

**Review scientific paper**

UDK: 681.5.01:004.384

DOI: 10.7251/SOCEN2425067M

COBISS.RS-ID 140572161

Paper received: 05.02.2024.

Approved work: 25.03.2024.

**Darko Matijašević<sup>1</sup>****CYBERNETIC AND SCIENTIFIC APPROACH TO THE SYSTEM****Abstract:**

*In the article, the system is approached primarily from a cybernetic and scientific management approach. The aspect of connecting the abstracted theoretical and instrumental approach and the importance of cybernetics as a science in the advancement and development of the general science of systems and its applicability in a wide spectrum is given. Comparison, classification of systems, giving essential features of the system, goal, functions, structure, processes, inputs, outputs, results, management, environment are also presented. Complex systems, complicated systems with their own specificity, as well as the cybernetic approach to modeling the management of such systems are also presented. Likewise, the article relates the organization to the essential features of the system. The article uses compilations, comparisons, theoretical approaches of domestic and foreign scientists, from the aspect of organizational science. Works are used and certain comparisons are made, in relation to Brekić J., Kavran D., Rajkov M., Viner N., Deželjin J., Srića V., Marković M., Luhman N., Čamilović S., Dugin A., Smith A., Marshall A., Fayol H., Taylor C., Weber M., Pusic E..*

**Keywords:** *system, cybernetics, organization, management science, goal, functions, structure, processes, complex systems*

**1. INTRODUCTION**

The relationship between man and nature, according to Brekić (Jovo Brekić), is the relationship of their interdependence, man's attempt to "master" natural forces, that is, nature by "appropriating" its resources, necessary for

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existence. As such, it represented a special peculiarity and challenge in the civilizational context of human existence. The realization of “space, rational and organized use of one’s own energy” was an important step forward for man, as a “rational being”, unique in his special self of “thinking ability”, from which “the first cognitions and conscious actions” arise, how to “achieve certain goal”. In this way, there was a need for further knowledge about the way to achieve the goal itself, primarily, “necessary for existence”. Man necessarily connects his existence with a social group, and at the very beginning of the concept of system and organization, this individual-social component of necessity must be observed even before the scientific one. Thus, on the basis of basic reactions in the function of human existence, individuals, and then groups, realities arise for thinking about the relationship among man, nature, society, and the laws in these relationships. With the further evolution of both man and society, and significantly based on scientific and technological development, there is a multiplication in connections and observations, and the systematization of knowledge about laws and the very processes that take place in the human and social environment and beyond. This interaction provides strong inputs for further thinking about the optimization of human existence, in addition to basic existential, in organizational forms, primarily society. These determinants essentially determine this early understanding of the system, as an universal instrument for understanding, analysis and then just management in the function of optimal functioning of all forms of social organization and activities. In particular, activities, which in an evolutionary sense also lead to production activities and the acquisition of goods, surpluses, exchange, trade, competition. The latter additionally gives importance to the treated matter of understanding the system and scientific dealing with the system.

## **2. Organization as a system**

According to Kavran (Dragoljub Kavran), the organization is “as old as human history”, what is known so far about the organization is only the beginning of knowledge, which is improved by developing and combining technical and scientific disciplines with the “ability” to adapt the social system to such changes but it also comes to the realization of the specific position, the “human existence” of such organizations. Man is the “basic driver of the organization” but also of its changes, and at the same time “subject and object of research” (Ćamilović, 1996: 16-24).

The sciences dealt with the static structure of the organization in a historical and philosophical context, dating back to the period of ancient civili-

zations. From an organizational, and especially a sociological, point of view, this structure had the dimension of a “territorial” static structure, related to space (village, city, state), along with the dimension of power - the “existence of government”. However, further evolutionary development, the development of social and production relations “necessarily” leads to interactions between “members of the organization” - people, individuals, who possess the peculiarity of “power” with social groups. In this way, hierarchical structures, “related to personality”, are established, and relations towards subordinates or the ruler are regulated on the principle of “seniority and loyalty”.

According to Rajkov, those systems that contain either natural or technical “subsystems” are considered “organizational systems”. The basic characteristic, the hallmark of these systems is “man”, who not only “establishes the goals and the way to achieve those goals”, but also ensures that the stated goals are achieved based on “management activities performed by himself or with the help of technical systems (Rajkov, 1982: 18).

The new quality is achieved by the very processes that take place in the organization as a system, especially the complex decision-making function, which further ensures the management of the system in the ultimate function of obtaining, receiving the new quality. There are several levels of decision-making complexity, “depending on the choice of decision” on the transmission of “a certain impulse or information”. The role of “specific apparatus” in the human organism is called “synapses” (in which several nerve fibers are connected to “one output”), and in the machine it is a “switching circuit”. Both the living organism and the machine “tend” to oppose, now based on this ability “the general tendency to increase entropy”. In this way, the system around itself can create a “local zone of organization”, which now functions as a whole in a wider environment. Therefore, the management of the system structure, processes and work as a whole is based on the “feedback” method.

Science is an objective, critical, methodically derived state. In other words, the goal of science is to determine the objective truth about reality. In order to achieve this goal, science uses certain socially accepted research procedures and appropriate criteria for evaluating whether a certain research result should be accepted as objective truth or not.

In the science of organization, “purposive thinking” was strengthened in a special way as the basis for understanding the organization. Organizations in the systemic sense were understood as “systems” that were managed with the aim of fulfilling certain purposes, and that organizations by themselves do not make sense in the context of their own existence. That is, the key and generally accepted assumption is that an organized system is “only rational” if it fulfills

the purpose, the mission of its existence. This “systemic rationality” is further understood and analyzed as the existence of “purposive rationality” for which a “systematic structure” is necessary. The systematic structure represents the “formal structure”, as a means, an instrument for achieving the purpose and mission of the system. There are, as in most scientific theories, fundamental “scientific doubts and dilemmas” regarding the key determinants of this theoretical determination of the science of organization in a systemic sense.

The affirmation of the organization is mostly associated with the period of the industrial revolution. With the process of introducing machines, there was a connection of workers into groups within one organization. Until then, workers participated in various stages of production and were usually in different or separate production units. In the new conditions, it is required that the complex system functions, and in this sense it was necessary to create conditions for the necessary, expedient organization and management. So, the evolution of industrial practice has “forced” the need to provide adequate answers. Science necessarily had to provide answers to the complexity of the challenges, the need for systemic analysis, systemic planning, discovery, classification and systematization of functional relationships created in new, dynamic processes. In particular, under these dynamic processes are understood the relations in the practical functioning of contemporary “modernist organizational systems”, modern society, industrial society that was created by the transformation from the previous “pre-modernist”, agrarian socio-economic system, into the previously mentioned new industrial order or paradigm of modernity .

In this context, the classical science of organization had a key limitation. Namely, one comes to the realization that, according to the classical theoretical approach, the organization has a “specific”, limited dimension of its purpose, mission. That is, “the very purpose of the organization” is limited by “closing it in its own purpose”, turning the organization into a “system in itself and sufficient for itself”, to satisfy only its own needs. With the classic, scientific approach, the system is understood as a single unit, which has its ultimate purpose-mission.

### **3. Scientific contributions to the understanding of systems and organizations**

Adam Smith (Adam Smith, 1723-1790) viewed the entire social system of that time from an economic point of view through the basic relationships of human activities, actions, economic principles and principles, which enable prosperity and progress of society and people. In these relationships, in var-

ious forms of organization, human nature and man are placed in the central place and reference point. The economic conditions of the free market, as the basis and determining factor of the regulation of the economy, creates a strong basis for the upgrade of liberal capitalism, and man as an “impartial, independent person” but a key category provides an equally strong basis for the moral category in the organization, but also a strong basis for development of legal sciences. The division of labor resulted in the improvement of production forces, but also greater dexterity and skill, which further resulted in an increase in the amount of work. An additional increase in the amount of work necessarily leads to and is mutually correlated with the increase in dexterity and skills, but also with the invention of a large number of machines (Smit, 1988: 123).

According to Marshall (Alfred Marshall, 1842-1924), political economy or economics itself essentially deals with the study of human work and especially the part of the activities of “individuals and society” that are directly related to “the acquisition and use of material things necessary for well-being”. Therefore, it is very important to notice Marshall’s effort to place “man” at the center of the study from the aspect of “his daily work and material resources” that are acquired in this way, that is, from the economic aspect, which according to him “on an existential level” surpass those “religious motives”, considering that they are “stronger”, however, it is very difficult to “distribute” them over such a long period of time. Namely, he observes a person in relation to his character, but also in his “most efficient” state, of using his brain, in the daily period in which he is “dedicated to work”, as well as his relations with his “colleagues, employers or employees”. Organization and planning provide “greater effectiveness” and the effects of individual action, and these were questions that were formulated and developed since the time of the creation of numerous theories of Greek philosophy (Maršal, 1987: 199).

Fayol (Henry Fayol, 1841-1925) meant management by the term administration. He divided the company, as an organizational system, into work groups, technical, trading, commercial, financial, security, accounting and administrative. The work that takes place in the company, the system, represents the functions of management. According to him, the technical function is not always the most important, although considering the quantity, quality and variety of technical works in production, this function “overshadows” all others. This approach is not correct, because on certain occasions, some of the other functions can have a more “useful” and significant impact on the entire enterprise-system. It is crucial that this function be in “close connection” with other functions in the company. The trade, that is, the commercial function, is also very important, because “knowing how to buy and sell” is, according

to Fayol, “just as important” as being able to produce. Without the financial function, it is impossible to establish the functioning of the company-system, and great skill is needed in finding capital and its optimal engagement. The security function has the task “to remove all doubts” of a social nature, which threaten the functioning of the system. The accounting function is presented as the “organs of vision” of the company as a system. Accounting, at “every moment” must provide information about the economic situation and state of the company and is a powerful management tool. According to Fayol, the administrative function itself is the most complex. He believes that this function sublimates administration, forecasting, organizing, commanding, coordinating and controlling. This very complex function “belongs” to the competence of the “boss” or “company manager”, the system. The common characteristic for all main functions in the system, i.e. operations, is that they “spread and extend” between the highest instances of the head company and individual segments, i.e. “individual organs of the social body of the company”. As the most complex function in the system, the administrative function is clearly distinguished from other functions in the system. So, the administrator has a multidimensional, internal role in the system, and not only the role of ruling; according to Fayol, it means “managing works in a rational direction”, that is, a way of managing by “directing work” and not by “ruling and managing” mentioned works. (Fayol, 2006: 23-28).

Taylor made the greatest contribution in the field of humanistic philosophy, which significantly contributed to the development of the science of organization, of course, in addition to other significant contributions in a general sense to philosophy, sociology and social sciences. At the center of his philosophical focus, he places man, the identity and importance of the individual, and generally sets the foundations of “exclusive humanism” in the practice of philosophy. This approach rejects the previous theology, and dealing with the “natural world” in which man lived, since God was involved in the very “life of society”, and people “lived in a vicious circle”. He also points out that Weber himself, with his term “decomposition”, has qualitatively shaped the essence of the transition or simply, the current “modern state” in which society finds itself with the transition to secularization. The modern state is fundamentally different from the pre-modern society, due to the negation of the previously mentioned peculiarities. In that “pre-modern society”, in which our ancestors were, Taylor points out that the approach of “exclusive humanism” could not be expressed, referring to ancient times, although he attaches certain importance to philosophical approaches, even if limited, in this respect. Significant trends in ancient philosophy, Platonism and Stoicism, each in their own way

“resisted the decaying and mechanical universe” (Taylor, 2011: 26-71).

Max Weber makes a very significant contribution to the development of social sciences, sociology of economics and organizational sciences. The focus of Weber’s scientific approach, philosophy, is the study of society, history, the capitalist organization of the contemporary Western society of those days (as opposed to Marx), its natural structure, that is, its general character. At the same time, he incorporated the role of man in this overall and complex philosophical approach. In a broader sociological context, he deals with “human action”, that is, “social action and especially social relations”. Weber connects these categories as an orientation towards the “idea of the existence” of a “legitimate order”. He calls the very “prospects” of creating a “legitimate order” the “validity” of the order itself. It defines that the “validity” of the order conforms to certain “maxims”, which are “obligations or models”. He emphasizes the “purposely rational motives of man”, so that “action” is oriented “according to the order”, which is based on “legitimacy” (Weber, 1976: 3-24).

According to Pusić (Pusić Eugen), the organization can be seen as a “group of people” and at the same time as a “set of individual activities” of group members, that is, as “collective action of the group as a whole”. Collectiveness implies “a series of individual activities”, and individual action, the “action” of the members of the organization, “which achieves its meaning” only by fitting this action into the “general task and goal of the entire organization”. Therefore, “each action” can be seen as individual and collective, but the existence of “collective and individual work in the organization” can also be observed. Depending on the intention of focusing on “concrete operations”, individual activity will be primary, and if “ways of permanent cooperation” or work in groups are observed, then “collective work will be taken” as the primary focus of attention. Processes of “centralization and decentralization” appear in the organization itself, so that centralization is considered “any tendency” in the sense of “strengthening control” over a certain activity in the organization “from one place”. Decentralization is a process of the “opposite direction”, and this relationship can have, based on the “content of the transferred functions”, the following forms: decentralization of execution, i.e., a state in which the execution of a certain task is transferred “to special centers”, and in the form of “a general center” “, primarily, has the right to “control over execution”; decentralization of execution and decision-making, in such a way that the “general center” retains “control” and decentralization of execution, decision-making and part of control, in such a way that the “general center” has only certain “control functions” (Pusić, 1986: 159-163 ).

Through constant scientific approaches to the organization but also to



other human activities, an emphasized evolutionary thread can be clearly seen in the approach but also in the upgrading of the level of knowledge and its application in wide areas. There is a visible development dimension in terms of the larger grouping of sciences and scientific disciplines, but also the science of organization itself. Now with the scientific and technological accelerations, through the mentioned time periods, we can also see technicism, measurability and legality in the general sense in the functioning of the organization. It can be seen, precisely on these examples that our basic starting point, how significant, systematic and scientifically based, first of all technologically established access to the system is as a universal instrument for the advancement of scientific and technological progress in a wide spectrum. Cybernetics itself, as a very exact scientific discipline, contributed significantly to this acceleration.

#### **4. Cybernetic and scientific approach to the system**

A system can be considered as a whole that consists of purposefully joined parts, which interact with each other, the whole with its environment, everything in the function of achieving common interests, or in the most general case it is understood as a separate functional unit that consists of a set of objects, their determined properties (attributes) and a set of relations that connect those objects as well as the properties of those relations. What is not included in the system is its environment.

Both in living and mechanical systems, according to Wiener, “sensory receivers” represent a “special apparatus” that collects information from the outside world, and this information is not taken in its “pure form” but through “transformative properties”, which “turns the received information into “new form” and this work reflects on the outside world. So, both in living and mechanical systems, the “central regulatory apparatus” is informed about the “actually performed” action, not the “intended” one. Management and communications are in this context on the same level. When “communicating” with a person, they are given a message, and they return a message “available to them”, not to us. When the work of a person is managed, a message is communicated to him, and although this message is of a commanding nature, there must be taken a care that “the order is understood and carried out” (Viner, 1964: 42-43).

Thus, based on this interpretation, it can be concluded that the system has many important features. The goal of the system is what the system strives for in its creation, existence and functioning, and achieves it through “its tasks”. The function represents “interrelated activities”, which are carried out in an adequate “structure” in order to “perform tasks”, which ultimately leads to sat-



isfaction, the achievement of the goal.

According to Srića (Srića Velimir), “a system consists of a set of its elements as well as the nature of their mutual connection”, that is, such a “set of elements as well as the nature of their mutual connection”, that is, such a “set of elements that are interconnected, so that they form a certain whole”. The basic characteristics of these systems are that: they consist of “parts”-elements, the mutual interaction of which leads to the achievement of certain results. Those individual elements have special “properties and functions” (Srića, 1989: 20).

When “internal differentiation of the system and the environment” occurs in the “unique system”, we come to multiplying the complexity of the unique system. This process can further produce serious consequences regarding the very character of the “single complex system”. The internal differentiation of the system and the environment can lead to the formation of different forms and relationships of its internal parts. The effect of these differentiations can be the achievement of “internal form”, the equality of all parts of the system, order according to “hierarchical” rank, differentiation into “center and periphery” but also differentiation into “functional systems”. There are interpretations that “eventual internal differentiations”, which require more time, ensure the final “stabilization” of the system at a higher “level of complexity”. However, it is important to point out a new dimension and approach when talking about the “hierarchical” modern organization of the system structure, created as a result of the “internal differentiation of the environment system”.

The complexity of the system begins to be noticed especially in the phase of strong expansion in contemporary modernist society, when the science of systems and organization began to be applied in an extensive, rapid and qualitative sense. In the industrial sector, there are appropriate answers through a “systemic approach” to the issues of optimizing the functioning of the production organization, “achieving maximum efficiency”, while creating the conditions of “minimum cost price”, generally spending, as a function of the goal, in the conditions of “an enormous network of interactions”. Automation and cybernetics try to provide answers through “computerization” to the stated, growing and increasingly complex requirements, current systems with complex, complicated systems themselves. A systemic approach is also required in the field of politics, on issues of “complex problems” in the fields of public affairs, policies, certain problems of planning in urban areas, and the like.

The systemic approach to complex systems, that is, “system thinking” is based on the observation of “all objects and phenomena, that is, empirical phenomena as a system.” Parts of the system, elements, are understood on the basis of “their mutual interactions”, as well as “relationships”, but only within

the functioning of the “system as a whole”. From the above, the sublimate can be extracted that the system approach, system analysis and system dynamics represent “specific features” of systems science, through which the complex dealing with complex systems and their optimization can be practically approached in a comprehensive and complex manner.

The complexity of the organization is related to many factors, such as the mission itself, the purpose of the organization, the environment, the business strategy of the organization and others. In relation to the same, different forms and types of organization are modeled and instrumentalized in practice, based on its organizational structure and the very characteristics of the organization as a system. In this context, the organizational structure could be understood as the relationship between employees and the organization, whether formal or informal, and the work process, that is, the process of working as the way in which it takes place, performs work in the function of achieving organizational tasks and goals.

## **5. Concluding considerations**

Attempts to systematize knowledge in general about observed phenomena and relationships between man and nature are a constancy of human activity, conditionally speaking a scientific work. Through the technological and evolutionary development of society, the system appears as a high-quality, universal model, through which events can be monitored, analyzed and projected in this generally applied sense. The combination of thinking and approach to this problem goes from the oldest intellectual-philosophical concepts of the relationship between the world and the universe, and as we see it now through ancient works, and further in a developmental sense following social and technological achievements. Likewise, natural observation and interpretation of the world, environment and microenvironment contribute to the development of the science of systems and organization. Observing the existence of series of elements of each system, their connections, the reaction of the structure and dynamic parts to external inputs, but also the dynamics of the processes that occur between the elements and subsystems, they provide a matrix of the behavior of the system as a model. By abstracting the essential from the non-essential, the possibility of optimization and work in complicated and complex systems is further improved. Cybernetics as a modern science, technological and algebraic basis for modern computer and artificial development and monitoring, process guidance has a significant contribution to the development of the science of systems and organization as a system. All this knowledge

provides a quality platform for modern technological processes and scientific breakthroughs that are just experiencing their acceleration. The role of the system approach and organization science, cyber work in this field is significant to note. Especially since the scientific-technological, quantum leap in a wide range of scientific fields is happening in our time. Basic and mentioned theories and approaches have given and have a significant contribution in this field.

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