take over strategic decision making, so humans are likely to stay in the loop in that respect. But, that is exactly what humans evolved to be good at prior to the advent of agriculture (and later industrialization). So, perhaps, returning human agents to primarily focus on strategic decisions (for family, community, state, firm, institution, etc.) will reinstate the selection pressures that nudge human evolution to better capacities to think strategically.

Fortunately, there are systems approaches to designing structures and functions in which humans can operate as agents and the system not suffer the inherent limitations of human decision makers. Some of these approaches are well known and quite old. They are best described as watching the watchers and double-blind monitoring. Internal auditing is an example of second-order monitoring with feedback to check or correct judgment errors in decision agents. Of course, this assumes that the system in question has an established and routine mission and remains relatively stable in its operations over long periods of time. In other words, the system cannot be growing and/or developing by more than some low rate. It can be shown that when novelty is being introduced into an evolvable system sporadically, episodically, and perhaps chaotically, as when corporations decide to introduce new product lines to enhance their sales and profits (see above) without strong evidence that such introduction will have the intended results without unintended consequences, that disruption to normal routines can lead to failures to adequately audit and report.

CONCLUSIONS

We are on the threshold of developing a whole new way of organizing our existing knowledge, discovering new knowledge, and using that knowledge to design human-built systems, such as governments, organizations, and social systems [5]. The core idea is that of systems science or the study of systemness in all organized material structures (which includes social systems). The objective would be to use this approach to transform our more-or-less naturally evolved, but currently unfit HSS into one that could "play nice" with the rest of the Ecos. All CAESs embedded in higher order CAESs (e.g. a species embedded in an ecosystem) produce outputs, material and/or energy, which benefits other embedded CAESs. Even waste products of many systems are useful to other systems as resources. The same must be the case for the HSS as a subsystem of the Ecos. What should our product be? We humans along with our cyber-physical resources are information processors par excellent. That competence, using systems knowledge might make us excellent managers of the planet.

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