

SYSTEMS CONCEPT DEVELOPMENT

Asaul A.N., Lyulin P.B.

Saint Petersburg State University of Architecture and
Civil Engineering, St. Petersburg,
e-mail: asaul@yandex.ru, p_lyulin@mail.ru

The article describes the path which the science has passed from the systems theory generation up to contemporary visions of systems. The works of science classicists such as L. von Bertalanffy, A.I. Uyomov, J.G. Miller, H. Maturana, as well as results of works of existing academic communities such as SPSUACE «Methodological problems of efficiency of investment-construction complexes» as «self-organizing and autonomic systems» have been studied in the article. This work is also focused on and critically evaluates major principles of systems theory (system structure, system elements non-uniformity, system observer integration), living systems theory (levels of organization, processors of living systems), autopoietic theory (requirements to system elements and six conditions criterion, interrelation with entropy and negentropy). Special attention is paid towards the advanced researches devoted to the living systems: living systems theory and autopoietic concept. Referring to the fact, that systems consisting of living and non-living elements, act differently, the author of the article shows the transition from studying of systems as mechanisms to living systems research.

Systematization concept, system notion and even theories in the modern scientific paradigm were developed rather long ago and currently hold its firm place in it. Despite the creation of various systems theories, the efforts to establish a universally acknowledged systems concept were unsuccessful. It is rather complicated to unite the results of works of L. von Bertalanffy, R. Ackoff, V.N. Sadvovsky, A.I. Uyomov, A. Rappoport, Yu.A. Urmatsev, B.S. Fleischmann, W.R. Ashby, M. Mesarovic, L. Zadeh, G. Klir and others.

Academic community has divided into two main determination groups. One of them leans towards the philosophic understanding of the term «system», while the second is based on practical use of system methodology and gravitates toward the elaboration of general scientific system notion. The latter is widely represented in the foreign systems movement (W.R. Ashby, G. Klir and others)

There are a lot of works written regarding the system notion development. Therefore, it is to expand on the contemporary understanding of the term «system». At present the term «system» is used in the scientific sphere in cases when it is necessary to describe the object under investigation as a certain complex unity, which is impossible to immediately provide an idea of, representing it graphically or by means of mathematical expression (formula, equation, etc.). The system is usually considered as a complex of elements and relations between them.

Mathematically it can be represented by a formalized notation:

$$S = [\{a_i\} \& \{r_j\}];$$

$$\text{def } a_i \in A \quad r_j \in R. \quad (\text{a})$$

It reveals the fact that the system is not a simple complex of elements and diverse relations and includes only those relations and elements which lie in the intersection (&) with each other.

If the system elements are non-uniform, it is reasonable to divide them into different sets of elements. For example, M. Mesarovic (M. Месарович, 1978) distinguished the set X of inputs and set Y of outputs, between which there is intersection which can be represented as follows:

$$s \subseteq X \& Y. \quad (\text{b})$$

Attributes (Q_A) are also included into the system notion in order to specify the elements and relations. It shall be noted as follows:

$$S_{\text{def}} = \langle A, Q_A, R \rangle. \quad (\text{c})$$

It ought to be remarked that the elements and components are often used as synonyms. However, strictly speaking, components are more general definition comparing to the elements and also can signify the complex of them.

A.I. Uyomov has expanded the above notion (Уёмов, 1978), by adding the attributes (q_j) standing for relations (r_j) along with attributes (q_i) describing elements (a_i).

The notion of objective appears in the system determinations while following the specification, at the same time the objective achievement conditions (environment SR , time interval ΔT) are specified in some of determinations (Перегудова, 1976). Thus, the system determination has the following view:

$$S_{\text{def}} = \langle A, R, Z, SR, \Delta T \rangle. \quad (\text{d})$$

The observer (N) is gradually involved into the system determination in addition to all the stated ones (N) – it is a person that represents an object or a process as a system at their studying or decision making. Referring to observer effecting the system, as well as system effecting the observer, the system shall be represented as follows:

$$S_{\text{def}} = \langle A, Q_A, R, Z, N \rangle. \quad (\text{e})$$

The selection of system determination reflects in fact the accepted concept and is considered the beginning of project planning. Moreover, it is important to realize that diverse determinations can be used at different system vision stages depending on the situation.

Analysing the systems determination development, it is possible to conclude that the ultimate solution has not been found yet. In prospect we can see how the entire theories and new fields of knowledge are being developed while searching for the unified universal system.

The change of systems science occurred after the scientists have concluded that the system consisting of people, e.g. economic or social one, has a range of attributes, which make it similar to a living organism. It is a living creature with its own cells, metabolic process and nervous system. Various public institutions within it act as organs, each of them performs its own special function in order to support the organism activity. The army, for example, act similarly to immune system, defending the organism from penetrations from outside, while the government takes decisions and rules similarly to the brain. This vision was at first given in the ancient world by the Greek philosopher Aristotle {Чанышев, 1981 #48} {Чанышев, 1981 #48} {Чанышев, 1981 #48}.

The science in its evolution has deviated from mechanistic view of the organisms. The scientists studying the living systems are attracted by the variability of processes, with the help of which the system adjusts to continuously changing environment. Many ideas and methods integrated in the sphere of «complexity theory», has led lately to the understanding of organisms as self-organizing and adaptable systems. The processes within these systems are decentralized, undetermined and change constantly. Complicated adaptive behaviour of such systems originates in the process of interaction between separate autonomic components. And the patterns, where the regulation conforms with a separate unit, have been accepted as insufficiently compliant with reality for the majority of real systems.

The above factors resulted in condition that in 1978 the general living systems theory was created in order to organize existing knowledge in the sphere of systems similar to a living organism (Jackson, 2002). The term of living systems was introduced by James Grier Miller in 1960 in order to signify the open self-organizing systems interacting with the surrounding environment and having specific attributes, peculiar for the living beings.

The main idea of life turns up in the process. If the process of matter-energy and data treatment stops, life is therefore over. Determinant life feature is ability to continuously maintain a steady state, where the entropy (or chaos) inside the system is significantly lower than inside its non-living surroundings. The living systems can maintain this state, being open and self-organizing systems at the same time, which are able to involve any required information and matter-energy from these surroundings. These systems process greater amount of information in comparison with non-living systems, except for the computer systems, which have much higher ability to process data.

According to the concept elaborated by J.G. Miller (Miller, 1978b), the living systems form eight levels of organization, complexity, evolving from a cell up to supranational system. The most typical examples of such wide range of living systems are a unicellular amoeba and United Nations

organization or International Monetary Fund. These are the levels: unit, body or organ, organism, group, organization, community, society and supranational system. The system permanently includes 20 critical subsystems (processors) at each level, which process the matter/energy or information, excluding two ones processing both the matter/energy and information: reproducer and boundary (Miller, 1978b).

At the same time society stands for any element, which has a mass and occupies physical space. Energy is determined in physics as an ability to execute the work. With reference to the energy conservation law, it can be stated that energy cannot be produced or destructed in the Universe, but it can transform from one type into another. Mass and energy are equivalent. This work applies to the integral definition of the matter-energy, since close interrelation of the matter and energy is commonly known. The living systems require specific types of the matter-energy in sufficient quantity (heat, light, water, vitamins, mineral substances). Energy required for implementation of processes within the living systems, is obtained from dissipation of molecule (or atoms regarding some social systems)(Miller, 1978a).

Marker is used as an information medium unit in general theory of living systems. This term serves for designation of signals, units or changes of the matter-energy, arrangement of which contents information from source to receiver (von Neumann, 1951). The marker can be represented by any information medium accounting from pages of «The Word about Igor's Regiment» up to TCP/IP protocol packets. Development of communication technologies increases the efficiency of data transfer, reducing the mass of markers and making them smaller so that they could be stored more compactly and transmitted faster and cheaper.

Practically any communication requires marker movement in the space from transmitting system to receiving one. This movement is subjected to the same physical laws as the movement of any other matter-energy type. The information is measured in bits (binary system position) being the lowest measurement unit providing two possible alternatives. Ability to store the information can be estimated by comparing mass of the marker and amount of information on it. For example, clay tablets with the wedge writing of the Sumeria times contain 10^{-2} bits per gram of the matter.

Information processors are used for processing the data inside the living system. Thus, the first-type processors interact with the matters or energy for implementation of metabolic processes in the organism. The other subsystems transmit information for coordination, direction and control inside the system. Some of the processes carry out both types of exchange simultaneously.

Another essential difference between the living and non-living systems lies in the fact that all the living systems include such components as DNA, RNA, cell proteins, which provide the living sys-

tem with unique properties. These components are not synthesized in the environment, but produced inside the system itself.

It is important to emphasize interrelation of the living systems functioning with entropy and negentropy. Entropy means chaos, self-destruction and self-decomposition in a simple understanding. Negentropy respectively is movement towards arrangement, organizing of the system. Regarding the living systems: in order not to die, the living system fights with the surrounding chaos by means of organizing and arranging the latter, i.e. importing the negentropy. This is the way the self-organizing systems behaviour is explained.

The concept of autopoiesis became the development of the living systems science. The autopoietic system idea was first elaborated by two neurobiologists Humberto Maturana and Francisco Varela with the purpose of description of life as phenomenon typical for open self-sustained and self-reproducing systems (Varela). At the beginning of 1970s H. Maturana and F. Varela wrote several works devoted to autopoiesis theory. (Maturana, 1980). Practically at the same time in 1979 Varela was to publish the work named «Principles of Biological Autonomy», (Varela F., 1979) which has elevated the mind and depth of his previous works. These books are the key theoretical literature of this sphere.

They describe the living formations as follows: «life is autopoiesis». The origin of this term is based on two Greek works: auto (αὐτό) -self- and poiesis (ποίησις) – creation, production. Word-for-word translation of the term «autopoiesis» means «self-reproduction».

The main idea of this term is revealed in the definition given in 1979. «Autopoietic system» is organized (specified as a unity) as a net of production processes (transformation and destruction) and consists of components which produce components:

1) which, interacting and changing, regenerate and implement the net of processes (relations) producing them;

2) composing it (the system) as a certain unity in the space, where they [components] exist, specifying the topological field of their realizations as this net» (Varela F., 1979).

Any unity corresponding to these requirements is an autopoietic system, and any autopoietic system realized in the physical space, is the living system. Special configuration of this unity – its structure – is not a sufficient condition for considering it as a unity. The key peculiarity of the living system is support of its organization, i.e. maintaining the net of relations which defines it as a system unity.

In addition to that, autopoietic systems are defined as systems, which reproduce themselves autonomously, and the only product of their organization is these systems themselves. It follows that this system takes care of its own support and growth and

perceive the surroundings as possible reason for instability of the internal functioning.

In order to determine the belonging of the object to the autopoietic systems, the classical autopoiesis theory suggests using the criterion of six conditions (Varela, Zeleny, 1992). In fact we have an algorithm of six steps to answer this question, whether the preset unity is autopoietic one. If a positive answer can be given to all these six questions, the system is autopoietic.

Nowadays the tendency of studying the living systems is one of the promising in the scientific world. Scientists of many countries work upon this problem of studying the living systems in economy. In Russia this issue is being studied since 2002 by school of science «Methodological problems of efficiency of investment-construction complexes» as «self-organizing and autonomic systems» at Saint Petersburg State University of Architecture and Civil Engineering managed by the honoured worker of sciences of Russian Federation, Doctor of Economics, Professor A.N. Asaul (Asaul, 2008).

References

1. Asaul N.A., (2004) Theory and methodology of institutional interactions of regional investment-construction complex subjects – St. Petersburg: Gumanistika. – P. 280.
2. Bertalanffy L. von, (1969) General system theory — A critical review // General systems. – M.: Progress.
3. Bogdanov A.A., (1989) Tectology: (General organization science) – M.: Ekonomika.
4. Heylighen F., (1999) The Growth of Structural and Functional Complexity during Evolution // The Evolution of Complexity / ed. J. Bollen & A. Riegler (eds.) F. Heylighen. – Dordrecht: Kluwer Academic.
5. Jackson Michael C., (2002) Systems approaches to management.
6. Miller James G., (1978) Living Systems. – New York: McGraw Hill.
7. Neumann J. von, (1951) Various techniques used in connection with random digits: National Bureau of Standards Applied Math Series 12: 36, 1951.
8. Peregudova F.I., (1976) Bases of system approach and its application to development of spacial ACS. – Tomsk: TSU.
9. Tracy L., (1994) Leading the Living Organization: Growth Strategies for Management. – London: Quorum Books.
10. Uyomov A.I., (1978) System approach and general systems theory – Moscow: Mysl.
11. Asaul A.N., Ivanov S.N., (2008) Decrease of transactional expenses in building due to optimization of information space. Edited by Asaul A.N. – St. Petersburg: ANO IPEV.
12. Maturana H., Varela F., (1980) Autopoiesis and Cognition: The Realization of the Living // Boston Studies in the Philosophy of Science. Vol. 42 / ed. Robert S. Cohen, and Marx W. Wartofsky (eds.). – Dordrecht (Holland): D. Reidel Publishing Co.
13. Mesarovic M., Takahara Ya., (1978) General systems theory: mathematical basis. – M.: Mir.
14. Varela F., Francisco J., (1979) Principles of Biological Autonomy. – New York: Elsevier (North Holland).
15. Under editorship of Tyukhtin V.S., Urmantsev Yu.A., (1988) System. Symmetry. Harmony. – M.: Mysl.
16. Ackoff R., Emery F., (1974) On purposeful systems. – Moscow.

17. Varela F., Maturana H., Uribe R., Autopoiesis: The Organization of Living Systems, its Characterization and a Model. BioSystems.
18. Agoshkova E.B., Akhlibininsky B.V. (1998) System notion evolution // Philosophy issues – 170–179: No. 7.
19. Asaul V.V., (2008) Synergetic effect of unification of building organizations into competitive structures // Economic renovation of Russia. No.2(16).
20. Platonov A.M., (2008) Activity of school of sciences «Methodological problems of efficiency of regional investment-construction complexes as self-organizing and autonomic system» // Economic renovation of Russia No. 4(18).
21. Zeleny M., Hufford K.D., (1992) The Application of Autopoiesis in Systems Analysis: Are Autopoietic Systems Also Social Systems? // International Journal of General Systems Vol. 21.

The work is submitted to the International Scientific Conference «Production management. accounting, analysis, finance», London, October, 19-26, 2013, came to the editorial office on 22.10.2013.

THE HR-MANAGER ACTIVITY RESEARCH FUNCTION IN HIGH-TECH ENTERPRISE

Latysheva V.V.

The Moscow Aviation Institute (The National Research University), Moscow, e-mail: latyshevaWW@mail.ru

Our study is aimed to be examined the origin causes and the possible ways for the acute staffing challenges overcoming, having developed in the last decade in a number of the Russian airlines. The young specialists', experts', and the professionals' exodus, the increase in terms of the appreciation and the training of the highly qualified specialists rise, needed to the high-tech production, the specialists' rapid deskilling, the human resources management strategy absence at many enterprises – all these and other challenges are fraught with the heavy social and economic consequences: the continuity and the connection between the generations loss at the enterprises, the improved cost of production, the competitiveness decrease of the manufactured products. To be prevented them, the airlines management is always needed of the operational information obtained, in particular, through the sociological monitoring.

The most interesting facts for the researcher have often been found, as a result of the interdisciplinary researches. So, the sociological methods application in the social and economic challenges study is allowed to be penetrated deeper into their nature and to be discovered the objective and causal dependences. Largely, thanks to the sociological methods high performance and their efficiency, the management solutions have been given the scientific justification, having concerned the employee motivation, the process organization of the beginners adaptation, the personnel marketing, the staff recruitment, placement and further promotion, the organizational core formation, the personnel evaluation, its development, the management teams formation and select team working methods, the career management of the professionals, the corporate culture formation, the employee

identification programs realization with the organization, and many others.

Therefore, today, there are all the grounds to believe, that along with the manager's classical functions, as having defined still by A. Fayolle – the planning, organizing, sharing, coordination, supervision, motivation – the modern manager on the human resources management should perform as well as his research function. It is also attached to the activities on the personnel management the strategic and innovative characters.

For the modern management systems construction (e.g. the quality management, the knowledge management), the knowledge and the skills are required to the leaders of all the administration levels of the high-tech enterprises, especially, in the field of the behavioral sciences (e.g. the psychology, sociology, and the social anthropology), as well as the economic and the social and management sciences, the social processes modeling and the prediction. They should be able to be stepped up the employees' creative potential, to be made the labor market analysis, to be created the reasonable motivational programs, to be able to be developed and to be communicated to the employees the successful activity criteria, as the organization, as a whole, and its individual structural elements and each employee.

The research function implementation of the manager on the human resources management is practically allowed to be realized the contingency approach in the management, efficiently to be monitored the quite new trends and its tendencies in the external environment, and to be made the adjustments and the corrections in the strategic and operational enterprises' plans, thereby to be increased the management decisions efficiency. So, it is not frequently, during such investigations the facts are opened and revealed, having allowed to be refuted or to be clarified the classical axioms of the management theory, and, moreover, to be changed the leaders' traditional guidelines and the directions, concerning the efficient methods of the management practices. For example, our studies of the recent years have been shown, that the people, who are engaged in the intellectual work, often, among all the stimulating and their motivating factors, are favored their opportunities for the creative self-expression, while maintaining the satisfaction average level of the physical needs. The publicly available statistics on the number of the layoffs airlines has been testified, the 67% of the workers at he age of 23–30 years old are being dismissed during the first year of the work, or (e.g. if they are the working students) – just after the Institute graduation. So, the differences in the dominant reasons for the dismissals of the staff's different categories have already been marked: if the workers with their length of the service, they are often dismissed, because of the size of their earnings dissatisfaction; then, the working students and the young specialists and the professionals, as the reason for their