## Filozofické vědy

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# METHODOLOGY OF FORMALIZATION OF PHENOMENA UNDER ANALYSIS AS A POTENTIAL PROBLEM OF INFORMATION-ORIENTED SOCIETY

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**Summary.** We have analyzed the history of advent of the methodology of formalized description of reality and its impact on society. In the context of the use of mathematical modeling systems we have analyzed potential problems of employing the formal approaches. We have arrived at a conclusion that there is a certain danger of applying principles of formalization in modern information-oriented society, related to increasing application of multi-stage formalization in interaction of the users of computer information systems with the outside world. Thus, the paradigm of formalization, which became one of the forces for progress in the technology-oriented society, works differently in the information-oriented society.

**Keywords:** formalization of reality; the development of science; information Society; mathematical simulation; living Earth simulator; Planetary Nervous System; danger virtualization.

With the birth of the society a problem of information exchange, both in terms of its transmission over a distance and of its storing over time has emerged. This problem is rooted in the fact that a person, perceiving the picture of the world around and analyzing it, is not able to directly share its contents with other people. This hindered the development of society, preventing individuals from sharing their experience and working together for its accumulation. A very simple, yet effective solution was found: formalization of the images in the form of ideas about them. The images were formalized by words and pictures. Words were formalized by sounds, and sounds and pictures by letters and characters, etc.

The way to solve the problem of information exchange through its formalization subsequently found its application in almost all fields of human activities: in music, the sounds of nature were formalized by artificial sounds created by man-made instruments and described by notes, modes, octaves; in mathematics, the real countable objects were described by figures replaced by numbers, first real numbers, then negative ones and even imaginaries; in physics, the real objects were replaced by models, first by full-scale models, then by descriptive mathematical models, etc.

It was formalization that was the main component of the scientific toolkit of human society development: it provided an opportunity to accumulate and share the information, and collaborate on projects. At the same time, the events proved the following: **the higher the degree of formalization is, the more convenient it is to use it**. A good example is formalization of words and syllables by characters or sounds by letters. In the second case, the level of abstraction and the degree of formalization are higher. At the same time, in order to read fluently, a Chinese needs to learn about five thousand characters, and for a European or a Russian it is sufficient to know three dozen letters. However deep formalization causes certain problems. The greater is a phenomenon or process under analysis, the more formalized elements it has and the higher is the level of nesting of formalization process in it, the more its formalized view differs from reality, **creating a problem of appropriateness of a formalized description of phenomena and processes**.

Up to a certain period, such problems were suppressed one way or another. And for the time being, the approach to development based on formalization brought nothing but tangible benefits. Formalization enabled description of phenomena and processes in a language understandable for everyone, to share the received formal description in order to provide joint activities of groups of people, to communicate the description to succeeding generations for practical application and development. In the era of technology-related period of human development the paradigm of formalization, in fact, enabled progressive advance of science and technology.

One of the most obvious examples of development of scientific toolkit based on formalization of reality is the construction of a descriptive model of phenomena that provides a basis for such method of scientific knowledge as modeling [2; 4; 5].

This method of learning passed several stages in its development. Initially, the **researcher developed the model and used it**, having been fully aware of the assumptions made in the formalization of the phenomenon under analysis that define the limits of the study. Further, the models were developed by research teams, and the **use of instruments became separated** from the developers. But at the same time the user was aware of assumptions made, at least in general terms, and understood the limits of use of the tool. Finally, the **use of modeling techniques in information systems became widespread, and the limits of use started to slip away from the user too often**.

Currently, full-scale, half-sized and mathematical models are being used to study processes and phenomena. Due to the development of electronics and computer technology, mathematical models which are an approximate description of any class of a physical fact as expressed by mathematical symbols acquired the greatest application in the study of social realm. Lately, mathematical models have often come into use to predict the behavior of complex technical and social systems. The problem of formalization of phenomena and systems under analysis has significant influence in case of use of such models.

It is known that during their existence mathematical models have taken quite a long path of development: from simple models of simple phenomena to systems and complexes of modeling of complex social and technical systems. And if in the use of simple models the results of modeling can be logically controlled by a person, the large-scale models, and especially multi-model complexes, are a ‘black box’ for the user, the principles of data processing of which cannot be understood by the user. Later, with the growth in scale of modeled phenomena, the operator of the model keeps the distance both from the modeling process and processing of input and sometimes output information of the model.

On this basis, the use of large-scale models and multi-model complexes describing complex social and technical systems is the most obvious example of formalization of the objects and phenomena under analysis.

An example of this phenomenon is the development of “Living Earth Simulator” (LES), developed by an international team of scientists. According to the developers, this model will be able to show everything that happens in the world starting with the weather and epidemics and all the way to international financial processes [1; 3]. Doctor Helbing, Swiss Federal Institute of Technology, is in charge of the project called FuturICT (Future information and communication technologies). The program developed within the project is designed to assist in explaining the processes that take place on the planet: how human behavior affects the development of society, how the world around us is formed, etc. By means of LES model it is expected to obtain a forecast of risks of various situations: to predict the distribution of contagious diseases, to establish methods of dealing with the consequences of climate change, to detect the incipience of financial crises, etc.

For the model to function properly it must be continuously updated with data of diverse content through data acquisition system similar to PNS (Planetary Nervous System). For this purpose, for example, within the Planetary Skin project, developed by Cisco in cooperation with NASA, the developers create a net of sensors that collect information on the current status of areas of atmosphere, lithosphere and hydrosphere. Furthermore, the developers have already identified in the Internet over seventy other sources of input data for modeling. It is proposed to use a specifically created high-capacity computer network as a technical basis for the model.

An important step in creation of LES model is design of algorithms that allow transformation of a huge scope of collected information into the input data system of the model, i. e. their formalization and aggregation. To accomplish this objective it is proposed to use the technology of the so-called ‘semantic web’ using unformalized metadata.

At present, due to cutting back of financing, the FuturICT project is suspended, but its current state already makes it possible to analyze the key properties of the LES model and to conclude that during its use, the input data for modeling is collected and entered not by operators, as in the case of a ‘regular’ model, but by intermediate program systems and components of the model itself. The model itself processes the results of modeling, delivering aggregated and controlled data to the operator.

On the one hand, this approach simplifies the situation monitoring task, but on the other hand, it moves a person away from working with real information more than ever, replacing the picture of the world around with a formalized model formed by a computer program. And the user is no longer aware of data corruption, including that one caused by inaccuracy of formalization, and it could not even guess the impact of such corruption on the results.

A certain isolation of the user from the real world by using models such as LES is a special, but very illustrative case. This case mirrors the trend. And this is far from being the only example, such a trend is observed not only in research, but also in everyday life, when the user communicates with the outside world not in person, but through the Internet. As the level of computerization of society increases, this trend continues to grow.

The use of formalization here is not the main point. There is nothing wrong in this approach, as long as the user is aware of the limits. The problem is that with the increase of the level of computerization of society, more and more regular users begin to use the sophisticated information products. And that’s where the problem lays: these people do not understand the danger of neglecting the principles of formalization.

With the end of the era of technology-oriented society and advent of the information-oriented era, more and more people have begun to use various electronic devices and technologies that seamlessly apply the basic principles of formalization. As part of this process, by now formalization has been used as a **research tool**, the problems have been smoothed over due to professional behavior of the users, and the risk of error was low. But when, with the advent of information-oriented era, **formalization became a tool of communication with the outside world**, the problem has become as acute as never before. Thus, the paradigm of formalization, which became one of the forces for progress in the technology-oriented society, works differently in the information-oriented society. To ignore the problems of its application by a growing number of users of electronic devices and networks becomes a downright danger.

So, what do we get in the end: The world of 'the harmony of numbers' that was promised by Pythagoreans and that is being developed in the 'non-Pythagorean' society on the basis of a proper system of formalization, or a virtual world of a formalized vision of reality, so far away from the real world? It's time for us to decide...

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