Law of *Increasing Intelligence* of Technical Systems

Navneet Bhushan
Crafitti Consulting Pvt Ltd, (www.crafitti.com)
Emails: navneet.bhushan@crafitti.com,
1B-401, Akme Harmony,Sarjapur Outer Ring Road,
Bangalore 560037, INDIA

Introduction

Despite its discovery by Darwin, 150 years back, acceptance of *evolution by natural selection* as a possible model of explanation of progress of cosmos is relatively a recent phenomenon. One of the earlier recognition of evolution due to ingenuity of human mind reflected in the successful inventions described in patents and technological knowledge was discovered and explained by the Theory of Inventive Problem Solving (TRIZ). This resulted in discovery of laws of evolution of technical systems which became the basis of classical TRIZ. The *purpose* of evolution of technical systems was to achieve the "Ideal system". Technical systems exist or are created to perform a function. The ideal technical system describes the fulfillment of the function with reduction in number of the elements of technical system that actuates the function. TRIZ and its laws of evolution of technical systems discovered in the *era of physical systems – the era of machines* – explained the fulfillment of function in an ideal way.

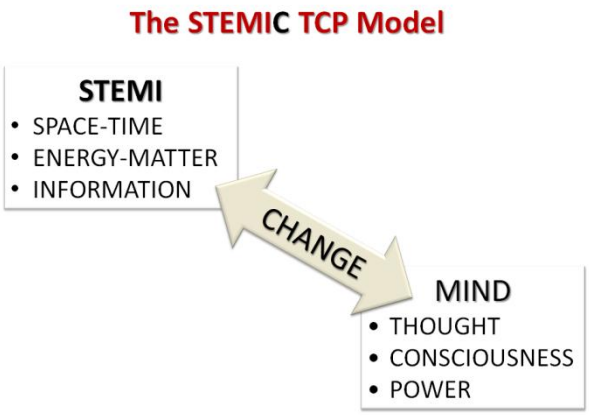
2. Three Eras – Machine, Information and Mind

From the era of machines – dominated by automobile – which incidentally became the model for classical TRIZ – we are rapidly moving in the *era of information.* Our understanding of "information" – its nature and its deeper manifestations – is increasing day by day. When we started investigating the applicability of laws of system evolution as described by TRIZ in *the current era of information*, we realized that TRIZ, *understandably* missed the key ingredient, i.e., information, embedded in modern technical systems.

We discovered that human beings by collectively evolving their technical systems, are trying to make each technical system as close to a human being as possible – or at least a model of human being and its environment based on the current understanding of the world *(for example, understanding of laws of physics and chemistry in making an automobile)* and the current understanding of the system called the human being. As man understands the world around it as well as its body and its mind, it wants to create an "ideal man" or at least an idealized human of all technical systems it is creating. *This is an unexpected discovery and may take the readers used to classical TRIZ, sometime to accept it.*

2.1 STEMIC-TCP Model

We propose in this paper, technical systems emerged due to increasing understanding of two key fundamentals of universe and their interactions – these are *Space-Time* and *Energy-Mass (we call these two fundamentals as STEM)*. *Every technical system in the physical era/machine era is a reflection of organization and reorganization in higher and higher order structures of mass-energy organized in space-time.* We propose, based on our recent and deeper understanding of "information", that information itself is one of the fundamentals just like space-time and mass-energy. We need to understand the concept of ideal system in the light of this proposal of making information itself as fundamental. This increases the complexity of technical systems, however, with three fundamentals – space-time, energy-matter and information – we get new lens to view the evolution of technical systems.



First fundamental is Space-Time which integrates space and time. Space and time were considered two separate fundamentals but modern physics integrated them as space-time. Space and Time Make up the Physics of the *Seen* while Space-Time the physics of the very tiny and very large. *The second fundamental is Energy-Matter.* If one look at the world around us, the universe itself, is an organization of Energy-Matter in Space-Time. The systems thinkers have talked about Matter, Energy and Information. If we look at the basic building blocks of universe we have Space and Time (Space-time), Energy and Matter (Energy-Matter), and *Information*. It is information that organizes matter and energy in Space-time. We call these the STEMI. The STEMI can organize or change its organization on its own based on principle of maximum entropy or *can be orchestrated* by Thought and Consciousness, i.e., the *Mind* of the "Matter" - the artificial. The ability to reorganize matter and energy in space-time using information is the ability of the Man. This requires Thought and Consciousness. This is the fourth fundamental which we call *Mind*. The ability to create these changes in matter and energy to organize into structures, we call, the Power. Hence the mind has Thoughts, Consciousness and hence Power (the TCP). The orchestrated changes in STEMI and changes in TCP due to observations from STEMI are driving the world towards increasing capability, evolution and design.

At the basic level of this framework lies a conceptual construct called a *System*. When we talk about definition of a System - from fundamental principles point of view – a System can be defined as a set of elements (Energy-Matter organized in Space-Time) working together (exchanging energy and/or information) and with the environment to achieve an objective or perform a function (create Change - in matter, energy and information in space-time). When the system is achieved/changed by thought and consciousness we make *systems artificial.* The ability to create and control CHANGE is Power. We call this the STEMIC TCP Model. Hence we need to leverage the new methods in the light of these four fundamentals.

2.2 Era of Information to Era of Mind

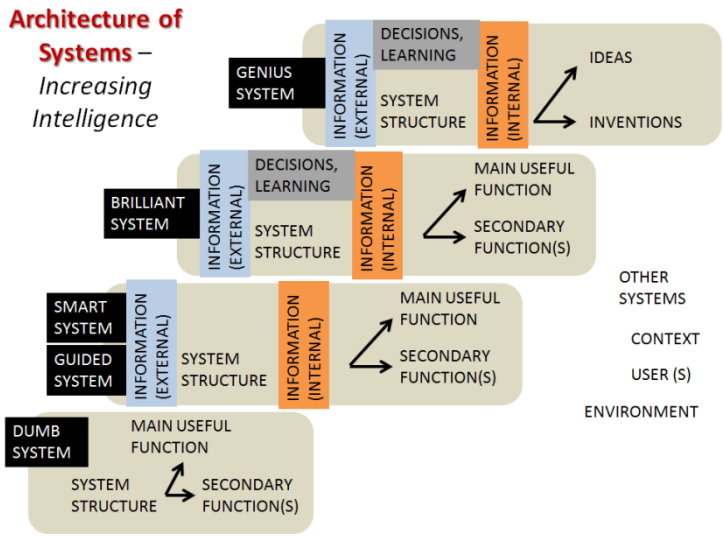
When we started embedding information in the technical systems, the machine era gave way to information era. The more we understand information and a related capability to process it, i.e., computing – the more we are embedding it in the physical systems. In the era of information, *technical systems started becoming "smart" and "brilliant" – the adjectives usually reserved for predominantly human faculty, i.e., intelligence.* Further, as we understand and realize the era of information which emerged under the shadow of era of machines – we need to see how the integration of third fundamental – that is *information* – to STEM making it STEMI – is impacting the evolution of technical systems.

Information is rapidly becoming all pervasive, all embedded, and all penetrated. We realize the ideal technical system today, not only need to perform certain pre-defined functions, but also process information for example, to choose the function it needs to perform at a particular moment. In fact, system should behave as an information processing system before they actually perform their physical functions in reorganizing/manipulating STEM. The STEMI interactions in technical systems, indeed has made the modern systems closer to human beings in their ability to process information, to create, re-organize, self-organize into new structures, control and manage precision of physical effects.

Further, we realize, since we have what some observers describe as the law of accelerating future, the fourth fundamental, i.e., *mind*, will be integrated into technical systems sooner than later. Even though information era is still continuing, with the STEMI integration, we have already started a deeper quest into the emergent phenomenon of complexity called the mind. The mind is now being thought of to be reflected in our future technical systems. We

believe, when we integrate the ability to process thoughts and in fact create "inventive" technical systems, we will enter the era of Genius Systems.

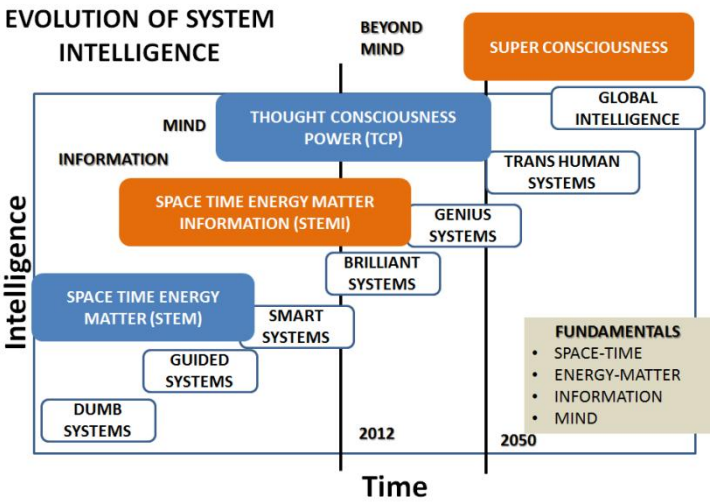
In an influencing work, "The singularity is near", Ray Kurzweil, defined why some futurists predict that non-biological intelligence will exceed biological intelligence by 2050 AD or so. We will enter the era of mind and beyond with *Genius Systems* giving way to *Trans-Human Intelligence Systems* (THIS). In the era of mind, the ideality will be defined in creating "perfect ideas" by the genius systems/trans-human intelligent systems – they may turn out to be "inventive Mr. Spocks" or "uncontrolled Frankenstein's". It is also a question for future, just as the key question to answer for us is why nature in its evolution missed "the wheel" but did not miss "opposable thumb".



The "natural selection" articulated and sold incorrectly as "survival of the fittest" has created immense problems in our history. Evolution, in fact, doesn't support it. Nature prefers to retain as much variety as possible. The evolution progresses by "elimination of the weakest". This is visible in evolution of technical systems as well. Technical systems however, have been chosen/developed/progressed through investment of immense material and intellectual resources of humanity. The evolution of technical systems in the STEMI era – driven by faulty "survival of the fittest" guidance, has created extreme competition in men, societies, countries and civilizations to control evolution. Whether it was designed by nature to speed-up evolution or was an innocent error of nature? The arguments can be created with same passion and logic by the proponents of the counter model to evolution, i.e., the intelligent design of the universe, vis-à-vis the evolutionary model. Yet Genetic algorithms, cellular automata and game of life in 1970s and 1990s showed us that "self-reproducing" systems are a reality and we can discover the laws/principles underlying these systems. We need to reach specific level of complexity to be able to "self-reproduce" besides achieving other emergent properties of complex systems. The argument is strengthened by the emergent of mind in due to complexity of brain.

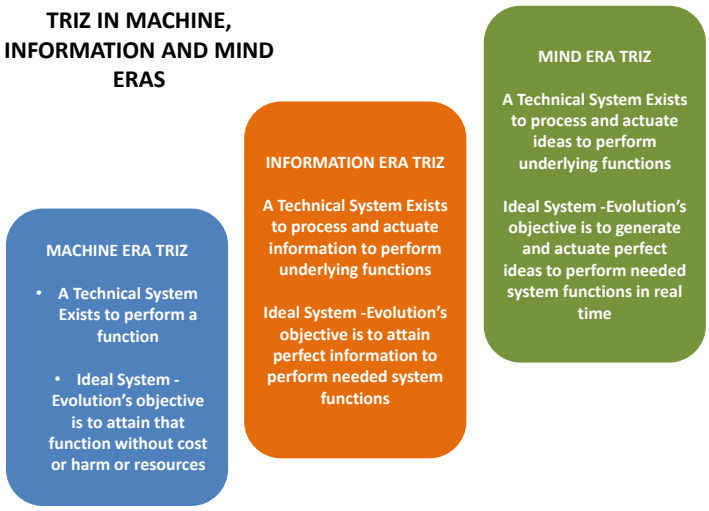
3. Increasing Intelligence of Technical Systems

Given our understanding of the current information era and how technical systems are evolving from their predominantly physical characteristics into information enriched technical systems, we propose in this paper a new law – *the law of increasing intelligence of technical systems.*



We are in the era of information today. This is an era that has replaced the era of machines that started with industrial revolution. This era of information is giving us systems that are becoming increasingly *intelligent*. From the *dumb systems* that were responding to inputs to perform specific functions, we have evolved to *guided systems* and *smart systems* of the information era. The next stage of evolution of technical systems is increasingly becoming clear

as we are seeing emergence of *brilliant systems* which we predict will become *genius systems*. By 2050 AD, the world will have technical systems with more intelligence than biological intelligence – predicted as the *Singularity*. From information era we are now entering rapidly into the era of mind. This we call as *law of increasing intelligence of technical systems.*



In the current Information Era, TRIZ needs to update its definition of a technical system to include "information". The goal of system evolution should be to create ideal systems that attain perfect information to actualize the underlying system functions.

In the emerging era of Mind, TRIZ should be about ideas and thoughts. How can any technical system process and actuate ideas? The ideal technical system will be able to generate and actuate perfect ideas to attain system functions needed in real time or even ahead of time.

4. Further Work

In this paper, we have proposed a new law of evolution of technical systems. We call this the Law of Increasing Intelligence of Technical systems. We further propose that TRIZ should incorporate this new law to the existing laws of evolution of technical systems as the current information era and future mind era of technical systems will require new ways and concepts to invent systems that current have the new fundamental of information and in future will have the fourth fundamental we call the mind as their most prominent components. This is an initial concept paper and we look forward to developing these initial concepts to solve new and emerging problems and also expand TRIZ for the new world.

About the Author

Navneet Bhushan (Navneet) is a founder director of CRAFITTI CONSULTING (www.crafitti.com) – an innovation consulting and research firm focused on co-crafting innovation in global enterprises. He is the principal author of Strategic Decision Making- Applying the Analytic Hierarchy Process published by Springer-Verlag, UK, as part of the Decision Engineering Series. Navneet Blogs at http://innovationcrafting.blogspot.com. He can be contacted at navneet(dot)bhushan(at) crafitti(dot)com. Currently he is working on his new book titled Crafting New Choices.

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