Information processes in open systems

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Abstract. The paper examines an approach to defining the concepts of "data, "information", "knowledge" based on their role and place in open systems in general systems theory. These concepts are key to the implementation of natural and technical systems.

Keywords: open systems, target function of systems, data, information, knowledge.

People almost all the history of humankind use the concepts of «data», «information», «knowledge». However, so far these concepts are intuitive, interpreted differently by most people, are among the most debatable in science.

Some definitions of information currently used in various fields of human activity can be cited [1]:

– in use information call any supplied or the data which interests someone. "Inform" in this sense means "to report something unknown before";

– in the equipment understand the messages transferred in a form of signs or signals as information;

– in cybernetics understands that part of knowledge, which is used for orientation, active action, management, i.e. for preservation, improvement, development of a system as information (N. Wiener).

N. Wiener also defined information as a symbol of content received from the outside world in the process of our adaptation to it and adaptation to it of our feelings.

K. Shannon, who laid the foundations of information theory, viewed information as the removed uncertainty of our knowledge of something.

Several other information definitions can be cited:

– information is data on objects and the phenomena of the environment, their parameters, properties and a state which reduce the degree of uncertainty which is available about them, incompleteness of knowledge (N. Makarova);

– information is a denial of entropy (L. Brillouin);

– information is a measure of complexity of structures (A. Moles);

– information is the reflected variety (A. Ursul);

– information is the content of process of reflection (L. Tuzov);

– information is a probability of the choice (I. Yaglom).

International and Russian standards define:

– knowledge of objects, the facts, the ideas, etc. which people within a concrete context (ISO/IEC 10746-2:1996) can exchange;

– knowledge concerning the facts, events, things, the ideas and concepts which in a certain context make concrete sense (ISO/IEC 2382:2015);

– the data perceived by the person and (or) special devices as reflection of the facts of material or inner world in the course of communication (GOST 7.0-99)

Academician N. N. Moiseyev even believed that due to the breadth of the concept there is no and there can be no strict and sufficiently universal definition of information.

There is now roughly the same discrepancy with definitions of data and knowledge.

This divergence of concepts takes place against the background of the rapid development of information technologies, information science, computer science, for which these concepts are key.

Based on the above, it seems relevant to propose a hypothesis that systematizes these concepts, determines their role and place in different systems. The present hypothesis is based on the basic provisions of the general theory of systems, the foundations of which were laid by such scientists as M.D. Mesarovich, Carl Ludwig von Bertalanfi [2, 3] and many others.

Some basic principle with which many experts agree today (but not all) in the field of the theory of systems is that backbone system performance is existence of some target function of a system. Target function can be tracked in many definitions of the concept "system", for example, of a selection [4].

In terms of target function, all systems can be divided into opened and closed. Open systems are those that, without an environment external to it, cannot realize their target function. Respectively, the closed systems from this point of view are self-sufficient. In reality all systems which we know are open, the closed systems purely speculative constructions.

On this basis, it can be assumed that open systems should have tools to interact with the external environment, by means of which the system receives (extracts) from the external environment what it needs (target flow) and, in addition, ensures its integrity. It can be assumed that such a tool (within the system) is the means for information interaction with the external environment. Data tools, information tools and knowledge tools are part of the tool.

The main tasks of data tools are to extract different objects (data) from the external environment and to determine the semantics of these objects (declarative knowledge). Obviously, these declarative knowledge must be trained by the system. The characteristics of these objects with a system-friendly semantics are data that must be further analyzed by the system.

The main task of the information tools is to determine the significance of the extracted data for the implementation of the target function. At each point in time, the system decompresses the target function into a series of sub-goals. Meaningful data for implementing sub-goals is system-specific information. This is the main stage, as the information becomes a guide to the system's actions regarding the external environment.

In order to determine relevance, the system must have a set of productive and procedural knowledge to which it must also be trained, and a system of decision-making on the significance of objects of the outside world for a set of sub-goals.

For similar situations, the system must accumulate some information set (primarily in the form of the above-described knowledge), which simplifies decisions to respond to these situations. This set represents the knowledge or experience that the system acquires in the course of its life.

Most closely, it is possible to lead A.A. Zhdanov's works in the field of autonomous artificial intelligence and off-line adaptive control to this context [5].

This most general, absolutely cursory examination of a question of the nature of systems and the principles of construction artificial (created by the person) systems. On the other hand, according to the author of the real work, the stated approach is represented new and rather constructive for further researches. On the way of realization of this approach a lot of the most difficult questions, such as, formalization and structuration of target function, definition of algorithms of determination of the importance, use of information tools for ensuring integrity of a system and a lot of others questions. Now it is hard to say what features, architecture and structure the central component (brain) of such systems – the computer has to have, but he has to be able to solve the problems considered above.

In the light of the above, it is represented appropriate to remember V.M. Glushkov's theses about the automated and automatic systems [6]. In this aspect the existing information systems are human-machine where a role of the person, first of all, this goal-setting and effective use of results of computer data processing. Automatic systems have to have the subjectivity considered above in the context of human-machine systems.

In conclusion, it would be desirable to tell the following. Consideration and further development of the questions considered above, in opinion of the author, can have triple character. On the one hand, these questions can make a little new nature of informatics as natural-science discipline, the studying information mechanisms in natural and social systems. On the other hand, the results received in the previous direction can be base for development of approaches to design of the artificial systems and technologies having independent, adaptive artificial intelligence, subjectivity. Moreover, from the third party, this approach can be used for further development of a formal basis of the previous directions – the general theory of systems.

Realization and development of the conceptual approach considered above demands significant efforts and some reconsiderations of many sciences, including philosophy, biology, social sciences, psychology, engineering sciences and many others, including, can be even, theology.

In addition, absolutely in conclusion. In such ordinary terms as "information technologies" and "computer sciences", two words - "information sciences" as natural-science sciences and "computer technologies" as engineering introduction in practice of results of information sciences would be desirable to trade places.

Ignoring of the questions considered above can represent essential technological hazards of opportunities of implementation of digital economy and in general information society.

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