Human Life Innovation Symposium - Lecture 1

The Evolution of Man-Made Systems and Society

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What if Extraterrestrials were to Come to the Earth

E.coli, a kind of bacteria, is made up of some 5 thousand genes. It is said that among those genes, only about 300 are required to sustain life - which begs the question, what are all those other genes doing? Truth of the matter is, current biological science has yet to reveal the answer.

Regarding "evolution," let me tell you this hypothetical story. What if extraterrestrials were to come to the earth after humanity had become extinct and look at the automobiles we drive today. The parts and structures necessary for transport would comprise only a fraction of what would be found in these cars. So, would they be able to understand for what purposes all those other parts and subsystems exist? Likewise, let's say that extraterrestrials were to unearth the law book. Maybe they would be able to understand the Constitution, but would probably have a difficult time making heads or tails of the voluminous amount of other complicated laws and regulations, and their significance. These situations are actually the same as that between us and our intestinal dweller, E.coli.

Whether it is modern automobiles or laws we talk about, one thing is certain, that these are systems that have evolved over a long period of time. And they now continue to evolve in their complexity, enormity and diversity. Just as with the living organism, in order to understand the evolution of man-made systems and society, it is first necessary to know the environments in which they exist, the needs they meet, the functions they offer, the histories behind them, as well as the manner in which these systems integrate with each other.

Limitations of Current System Design

The goal of every system's evolution, I suggest, is robustness - the sturdiness and flexibility to accommodate itself to changes in its condition as well as to withstand a reasonable amount of disturbance. However, giving robustness to the systems we currently design is not an easy task. Systems become more complicated because various and diverse functions are needed for them. As a result, they become more difficult to control and potentially vulnerable to catastrophic collapse. Massive power grid blackouts, as well as the Challenger accident, are examples of such weakness.

System design until now has been "knowledge-intensive," or in other words, all imaginable parameters and scenarios are prescribed. When the system is faced with something unexpected, it becomes occasionally unable to cope with it. So when something happens, fixes are put in patchwork after-the-fact fashion making the system more and more complicated. I believe that the large-scale software applications of today, for instance, are reaching a kind of a limit in such a way.

What New System Design should Be Like

From now on forward, we need to consider not only a system's functions, but also the sustainability and resiliency of those functions. As with a living entity, we aim at the realization of evolving systems which allow us to do without all knowledge, tolerate mistakes, protect against attacks and risks with ample defenses, and learn the knowledge that it gains along the way. What this calls for is the new technology that gives a system the capabilities to design, create and repair itself, and meet the demands of a changing environment.

It will become necessary to further research the principle of organization as applied to a broad range of fields from man-made systems to society in general, as well as how networks are formed in such systems. We must clarify what are the systemic principles of robustness, how spatial structures, redundancies and hierarchies contribute to this, what is sacrificed in return, and finally, how we can reach the point where this is all attainable. I think the current status of the Internet which has grown autonomously may be a good reference to draw upon.

Also, we must investigate the conditions and environments where such systems can fully function to install and improve the necessary social institutions.

Mindset Worthy of the 21st Century

The mindset of post-modern humanity has been that of analyzing, theorizing and sorting out the issues. Science technology has also these same values in common. It has resulted in the "today" we all live in. And, at the same time, we are seeing its limitations being exposed. That is why we need a new mindset that is worthy of the 21st century; creating, nurturing, and solving problems. At this juncture, with this mindset, we must rise to the challenge of new social systems, new technologies and new institutional designs that are evolving with ever increasing complexity.