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In the Search for a Precise Objective and True Definition of Systems

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ABSTRACT : The objective of this research was to determine if there is any definition of a system other than that proposed by Bertalanffi L. (1968) and for this, the existing literature from 1968 to date, related to the systems, was reviewed, but only the cases that were considered most relevant are commented. From this review it is concluded that most of the researchers use the original definition of Bertalanffi as a starting point. However, when analyzing it carefully, it is concluded that it is applicable to any object or entity existing in the world, and therefore, it does not define anything specific, nor does it allow distinguishing a system from something that is not. In this paper, a definition of a system is developed that is specific and allows systems to be distinguished from other entities that are not, and the various types of systems are analyzed to contrast the definition and verify that it is general and specific and allows to unequivocally determine whether something it is a system, or it is not.

Keywords: System, organization, structure, process, product,

1. INTRODUCTION

Perhaps the most important concept associated with systems is the notion that when studying natural phenomena, facts, problems or any situation emanating from reality, their understanding and explanation are facilitated when they are observed with a broad approach in which it is considered that the the effect or total result is a consequence of the conjugation of various elements that participate and that, being interrelated and harmonized in a coherent way, manage to generate results of greater value that can only be attributed to the whole and surpass the simple aggregation of partial and specific effects of the elements involved.

This led many scientists to adopt this notion as the basis for their research and to spread its use, giving rise to the concept of a system. Although during the first half of the 20th century many authors used the concept of systems in their scientific writings, it was until 1968 when Bertalanffi L. (1968) wrote a book considered by many researchers as the foundation of the General Theory of Systems, which It has been taken as the basis for the realization of many other investigations regarding systems in general and regarding the study and explanation of many natural, social and technological phenomena.

In his book, Bertalanffi L. (1968), establishes the following as a definition of a system: “A system can be defined as a complex of interacting elements” (Bertalanffi L., 1968, p. 56). If you analyze this definition, you can immediately see that it is so general that it can be applied to anything, phenomenon or object. Everything that exists in our terrestrial nature and in the universal scope within the reach of human perception, is made up of physical entities that have components, in a strict sense, you can find components or parts that integrate it to anything existing and always it can be determined that these parties are interrelated and interact.

The first defect that can be found in this "definition of a system" is that if everything that exists is a system, then the definition does not fulfill its role of delimiting what a system is and therefore cannot be used as a basis to identify those entities that are systems, because all existing entities will comply with it. However, even with these defects, this definition is the one that has been used since 1968.

The work of Bertalanffi, tried to establish a set of properties generalizable to all systems and used various isomorphisms based on mathematical functions, to try to show common aspects in all systems, it is necessary to point out that these generalizations are difficult to find in all types systems, especially when studying specialty fields not related to biology, which was the subject on which Bertalanffi focused his observations and analysis. It is prudent to point out that the essence of systems cannot be described through mathematical expressions, since they are entities so complex that no mathematical model can contain enough variables and simulate behaviors as complex as those that can be found in systems, later we will have the opportunity to describe the true essence and complexity of the systems.

Then it can be concluded that based on a definition so general that it does not define anything, a lot of research and design work has been developed around the concept of a system, which means that without having a clear idea of the tools that guide reasoning and analysis, important results have been achieved. It should be expected, then, that with a clearer and more precise description of the systems and the characteristics and properties that are common to all of them, it will be possible to go even deeper into the progress achieved, find new research routes, new systemic tools and increase the scientific value of the concept as a framework for analysis.

The important thing is that it has been established that until now the definition of the system that has been used the most, and is still being used, is that of Bertalanffi L. (1968) or some similar variant in which, according to the area of specialty, some specific features are added to it which are obviously only useful when working in that specialty area.

2. System Definition

This part discusses the system definitions that have been used after the first edition of Bertalanffi L. (1968) was published. McLoughlin J. and Webster J., (1970) undertake a review of the literature in relation to urban and regional systems, therefore, their interest is clearly related to social systems although they do not use this term in their article. Its definition establishes that they are a particular class of systems and describes them as a set of dynamically interrelated elements with characteristics of growth and change that can exhibit certain qualities of intrinsic organization as can be found in other types of systems. From what these authors affirmed, two things should be highlighted, the first is that they use the basic definition of Bertalanffi L. (1968), to which they add characteristics of human nuclei, which are their field of study: growth, change and organization. . Importantly, they consider that the organization is also part of other complex systems.

Becht G. (1974), makes an analysis of the scientific development and the role that the concept of system has had in it, especially with regard to control, which has been copied from living systems and incorporated into designed systems by the human being. His concept of system remains attached to the conception established by Bertalanffi L. (1968). Berth states that a system is an arrangement of physical components, or a set or collection of things connected or related in such a way that they form or act as a single unit or a whole. The vagueness of the terms used as "things" and "connected" confirms the suggestion that this definition of a system can be applied to anything that exists in our reality.

Leighninger R. (1978), makes an analysis of the logic and history of Systems Theory, with a specific focus oriented to its use within the social sciences. It establishes that this theory establishes a bridge between the biological, the mechanical, and the human or social, and that it must be particularly abstract because it seeks organizational similarities in a wide range of beings: physical, organic, and socio-cultural. It does not propose a specific definition of a system, but it intrinsically accepts Bertalanffi's approaches.

Dowling G. (1983) proposes that marketing be analyzed through a systems approach that responds to the principles of the General Systems Theory and for this it relies on the concepts set forth by Boulding K. (1956), who in turn, he states that in his article he handles the concepts of systems as stated by Bertalanffi L. (1968),

which makes it evident that until 1983, the definition of the system used corresponded exactly to the one stated by the latter.

It is difficult to find in Luhmann's publications a concrete and specific definition of what a system is, it suggests that actions constitute an important part of social systems and that they depend in an important way on communication (Luhmann N., 1998) and (Luhmann N., 1983).

Miller J (1986) provides a vague description of systems by pointing out that it is an axiom of Systems Theory that they all have some common attributes. That they all consist of units coupled in particular relationships. He also affirms that the units of concrete systems are other concrete systems. Miller studied the functioning of living systems in considerable detail, but it is observed that his study was not guided by a strict and clear conception of what a system is, it only relied on the notion that they are interrelated components, everything else was deduced by him, from direct observation of what he calls living systems.

Rosen R. (1986) confirms that researchers have tried to characterize or define the notion of a system and that everyone assumes that a system is what systems theory is about. He also states that up to the time of writing his article the efforts have been contradictory and unsatisfactory and that many believe that there is no such thing as a system and therefore deny that systems theory is about anything. According to Rosen, the founders of systems theory did not attempt to say what a system is and vaguely stated that systems theory encompasses all studies of interest to more than one discipline.

Saviotti P. (1986), Uses a general system approach to study changes in technology as a result of a process of adaptation to external environments similar to the concepts of homeostasis and self-regulation shown by biological and electronic systems. His focus is on products, to which he assigns the attribute of being technology and describes them as complex systems that are made up of a large number of parts that interact in a non-simple way. It follows from the above that Saviotti bases his research on the same simple concept of a system established by Bertalanffi (1968) and all the properties and characteristics of the systems he analyzes are obtained from his specific field of study. It postulates that every technological system has an internal and an external environment and a set of goals or objectives. It is striking that as he describes it, the goals are not part of the system but elements outside it.

Chen D. and Stroup W. (1993) present a dissertation on the application of systems thinking in educational contexts and propose the possibilities of conducting research to discover the implications of systems thinking and learning. Its starting point is based on a totally traditional and primary definition of systems: "A system is an assembly of interacting parts, the sum of which exhibits a behavior that is not observed in its constituent parts." As can be seen, it is a definition of great generality similar to that of Bertalanffi (1968), with a notorious defect: it proclaims that the behavior of the system is important and does not mention the result.

Like many other authors, Schilling M. (2000) develops a broad argument about modularity in systems, but she never stops to describe what is the object of her analysis, that is, she does not specify clearly and in detail what a system is. Precariously, it outlines that all biological, social, technological or other entities are nested systems, which means that at any level of analysis the entities are systems and that each of their components is, at the same time, a system. For this author, the fundamental notion of a system is the same simplistic interpretation that researchers have used according to Bertalanffi L. (1968), that a system is a set of components that interact or are related in some way.

Adams K.M. (2012) states that it is necessary to find a clear way to establish what the Theory of Systems is and performs a historical analysis on the attempts that have been made in this regard: The General Theory of Systems, The Theory of Living Systems, The Mathematical Systems Theory, Cybernetics, The Theory of Social Systems and the Theory of Philosophical Systems. In Adams K.M. et al. (2014), it is described how from 30 properties found in systems that cover 42 fields of science, they developed a group of them, which gave rise to seven groups that were called axioms of systems theory.

The important thing is that for the first time in 45 years someone considers that the simplistic definition of Bertalanffi (1968) is not adequate to define systems, the adverse thing is that the proposal of Adams K. M. (2012) and Adams K.M. et al. (2014), is built based on 30 behavioral properties shown by the systems, and many of them are only found in systems corresponding to specific fields of reality and are not generalizable, so that they cannot be used to generate a definition of system. It is also striking that these authors consider that

a system is a construct, when the systems are real and are physically manifested through their actions and results. A system, for it to be, must exist empirically, they are not entelechies.

If there is something to criticize the proposal of Adams et al., It is that the seven "axioms" that they infer from the 30 properties are the result, again, of a generalizing intention that seeks, in a forced way, to arrive at concepts so vague that they can be applied to any system, in any field of specialty and perhaps to any other entity; With this, any intention of definition is lost, which must identify characteristics of the entity to be defined, which are part of its essence and therefore are feasible to generalize. Defining based on concepts that are so common and general that they can easily be related to some set of entities should be avoided.

Sillito H. et al. (2017) consider that the General Theory of Systems (TGS) provides a self-consistent general framework capable of accommodating and showing the relationships between a wide variety of definitions and beliefs about systems. They posit that the emergency property is the one that allows to distinguish what which is a system of what it is not. This last consideration is obviously false, since the so-called emergency property is a trivial concept: it is enough that a set of entities, objects or things of any type are physically brought together, so that the set acquires various characteristics that are not shown by any of the elements of the set. If, in addition, the assembled elements interact in some way with each other, even more so, effects not shown by the isolated elements can be found, and even so, said assembly may not be a system.

These authors establish that the INCOSE and ISO / IEC / IEEE15288 definitions are based on the notion that a system is a combination of interacting elements organized to achieve one or more established purposes. With which they recognize that the basic definition of Bertalanffi (1968) continues to be the pattern under which current approaches and methodologies related to systems are developed, in the field of Systems Engineering. They end up proposing two definitions of a system that are elaborated from the notion of a set of interacting parts. It is important to note that in their research, these authors included the work of Adams K.M. (2012), but did not incorporate any of the concepts proposed by him in their system definition proposal.

Based on the research reviewed above, it is feasible to affirm that to date, in all areas in which the notion of system has been used as a fundamental element for the analysis and explanation of phenomena and the development of new concepts, methods and tools, the one proposed by Bertalanffi (1968) has been used as a system definition, with the additions and details that have been derived from the scientific or technical specialties in turn.

In order to support the arguments about what a system definition should be, it is necessary to specify what a definition of something is. According to the dictionary, a definition is: "a proposition that clearly and accurately exposes the generic and differential characteristics of something material or immaterial." Therefore a definition must allow us to differentiate something that meets the definition from something that does not. The "definition" of Bertalanffi, does not allow to differentiate anything because it is applicable to everything. It does not allow to differentiate a system from something that is not, so it is not possible to use it as a definition of what a system is.

To develop a system definition, it is necessary to identify certain characteristics that are generalizable, that is, they are identifiable in all systems and that also constitute an exclusive set of systems that is, no other entity, other than a system, may contain the complete set of such characteristics. Some entities may have one or more of these characteristics, but only systems will have all of them. If something has some of the characteristics, but not the full set, then it is not a system.

3. Systems Features

The concept of system was discovered by human beings when studying living beings, for this reason biologists were the first to investigate and publish works in which the subject was proposed and it was biologists who developed the concept and proposed it as an element applicable in all sciences as a basis for analysis and theoretical foundation.

To identify the characteristics that can be used to define systems, it is convenient to delve into the analysis of living systems, since they are the most complex and therefore must show more or less clearly all the exclusive characteristics. systems possess. Miller J. (1978) made a broad and detailed description of what systems are

like in the field of living beings and is, therefore, a good source of information to know what they are and their distinctive or defining characteristics.

Miller J., proposes that every living system is made up of 19 subsystems, each one with a generic function so that together they manage to provide all the functions that the system requires to operate. Given its generality, this model is true and easy to explain in the system that was used as the basis for its development, however, as one tries to apply it to other more complex systems, some aspects of the model are no longer clear and the generality sought by Miller J., fails. However, this author establishes some generic aspects about the essence of the systems that are generalizable given that they identify basic elements that are not associated with any specific function of the system.

The first notion, and perhaps the most important, is that a system is made up of a set of elements that provide necessary results to fulfill the purpose of the system. We will call these elements "components" from now on. Each component has to generate one or more actions, depending on the complexity of the system.

Miller J. points out that every system has a structure and defines it in terms of a spatial distribution that has an established pattern and also postulates that the structure is a set of relationships. This last concept is the essence of the structure, for the purposes of this research, the structure is determined by the patterns of interrelation that exist between a set of components. From the above we can conclude that every system must have an identifiable structure, a pattern of connections between its components that establishes the possibilities of interconnection and exchange between the components.

According to Miller J. another crucial part of systems is the process, which he describes as: all matter-energy or information change over time. The process is, then, a stage or part of the system in which changes are made on matter using energy and information. The important thing about the process is that it transforms matter through actions that are feasible due to the use that is made of energy. The process is the element of the system through which the expected results are generated. Obviously it is not a random process because if the result is specific and predicted, the process has to be perfectly determined and be exact and suitable for this purpose.

Something that Miller J. (1978) does not explicitly analyze is that the components are organized, that is, each one is assigned certain tasks that are congruent with each other and necessary to generate the purpose of the system. The definition of the congruent tasks that various participants in an activity must perform to achieve an expected result is called organization, therefore every system is based on a pre-designed organization that stipulates what each component has to do. The organization is an indispensable element of the system, it is an intelligent design that predetermines what must be done to obtain a result and what each of the components must do to ensure the expected final result.

“All processes involve some kind of transmission between subsystems within a system or between systems. There are entrances across the boundaries of a system, internal processes within it, and exits from it ”(Miller J., 1978, p. 34). This gives the guideline to intuit that a system is an entity that receives inputs or inputs from its external environment and through actions of some kind, transforms them into products that it supplies to other systems. These actions can be as complex as those performed in biochemical reactions or as simple as the application of a force.

The analysis carried out on living systems as described by Miller J. (1978), brings out the essential characteristics of a system, that is, those that allow them to be identified and at the same time differentiate them from any other entity. In summary, it can be said that a system has the following ontological characteristics that describe it precisely:

- **Components**. Systems are made up of a set of components that perform consistent and determined actions.
- **Structure**. The systems have a structure made up of interconnections between the components that allow the exchange of matter, energy or information.
- **Organization**. The systems have an organization that establishes the actions that each component must perform.
- **Process**. The systems work based on a process that establishes the way to combine the actions of the components in order to obtain the final expected result of the system, which can be actions or

materials. The processes can receive inputs that are transformed into material products of the system and if they do not receive them, then the results of the system are actions.

- **Products**. They are the results obtained from the process, which can be actions or materials.
- **Energy**. The systems use energy to generate the actions performed by the components, which can be received from the external environment or generated by the system based on materials also obtained from the external environment.

When we need to check that something belongs to a class established by a definition, what we do is select the characteristics that all members of that class must meet and determine if the entity being evaluated has them. In the case of systems, any entity that is a system must show all the six characteristics that were stated above, it will be enough that it lacks one of them so that it is not considered a system. Established in this way, the definition of the system is clear, specific and delimiting, it allows the systems to be identified and to discard from this classification any entity that does not present all the stated characteristics.

The definition of a system could be written in very simple terms, saying that a system is anything that meets the six established characteristics, but a wording can be created that describes a system based on its characteristics. In this way it could be stated that:

"A system is a totality that uses energy to operate a set of organized components that are interrelated by a structure and whose actions are combined in a process by which a result is generated, which can be actions or materials."

In two previous publications, Perez G. (2020) and (Perez G., 2020 b), it was proposed that a system is a set of actions, since the actions and the result are the two most important parts of interest to those who observe or use systems, preference was given to considering actions as constituent elements of the system. Defined in this way, a system is still somewhat specific and discriminable from other types of entities, but this interpretation tends to be simplistic and for this reason a more complete definition is proposed in this paper.

4. Natural Systems

In our real world, there are two types of systems those that were created by Nature and those that are created by humans. The former exist and can be observed by us, but their exact origin is unknown. It was from them that humans acquired the concept of system and where we learned the basic principles that distinguish them.

The most obvious natural systems are living systems that are part of living organisms, but there are other natural systems, that is, not created by humans, which are not living organisms, but whose design has a natural origin. For example, if a group of ants that meet to transport food to their colony is observed, the elements that constitute a system can be identified, the components are the ants that carry out coherent actions in order for the food to reach the colony, what each one has to do are actions that are already pre-established in their “brain” that are complemented by actions derived from the information they receive about where the food is. This means that the organization is partly pre-established and partly generated in the real situations that are presented to them.

The energy to generate the actions comes from the functioning of the ants as an organism, the structure is constituted by the contacts that they can make with other members of the system, the inputs are provided by the environment, that is, the food that they are going to transport, the process It is the set of coherent actions that they carry out until the food is inside their colony and the product of the process is transport, that is, the movement of the food from its origin to its destination in the colony. It is a system that generates actions and not materials, since transport is a set of actions and the material is not subject to transformation of any kind.

Living systems are the most complex that exist and this is reflected by Miller J. (1978). In them, each component is capable of carrying out many different actions and participating in various structures at the same time, obviously the organization can change depending on the circumstances as well as the processes and products. Such complexity can only be found in natural systems. One of the most complex natural systems is the human brain, the components are neurons that generate electrical impulses and biochemical reactions as actions, with all the variability in organization, structure, actions and products that have already been

discussed and contain one of the most disturbing secrets: by what processes do electrical impulses and biochemical reactions become ideas?

5. Systems Created By Humans

Human-created systems are of two types, technological systems, so called because they are created based on the technology known to mankind, and social systems, which are systems in which the components are human beings. The first are systems in which the organization, components, structure, process, energy, inputs and the product are established and designed by human beings.

Human beings are capable of creating systems because they have intelligence and based on it they are able to define a product and determine the process that is required to generate it. It is also intelligence that allows them to design the organization and structure and determine the energy sources that are required and the type and quantity of inputs that will be consumed.

In the simplest technological systems, all the elements of the system are fixed, the required product is perfectly determined and is always the same, so that all the other elements of the system are also constant. An example of a simple system is an internal combustion engine, the engine will always produce the same product which can be called: torque, all the components of the system always perform the same actions with greater or lesser frequency or intensity, but always the same. same actions.

Within certain limitations established by the ability to handle complexity, human beings have been able to create systems that have variable behaviors where the elements of the system can vary within certain limits. Computers are an example of these variable systems that can change based on certain inputs or adopt various previously designed configurations. Technological systems do not reach, until now, the levels of complexity of natural systems. Technological systems can change and function based on different designs, but all of them must be previously conceived. In technological systems, the product is constant in each of the configurations that the system can adopt.

6. Social Systems

Social systems have a characteristic that distinguishes them: their components are human beings, and actions are therefore human actions. Like all other systems, social systems have the same six characteristic elements:

Components. In this case, they are always human beings, although some machines that are operated by human beings may also participate to generate actions determined by them or automata that generate actions that a human could perform.

Structure. Interrelationships are constituted by the connections that can be established between human beings through their senses and allow the relationship between people. They are always established based on the senses that the human being has, mainly sight and hearing, and this restricts the distance that may exist between the participants, although distances can be extended through the use of technological devices that allow maintaining the relationship between people. The structures present all the possible variety from being constant and very rigid to being totally variable subject to human decision.

Organization. The organization, that is, the definition of the actions that each component or person has to carry out, can be designed in detail and be mandatory or there can be full freedom for each person, based on their intelligence and motives, to establish which are the coherent actions that they have to perform. The latter is only possible when the components are human beings because the organization requires intelligence to analyze and determine which are the congruent actions that need to be carried out to fulfill the purpose of the system.

Process. The process can also be defined in detail and have precise instructions for each of the people in order to correctly combine their actions with those of the other participants in the process, so that the system can generate the expected product, be this a set of actions or a material product based on the transformation of inputs or a combination of both.

Products. The product of a social system can also be designed in detail in a way that imposes severe constraints on the process, components, organization, structure, inputs and energy or it can, at the opposite

extreme, be a general purpose that can achieve in many possible ways and there is ample freedom for smart components to act and manage to combine their actions to achieve the desired product.

Energy. The main energy that generates the actions is provided by the people who participate as components of the system, but if there are components in the system that are machines, then there must be systems that provide another type of energy required by the machines to operate.

Although complex natural systems are precise, each system has to comply with certain products defined in detail, although they can be many and complex. Something similar happens with technological systems created by human beings, all are designed precisely in accordance with the expected result or product, the components strictly carry out the actions specified by the organization and precisely in the order established by the process. . Social systems, on the other hand, can exist in a wide range of possibilities, from those that function based on strict limits that restrict the action of the components and the possibilities of all other elements of the system, to those that work by giving the people the ability to determine all the elements of the system according to their intelligence, criteria and motives, except the product that, although it is of a general nature and obtainable in many ways, must always be clearly established and known by all participants.

Social systems are very important because all technological systems are created and elaborated on the basis of social systems. They are part of the companies, everything that a company does is done through social systems, from administrative to production lines, everything is managed and works based on social systems. Governments, education and any public or private institution is made up of social systems, therefore proper management in all areas depends on having a good knowledge of social systems, how they work and what can be expected of them.

A restricted and strictly limited social system is represented by an assembly line. In it, the product is perfectly defined in all its aspects, the assembly process is designed to combine all the actions of the components so that these actions, when combined, give shape to the product that is expected at the end of the assembly line. The components of the system, in this case, are people, machines that help people to perform their actions and automata that replace them.

In the assembly line, people have perfectly established the actions they must carry out and they are not allowed any tolerance in it, they have to perform exactly the actions that have been determined, or the expected product will not be obtained. This is an example of a strictly controlled and limited social system, the tolerance limits are narrow for all elements of the system.

However, if we suppose that we are in the same company to which the assembly line belongs, the planning department, for example, is made up, also by social systems, obviously with very little automation. For social systems in this direction, general goals are established such as: to propose a strategy to expand the market, with this objective in mind, the participants in the social system in charge of this purpose, determine what must be done and the results that must be achieved and the specific actions are left to the discretion of the people, it is not so important what they do but what they achieve in the end and deliver as a result of their work. A test and adjustment process will surely follow until an acceptable product is obtained. The process to obtain the product is also lax, it is only defined in general.

There are other social systems where the product is defined in a general way, such as in a soccer football game, each team is a social system whose components are people, the structure of the system is generated by the participants through the connections they decide to establish with the teammates through sight and hearing primarily. Each person analyzes the situation that occurs on the field and determines the actions they consider appropriate to achieve the goal, generates their participation in the organization and executes the process, and with each new movement, they have to redefine everything, since the conditions are constantly modified. In this case, there are no strict limits for any of the elements of the system and there is only a general purpose for the product: the goal, which can be achieved however, there is no predetermined type of goal with specific characteristics, it should only be achieved that the ball cross the goal line, no matter how. Of course, the rules of the game impose restrictions on actions and they have to be respected by the players.

Another example of a social system with a lot of freedom of action for the components, that is, the people, is the traffic of cars in a city. Each of the motorists establishes a structure through which they relate to the people around them, but each one decides which relationships to establish. Each person also decides at all

times what actions to take to achieve the product of the system: that everyone can move without hitting another car. Thus, automobile traffic occurs and is achieved by the congruent actions that all participants decide to execute, defining the organization and the process.

Between the restrictive and exact assembly line, to the soccer game and the traffic in a city, there is the whole possible range of social systems that vary in the degree of restriction that is imposed on the elements of the system. The important thing is to establish what is the appropriate degree of restriction for the results that are expected in each area or situation. Obviously, the clearer and more defined the product, the more restricted the system must be if such a result is to be obtained with few differences from what is expected.

This is very important for companies, given that everything they do is done through social systems, it is necessary that they establish restrictions on the systems so that the results are predictable and the products that are required are obtained.

The more restricted and exact the process of a social system must be, the more it resembles a technological system, in which the structure and organization are unique and constant. The more relaxed and free the process, the more it resembles a living system, in which the structure and organization are variable. The variation of the organization always depends on the existence of intelligence capable of creating the congruent actions that the process requires and assigning them to the appropriate components. In the case of social systems, this intelligence is human and in the case of living systems it is artificial intelligence, similar to that designed for computerized systems, immersed in the components and the structure. In both cases, it is evident that the variable organization requires information to be generated; It is the information that allows the components to acquire their role within the organization and incorporate the pertinent actions into their operation. Without a communication system it is not possible to achieve organization in any system.

All social nuclei, from the family to the countries or the whole world, are made up of social systems that are located somewhere between the extreme of rigid and restrictive systems such as an assembly line or a military aviation team executing Acrobatic maneuvers or at the extreme of lax and free systems where the result to be obtained is not clear or is not mandatory or necessary for the participating components and each one decides how to act based on their convictions, preferences or other possible motivations.

7. Conclusions

The research carried out made it possible to verify that in all areas the original basic definition of Bertalanffi (1968) has been preserved as a basis for the study of systems, which tacitly establishes that everything that exists in the real world is a system and therefore, it is not possible to distinguish a system from something that is not, so that it is not possible to accept said statement as a definition of nothing.

The observation of living systems, allowed to discover what are the elements that constitute them and establish six of them as characteristic and generalizable to all types of existing systems in our real world. These six elements are: Components, structure, organization, energy, product and process, which turned out to be the distinctive characteristics that identify any system and that therefore can be used to establish a strict, specific and general definition of the system.

The definition of the system that was established in this work was contrasted with the characteristics that the systems show in the three areas that determine a typology of the systems: Natural systems, technological systems and social systems and it was concluded that it is a general definition, which allows systems to be identified and distinguished. Under this definition, a system will be that entity that has the six established characteristics and only if it has all six, it will be enough that it lacks one of them so that it is not considered a system. If you adopt the definition proposed here, a large number of entities that had this category under Bertalanffi's definition are discarded as systems.

In any case, given the essential differences that exist between the three fundamental types of systems, some properties will be general and shown by all systems and others will be shown only by systems belonging to a single type. The definition proposed here raises an important advance in the study of systems, firstly because it allows concentrating efforts only on those phenomena that are generated by true systems and secondly, because the specification of the six essential characteristics raises the opportunity to review many previous

studies and rethink the analysis under the new concept proposed here, which could indicate new research alternatives.

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