Applications of Analysis of Systems as an Independent Science

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Abstract

This paper summarizes research that has been done with systems as research object. It has been defined the concept of "system" and other fundamental concepts of system analysis. The relationships between these concepts has been formulated in the form of axioms, and based on these axioms, the general theory of systems was developed as a particular case of the L theory of calculus of statements. Finally, from the analysis of these studies, we can conclude that: it is possible to apply system analysis to any type of organisation, which is investigated by other branch of science, since system analysis is an independent branch of science..

Keywords— System's Analysis, General theory of systems.

1. Introduction

The results of several issues are presented that they have been researched having: systems as a focus of study: the field of science in contact with systems; the different ways of explore systems. The concept of *"system"* and other fundamental concepts of system analysis have been defined previously. In previous papers we have presented examples of ordinary systems [9], of those the empiric basic characteristics can be shown that meet them in only research object, being pointed out of other research objects. Then we have defined ideas like, a component of a system [9]: base of a system, as a sum of properties of components of system that defines to the same one; external means which are common to a system and its components; boundaries between a system and external environment and lastly: function of a system, as an integrative sum of its components. These ideas have been explained [9] by means of the analysis of some examples of ordinary systems such as: the solar system, an organism, an automated administration system, a reactor of an atomic station, a company, the system of chemical elements, algebraic system, etc.

It has also been formulated, by axioms, the relationships between these concepts. Taking this into account, it has been developed the general theory of systems as a specific case of L theory of calculus of statements. Then, it was defined that the main purpose of every system is the conversion of matter properties. Considering that system analysis, as the science of systems, has a triangular structure, where: the base is formed by systems; summit is the general theory of systems; and in middle there are the applications of other theories related to systems. And, it has been established that system analysis is an independent branch of science, and it has likewise been defined with the following stages of simple evolution of systems: 1) emergence and synthesis; 2) functioning; 3) degeneration and collapse. It has been defined cyclical evolution of systems as the sequence of simple evolutions with an invariable function. It has also been included a list of examples and applications to typical cases of system analysis with the solution to practical problems [9], for which different fundamental cases of system analysis have been formulated. This paper has a list of works, which published results of several researches.

Taking these studies as starting points, a conclusion has been reached: it is possible to apply system analysis to any class of organization, which is studied by others branches of science, so it is possible to say that system analysis is an independent branch of science. We sustain that systems of different type and destination are research object of systems analysis. Studies about system analysis have been raised, through some publications carried out in territory of the former USSR, and published during 1948-1992. The methodology used to carry out these researches has been the one provided by scientific method, that is to say: a central hypothesis is formulated and then it is whether refuted or proven, and then taking it as true others can be deduced. The analysis of systems is based on the definition of *"what a system is"* and which are its relationships with the environment or external. These systems had been investigated with help of philosophical means: categories, laws, and structures of categories; and the conclusion was that: a system is a reality with properties apart from the ones of its components, unified by a function of those properties.

2. Development

2.1. Characteristics Of Systems

Now our question is: *What do all systems have in common?*

Firstly, they have particular properties and, second, the integrity of those properties. Really, when we speak of a system, we use together with the word *"system"* the definition of its type: economic, computer, physical, chemical, etc. All those definitions point out types of properties of systems. The particular properties of a system, point out their type and they characterize it. At this point, we should emphasize that properties do not always form a system, but only in those cases is that they conform the integrity of the same one. Then, *a common feature should characterize the integrity of properties.* Analysing previous examples [9] it can be seen that the essential characteristic systems possess is its function and it is a necessary condition for a system to exist. To limit the research scope we define that the real object has a number M of properties, where M can or cannot be limited. The number of discreet properties is smaller than the number of properties of the whole matter. Then, looking at a real object as part of a system, we give him the number M of calculated properties. We point out this characteristic as N. Continuing with precedent analysis, any real object can be a part of a system, but a system is conformed solely of the properties of the objects that compose it. Then the question is: *Where are they remaining properties of components of system?* If we consider each object as a vectorial space of M dimensions where each dimension is the representation of one of the properties of the object, system could also be represented as a vectorial space whose dimensions are a number m of properties common to all component objects. Remaining dimensions that conform objects of a system but are not included in the same one, they are part of what we will denominate base of the system. We will call **M** to the number of properties that characterize the object and **m** to the number of properties that characterize the system.

As examples of simple properties we can mention: computer, kinematics, electrostatic and the energetic would be as an example of combined properties starting from the simple ones (it is potential, kinetics, nuclear, thermal, mechanics, electric and other energy varieties) consequently, the relative number of properties that form the system is defined by the following approximate correlation:

$\delta M = m/M \approx (1 \div 10)/M$ **... (1),** Where it is possible: $\delta M \rightarrow 0$, when $M \rightarrow \infty$ **... (2).**

Apart from the properties that form the system, a great quantity of other properties that do not participate in the formation of existing system. Their approximate number is equal to:

$\Delta M = M - m$ **... (3),** where it is possible: $\Delta M \rightarrow M$, when $M \rightarrow \infty$ **... (4).**

It can be defined, then that: *Those properties of components of system that do not define the system, are denominated the base of the system and we indicate it with the letter B and we say that the base is characterized by the group of properties* ΔM.

Using the group of properties as the measure of the system, parts and base, it is possible to establish the following theoretical relationship: $N = S \cup B$ **... (5),** that is to say, the union of properties of components of a system, is similar to the union of properties of system and of its base. The separation between the real object belonging to system and the rest of the matter, creates a limit where what is not the object itself is the external mean of the system. It is defined external mean to system, to all that does not conform part of the system or their base and we indicate it with letter **V**.

We designate the limit of system as letter **G**, and in systems analysis the first division to carry out is the separation between objects of a system and external means. Limit **G1** between object and external means is simultaneous. A second division is carried out when separating properly this system of base and in turn, between system and its base we find a second limit **G2**. Limits **G1** and **G2** have different forms.

2.2. Function Of A System

The separation of the system **S**, of its base **B** and of external means **V** leads to emergence among them of the relationships for orderly pairs: **<SS,SB,SV,BS,BB,BV,VS,VB,VV> ... (6),** relationships of the system with each one of them give us: **<SS,SB,SV,BS,VS> ... (7).**

For what we define that the group of external relationships of system (7), will define the function F of system and if all relationships are coherent in the interval of time ΔT and they are subordinated to the following conditions: **condition 1** - integrity of relationships; **condition 2** - stability of formed properties of the system; **condition 3** - stationery of relationships; **condition 4** - stability of relationships. Then, the function of system **F** in the interval of time **ΔT** is defined with the expression: **F = <SS,SB,SV,BS,VS>** in **t**∈ΔT and conditions 1-4. (8).

The expression (8) keeps in mind external relationships of the system, but its properties are characterized by interior relationships of properties of system **si**, their characteristic **sij** and their quantity **sijk**, defining integrity or functionality of system:

$F = F(s_i, s_{ij}, s_{ijk})$ ... (9). Integrity of a system is possible when its structure functional interior (9) corresponds to external relationships (8), that is to say: **$F(s_i, s_{ij}, s_{ijk}) =$ <SS,SB,SV,BS,VS> ... (10).**

Of (10) one can say that system exist when there is correspondence among the interior properties of system (as integrity), and its external relationships.

Up to now we only use empiric characteristics of systems. Starting from the necessity of the definition of systems properties characteristics arises **si** and of function **F**. The characteristics of properties are **sij** and their quantities **sijk**. Properties **si** and their quantities **sijk** are studied in applied sciences as physics, chemistry, economy, etc.

Function F in (10) it is represented by characteristics of all their components. We have already defined main ideas about system: system **(S)**, amble of system **(N)**, base of system **(B)**, external means **(V),** limit between system and external means **(G1),** and limit between system and its base **(G2).**.

Then, systems as research objects, can be represented by the following group: system, base, external means, limits **G1, G2:<S, B, V>, G1, G2 ... (11).** It arises the condition 5 then:

Condition 5 - in system analysis object real-amble of system is replaced by association (5) of system and its base. External relationships descript as association of relationships are (7).

Neither base nor external means are systems, and we can represent them as association of parts.

$B \sim \langle B_1, B_2, B_3, ..., B_k, ..., B_K \rangle$ ... (12), $V \sim \langle V_1, V_2, V_3, ..., V_l, ..., V_L \rangle$ ... (13),

Where: "**~**" is an equivalence sign; **k,l** – they are orderly numbers of parts; **K,L** – it is quantity common of parts, Base **B** is limited but external means.

Relationship of distribution of system base B to parts **B1, B2,..., Bk,..., BK** (12) it drives to structure of relationships interiors of base (**BB**) in form of relationships matched up among their parts. Relationships of base with system **(BS,SB)** and of base with external means **(BV,VB)** have the same type of match up, but due to the integrity of systems and distinction of limits **G1,G2** they are very different. In some parts of the base it is possible the existence of other systems.

Division of external means of system **V** in parts **V1,V2,V3,... ,VN** (13) drives to structuring interior relationships of external means (**VV**) in form of relationships matched up among their parts. Infinity of external means is limited by definition on the more related with properties of system **N** behalves.

2.3. OTHER IMPORTANT NOTIONS.

We can enunciate our first working hypothesis:

Hypothesis I: *Each system has a group of properties corresponding to real objects that allow him to carry out a function.* Starting from Hypothesis I, and with help of philosophical logic, main ideas can be deduced, from the notion of *"system"*:

- real object as amble of system; properties of system that conform real object; external means to real object (and to system); limit among real object (and system) and external means; system base as a part of real object, which does not belong to system; limit between system and their base; external relationships between system and their base and exterior means; function of system and their external relationships according to integrity, different states and stability.

Relationships among these notions were set in form of axioms.

2.4. General Theory Of Systems.

Up to now we have considered main notions and axioms in the branch of systems. But, due to the lack of rules of conclusions about new truths (theorems) it is difficult to build a new general theory of systems. It is known that the sustain of any theory is the enunciation of conclusions (enunciation of predicates and theory of multitudes are insufficient to build theory of systems).

Conclusions of **L** theory allow to affirm that it is complete, not contradictory and axiomatic: in order to use L theory as a base for general theory of systems is necessary to prove the truth of all axioms in the branch of systems. Under that circumstance, general theory of systems will be a particular case of L theory, at the moment of arriving to conclusions. Necessary test can be carried out in two ways: 1) by means of L theory, using rules of conclusions (Modus Ponens); and by means of tests using computer with help of the language PROLOG. Results obtained from this series of test were positive.

2.5. Systems As Research Objects

If we look at systems as research objects more cautiously, we can say that a system is characterised by its formation properties and its function. Systems can be classified by their properties (computer, mechanics, economic, etc) whose properties can be simple (electrostatics, kinematics), compound (mechanical, ecological) and they can also have a varied nature (alive, not alive, natural and artificial). It can also be defined a type of systems according to their properties, class of systems, according to quantity of simple properties; and species of systems, according to nature of their properties. Classification of systems according to their form and their expression of function was determined according to gender of systems: according to relative level of integrity; according to level of stability (stable-unstable) and according to stationary level (stationary-not stationary).

2.6. Destination Of Systems.

Main destination of each system is realisation of its function beyond its formation properties. The function of a system is not included in its formation properties and consequently, it includes other properties. We call to those functional properties and, we say that destination of each system is transformation of matter properties.

2.7. A Place For System Analysis In Science.

¿Which is the place that system analysis has regarding other sciences?

Every science has the following common structure: science science-branches (physics, chemistry, biology, economics, etc.) scientific disciplines (for example, in physics: astronomy, acoustics, optics, mechanics, heat, etc.) scientific specialities (for example, in heat: calorimetric, thermodynamic, thermometry, etc.). System analysis does not belong to any branch of science, but studies systems of all branches of science. Consequently system analysis, as science of systems, is presented like an independent branch of science.

2.8. Dynamic of Systems.

We can formulate now the following hypothesis.

Hypothesis II: *Each system is limited in time and space*. From this hypothesis we can deduce that systems appear and they disappear. Besides this, a system is inertial, because it represents properties of a real object. It is for this reason that appearance and disappearance moments of a system are separated in time, as their simple stages: stage I: appearance and synthesis, stage II: stable and stationary operation with constant function, stage III: degradation and decomposition.

The form of simple evolution of a system is trapezoidal. It is also possible recurrent evolution of systems as a succession of simple evolutions with a constant function.

2.9. Some Applications Of Systems Analysis.

– Principles of management as a scientific discipline, studies of administration systems of companies according to conditions of market, were compiled and used in some universities [3].
– Possible application of systems analysis was also studied for the synthesis of control systems of reactors in atomic stations [4].
– Recurrent evolution of universities was studied, considering the conditions of degradation of educational system according to country [5].
– It was considered the possibility of application of system analysis in sports [6].
– Connection of system analysis was studied with theory of cycles [7].
– System analysis was used together with methodology of presupposition for elaboration of presage of recurrent evolution of administration systems [8].
– Students studied (with permission of Sacred Vatican) possibilities of systems analysis of Catholic religion, as system of conception of world (in University State Technician of Donetsk, 1998), It was studied methodological connection between system analysis and object oriented programming (in University State Technician of Donetsk, 1997).
– With help of system analysis, Avant-Project of computer-analytic system was elaborated for a city (in University State Technician of Donetsk, 1996).
– It was carried out system analysis to study new global system "MediaInternet" (in MediaInternet, Buenos Aires-New York, 2000).

2.10. Perspective Of Systems Analysis.

Accumulation of empirical results will allow development and evolution of theory of systems. In order to accomplish this, it is necessary the application of its theoretical principles by universities mainly as investigation centres for systems of different types: computer, technological, economic, political, military, etc. These investigations will allow an increase in the body of knowledge that sustain systems analysis as a new science.

3. Conclusions

Most of the results of the raised investigations [1], [3]-[9] have been carried out and discussed in universities and scientific centres of Ukraine, dedicated to research of systems and their analysis. It has been used the experience of scientists in others countries and academics such as Mesarovitch and Bertyalanfy [10, 11]. These results are those that allowed to enlighten the central ideas of theory of systems and to increase the knowledge about their characteristics and evolution.

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