OSJ | OPEN SCIENCE JOURNAL

RESEARCH ARTICLE

On the Essence and Ontology of Systems

Gustavo de Jesus Perez Duran[1]*

[1]Universidad Autonoma De Guadalajara, Mexico

*Corresponding author: Gustavo Perez Duran: gustavo.perez.g@gmail.com

OPEN ACCESS

Citation: Duran G.J.P. (2020) On the Essence and Ontology of Systems. Open Science Journal 5(3)

Received: 18th May 2020

Accepted: 29th June 2020

Published: 10th August 2020

Funding: The author(s) received no specific funding for this work

Competing Interests: The author have declared that no competing interests exists.

Abstract:

In the first part of this research, publications were reviewed from 1968 to 2019, with the aim of observing how the definition of system has evolved, since it was established by Ludwig Von Bertalanffy. From this review it is concluded that this definition has not changed in essence, all the researchers consulted use concepts similar to those of Bertalanffy, when they propose a definition of system. However, according to the specific field of work, the authors add their own characteristics.

Bertalanffy's definition and all that have been derived from it postulate that a system is a conglomerate of interacting components. But after a brief reasoning it is concluded that everything in our universe meets that definition. A system is an atom, a cell, a chair, a galaxy, or the universe as a whole. So systems theory would be the theory of everything, which is too broad and imprecise.

Vagueness and imprecision have been eliminated when the concept of system has been applied to specific fields of knowledge and human activity and in each of them characteristics have been added that define more specifically the systems that are relevant to certain technical or scientific specialties. However, this has caused that many concepts developed in one field cannot be extended or used in others.

In this work, a system definition is established that allows us to clearly and precisely describe what these entities are and distinguish them from other concepts and entities. In this way it has been possible to characterize what a system is, using concepts that are applicable to any of the types of systems that can be found in our known world: natural systems, man-made systems and social systems.

Keywords: System, Ontology, Systems definition, Social systems, Natural systems

Introduction

Dori D. et al. (2019) point out that Aristotle raises the first known idea about the nature of systems: "the whole is something beyond its parts and not just the sum of all ". This statement describes the feature that has been considered more distinctive and exclusive of systems: emergent properties. However, the most well-known and used definition of system is the one established by Bertalanffi (1968) which expresses that a system is: “a complex of interacting elements”.

The definition that Bertalanffi established for the concept of system: "conglomerate of interacting components", does not really define anything because in any material object that exists in the universe it is possible to find components that integrate it and then this definition cannot be accepted as such, by virtue of the fact that it does not define anything since a definition must delimit and establish a set of characteristics that can only be found in the entities or objects that conform to the definition. Thus, Bertalanffi's definition cannot be used as a solid basis for any investigation or application of the system concept.

This research is qualitative and therefore was carried out based on facts on which an analysis was carried out that allowed generating a general theory on the definition of the system and obtaining a precise and specific ontological description of systems, which will contribute to generalizing logically and clearly its properties and characteristics covering the three areas in which the different types of systems are located: natural systems, human-generated electromechanical systems and social systems.

The question that was used to guide and guide this research was the following: ¿Is a definition of system as general and imprecise as the one established by Bertalanffi and that the great majority of researchers have accepted and adopted, valid and useful?

The objective of the research was to search for an ontological description of the systems that would identify their true essence, allow the systems to be distinguished from other types of objects, entities or concepts, and thereby lay the groundwork for reviewing the investigations carried out so far in order to find opportunities for greater precision or improvement and guide the development of new research in this area.

The central element of this research is the definition of a system established by Bertalanffi L. (1968), the exclusive objective of reviewing the literature on systems from 1968 to date, was to try to find out if in that period any researcher had proposed any more precise definition of system, oriented to describe the ontological essence of the systems and to characterize them in a specific way, endowed, therefore, with unique and exclusive properties, not possessed by other types of entities. Only those that are considered most relevant are briefly described below. No comparative analysis was sought. It is only intended to show the opinions of the selected authors.

It is interesting to analyze how the concept of system has been handled through the years, after Bertalanffy published his General Theory of Systems (GST). For this we will analyze some statements of various authors after 1968:

1. McLoughlin J. and Webster J. (1970), consider that a system is a set of entities, real, conceptual, material or non-material, which interact, one with the other, to form an identifiable whole. This adds very little to what was established by Bertalanffy (1968).

2. Becht G. (1974). Its definition of system is: A system is an arrangement of physical components, or a set or collection of things, connected or related in such a way that it forms or acts as a complete unit or a totality. This also does not add anything significantly new to the concepts previously expressed by Bertalanffy and other authors. In his article he considers the existence of formal systems like logic, calculus and axiomatic theories and conceptual systems like diagrams or atomic models.
3. Miller J. (1978), analyzes the structure and behavior of various living systems and establishes that they are based on structures whose components are also systems. It states that the five types of systems it proposes are made up of 19 component systems, although in some of them the participation of the 19 components indicated is not clear.
   Miller considers the existence of conceptual systems that are made up of words, numbers and other symbols and concrete systems that are the accumulation of matter-energy in a region of space-time that is organized in interrelated and interacting subsystems or components. Accordingly, Miller J. (1978) definition, coincides with that of Bertalanffy L. (1968).
4. Leighninger R. (1978), interprets the definition of system and says that they are usually simple and general, such as: "a totality of interacting elements" or "dynamic interrelationship of the components" or "one whole that works as it by virtue of the interdependence of its parts. " And he stresses that two salient features of systems theory are prominent in these definitions: a concern for the whole and for interrelation.
5. Langlois R. (1983) , refers that: “ A system is only the set of parts plus a set of relationships between the parts ”, but also discusses the role of GST as an integrating element of science. He points out that Systems Theory has failed in its attempt to revolutionize scientific methodology because at the most general level, it has nothing revolutionary to offer. In essence it retains the meaning of Bertalanffy's (1968) definition.
6. Luhmann N. (1983). As in other of his writings, this author does not propose a specific definition of system. He reiterates that the distinction between system and environment allows us to distinguish which elements belong to the system and suggests that the elements of a system can be actions and consider them that way, it is very relevant for action systems and for social systems.
   He points out that a self-referenced system is a system that reproduces itself or is an autopoietic system that generates the elements that make up the system.
7. Miller J. (1986) , maintaining a very general conception of systems ontology, affirms that it is an axiom of systems theory, that all these have certain common attributes: they all consist of units integrated in specific relations.
8. Resconi G. (1986) considers a definition of system that coincides with that of Bertalanffy (1968), although it is expressed in even more general terms. Rasconi states that a system is a formal relationship between observable characteristics or attributes. This author proposes a new concept which he calls the Logical Theory of General systems.
9. Rosen R. (1986) , according to this author, for a long time there has been an attempt to characterize or define the notion of system,

however, the results have been contradictory and unsatisfactory, which has suggested that there is no such thing as a system and therefore it is open the possibility of denying that systems theory refers to something in particular. He adds that the founders of systems theory did not attempt to say what a system is and characterized it only partially and subjectively, saying that it encompasses all studies, of interest to more than one discipline.

10. Adams K., et al. (2014), carry out an analysis of the meaning of the concept Systems Theory. They consider that the general theory envisaged by the founders has not emerged and that the GST has been subject, lately, to strong attacks by various authors.
    To cover such deficiencies, they propose that Systems Theory be defined in terms of a construct made up of seven axioms, each of which is defined in terms of propositions that basically describe the properties that systems usually show in the various fields. of reality and science. In total, these authors propose thirty properties of systems as propositions to describe the axioms. These axioms, in turn, are the characteristics that explain what a system is.
11. Dori D. and Sillito H. (2017) . These authors investigated different system meanings with the aim of synthesizing a definition or a family of definitions. They managed to compile approximately 100 system definitions that include 2665 different words in their postulates.

The system definitions that they consider have a greater acceptance among systems engineers, reiterate the traditional concept of Bertalanffy (1968), of being a set of elements that achieve a defined objective. These authors highlight that many definitions refer to properties, functions, capabilities and behaviors of systems. They conclude that all these definitions correspond to different domains and perspectives of the world, but can be understood within the framework of the concepts analyzed by them in their article.

System definition

When reviewing the literature in relation to systems, a surprising conclusion is reached: there is no concrete and clear definition of what a system is, despite the fact that a huge number of theoretical developments have been made about its behavior, its characteristics and their properties, some of them surprising, complex and very useful for mastering and controlling them, in real operating situations.

If we start from the definition of Bertalanffy L. (1968), we immediately conclude that it is applicable to any existing object in the real world. Anything from one to Galaxy, to an atom, can be described as a complex of interacting elements; a stone, a desk, and everything one can find in the world, can be interpreted as a system according to this definition.

However, in the articles that are written about systems, systems that are capable of generating observable results, that are dynamic, that perform actions, produce changes and generate movement, are always analyzed. Nobody writes or analyzes, as systems, the inert materials that exist based on a perfect balance of their components and that are static, immutable and do not generate any observable results, nor any type of human construction that works based on static balance. Therefore, we must admit that although these latter entities can be considered systems according to the traditional definition of Bertalanffy, do not have the characteristics and behavior that are of interest to systems researchers.

Therefore, in order to properly focus the analysis and study of the systems, it is necessary to restrict the characteristics of the entities that will be considered as such and find a more stringent definition that identifies and characterizes the systems as generators of observable results, since they are the ones that have a determining influence in the universe, in nature and in the life and technological evolution of the human being.

It is essential to rule out the possibility of considering that there are such things as abstract systems or conceptual systems, since by their very nature, concepts, even if they had a very clear definition, are not entities that can interact as established by Bertalanffy's definition. L. Bertalanffi (1968). They are creations of the human mind that are given meaning but cannot be connected in any real way.

Furthermore, Bertalanffy's definition, which as has been shown, is the one that continues to be used in all areas in which systems are studied, cannot be considered a definition, because it does not define anything, it generalizes so much, until it is applicable to everything what exists in the universe, which does not allow distinguishing a system from what is not . A definition is intended precisely to enable us to distinguish between entities that conform to it and those that do not. Bertalanffy's definition absolutely lacks this ability.

Therefore, a definition of a system is needed, which really describes its essence and allows distinguishing a system from other types of complex conglomerates of components. A definition that applies to all systems equally, that establishing its essence, describe rigorously its ontology and provide them with observable characteristics , own, unique, complete and rigorous, so that they can be identified to determine that an entity is a system or determine that it is not, in case it lacks one or more of the characteristics contained in such definition.

From the general concept of system established in Bertalanffy's definition, they have been studied and analyzed in different specialized fields. The first of these fields and the one that originated the primary concepts was the study of living systems. J. Miller (1978), developed a theory which states that all living systems are composed of 19 components. From the study of living systems or organisms, various properties of the systems were derived, which have been tried to be taken to other fields or types of systems, although it has not always been fully achieved. Living systems are part of a much broader set of systems, which we will call natural systems and which includes all those systems that are generated in nature. In addition to living systems, these systems can be mechanical, electrical and electromechanical.

Another field, very broad, is made up of the systems that the human being creates, based on technology. These systems cover various specialties: they can be mechanical, electromechanical, electronic or can be made up of combinations of these specialties. Since they are human inventions, they have limitations derived from the technological capabilities achieved and do not manifest some of the properties of living systems, but, in turn, give rise to other properties that cannot be identified in the latter either. We will call these systems " technological systems "

Finally, there is another field of specialty that is made up of systems in which human beings participate, can be designed with specific intentions, or can be generated freely through the interaction of people. They are called social systems and due to their genesis they have special characteristics, which give rise to specific properties that are not manifested in the two previous fields.

The studies carried out in the three specialized fields that have been described have allowed the specific systems of each of them to be characterized in detail and their behavior to be precisely known. In this way, at least thirty properties of the systems have been identified, which Adams K. et al. (2014) used to establish a system definition based on a construct with seven dimensions or axioms that are, in turn, defined based on the thirty mentioned properties. This is the broadest definition of system that was found and separates forcefully from the traditional Bertalanffy definition adopted by most researchers. It is a good effort, but as previously stated, the thirty properties proposed by Adams K. et al. (2014), are not applicable to all systems and therefore cannot be considered a general definition. In addition, this type of " definitions " describe the behaviors that are observable in an entity and not what the entity is in its essence, so they do not define anything.

Systems ontology

By studying systems with an ontological approach, what we want is to identify the essence that characterizes and distinguishes them from other entities and that is present in all of them, making it general in nature. A careful observation of the descriptions of the systems allows us to identify the following common characteristics:

1. All systems have components that act or perform actions. Living systems have components that are living subsystems. Technological systems have components that are machines, mechanical, electrical or electronic, that also generate actions. The components of social systems are human beings, who are responsible for carrying out the actions.
2. All systems have an organization that specifies what each component should do. In order for the actions carried out by the components of a system to be consistent with the final result to be obtained from the system, it is necessary that an organization has been established or designed beforehand, which establishes what each component must perform. In living systems, the organization is established, although it is not possible to determine how it originated. In technological systems it is designed by human beings. In social systems it may be predesigned or established at the moment by those who participate in the system.
3. All systems have a structure made up of interconnections or interrelationships, between the components, which allow the actions to be combined. The structure is defined by the interconnection arrangement, different arrangements give rise to different structures.
4. All systems require an energy or an input supply that the system is capable of converting into energy. The components perform actions and generating an action requires energy, so they must be supplied with energy or have the capacity to generate it from certain specific inputs. In all three types of systems, the components transform energy into actions.
5. For a set of actions to generate a predefined result, they have to be conjugated through a process that establishes the order, synchrony,

sequence and consecutiveness that is required for the expected result to be obtained. The result is what determines the design of the process that will allow obtaining it.

6. The systems carry out actions that combine to generate a more complex action or transform inputs into a material object.
7. All systems have a preset result, which can be an action or a material object.

As said so far, it would seem that a system is an entity made up of seven parts: components, organization, structure, energy, process, actions and results, which is generalizable to living systems, technological systems and social systems. This would imply that the definition of system would consist of a text that describes these elements and their participation in the operation of the set. However, systems are important and special only insofar as they are capable of producing results, since these are tangible and observable and also constitute the element of value that makes them useful and generates benefits for their environment.

This necessarily leads us to think that the system, as a generator of results, is made up of actions and that the other parts of the complex are the ones that make the creation of the systems feasible. Therefore, the essence of a system is integrated by the system itself and all the additional parts that give rise to it and characterize it. The ontology of a system has to be understood, then, through an analysis that encompasses the system and its elements and the complex of parts that generate it. All this, considered as a unit.

According to the analysis in the previous paragraphs, it is now feasible to establish a system definition:

"A system is a set of congruent actions, which are combined to obtain a pre-established result and which are generated through a complex of indispensable parts that are: energy, components, organization, structure and process."

This definition is closely paralleled with the traditional definition of the Bertalanffy system (1968), but it is precise and specific. It does not encompass all things in the universe as Bertalanffy's does and all that definitions similar to it. By means of this new definition it is possible to distinguish between what is a system and what is not. In addition, the characterization provided by the parts allows to discriminate one system from another, with much greater precision and clarity.

This definition is applicable to any system in any of the three specialty fields that were previously established: the field of living systems, the field of technological systems and the field of social systems , so it is general in nature and also describes the ontological essence of systems based on characteristics that allow the unequivocal identification of a system. In order to check the generality and applicability of the system definition that has been established, it is convenient to analyze how it should be interpreted in each case:

Natural systems . They are the systems that we find in nature and among them, living systems are especially interesting. It must be taken into account when speaking of living systems that are extremely complex systems and the characteristics that have been established in this work to determine the ontology of a system can be considered with other words or names. Should also be noted that in J Miller. (1978) and Miller J. (1986) the system established by Bertalanffy L. (1968) that considers the joint systems of components is used as a system definition.

Miller J. (1978), includes energy as necessary for the operation of systems, establishes 19 components that are communicated through a structure of interrelationships, considers the existence of an organization since each component performs predetermined actions, calls process a what in this work is called a system and intrinsically considers processes, since every system is based on a predesigned process that determines the way in which actions are combined. It also includes the analysis of the results obtained from the systems and describes how these occur in cells, organs and organisms.

Due to their complexity, living systems have complex and variable structures and organizations, each component is capable of many actions and each system is capable of generating more than one result. However, all the results are previously established, as are the processes and the organization. Now, the design of the organization based on a desired result is something that requires intelligence and in the case of living systems, that intelligence has an unknown origin, which does not invalidate that we can identify it with the term assigned to it in the particular case of human beings. By analyzing technological systems and social systems, the role of intelligence in the creation of systems will become clearer.

Technological systems. These are systems created by the human being and this is possible because being endowed with intelligence, the human being has the ability to conceive a desired result and design an organized set of components that based on a structure and through the supply of energy, be capable of generating a system, that is, a set of coherent actions that, carried out in accordance with a previously established process, produce the desired result. In all of the above, it stands out that intelligence is the crucial element that allows human beings to create systems, since only through intelligence is it possible to conceive the organization of the structure and process that a system needs.

Currently man-made systems are electromechanical and electronic, mechanical systems such as steam locomotives practically no longer exist. A good example of an electromechanical system are those generated by internal combustion engines, they are a consistent set of actions that produce a result called torque. The system is generated by a set of components that perform different actions controlled by an organization, a structure and a process, designed by humans using their intelligence to discern how components should function, what actions should be carried out and how these actions should be combined.

This example allows a good analysis of what a system is. The internal combustion engine is an object, when it is idle it is not a system, since it lacks energy and does not generate actions or results. This clearly and forcefully illustrates that the system is not the engine, but the set of conjugated and congruent actions. It is also worth mentioning that it is the conjugation of the actions that makes appear a characteristic that is considered fundamental in the systems: the emergent properties that cannot be observed in any part of the system or in any of the elements or actions that make up. Similarly, a dead cell is no longer a system, the system was constituted by the actions that the cell performed to generate its results.

Electronic systems are much more complex than electromechanical systems and have some similar characteristics, keeping the appropriate proportions, to those observed in living systems: they can modify the structure, organization and process, each component can perform various different actions and its structures can reach considerable levels of complexity.

However, the concept is maintained that electronic objects are not systems, they are simply objects when they are inactive. The electronic system is created when energy is supplied to the object and works according to the structure, organization and processes that were designed specifically. A computer turned off, it is not a system, it is an object, the system emerges when the computer is turned on and works.

It is important to note that all natural systems, which are not living systems, turn out to be mechanical or electromechanical systems. An example of them are the systems formed by the systems of planets and satellites that remain in orbits around stars, the galaxies and other gravitational systems, which are mechanical systems. On earth, there are mechanical systems like rivers and electromechanical systems like storms.

Social systems - Social systems have a very special characteristic, their components are human beings, and human reasoning, intelligence, will and decisions intervene in the system's operation, which increases its complexity to an extreme degree. Otherwise, they remain congruent sets of actions that generate an expected result.

In social systems, structure, organization and processes encompass a very wide range of possibilities, in which each of these parts of the system can present, in a totally independent way, different degrees of precision, rigidity or variability. This is because the human being can influence the determination of such parts.

In order for a social system to be generated, that is, a set of congruent actions carried out by human beings, a set of them must be integrated, with the possibility of interrelation. The less specific and rigorous the structure, organization and processes are, the more intelligence, reasoning and human will intervene in the system. It is worth analyzing some examples that illustrate the wide range of possibilities that may present a social system.

There may be social systems such as, an orchestra, in which the organization, structure and processes are established to detail, rigidly and thoroughly established, so that all musicians have to follow them unequivocally and rigorously. On the contrary, in a jazz ensemble, the organization and processes can change with some flexibility, within certain general rules, although this obviously modifies in some way the results achieved. A military contingent marching and maneuvering as a group are also an example of a social system where all actions and processes are defined in detail and are performed with precision.

The flow of cars on the streets of a city is a social system that is achieved through the actions of the drivers involved. In this case, the desired result is that everyone can go where they want to go and avoid collisions, however, the actions have not been predetermined, each driver analyzes the situation and the actions of others and according to their criteria, guided by their intelligence , determines the organization, that is, the actions to be carried out. The structure is also established by drivers, when determining which events they pay attention to and how; they use their sight and hearing to interact with other drivers. The process is designed by drivers and the system is the set of congruent actions that allow the flow of cars.

In a soccer game something similar happens: the players decide the actions to be carried out analyzing the situations and anticipating what may happen or trying to provoke a favorable reaction in their contenders. Players define the organization taking into account the desired result.

When it comes to societies such as cities, towns or countries, social behaviors and other results derived from the conjugation of people's actions are consequences of the systems that can be configured by organized actions. In a society, a large number of systems will be generated that will be determined by the structures that manage to establish themselves, but mainly by the organizations that determine the dominant actions that define the social result. Social systems, in this case, are integrated by the actions that people carry out and that are conjugated through spontaneous or induced processes in some way. In these cases, there is a very high degree of freedom for people to decide their actions , even though society operates within a general framework of social, legal and moral restrictions.

The previous reflections forcefully establish that the traditional definition of a system as a complex of interacting components is too general and therefore does not reveal the ontological nature of a system, due to this, the advances made in the study of systems they have been based on the discoveries made on particular systems belonging to specific and limited fields of science and especially of technology. This has resulted in generalizations that have been very limited.

It must have been made clear that the true ontology of systems, which is specific to this type of entities and which is also generalizable to all, is that they are sets of actions generated by a complex of parts that must include: energy, structure, organization and process.

Luhmann (1983) considers to actions as elements of the system and notes that the elements of the system are not the actors that produce actions. The concept of autopoiesis that Luhmann created confirms that he considered actions as the constitutive elements of social systems, and this is evident in the following statement: “Actions are not produced for subjective reasons or intentions. They are produced by the system of cross-references between the same actions ” (Luhmann N., 1983, p. 993) .

It should be noted that (Luhmann N., 1998) , suggests that social systems are made up of actions: "Social systems are therefore based on a type of action or on an aspect of action" (Luhmann N., 1998, p. 140) , however this phrase is ambiguous, when it adds: “or on one aspect of the action”, without mentioning what is that aspect of the action that could be the constitutive element of social systems. Furthermore, Luhmann also asks: "Ultimately, does a social system consist of communications or actions?" (Luhmann N., 1998, p. 141) , and with this he confirms that it is not possible to find in his proposals a clear position about what are the elements that constitute a social system. But the central role played by actions in social systems is clear from their statements.

It is important to highlight that although Luhmann only addresses the ontology of social systems in a brief and superficial way and that, even when he does, he does not make forceful and precise statements, it is possible to find in his ontological positions the first manifestation in the sense that the social system is not made up of components that carry out actions, which would be the interpretation derived from Bertalanffy's approach, but, in some way, by the actions themselves or by communication, as is interpreted by his followers.

The organization

The organization is the part of the systems that establishes which are the actions that each of the components must carry out and therefore constitutes one of the elements that has the greatest influence on the nature and results obtained from a system. Therefore, it is important to analyze how the organization is in the three types of systems: natural systems, technological systems, and social systems, since they present different characteristics that are decisive for understanding the concept of system.

Natural systems, have an organization designed by something that works in a similar way to human intelligence but that is created by some unknown process, that the human being has not been able to identify, is one of the mysteries that we have to accept as real, but ineffable. However, it is an organization that can be recognized, identified and understood by the human being, which means that the intelligence that creates it, manifests itself translated into terms and characteristics accessible to us.

The organization in natural systems is defined in detail, each component performs exactly different actions that are always the same and correspond to those established in the design. The components of a natural system are extremely complex and can perform many different actions, depending on the different structures it may have in place with the other components of the system. Natural systems have the ability to modify structures and organization depending on information or situations that occur in their environment and that feed it with inputs that detonate certain homeostatic activities in the system. In Miller J. (1978), a description of the cell as a system can be found confirming the above. According to this author, the cell receives as inputs: matter, energy and information, and it is the latter that must be used to modify the organization and structure. Information becomes the enabling tool that allows to introduce organizational changes to better face the internal and external updates.

Despite its variability, once an organization has been established, the components are strictly subject to it, thus ensuring that the results obtained are as expected. The components respond in a disciplined and exact way and produce the results that are established for them. This way of operating according to organizations and variable structures is a property of living systems that is also observable in social systems, as will be seen later.

The comments made about living systems are considered valid from the cell to the organisms, but it is not possible to accept that they could be extensive for groups, societies and organizations, given that it is difficult to extend to these systems, the principles established by Miller J. (1978) for the cell, the organ and the organism, which are systems designed by some unknown type of intelligence and whose components work with strict adherence to the organization and structure that is established. Groups, societies and organizations belong to the realm of social systems and it is there that they can be analyzed with certainty and clarity.

Human-designed systems tend to be much less complex than living systems, mainly due to the ability of human intelligence to understand and design complexity and especially because of the technological difficulties faced when trying to build overly complex mechanisms. with variable functions.

In general, the mechanical systems are simple, the organization and the structure are invariable and all the components strictly carry out the planned actions so that the results obtained are exactly as expected. A mechanical system is totally predictable and reliable and in that way they are designed and built.

All human-built systems, whether mechanical, electrical, electromechanical, or electronic, have detailed organizations designed to accomplish the actions that will shape the systems and ensure that the desired results are obtained. All the components will carry out exactly the actions that the organization determines and there is no possibility of anything else happening. They are rigid organizations, the components are absolutely reliable and everything always works as expected. We must understand that we are talking about correct operating conditions without failures in components or structure.

As far as the organization's operation is concerned, technological systems are similar to natural systems: the components always carry out exactly the actions that are assigned to them by the organization. There are some technological systems that allow a certain degree of variability in structure and organization and work with controlled variations in these parts of the system, some examples of them are found in highly specialized computerized systems, such as those used in airplanes and to some extent in regular computers.

Social systems, on the other hand, present a complete range of situations regarding the rigidity or variability of the organization and structure. The essential characteristic of these systems is that their components are people, that is, the actions that constitute the system are carried out by human beings and human beings have as one of their characteristics the will that enables them to do exactly what they are asked to do or interpret the orders and do something similar, but not exact, or to make any variation of the action between these options and that of doing nothing.

It was exemplified on a previous page, that systems such as those based on the actions of an orchestra, operate based on an organization defined in detail in all aspects of the actions and the human beings who participate try to carry out exactly what is required from them. Orchestras are rigid systems, it is known what is expected from the musicians and is usually obtained.

Other social systems like assembly lines in a car factory, for example, are also systems with rigid organizations where the people who work on them adhere precisely to the established organization and structure. However, many of the tasks that are performed in other parts of the company will present organizations that vary in the degree of rigidity and are not as strict as that of the assembly line.

In areas other than the assembly line, the organization can be designed and established with different degrees of rigidity and precision, from highly disciplined areas to areas where the objective to be achieved is established and the power is left to the people, according to their criteria, to define what are the actions to be performed. Of course, all managers want all organizations in their areas to have a certain degree of rigidity, but the reality is different: in companies there is a wide range of degrees of rigidity in the organization and the results are not always as expected.

A soccer team, as previously mentioned, is an example of a social system: the components of the system, that is, those who carry out the actions that constitute the system, are human beings and in this case there is no pre-established organization, only the expected result is established, which consists of scoring goals and once the ball is in play, each player analyzes the situation and decides what actions to take and this changes at every moment, so the organization, designed based on the intelligence of the participants, is absolutely variable. The structure, that is, the interrelationships that connect the components, are established by each of the players and this makes it equally variable.

This example illustrates a crucial issue of social systems, as the components are people, their decisions must be guided by the organization and for the organization to reach a person, communication is required, therefore in social systems, communication is the indispensable ingredient of the organization and not the constitutive element of the systems as it has been interpreted in relation to Luhmann's writings.

In the soccer game, each player gets the information he needs to make decisions and act, from the communication he establishes with his teammates through sight and hearing, he has no other means of communication. But it is this communication that allows him to use his intelligence and decide what actions to take and this means that he contributes his part of the organization that is required to achieve the desired result: the goal.

Society in small nuclei or at the level of a whole country will achieve certain results with the organization that is consolidated and this will necessarily require communication. Also in these cases systems will be established with organizations of different rigidity, but societies tend to behave according to organizations of little rigidity and the achievement of certain desired results must be based on achieving an adequate organization based on correct and effective broad communication.

Conclusions

The most important innovation of this research consisted in establishing that the systems are not made up of components that interact, but are made up of actions that combine to generate a result. Before this, everyone was talking about system components and not what the components do. However, the reflection that an inactive system such as a dead organ or organism, an inert electromechanical artifact, lacking energy and a group of assembled but inactive people, are conglomerates of components that in some way are interrelated but are not systems, given that they do not generate actions and therefore neither results, it constitutes the most important conclusion and is the basis on which the theory proposed in this work was built.

The next innovation is to have determined that every system has different elements that determine the creation of the system: Components, Organization, Structure, Process, Energy and Results. Nobody, before, had established a specific description of these elements and their role in the generation of the system, nor had they been considered as indispensable parts of any system. Perhaps partially some of them had been discussed but in isolation and only in some specific applications.

The definition of the system established in this work and the identification of the elements that make up any system, have allowed, for the first time, to establish essential ontological concepts that are applicable to all types of systems, which is why they constitute the first description of the systems that It can be generalized.

By considering systems as sets of actions, two fundamental objectives are achieved to better understand systems, on the one hand their ontological nature is clearly identified: they are sets of actions and on the other, they are distinguished from many other objects, phenomena or events. The most relevant thing about it is that this definition is naturally and simply applicable to all systems in the three areas of our reality: natural systems, technological systems and social systems.

Furthermore, systems as sets of congruent actions that are combined to obtain a result, clearly reflects the meaning of Bertalanffy's definition that systems are complex of components, the only thing added is clarity and specificity when establishing that the components are always actions.

Furthermore, it has been shown that all systems are generated from a set of parts that include: energy, components, structure and processes, which constitute specific characteristics that complete the description of a system and establish its capabilities and limitations. This new way of understanding and studying systems will surely lead to a rethinking of many concepts and results and will open the way for new research.

Since the systems are made up of actions, the fundamental part that determines them is the organization and this is rigid in natural systems and in technological systems, because they work based on components that lack intelligence and are designed to carry out the actions that organization gives them. However, the components of social systems are human beings with intelligence and therefore in social systems where the organization allows it, people participate in the creation of the organization, based on the analysis of situations and based on their ability to decide, although they are only able to control their personal actions and this only until the moment they are executed, since the way in which they are combined with those of other members of the organization is beyond their control.

This new way of understanding social systems also opens up a wide range of possibilities to study, understand and manage them. The approach that has been presented here has yet to be expanded but, from the outset, it shows a new way of addressing many problems that have been partially solved by other approaches. The theory that has been developed in this work is clear, simple and forceful. It does not have the philosophical and conceptual complications of other theoretical developments that have been elaborated in relation to social systems.

The traditional approach based exclusively on the components of the systems has caused that many concepts are only applicable to certain types of systems or to certain specific areas of science, technology or human activity. The lack of generality has made it difficult to transfer knowledge about the systems. Now with the concepts introduced here it will be easier for researchers from different scientific specialties to exchange knowledge about systems.

Knowing in detail and precision the ontological essence of the systems and knowing that they are constituted by actions, you will have to rethink many previous investigations that did not consider this characteristic or the requirement that every system must be based on six elements and this, in addition, will open new research that takes advantage of these innovations.

References:

Langlois R. (1983). Systems theory, knowledge, and the social sciences. . In: Machlup, F., Mansfield, U. (Eds.), The Study of Information. https://pdfs.semanticscholar.org /9664/4d45a67a23e66c327acbb0a70ada4f949333.pdf , 581 - 600.

Leighninger R. (1978). Systems 7eory. 5 (4).

Luhmann N. (1983). Insistence on Systems Theory: Perspectives from Germany-An Essay. Social Forces. http://www.jstor.org/stable/2578274. , 987-998.

Luhmann N. (June 1983). Insistence on Systems Theory: Perspectives from Germany-An Essay. Social Forces, 61 (4), 987 - 998.

Luhmann N. (1998). Social systems: Guidelines for a general theory. Barcelona, Spain: Anthropos Editorisl. Ruby.

Adams K. et al. (2014). Systems Theory as the Foundation for Understanding Systems. Systems Engineering .

Becht G. (1974). Systems Theory, The Key to Holism and Reductionism. BioScience,, 569 - 579.

Bertalanffy L. (1968). General System Theory: Foundations, Development, Applications. New Tork: George Braziller.

Dori D. et al. (2019). System Definition, System Worldviews, and Systemness Characteristics. IEEE SYSTEMS JOURNAL .

Dori D. Sillito H. (2017). What is a System? An Ontological Framework. Systems Engineering .

McLoughlin J. and Webster J. (1970). Cybernetic and general-system approaches to urban and regional research: a review of the literature. Envaironment and Planning , 369 - 408.

Miller J. (1978). Living Systems. McGraw Hill Inc.

Miller J. (1986). Can Systems Theory Generate Testable Hypotheses ?: From Talcott Parsons to Living Systems Theory. Systems Research , 73-84.

Resconi G. (1986). A general system logical theory. Int. J. General Svnems , 159-182 .

Rosen R. (1986). Some comments on systems and system theory. International Journal of General Systems, 13 (1), 1 - 3.