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THE THEORY OF SYNERGETICS AS A METHODOLOGICAL BASIS FOR THE DEVELOPMENT OF NONLINEAR PROCESSES IT INDUSTRY

Abstract. The article analyzes the state and development of synergetics. Features of synergetics are considered. An analysis of its applications is given. The issues of evolution and self-organization reflected in synergetics are considered. The processes of the information field are shown. related to synergetics. The conclusion about possible construction of the synergetic theory of the information is made. In particular, the applications of synergetics are considered: the theory of dynamic chaos, the theory of deterministic chaos, the theory of fractals, the theory of catastrophes, linguistic synergetics and forecasting. It is shown that synergetics creates supporting positions for the development of modern, new, promising areas of theoretical informatics: nanoinformatics, bioinformatics, quantum informatics, geoinformatics, definite informatics, Semantic Web and others.

Keywords: information, philosophy of information, synergetics, information field, modeling.

Introduction

The theory of synergetics as a methodological basis information processes, is able to most fully reflect the complex nonlinear processes in IT indutry, to investigate its systemic nature, sources of spontaneity, disorder and, at the same time, development.In recent years, there has been a rapid growth of interest in the interdisciplinary field, which is called "synergetics". Solid monographs, textbooks, articles, etc. are published. Synergetics as a worldview category covers all new areas of knowledge and ideas, sometimes, incidentally, unjustifiably and even incorrectly.

The Internet is full of publications and discussions on this topic.

The theory of the information field is developing more modestly, but recently work in this area began to serve as a generalization of many processes occurring in computer science.

The information field and the infosphere serve as a source of information and description of the surrounding world. According to the authors, the mutual consideration of synergetics and the information field will enrich the information theory and methodology of information processes research.

Analysis of recent research and publications. The interpretation of the term "synergetics" can obviously come from the creator of this wonderful field, O. Evzikova. According to his definition, synergetics deals with the study of systems consisting of a very large number of their constituent components (subsystems), which are in a coordinated interaction, determine the behavior and properties of the system as a whole [1].

This definition has become a classic and therefore literally passes from one work to another by a variety of authors: V.Tron, M. Boguslavsky, V. Budanov, E. Knyazeva, S. Kurdyumov, V. Kremen, I. Kudryavtsev. This word means the joint action of these components. It was noted. that the term "synergetics" was preceded by the religious origin "synergy", also means an act of merger (with some higher force) [1, 2, 4-6].

It is the synergetic approach that shows the most important role of resonant phenomena, scaling (in computer science, most often, doubling) in the processes of evolution and revolutionary states of information systems.

Extremely interesting coverage of these aspects can be found in the works of the famous scientist V. Budanov and his colleagues, in particular, in the work of V. Budanov. In general, the provisions discussed here are disclosed in detail in the works of a well-known expert in synergetics V. Kremen, Y. Danilov (and a number of other authors). Defining the role and place of synergetics in modern information theory, V. Kremen and Y. Danilov points out that in this rather new field of knowledge (as in many others) synergetics leads a bridge through the gap that separates the reductionist approach in the assessment of phenomena from the holistic[5, p.77].

In contrast to ontologies and model descriptions of various individual specific sciences, synergetics describes the general patterns of evolution and behavior of systems.

Synergetics establishes relationships and reflections of interconnected systemic phenomena. Synergetics provides tools, approaches and methodology for a reasonable transfer of the results of the study of subsystems, parts, sections to their integral integrated and higher in the hierarchy system levels. Here, however, we can only talk about applied synergetics.

Main part

Consider the most studied areas of synergetics. A short list of areas of applied synergetics in numerous scientific sources for the query "synergetics" as of early 2021 is as follows, namely: applications of synergetics are distributed between different areas:

the theory of dynamic chaos explores the extremely complex, hidden order of behavior of the observed system; the phenomenon of turbulence;

the theory of fractals deals with the study of complex self-similar structures, often arising as a result of self-organization.

The process of self-organization itself can also be fractal; catastrophe theory investigates the behavior of self-organizing systems in terms of bifurcation, attractor, instability; linguistic synergetics and prognosis; semantic synergetics; psychosynergetics (synergetic processes in psychology), etc.

Thus, characterization of synergetics as a scientific paradigm includes three main ideas: openness, nonlinearity, dissipation (Fig. 1).

The following notions of synergy also play an important role in the synergetic approach ghettos as fluctuations and bifurcation points.

Fluctuations as small deviations from statistical equilibria are massive about phenomena of changes that occur in the system.

However, the impact on these changes is difficult to determine you without statistical analysis of those phenomena which cause such deviations.

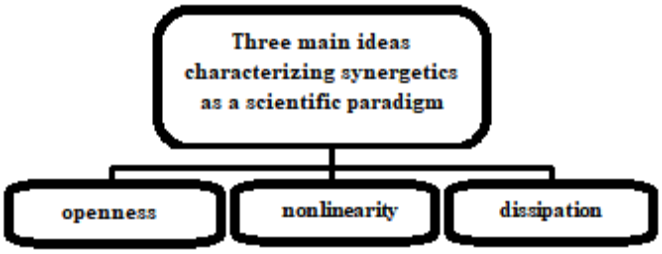

Fig. 1. Three main ideas characterizing synergetics as a scientific paradigm

For analysis of fluctuations requires information system that can provide failures early, processing, analysis, and distribution information on socio-economic processes occurring in society. The fundamental principle of self-organization is the emergence of a new order and the complication of systems due to fluctuations (random deviations) of the states of their elements and subsystems. Such fluctuations are usually suppressed in all dynamically stable and adaptive systems due to negative feedback, ensuring the preservation of the structure and close to equilibrium state of the system.

An important concept of synergetics and synergetic approach is chaos. Chaos in synergetics has dual essence. On the one hand, there is chaos destructive and leads to disorganization of the system, and on the other - it is constructive and contributes to the processes of organization.

Openness of information systems is shown, first of all, due to the intensive exchange of information with the external environment. Such information exchange provides an opportunity ensure coherence of actions, in addition, openness allows the existence of stable nonequilibrium states of the system, or its attractors. Attractors, in turn, ensure existence such a form of organization that is adequate self-structuring of the system.

But in more complex open systems, due to the influx of energy from the outside and increasing imbalance, deviations increase over time, accumulate, cause the effect of collective behavior of elements and subsystems and, ultimately, lead to "shaking" the former order and due to relatively short chaotic state or to the destruction of the old structure, or to the emergence of a new order.

Well-known authors agree that synergetics plays the role of metascience, and therefore it is especially productive in interdisciplinary areas and in the latest areas of scientific and technological progress, which, of course, include the study of modern information systems and information processes in them.

The same is true of synergetics and the general theory of information processes and systems, the mathematical apparatus serving them, because in both visions mathematical descriptions support the general theory of systems, especially dynamic ones. Synergetics is multifaceted, as expected from an interdisciplinary approach. At the same time, it has a kind of "zest", the same one that helped to increase interest in it. According to some authors, synergetics gives its user interesting tools for the study of dynamic information systems and processes and systemic impact on them. This is all the more important because the signs of dynamic processes in modern conditions are rapidly accelerating the functioning of information systems are becoming more pronounced.

In addition, in synergetics, a kind of link between these two approaches, the consideration takes place at an intermediate, mesoscopic level, and macroscopic manifestations of processes occurring at the microscopic level occur "by themselves" due to self-organization, without a guiding and guiding "hand". acting from the outside of the system. This fact is so important that synergetics could be defined as a science of self-organization and as a science that expands the vision of the studied phenomena so that there are previously unavailable opportunities for generalizations, giving rise to fundamentally new promising scientific solutions (including in the field information processes and systems).

Thus, it seems that synergetics creates a foothold for the development of modern, new, promising areas of theoretical informatics, such as nanoinformatics, bioinformatics, quantum informatics, geoinformatics, definite informatics entrostat, theoretical informatics, SemanticWeb (Ontonet), macromedia, and infodynamics. To a large extent, this is due to the fact that these and other new disciplines arise and develop as interdisciplinary.

For example, if we resort to attempts to allocate nanoinformatics in a separate special field of knowledge, we can immediately assume that

knowledge information in classical computer science in some way connects and intertwines with knowledge information in the field of nanotechnology, complementing and developing each other and providing a qualitatively new effective tool for information services of nanotechnologies. At the same time there are processes more perfect and bigger, than simple reduction of one in another, ie processes for the description of which only the reduction approach can appear insufficient.

Some new mechanisms of functioning with new parameters are self-organized, and in themselves the former parameters of the state do not disappear - they remain, but the system is much more productive to represent not in them, but in others - the parameters of order.

I repeat: the relationship between the parameters of the order and the parameters of the state is not one-way - there is a mutual two-way counter-directed relationship. As many authors note, the famous researcher Hacken called such a bilateral dependence a circular causality.

Conclusions

Thus, in synergetics there is a reassessment of the role of chaos in the evolution of nonlinear complex systems. It is proved that the development process is associated with a large the number of coincidences they have weak, small impact and not determined process dynamics. Only a few attempts pass to the next level of development, therefore, chaos was seen as a destructive force, it has a hidden potential for small fluctuations, coincidences. They are at the micro level certain conditions may determine the general the course of events, this requires an unstable state of an open nonlinear medium. This means the sensitivity of the nonlinear medium to small fluctuations that amplified by nonlinear positive feedback. In condition instability there is a connection of micro and macro scales. And small disturbances can determine the macro picture of events.

Characterization of synergetics as a scientific paradigm includes three main ideas: openness, nonlinearity, dissipation. The proposed direction of information-theoretical research is often called synergetic information theory. Apparently, this name of the theory is due primarily to the fact that synergetics is able to describe the reflection of systemic formations, such as order and chaos.

Therefore, given that the term synergetics translated from the Greek (synergetikos) literally means a common, coherent, the phrase "synergetic information theory" is justified.

The article substantiates the theoretical and methodological principles of a synergetic approach to information support of information systems based on the study of its patterns, trends, features, consisting in the presence of self-organization in the subject and in the object in a given area; nonlinearity; chaos as destructive and at the same time a constructive phenomenon; fluctuations, bifurcation points, that lead to changes in the system.

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Теорія синергетики,
як методологічне підґрунтя розвитку нелінійних процесів ІТ галузі

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Анотація. Стаття аналізує стан і розвиток синергетики. Розглянуто особливості синергетики. Авторами виконано грунтовний аналіз її складових. Розглянуто питання еволюції і самоорганізації, що відображені в синергетиці. Показані та проаналізовані процеси життєдіяльності інформаційного поля, які безпосередньо пов'язані з синергетикою. На основі проведеного аналізу зроблено висновок про можливу побудову синергетичної теорії інформації. Зокрема, розглянуто наступні складові синергетики: теорія динамічного хаосу, теорія детермінованого хаосу, теорія фракталів, теорія катастроф, лінгвістична синергетика і прогностика. Показано, що синергетика створює опорні позиції для розвитку сучасних, нових, перспективних напрямків теоретичної інформатики: наноінформатики, біоінформатики, квантової інформатики, геоінформатики, дефінітної інформатики, SemanticWeb та інших.

Ключові слова: інформація, філософія інформації, синергетика, інформаційне поле, моделювання.