Systems Science: is it necessary? *

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Abstract

Around twenty years ago apparently due to the proliferation of diverse systems approaches, which had been conceived during the assumed evolvement of a generalized **systems movement**, it was considered necessary to organize the emergence of **Systems Science**. The proliferation of various basic conceptual hypothesis, mathematical techniques, computational procedures, logic-al networks among several other tools together with the diversity of aims, types of systems and organizations was considered normal, necessary and useful. It was accepted de facto that every approach was related to a particular perspective needed for grasping better certain aspects of the reality. However, until today it has been disregarded that the **systems movement** emerged from **holistic** realms, **analytical** concerns and **technocratic** advances; three domains whose aims and procedures must be purposely and harmoniously integrated as basic elements of whatever might become the assumed **Systems Science**. It is a huge puzzle to deal with, and it is also an unavoidable challenge that may and even should encourage systems researchers and practitioners to confirm their capabilities.

Systems Thinking

The **systems movement** emerged explicitly in the 1950s from two different courses of theoretical assumptions and practical experiences related to the concept of **system** as a physical or biological entity or as an intellectual arrangement of human labor & actions and man-made facilities. Each system being maintained as a whole, thanks to the way its parts are interrelated. These systemic streams were the **analytical** one - the culmination of the traditional scientific approach derived from the *metodo resolutivo*, successfully introduced by Galileo Galilei (seventeenth century) - and the **holistic** one derived from the self-organizing features inherent to the open system. A conceptual tool that Ludwig von Bertalanffy used in his research on biological subjects (in the 1930s) and consolidated afterwards in his psychological and social studies.

The **analytical** approach aims at identifying first the elements that presumably may or will or should constitute an intended system. The **holistic** approach aims at recognizing first the system as a particular wholeness and at identifying its elements afterwards.

The **analytical** avenue necessarily emerged for replacing ancient holistic assumptions that were considered secret and practically inaccessible to human mind. There were beliefs that had originated in metaphysical and mystical interpretations of what seemed to be the organizing forces of the universe. But, what humans, along millennia, could only see as a mysterious organization was replaced by simplified sets of mechanized arrangements, which could not be at all regrettable because it was a necessary change conceived more than 5 centuries ago. In those years that replacement was a further step given in the right direction, which some humans keep always searching, though not consciously enough.

It happened during the first half of the twentieth century when several and certainly new **holistic** views inevitably emerged in the mind of numerous scientists and philosophers: Alfred North Whitehead, Jan Smuts, A. Angyal, R. Buckminster Fuller among other. However, it was the thinking of Ludwig von Bertalanffy (1950) what consolidated the objective basis of the holistic approach needed for scientific research when he related it conceptually to the functional features of the living organism seen as an open system. It was an approach that unavoidably emerged in

agreement with **gestalt** psychology, which has helped to discover alternative ways of creating the **Gestalten** properties that must characterize the organization of every societal system. It was altogether the recognition that humans perceive patterns of configurations rather than sums of sensations.

However, soon since the very beginning, a third course, the **technocratic** one, was incorporated in the **systems movement**; certainly because it was an activity concerned with the operation of devices integrated with parts connected among them or the result of processes purposely organized. These devices were composed by set of parts and sequences of actions that altogether in each case could be identified as one or another system designed for accomplishing better a particular human task. It has been a stream engendered and maintained by the enormous fascination that in many human minds provokes the results of technological work and methodological efforts. Work and efforts that have aimed since the second half of nineteenth century at increasing the speed of **transportation**, **telecommunications** and later also of the kind of **data processing** which has impelled the development of a generalized automation, supported by a charming artificial intelligence. Many innovations have been carried out for making more efficient these three approaches when dealing scientifically and technologically with such a kind of concerns.

The use of cybernetics since the 1940s, helping to introduce self-regulatory possibilities in the operation of technological devices, definitely consolidate the incorporation and acceptance of the technocratic course in the **systems movement**. Unfortunately many technological and methodological innovations have been badly deviated to activities exclusively organized for the sake of making business more profitable.

In practice, since the 1950s (after the constitution of the Society for the Advancement of General Systems Theory in December 1954, which three years later, changed its name to Society for General Systems Research) each one of these courses has been independently developed. Scientists, researchers, technologists, engineers, managers, psychologists and economists who have accepted that **system** is a useful concept when dealing with specific questions related to quite different human concerns, have been sharing a common vocabulary. However in practice the meaning of some basic words, statements and explanatory arguments is different and sometimes even contradictory, but many practitioners and even researchers are only partially aware of this difficulty. **Systems thinking**, as a conceptual domain, is one expression of such a kind. It seems not only convenient but necessary to examine again and again why and how conflicting interpretations arise and to examine how to eliminate them. This paper is a modest contribution.

The Analytical stream

This course arose from the scientific method that has been used during the last centuries for organizing the industrialization of more and more human concerns. It became an essential factor in the systems movement as a result of advances attained through the application of **operational research** techniques (linear and dynamic programming, queuing theory,...) that were invented during the 2nd World War for increasing the efficiency of actions carried out by **systems**. Due to their success in reaching goals delineated in advanced these systems were designed and built for the operation of factories and the administration of activities in all kind of enterprises and public services. Each of these systems is composed by workers employed for dealing with specific tasks that must be carried out according to certain order and sequence – determined in advance - in order to assure the proper organization, arrangement and even manipulation of well identified concerns. To attain results previously conceived as feasible ones is a task that cannot be optimally organized. Many difficulties arise, due mainly to the unexpected consequences that may provoke the

spontaneity of every individual involved. Every human cannot avoid to be culturally biased according to familiar, communal, local, ethnical and national circumstances. The individual interests and motivations become the source of numerous discrepancies.

In recent years it has become more usual to create systems that aim at taking advantage quicker and more effectively of the resources available, using more efficiently the labor carried out by persons exclusively performing as human resources. These systems also aim at providing goods or services to other humans who must exclusively behave as buyers, consumers, customers or patients. Needs of most people involved are usually not even identified, as the goal is to assure the successful operation of every system. The social and economic impact of several successful systems cannot automatically altogether contribute to effectively push ahead the development of human species.

Under the influence of engineers' experience the systems thinking needed for this kind of concerns, has rather paradoxically evolved as if it were one or another specialized discipline. **Systems Engineering** has been strongly and diversely supported by all kinds of analytical (traditional) procedures in order to increase the number of technological facilities in every society. **Systems Analysis** has widely and wildly determined the successful acceptance of **Systems Management**, which seems to be employed diversely, though in fact it is almost always restricted to selfish aims, against or simply disregarding and even ignoring values, needs and motivations of the vast majority of people. The main goal of these systems is to assure the successful manifestation of business for the sake of **monetary profits** and **financial benefits**, which are systematically announced as the **unique way** towards the **progress** of every human society. Along the last decades very few analysts, managers and engineers have recognized that these systems should not disrupt inconveniently the biosphere, neither disturbed the ecosphere .

However, the undeniable advances (?) in systems analysis have definitely determined the kind of education and training needed for the formation of human resources. In fact these two actions are systematically restructured and continuously reorganized for determining how to **civilize** every human being - for helping everyone to identify as best as possible his or her role in every society. The main result of this kind of civilizing process is regrettable. A certain number of apparently lucky people, after being civilized, will know what they should do in order to become efficient human resources; for being employed from time to time as workers or employees who are placed in one of the constituted hierarchical levels. Many highly educated humans, who belong de facto to these resources, are in charge of scientific and technological research needed for continuously improving the civilizing trends, though they are clearly questionable.

At the same time the masses are induced, persuaded, influenced, impelled, compelled,... to become buyers of all kinds of things produced by the industrial apparatus constituted by systematically modernized systems needed for further exploitation of natural and human resources. The things produced are finally sold by means of **clever** marketing procedures. The situation at present, all over the world, is nearly catastrophic, though the taste of the near crisis is different in the **rich** but unfairly exploited developing countries inhabited by poor people than it is in the G8 countries. Meanwhile many systems analysts and systems engineers continue arguing, louder or quietly, that this is the **unique civilized option**.

Altogether this situation is the outcome of economic policies that are continuously redesigned for maintaining billions of people subordinated to the decision making conceived and instrumented in accordance with the élites' interpretation of what civilization ought to be. Systems management and systems engineering are based on the **Bottom ==> Up** growing effort (It is described and commented below) that aims at increasing the availability of all kinds of assumed resources for maintaining the trends of civilization. This endeavor comprises the continuous and systematized:

- search of new ways of making available hidden resources.
- exploitation of all resources available.

As a whole this endeavor demagogically aims at organizing the growth and expansion of industrial and financial interests carried out by larger and more complex systems in the **name of progress for the human society**.

The Technocratic stream

This course has been consolidated by the insertion of **Technological Cybernetics** in multifarious industrial, economic, and administrative areas where it was considered indispensable to create, build, and maintain automatic devices and processes for increasing their efficiency and effectiveness. These technological advances have also been employed for supervising and controlling the performance of workers and even for reducing the number of workers in order to reduce the production costs. In recent years, many more technological innovations and particular advancements in Information and Communication Technology (ICT), in the **delight** of Artificial Intelligence (AI) and in other subjects supported by increasing interactions between software methodology and hardware engineering have become the stimulating **engine of post-modernization**. It aims at modernizing everything and is announced as the only way humans may progress. But day after day wealthy people become wealthier while poor people have no other choice than a miserable way of life if they are lucky enough.

In fact one of the main drives of this engine is the increasing fascination - in the mind of many researchers, experts, scholars, consultants, and also practitioners (engineers, economists, sociologists); and in the brain of most users as well - caused by the unbelievable operation of recent technological advances. However, what is really the main drive of an ultra modernization of societal systems is the voracious eagerness of those few humans – the decision-makers - who manage the affairs of every big corporation for increasing ad infinitum monetary profits and financial benefits needed for further investments.

Fortunately (!) it is always in the name of humanity.

Unfortunately, willingly or not, what today deteriorates very quickly the perspective of the human society are those attitudes of the same decision-makers who disregard the need of creating societal circumstances for helping and encouraging billions of human brains to creatively develop their intelligent capabilities. Instead of being recognized the need of increasing the responsible potentiality of individuals in every community more humans are continuously put aside from every set up societal system. Evidently their work is: less efficient, barely reliable and poorly effective; when it is compared to the operation of new machines that have been designed for a generalized automation. Besides workers and employees are always asking for higher wages and salaries, lesser working days and a shorter working day. Machines instead never complain when they are substituted while unemployed people always protest refusing to comprehend that there are times when more jobs cannot be created.

Therefore what is urgently necessary for making happy the human society is to create the needed circumstances that may help to properly maintain the dynamics of new features of the homosphere peopled today by more than 6 billion humans. The radical suggestions proposed are: to accelerate the upgrading of every technological possibility and to maintain under control – by means of behavioral engineering – the people employed and also those who unfortunately but necessarily must accept to be put aside.

Bertalanffy denounced that the growing **robotomorphism** and **zoomorphism** would cause the **decerebralization** of human minds and the dehumanization of human beings. Instead of being worried about these facts, it would be better to create soon the circumstances needed to put into practice the **final anthropic principle**, which is based in the "strong artificial intelligence in intelligent, non-carbon-based, self-reproducing entities".[Rohman, 1999] that will populated the planet after the death of the sun.

The Holistic stream

This course is derived from the **Bertalanffy's Systems Thinking (BST)**, which is the approach that may reveal the **Gestalten** properties that characterize the higher levels of organization, the so-called **living systems**. These properties are common to all living matter from bacteria to human societies. Living systems, whether individuals or populations, have to be analyzed as **open systems**: open to matter-energy exchanges with an environment.

BST is basically a way of dealing with the numerous variables related with the various factors involved in the manifestation of a particular open system. It is used for tackling one or several aspects of the problem that unavoidably arises as soon as the system cannot maintain its steady state when exchanging matter, energy and/or information with other systems located in its surroundings. **BST** helps to search out what the causality of the disruption could be and to find out how the disrupted system may become functional again, reducing or eliminating what caused the disruption. **BST** is the ideological framework needed for organizing an indispensable research about the way of reestablishing the flow equilibrium in every disrupted system.

Today it is urgently needed first of all to recognize the validity of suggestions and warnings expressed by Bertalanffy more than three decades ago. It is also necessary to examine how his ideological thinking may be developed for facing properly, at present, the effects of the dynamics of the whole civilizing venture. Knowing that the number of people continue increasing while the terrestrial nature continue being unilaterally reduced by means of generalized exploitation, makes indeed indispensable to create societal systems that may encourage a growing cooperation among people, and also between people and all the other living beings.

Bertalanffy in the 1960s made a call for a universal declaration of interdependence and advocated a new global morality: "an ethos which does not center on individual good and individual value alone, but on the adaptation of mankind as a global system, to his new environment".

In 1968 he wrote: "The image of man is not only a theoretical question, it is a question of the preservation of man as human." He believed humanity faces a clear and present danger of being dehumanized even destroyed, by debasing self-images.

He feared that "a self-image portraying the human being as just another animal would tend to make us indifferent to social inequities and to make us fatalistic about the recurrence of war. He was concerned that the mechanistic image of man would encourage people in all walks of life to treat their fellow human being as assembly-line object to be manipulated rather than as a unique individual to be treated with respect."

In 1969 F. E. Emery recognized that biological and social phenomena should not any longer be examined by means of the traditional scientific analysis. It is indeed disastrous that this practice is what prevails in 2002.

The civilization at the dawn of the 3rd millennium has become an efficient source of the worst crisis ever faced by humankind, which has become an endangered species due to intelligent performances supported by narrow minded and shortsighted attitudes. It is quite contradictory and increasingly dangerous to continue discovering and encouraging administrative talent and producing technological innovations for improving the functionality of administrative, economic, industrial systems and the operation of technological systems designed as recipes for making **sustainable** the **unsustainable** civilizing trends.

May still the systems movement contribute to overcome this crisis? Yes, indeed if and only if researchers, scholars & experts accept to develop the Bertalanffy's suggestion:

Systems Thinking globally engaged based on
ethical, ethological, biological and ecological criteria

The Top ==> Down holistic endeavor

"All the world over and at all times there have been practical men, absorbed in **'irreducible and stubborn facts'**. All the world over and at all times there have been men of philosophic temperament who have been absorbed in the weaving of general principles. It is this union of passionate interest in the detailed facts with equal devotion to abstract generalization, which forms the novelty in our present society. Previously it had appeared sporadically and as if by chance. This balance of mind has now become part of the tradition, which infects cultivated thought. It is the salt which keeps life sweet. The main business of universities is to transmit this tradition as a widespread inheritance from generation to generation" (Whitehead 1925)

Bertalanffy's work is an example of such a balance of mind. Every human must search ways to systematically improve his or her respective individual performance engaged in grasping what the **order of Nature** is and how this order could be **maintained in flow equilibrium** knowing that this order is continuously disrupted by greater human demands. However, everybody must recognize that everyone will **judge differently** every disruption because he or she has always a very personal view about the way of restoring the order.

In the 1920s Ludwig von Bertalanffy started to write *Modern Theories of Development*, based on his knowledge of facts unavoidably happening in living beings. His intellectual efforts were based on an extensive use of **open system** (#), as an essential concept in the theoretical generalization that helps to comprehend how stubborn facts are ordered and how new facts can be created in order to harmoniously modify the required order. This generalization culminated in the Bertalanffian **Systems Thinking**: TOP ==> DOWN approach as a holistic endeavor that emerged as a methodological concern and evolved as General Systems Theory.

This BST aims at identifying the **'forest'** in order to search and deal consistently afterwards with one **'tree'** or another, while learning to be increasingly aware of what the survival needs of the forest - seen as an open system – would be.

This holistic approach must later be confronted to grasp how the interactions among the town, the forest and the lake evolve altogether. Subsequently another holistic endeavor would aim at searching options to ameliorate the urban perspective, bearing in mind the need of maintaining suitable interrelations among the factors involved. What is needed is to assure the maintenance of a steady state of the whole set of dynamical features that characterize the peculiar manifestation of

natural circumstances and the particular social conditions that had been previously conceived and implemented.

The use of a holistic endeavor for dealing with most human concerns does not certainly need to take into account the situation of the whole cosmos. Most human affairs can be properly attended through holistic views of the familiar and/or communal surroundings

Human mind, after many millennia of hard development, still seems to maintain its inherent capabilities; those that allow any human to determine the boundaries of the questions he or she desires to deal with. Every individual can determine on his or her own – inevitably in accordance with personal motivations and specific interests - the holistic endeavor needed for dealing consistently with any particular leaf, flower or fruit of that **'tree'.** It is always conventional the wholeness whose self-organizing possibilities should be preserved, in order to assure that it may function properly for **maintaining** the **steady state** of the same whole. Such possibilities allow every individual either to be open-minded, broadminded or high-minded or to become a bloody-minded or a narrow-minded or a simple-minded fellow who restricts purposefully his or her performance. Nowadays it is frankly paradoxical that many human interests remain restricted, despite the globalizing perspective that technological advances have made feasible. Human concerns seem to be more and more conditioned by an immediate utilitarianism, a myopic opportunism, a blind selfishness, a rapacious voracity that aims, in each case, at unilaterally taking advantage of everything, being comprised the members of most living species and also the labor and situation of most humans.

Consequently it can be claimed that every human must keep learning:

* To perceive better what is happening around him or her.
* To interpret better the information perceived by him or her
* To interpret better the information provided by many other humans.
* To infer from the knowledge acquired through always biased interpretations, what the global order might be.
* To become globally minded.

Similarly, it is the way a human manages to grasp the information that arrives to his or her brain what may motivate him or her to be **humanely concerned** when performing, while learning on his or her own – necessarily under the influence of various interpretations - to **enlighten** himself or herself. In this context to enlighten someone would mean to find out how to contribute to maintain in flow-equilibrium the planetary conditions that have made and continue making possible the presence of life on Earth. Humans must indeed recognize that some evolutionary forces (though several of them will remain unknown forever) contribute significantly to increase the survival chances of the human species.

The TOP ==> DOWN holistic endeavor is the conceptual possibility that has been exerted very diversely by humans who searched how to survive while learning:

° To hunt and gather better and better during their nomadic life;
° To organize their concerns in increasingly urbanized (civilized ?) environments.

It is this kind of holistic endeavor what may help the human mind to be conscious enough about the factors that may and should be taken into account when pushing ahead the development of human potentiality. It is a question that humans may learn – through practical experiences supported by theoretical assumptions – till finding out gradually how to consistently develop it, bearing in mind that the natural circumstances (all along many millennia) did not motivate neither allow the nomadic humans to be more than locally minded.

Slowly, during several millennia, since around 10,000 years ago, and extremely quick during the last centuries some more humans found possible and considered necessary to be regionally minded, terrestrially minded, globally minded, cosmically minded and universally minded. It has happened in this way, though most humans until today do not realize that the behavior of any particular human is intrinsically holistic because every individual performs necessarily as if he or she would really be the **center of the Universe**. Gradually everybody must unavoidably recognize that many other centers of the same Universe are trying to learn how to similarly perform, though very often inconsistently.

The perilous Bottom ==> Up growing effort

However, any conceptual concern – Systems Thinking cannot be excluded – can be also 'maneuvered' in the opposed sense. It is the kind of systems thinking that has emerged in the mind of humans who have believed that it can be based on a BOTTOM ==> UP growing (integrative) effort applied to one or another fragmented situation.

Very often it is assumed that the BOTTOM ==> UP growing effort will assure the emergence of an assumed wholeness constituted by new circumstances, those generated by the various actions that were accomplished.

It may aim at determining what to do with trees, leaves, flowers and fruits found here and there, very often unexpectedly, while assuming that what essentially matters is to efficiently do everything. Until today to do something efficiently often motivates a person or even a company to carry out activities no matter whether it is obtained a useless or inconvenient or unfair result. It happens also that a pretended efficiency causes undesirable side-effects which appear because the traditional fragmentation carried out for organizing the scientific analysis does not help to prevent the emergence of this kind of effects.

During the last decades an increasing number of projects and actions dealing **officially** with systems have been and continue being, conceived, designed and implemented by means of BOTTOM ==> UP approaches that cause numerous **'side-effects'** which are seen as if they were **'evil'** sources. An increasing number of more complex regional and **'global'** problems are inevitably reaching crisis point, because those humans who are performing as decision makers refuse to recognize how the terrestrial conditions are nearly to be overwhelmed by the impact of human activities.

The whole situation is already seriously dangerous, but it worsens day after day because more and more professionals, until today, are educated de facto in accordance with a generalized reductionism. It obliges them to become de facto **'systems analysts'** and to perform without making any effort to comprehend the wholeness of the set of subjects they are or might be interested to deal with. Instead of learning to think and perform holistically, many professionals keep assuming that the features of a desirable system will emerge from idealized and scarcely interrelated concepts through simplified efforts of individuals

Very intelligent **systems analysts** and cleverer **systems engineers** tend to use the word **system** as if it were very powerful on its own, perhaps assuming that it has magical possibilities. Others dare to imagine that the conceptual fragmentation of every aspect of the reality will be necessarily overcome by an **invented self-organized integration**, without being able to recognize that a congruous search of the steady state of the wholeness that has been **arbitrarily fragmented** is an impossible task. It has been also claimed that every problem on the Earth will be solved by means

of a **generalized love** or through individual actions that aim at building harmony with fragments of various wholes that were abruptly disrupted. In fact the evolvement of this process makes impossible to identify what the wholeness could be.

Optimistic Summing up

From now onward, the TOP ==> DOWN holistic endeavor must overcome the consequences generated by the BOTTOM ==> UP growing efforts that have been used, quite extensively and diversely, by systems researchers: those who dogmatically believe exclusively in systems analysis applied to fragmented aspects of the whole reality. They simply refuse to recognize that any human being has inherent capabilities that allow every individual to grasp patterns and configurations. Instead, everyone should prepare himself or herself to identify and recognize consistently how the various factors involved are interacting among themselves.

Besides, based on arguments expressed by Bertalanffy about the need of nurturing individual creativity against the mystical belief in the group, team or committee brainstorming, it can be claimed:

- that only inside one or another particular human mind it is possible the emergence, presence and evolvement of one or another **(open) system** as a **functional concept**;
- that only one or another human being can identify, through his or her mind, why an open system is an assumed **whole composed by parts and their interactions plus the exchange of matter and energy**;
- that only human beings can identify, through their minds, the need of **behaving humanely**;
- that only human beings can make evident, through gradual rumination, the **responsible role that every human being** must play during his or her relatively short individual existence.

After all, any human willing to grasp what might be a particular **wholeness**, must learn to identify and handle the information that characterize the **parts and their interactions that constitute what was first perceived as a whole.** Every individual soon may become conscious enough about the need of learning to be globally minded and humanely concerned and act accordingly while providing an answer to the very fundamental question:

For what purpose am I and are we living?

A relatively good answer – biased unavoidably by biological, psychological and social circumstances and determined inevitably by intellectual and emotional possibilities and failures – may become pretty soon a very complex question to express and even more to negotiate in front of other also relatively good answers

"We are dealing with emergent realities; no longer with isolated groups of men, but with a systematically interdependent global community. It is this level of [reality] which we must keep before our eyes if we are able to inspire large-scale action designed to assure our collective and hence our individual survival." (Bertalanffy)

Ludwig von Bertalanffy in the 1960s expressed that it was necessary to explicitly build a science for effectively improving the situation of human beings on Earth. **"...this is a question not just of abstract theory and specialties in the Ivory Tower of academic science. Rather, it is part of a far wider question: that science, and a science of and for man in particular, has become**

deeply problematic in our days" I dare to assume that Systems Science may help if and only if.... the Systems Community accept such a huge, respectable and beautiful challenge.

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(#) Open system: An entity that continuously exchanges matter/energy and/or information with its environment. It can be a living organism receiving nutrients from its surroundings at a rate proportional to its surface and destroying wastes at a rate proportional to its volume. The living system grows as a result of these two processes, till a limit - determined by internal interactions among the constitutive parts - is reached. It can be a social organization receiving information from its environment and providing the processed information that justifies the functionality of the same organization.