Thoughts on the General Systems Theory

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Abstract
The most common definition of systems is formulated as “a combination of elements”, or even as “any object is a system”. Many authors have presented the formal definitions of an aggregation of two multitudes: elements and relationships. but a single, universally accepted Systems definition still does not exist. In this article, Why this happens, what matters in definitions do not have the answers yet, how “General Systems Theory” metascience and “Systems Engineering” particularistic science relate, the paradoxes of general systems theory, and much more will be discussed.
Keywords systems’ definition, general systems theory

1 Introduction

Known classic of General Systems Theory V.N. Sadowski brings dozens of existing Systems’ definitions [1]. Other authors add new definitions, but a single, universally accepted Systems definition still does not exist. Why this happens, what matters in definitions do not have the answers yet, how “General Systems Theory” metascience and “Systems Engineering” particularistic science relate, the paradoxes of general systems theory [1], and much more will be discussed in this article. These issues arise primarily in the course of the analysis of existing definitions and their research by V.N. Sadowski in the book “Foundations of General Systems Theory”. From our point of view as long as it is the best and most comprehensive study to date of the existing state of things in terms of the General System Theory (GST).

The purpose of this paper is to formulate the most pressing issues in the context of system definitions and attempt to identify ways to address them.

2 Existing Definitions and Issues Arising from Them. Entropy

The most common definition of systems is formulated as “a combination of elements”, or even as “any object is a system”. Many authors have presented the formal definitions of an aggregation of two multitudes: elements and relationships [2].

Our task is not to refute or criticize existing definitions. We’re just going to try to formulate questions to the definitions and try to find answers to those for which it is possible within this article.

In the analysis of any definition there is the first important question, the answer to which is connected to all systems definitions and classifications. This question will be worded as follows: “Does a system really exist?” Not many researchers ask this question, but those who are wondering, as a rule, respond to it positively. It seems to us that the question can’t be answered at all. Why? Let’s think constructively.

Were there Systems before the mankind? If we answer in the affirmative (systems have always existed), what is the point in trying to determine them? They already exist, someone created them, and therefore defined? And what about those systems that the man himself creates? And what about those systems, which include both elements: those existed prior humans and artificial elements? This question is based on the idea that if we say that the system is there, so we know what we say, and this system has already been described by someone and you can explore it as a system. Obviously, prior to mankind, to be exact, even to the end of XIX century, no one knew what the system in the modern sense were, did not describe them. So, we can only speak of the objects or entities existence, but not the system.

If the answer to the existence of systems prior humans is negative (system concept was invented by a man, and prior him the concept did not exist), then we are just coming to terms of Kant transcendental idealism, according to which the person is not doing anything, but only “reflects”.

It seems to us that the answer to this fundamental question must be sought in the following. A man created the concept of a system. He “adjusts” the existing reality to his concept. In fact we find the objects, try to assign them the system properties (which we have invented ourselves) and state that systems exist. It’s fine if scientists understand that examine just a model, not the system. The researchers come to paradoxical conclusions: for example, the type (genus, family) of animals-is also a system. Obviously, from the point of view of nature of it is not so, because the concept of genus, species, family also came up with people. Certainly, nature was not busy with splitting all living beings into the genera and species. In fact, these systems are completely virtual. Otherwise we’ll have to admit a creator, who invented not only flora and fauna, but also classified them.

Thus, if we wave away the non-scientific idea of a universal creator, we are forced to admit that the system did not exist before humans and does not exist now. Here we see the fundamental paradox of the system science: everybody talks about a non-existing, and not only talks, but also uses in their practice and research.

Of course, aside from all of this there are artificial systems that people originally created as such. But in this case, and the conceptual apparatus is immediately objective. In particular, if we build a car as a system of interacting elements that has to deliver goods from point A to point B, we define the system on the basis of interacting elements, goals and functions.

Thus, solving this major issue, we split at least (and fundamentally) natural and artificial systems, knowing that the latter are systems a priori.

Now we continue the argument about natural systems (which exist only in our minds?).

Usually, natural systems are classified as animate (living) and inanimate (non-living) ones. If every living individual can be somehow dragged into the system concept, the inanimate objects can be appealed to only in the form of models, as we do not know enough about them, about the hierarchy of these systems, and possibly even the dimension in which they exist. For example, a stone lying in the mountains. Is it a system? From the point of view of the most general definition ("any object is a system") a stone is undoubtedly the system. From the point of view of the extension of the concept (for example, an observer or function), the stone can't be considered a system, until we started to study it and / or until it is comes into operation. Of course, we can think of the functions of internal heat, molecules and atoms inside it, the crystal structure, etc. But is it a system while it is lying, and it is not being studied? In that case, why bother to talk about such an object as a system? Only because of a common definition of the System itself?

No less obvious the application of the notion "system" to objects of fauna. Is a particular bird a system? From a biological point of view (only because it is more convenient to be studied by a man)-of course. And from the point of view of other fauna? Possible-it is also a system. A bird feeds, feed others, in addition it gets a lot more besides input actions. We may say that here the interpretations of definitions of the hierarchy, morphology and interaction of elements, the micro and macro levels are performed. One point confuses us: the bird itself does not know it and, moreover, does not take any concerted action to be in the system. Just feeds, breeds and dies. From this point of view, it is like the inanimate nature, stone, which also does not "know" that it is the system.

There is only one answer to all these questions: a human called it a system. He himself invented system. And each person (the researcher), has its own system. In fact, this system is some kind of a model for our understanding of a particular entity. The model itself, in turn, is also a system. And when the researchers begins to study the model, he/she has to disengage himself/herself from the "system" (more precisely, from the subject). No researcher argues with this. Do we do with an object, which exists, not realizing that it a system?

But the most paradoxical is that the person giving the definition of the system, tries to simplify the study of all the systems to unify their properties, suggesting that in the future it may be possible by studying one (the one that he understands) system to project (extrapolate) the system properties on the other system he understands less. If this does not work directly, it makes changes to the definitions, complicating them by adding new elements and features. Such "fitting" of definitions for a research specific needs leads to the greater separation of new definitions from classical ones, and, as a consequence, to greater entropy in the system definitions themselves.

Discuss the entropy and the second law of thermodynamics, which, from our point of view, is applied indiscriminately to almost all known systems.

Interpretation of second law of thermodynamics is unambiguous: "Entropy of an isolated system may increase or remain unchanged. Reduction of entropy in an isolated system is impossible" [3]. What do many systems researchers do? They apply the second law of thermodynamics and the concept of entropy itself to any of the studied systems. In this case, few people pay attention to the paradox that, for example, self-organizing system does not increase the entropy inside themselves, but reduce, not desintegrate, but are being created, and organize themselves. This error has been long known to physicists and many other scientists. The concept of an isolated system in the definition of thermodynamics means no system interchange with the environment, not only by means of substance (closed system), but also by energy. The gross error is also the application of the concept of systems entropy to the systems which are not in equilibrium (initially entropy is a measure of the thermodynamic system in equilibrium).

Another mistake made by researchers who follow the fashion-application of the laws of thermodynamics to any system, including ones of not physical, and certainly not of a thermodynamic nature. For example, how does a perfect system of geometric axioms relates to thermodynamics and how we can apply the principles of entropy change to it?

However, despite these considerations, all systems eventually die (entropy increases). Why? Is there a common cause of death of all the systems? And may the root cause of this common cause be the determination, which is man-made? Meaning that the man gives the definition of the system in which it ends its existence (and this definition may include this course latently, possible only in the context of the investigator).

Most researchers believe that the system is, by definition, hierarchical, that the system itself may enter into other systems as an element (subsystem), and each of the elements of the system is the system on its own level of consideration. However, if at the intuitive level, this can be imagined, at the level of universal definition systems this property may seem controversial. Why?

If we assume that the system as a term was invented by people (not nature and not the creator), then considering a particular system in a large number of cases, the researcher does not appeal to the macro or micro systems, even not assuming that there is a hierarchy. As an example, study the alphabet. With this study, it is possible to ignore the fact that a particular alphabet is a subset of all human alphabets. But at the micro level, in some context, we are absolutely not interested in each letter as a system (for example, lettering or placing them side by side in constructing words, etc.). One can argue that in this case a systematic approach does not apply. But in course of the alphabet model study we can look at it from the point of view of other system properties, in particular the main-integrity (agregation of letters has properties not possessed by each letter separately).

Perhaps we have no questions only to this particular property system-a property of integrity (the interaction of elements of the system leads to system properties / functions that each element separately unable to perform or "the object properties can't be reduced to the sum of the properties of its constituent elements and non-deducibility of the last properties of the whole".

3 System Paradoxes

The urgency of our questions is confirmed by systemic paradoxes in V.N. Sadowski works [1].

And in particular, the first paradox of hierarchy, which is the following: for a complete description of the element as a "system element" there must be a full description of the system that can't be described fully until each element is described.

Therefore, the question of the legality of a systematic approach analysis of micro and macro-level systems remains a question, the answer to which is possible in our view only in specific applications, with significant restrictions in the context, or the use of artificial systems with known properties, as-built for specific purposes.

Let's consider a simple example. A man, as a biological system, consists of elements (subsystems): circulatory, digestive system, musculoskeletal, respiratory, etc. If we try to describe the circulatory system, as a separate, outside of the body, we can miss important features of nutrients carried by the blood, oxygen, and various chemical elements necessary for metabolism, etc. For a complete description of the circulatory system, as part of the body, we need to have a complete description of the body (including the blood system). Thus, for the study of any element of a complex system, we have to build a model that is different from the object due to substantial simplification.

Considering the provision of oxygen, we can abstract away from the digestive system, which significantly affects feedback and the circulatory system, which in some cases may be affected so much that the work of the respiratory system will be blocked.

Even more interesting example is when a person studies a community of people, to which he /she belongs, and his/her decisions can affect the outcome of the system. In this case, self-knowledge is not just difficult, it is impossible.

On the other hand, if we consider a vehicle as the system, studying any of its units (subsystem) is simplified by the fact that creating a car we base its structure on system properties.

The rest of the paradoxes is formulated similarly based on the fact that it is impossible to explore a part, not knowing to the whole and vice versa.

Here we do not just agree with V.N. Sadowski, but get confirmation of these issues. Namely: "The attempt to interpret paradoxes considered static, applied to the system knowledge, taken out of its development, inevitably leads to the conclusion that the system thinking is impossible."

4 How to Answer These Questions

In what direction should one look for the answers to these questions?

The first way is, of course, a sharp decline in the number of systems, consideration of only artificial systems, which were originally created as a system, not disseminating research results to other systems.

The second method, proposed by V.N. Sadowski, is to explore the hierarchical systems by fixing some elements/connections/properties. As is done in the systems of equations, where the number of unknowns by more than 1 greater than the number of equations. Solving such systems of equations, the researcher captures part of the unknown variables and then solves the solvable system of equations. Unfortunately, this method, as well as the method of successive approximations, proposed V.N. Sadovski, does not allow to solve systemic paradoxes efficiently, in real time, with the right qualities in the study of systems.

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