

*UDC 332.012***Ihor Oliychenko**, Doctor of Public Administration**Maryna Ditkovska**, PhD in Public Administration

Chernihiv National University of Technology, Chernihiv, Ukraine

**SYNERGETIC APPROACH TO THE MANAGEMENT OF SOCIO-ECONOMIC DEVELOPMENT OF THE REGION****І.М. Олійченко**, д-р наук з держ. упр.**М.Ю. Дітковська**, канд. наук з держ. упр.

Чернігівський національний технологічний університет, м. Чернігів, Україна

**СИНЕРГЕТИЧНИЙ ПІДХІД ДО УПРАВЛІННЯ СОЦІАЛЬНО-ЕКОНОМІЧНИМ РОЗВИТКОМ РЕГІОНУ****И.М. Олейченко**, д-р наук по гос. упр.**М.Ю. Дитковская**, канд. наук по гос. упр.

Черниговский национальный технологический университет, г. Чернигов, Украина

**СИНЕРГЕТИЧЕСКИЙ ПОДХОД К УПРАВЛЕНИЮ СОЦИАЛЬНО-ЭКОНОМИЧЕСКИМ РАЗВИТИЕМ РЕГИОНА**

*The article focuses on the theoretical foundations of synergetic approach to the management of socio-economic development of the region. The laws, trends, characteristics synergetic approach that lead to changes in the socio-economic system are studied. The methods of applying the synergetic approach to the management of socio-economic development of the region are considered. Methodological foundations of synergetic approach to the management of socio-economic development of the region and its information component are suggested.*

**Key words:** socio-economic development of the region, synergetics, openness, nonlinearity, dissipativity, complexity, nonequilibrium, chaos, self-organization, point of bifurcation, fluctuation, dissipative structures, attractors.

*Висвітлено теоретичні основи синергетичного підходу до управління соціально-економічним розвитком регіону. Досліджено закони, тенденції, особливості синергетичного підходу, які призводять до змін у соціально-економічній системі. Розглянуто методи застосування синергетичного підходу до управління соціально-економічним розвитком регіону. Запропоновано методологічні основи синергетичного підходу до управління соціально-економічним розвитком регіону та його інформаційної складової.*

**Ключові слова:** соціально-економічний розвиток регіону, синергетика, відкритість, нелінійність, дисипативність, складність, нерівноважність, хаос, самоорганізація, точки біфуркації, флуктуації, дисипативні структури, аттрактори.

*Освещены теоретические основы синергетического подхода к управлению социально-экономическим развитием региона. Исследованы законы, тенденции, особенности синергетического подхода, которые приводят к изменениям в социально-экономической системе. Рассмотрены методы применения синергетического подхода к управлению социально-экономическим развитием региона. Предложены методологические основы синергетического подхода к управлению социально-экономическим развитием региона и его информационной составляющей.*

**Ключевые слова:** социально-экономическое развитие региона, синергетика, открытость, нелинейность, дисипативность, сложность, неравновесность, хаос, самоорганизация, точки бифуркации, флуктуации, дисипативные структуры, аттракторы.

**Problem statement.** Modern Approaches to Management use a linear representation of the functioning of systems. According of this approach the results of the external action to the system must be unambiguous, linear and predictable. However, the development of system concepts, cybernetics and synergetics has led to changes in the style of scientific thinking and approaches to management. Synergetics offers a new methodology for complex systems research and management of these systems. The word “Synergetics” comes from the Greek “synergos” - co-operating. It studies combined effect of many subsystems, which resulted on the macroscopic level there is structure and proper functioning. The subject of Synergetics is synergetic mechanisms of self-organization, so it is also called the theory of self-organization.

**Analysis of recent research and publications.** The study of theoretical and methodological aspects of using synergetic approach in economy, considered in studies of I.S. Dobronravov, V.S. Bilous, V.D. Derbentsev, B.V. Ilchenko, G. Nicolis, G. Haken, E.N. Knyazev, S.P. Kurdyumov, G.G. Malinetskii, V.P. Milovanov, L.D. Bevzenko, Y.P. Bogutsky. However, despite the significant achievements of these authors remain poorly

understood issues related to the use of synergy in research of information processes in the management of socio-economic development of the region.

**Allocation of the unsolved earlier parts of the overall problem.** Despite the fundamental research information support of regional management, the problems of implementing effective approaches to the management of the region in the modern conditions not enough researched. One of the important problems is the research of characteristics and basic synergetics ideas in applying to improved management of region. Therefore, the problem of using a synergistic approach to information support of the management systems socio-economic development of the region is particularly relevant.

**The objectives of the article.** The purpose of the article is substantiation of synergetic approach to research information processes in the management of socio-economic development of the region.

**The main results of the study.** There are many definitions of the term “Synergetics”. “Synergetics” is defined by R. Buckminster Fuller as a system of holistic thinking. “It is multifaceted and involves geometric modeling, exploring inter-relationships in the facts of experience and the process of thinking. Synergetics endeavors to identify and understand the methods that Nature actually uses in coordinating Universe (both physically and metaphysically). Synergetics provides a method and a philosophy for problem-solving and design and therefore has applications in all areas of human endeavor”. “Synergetics, in the broadest terms, is the study of spatial complexity, and as such is an inherently comprehensive discipline. ... Experience with synergetics encourages a new way of approaching and solving problems. Its emphasis on visual and spatial phenomena combined with Fuller's wholistic approach fosters the kind of lateral thinking which so often leads to creative breakthroughs” [13].

Amy Edmondson describes synergetics “in the broadest terms, as the study of spatial complexity, and as such is an inherently comprehensive discipline” [5]. Cheryl Clark synthesizes the scope of synergetics as “the study of how nature works, of the patterns inherent in nature, the geometry of environmental forces that impact on humanity” [4]. By Hermann Haken Synergetics is an interdisciplinary science explaining the formation and self-organization of patterns and structures in open systems far from thermodynamic equilibrium [15]. Self-organization requires a 'macroscopic' system, consisting of many nonlinearly interacting subsystems. Depending on the external control parameters (environment, energy-fluxes) self-organization takes place.

Term “synergetic” has more practical value. Collins English Dictionary defines Synergetic as: 1) acting together, 2) (of people, groups, or companies) working together in a creative, innovative, and productive manner [14]. The word “synergistic” is defined as working together; used especially of groups, as subsidiaries of a corporation, cooperating for an enhanced effect; “a synergistic effect” [8]. The term “synergistic effect” is defined as effect arising between two or more agents, entities, factors, or substances that produces an effect greater than the sum of their individual effects. It is opposite of antagonism [7].

Characteristics of synergetics as a scientific paradigm include three main ideas: openness, nonlinearity, dissipativity. Openness is a one of central concepts in synergetic theory. The initial formulation of this concept consisted of a dichotomy, defining an open system in contrast to a closed system [2]. An open system is characteristically negentropic, where a closed system is characteristically entropic. An open system is dynamic and a closed system is static [10].

There are some Levels of openness. Factual openness concerns the permeability of the boundary which Separates the system from its environment Matter, energy, and information cross this boundary. Active openness appears when one system communicates with another. It is assumed that communication will require a language that is common to both systems. Flexible openness occurs when one system constructs a model of the behavior of the other

system with which it interacts. Creative openness exists when a system constructs the context in which it must work, or it radically changes the rules of the game in a known context. Reflexive openness is manifest when a system can develop strategies for action on other systems. It is able to use self-referencing in order to analyze and modify its own behaviors [1].

In mathematics nonlinearity signifies a certain type of mathematical equations which contain unknown quantities in powers more than 1 or coefficients depending on properties of a medium (system). Nonlinear equations can have several, more than one, qualitatively different solutions. The physical sense of nonlinearity is that a certain set of solutions of a nonlinear equation corresponds to a multitude of evolutionary paths of system which is described by the equation (a nonlinear system). An important principle of nonlinearity is “the rank growth of a small”, or “the strengthening of fluctuations”. Under certain conditions, the nonlinearity can strengthen fluctuations. It is able to transform an insignificant difference into an appreciable one which has macroscopic consequences.

The nonlinearity also signifies the possibility of unexpected, emergent, changes of direction in the course of a certain process. The development occurs through accidental choices of a path around bifurcation points, and the change (such is the nature of things) is, as a rule, never repeated [6]. The nonlinearity may create the possibility of rapid development processes.

Dissipativity means chaotic elementary processes in the system, the factor of “natural selection” that destroys everything that does not meet the trends. A dissipative structure is an organized nonequilibrium state of matter created and maintained due to dissipative processes [9]. The term was proposed in 1967 by Belgian chemist and thermodynamicist Ilya Prigogine.

Important concepts of synergetics are also Complexity Nonequilibrium and Chaos. Complexity is not only a complicated composition of elements within a system. That is, complexity is not simply connected with a large number of interacting elements or components and intricate interactions between them. It is a characteristic of behavior of open nonlinear systems, in particular of the structure formation in them, spatial and temporal patterning. Complexity of structures and of their behavior is conditioned, first of all, by their tempos of evolution. The tempo, or the rate of evolution of open nonlinear systems, is a key characteristic in exploring complexity [6].

Nonequilibrium defined as the state of an open system in which take place a change in its macroscopic parameters such as its composition, structure and behavior.

In synergetics are revealed common patterns of the complex systems behavior. One of the most essential element of this thinking is the constructive role of chaos in evolution. Chaos looks like a destructive element of the world In the classical point of view. Randomness is considered as a secondary and subsidiary factor which is not of principal importance.

Synergetics reveals the creative role of chaos in the evolutionary processes which occur in nonlinear complex systems. Chaos and fluctuations on a micro-level play an essential role in determining the actual trends, or “aims”, of processes at a macro-level. The macro-organization evolves from chaos on micro-level. Order and chaos, organization and disorganization are well-balanced in the world. Chaos is a necessary condition for self-organization. Besides this, chaos serves as a basis for integration of relatively simple evolutionary structures into more complex ones. It is a mechanism of coordinating their tempos of evolution. Chaos, fluctuations on micro-level, can also be a way of evolutionary switching, allowing a periodical transition from one evolutionary regime to another one.

Thus, synergetics reveals the sympathetic, creative face of chaos. Chaos opens up the possibility for the appearance of something completely new, an element of chaos is desirable. Thanks to the liberation from the old and to the turn of evolutionary processes to an opposing regime, something new can emerge from the remains of the old [6]. Chaos is a factor of unification of complex social structure. Chaos leads to the establishment of coherence of development in all parts (substructures).

Synergetics also uses concepts such as point of bifurcation, fluctuation, dissipative structures and attractors. A bifurcation occurs when a small smooth change made to the parameter values (the bifurcation parameters) of a system causes a sudden 'qualitative' or topological change in its behaviour [3]. Bifurcations occur in both continuous systems, and discrete systems. The point of bifurcation is a condition of system when very small influence leads to global changes. There are two principal classes of bifurcations: local bifurcations, which can be analyzed entirely through changes in the local stability properties of equilibrium, periodic orbits or other invariant sets as parameters cross through critical thresholds; and global bifurcations, which often occur when larger invariant sets of the system 'collide' with each other, or with equilibrium of the system.

In the bifurcation points system becomes unstable and can have a number of alternatives that are related to the transition to other conditions. Fluctuations are the small deviations from statistical equilibrium. Besides fluctuations are random changes in the system. Dissipative structures are the Space-temporal formation that can occur in highly non-equilibrium conditions. They correspond to some form supramolecular coherent behavior of huge number of molecules. Attractors are relatively stable structures. They are the result of the evolution in open, non-linear environments. When choosing the path of evolution system and output to one of the structures-attractors, all other evolutionary paths are closed.

Processes occurring in the management of socio-economic development of the region in modern conditions refer to exchange of information that is increasing and accelerating. This is a sign that modern society is a complex, dynamic system that organizes itself and operates in a nonlinear environment. In such circumstances, management system, built on the principles of linearity is ineffective and there is a need for a new approach, based on synergistic approach and the ideas of self-organization. The objects which create new structures that meet their own trends are capable of self-organization. In addition, in current social-economic systems, the important factor is the exchange of information. The intensity of this exchange is provided by using of latest information technology. In Social systems the stability is supported through stability of subsystems by replacing those elements that are not able to perform its functions. Implementation and development of information systems in the management of socio-economic development of the region is a factor increasing stability by providing accurate, timely and relevant information to managers for management decisions. In this way, information systems affect the upgrade process subsystems of the social system, they can create new links in the administrative structures that were not possible under the conditions of use of "classical" information technology to build a new system to ensure the system of regional management, through the formation of personnel reserve, allowing for interaction of executive power and society [11].

Openness (transparency) of governance is manifested primarily through intensive information exchange with the environment. This information exchange enables to ensure coordination of actions. Also openness allows existing steady nonequilibrium state of the system or its attractor. Attractors, in turn, ensure the existence of this form of organization that adequate self structuralization system. An important role in the development of regional management has nonlinearity. One manifestation of nonlinearity is multi-variant, which manifests itself in relation to regional management in decision making.

The manager must remember that he (she) must implement only those solutions that do not deny the natural process of self-control of object. Also he (she) must consider the fact that the presence of an unstable, non-equilibrium state of the system, even a minor exposure can lead to catastrophic consequences. In these situations, the role of information systems should be stabilizing and they must provide the ability to select the required number of data in the circumstances variety of solutions and allow them to choose the most reasonable alternative. It can also provide stability equilibrium of system by analyzing the intrinsic properties of the environment and identify the field of possible ways of development. In the future this information may be used in the application of program-oriented approach to solving social and economic problems.

Another aspect of nonlinearity in regional management is cyclical processes that take place in it. Waviness is a sign of social and economic processes, and nonlinear waves are a form of development. These processes are the manifestation of information exchange that exists in the system of regional authorities. These waves are associated with both the state of society and with seasonal fluctuations that occur in the system. In times of crisis there is a need to harmonize the processes that have different rhythms of development. In addition to developing relevant programs is necessary to ensure their realization considering the political processes in the country. This development and implementation depends largely on the information base, which is statistical information and information that flows through branch channels in the regional administration, the capacity of information system, which is interpreted as the ability to provide an answer to the most essential questions, and the efficiency of the integrated public information system at the national and local levels.

An important concept of synergy and synergetic approach to regional management is chaos. Chaos in synergetics has a dual nature. On the one hand there are the devastating chaos which leads to disorganization of the system, on the other it is constructive and promotes the process of organization. For regional management is important that destructive chaos is aimed at those structures that socio-economic system isn't need and lost their relevance. For those who take part in the development of social-economic system more important is a constructive chaos. As a constructive chaos can be used chaos inherent to the market and such things as freedom of expression and democratic mechanisms in social management. The role of information systems in the management of chaos is determined by their analytical subsystem that allows using mathematical models to determine those limits of the system that describing the relationship between processes of destruction and development.

Synergetic concepts such as fluctuations and bifurcation point play the important role in synergetic approach. Fluctuations as small deviations from statistical equilibrium are widespread manifestations of changes taking place in the system. However, the impact of these changes is difficult to determine without a statistical analysis of the phenomena that cause such deviations. For the analysis of fluctuations is necessary use an information systems that can provide collection, processing, analysis, and dissemination of information on the socio-economic processes in society. State statistical systems provide the necessary data for management both at local and national level.

Fluctuation leads to changes in the system, manifested as a point of bifurcation, in which it has a number of alternatives. In this case, it is necessary use information systems that enable the professionals to make conclusions about the managed processes. Expert systems and decision support systems can perform this function. These systems are especially needed in the management of economic sectors, for determining the ways of their development.

The point of bifurcation specifies the time when manager must make decision. The results of introduction of the new solution cause the fluctuations that determine the new point of bifurcation. Therefore errors on lower levels of management provoke errors at higher levels due to fluctuations from bottom to top. At the same time, errors at higher levels as fluctuations spread from the top to lower levels and influence the on processes in society. This confirms the correctness of the Concept of electronic governance system that by integrating different information systems will improve the coordination of activities at all levels of government [12].

Based on the analysis of the concept of synergy in the system of regional management and its information component can formulate the main features of a synergistic approach to the management of socio-economic development of the region.

Synergetic approach to regional management is the deep cognition of self-organization of complex, non-linear, open systems, which are the subjects and objects of governance through collection, analysis and dissemination of information; identifying ways of further

development of the information society and the decision-making process, that contributing to this development; providing structural changes in the socio-economic system.

**Conclusions and suggestions.** The analysis of management processes from the point of synergy leads to the conclusions concerning the main principles for a synergetic approach to the management of socio-economic development of the region and its information component. This is a self-organization in both subject and object in the regional management that has informational purposes; it is an openness of authorities, through which information exchange in the form of network flows provides interaction of all components of regional management; the presence of non-linearity which manifests itself in multivariance, cyclic recurrence and resonance phenomena due to the diversity of information environment in which operates a management system; chaos as both constructive and destructive phenomenon that allows analysis by socio-economic information in regional management, and develop effective solutions to ensure the development of institutions that are relevant for a given socio-economic system; the existence of fluctuations which lead to deviations from statistical equilibrium and information we need to collect about that, analyze and distribute in regional management in order to determine trends; the presence of bifurcation points that lead to changes in the management system is an important element the work of manager, who on the basis of information on the state of the system develops options for making analyzes and chooses the most favorable in terms of solving the existing problems.

#### References

1. *Arne Collen and Gianfranco Minati. Openness in a General Process Model for Systems Design in Education [Електронний ресурс].* – Режим доступу : [http://link.springer.com/chapter/10.1007/978-3-642-58035-2\\_21#page-1](http://link.springer.com/chapter/10.1007/978-3-642-58035-2_21#page-1).
2. *Bertalanffy, L.* Perspectives on general system theory. – New York : Braziller Press, 1975.
3. *Blanchard, P.; Devaney, R. L.; Hall, G. R.* (2006). *Differential Equations.* London: Thompson, pp. 96–111.
4. *Cheryl Clark, 12 degrees of Freedom, Ph.D. Thesis, p. XIV.*
5. *Edmondson, Amy C.* (1987). *A Fuller Explanation: The Synergetic Geometry of R. Buckminster Fuller.* Boston: Birkhauser. pp. IX.
6. *Helena Knyazeva.* The Complex Nonlinear Thinking: Edgar Morin's Demand of a Reform of Thinking and the Contribution of Synergetics.
7. Режим доступу : <http://www.businessdictionary.com/definition/synergistic-effect.html>.
8. Режим доступу : <http://www.thefreedictionary.com/synergistic>.
9. *Kondepudi, Dilip and Prigogine, Ilya.* (1998). *Modern Thermodynamics – from Heat Engines to Dissipative Structures, (ch. 19: "Dissipative Structures", pg. 427-57).* – New York : John Wiley & Sons.
10. *Maes, P. and Nardi, D.* Meta-level architecture and reflection. Amsterdam: North-Holland 1987.
11. *O'Brien, J., Marakas G.* Management Information Systems (10th ed.). – Boston : Irwin McGraw-Hill. 2011.
12. *Olifirenko L.* Organizational Development Of Public-Private Partnerships / L. Olifirenko // Ukraine – EU. Modern technology, business and law : collection of international scientific papers : in 2 part. Part 1. Modern priorities of economics, management and social development. Environmental protection collection (Košice, Slovakia, March 30-April 2, 2015). – Chernihiv : CNUT, 2015. – P. 32–33.
13. *Buckminster R. Fuller Synergetics: Explorations in the Geometry of Thinking and Synergetics 2: Explorations in the Geometry of Thinking.*
14. The official Collins English Dictionary online. [Електронний ресурс]. – Режим доступу : <http://www.collinsdictionary.com/dictionary/english/synergetic>.
15. *The Science of Structure: Synergetics Hardcover – 1984.*