Abstract. Taking into account that all systems tend to function in the same way, the authors emphasize the significance of a deep understanding of the concept of a system for any scientific research. A holistic view of the concept of a system, its development, and its application gives deep understanding of how to organize the process of scientific research effectively. Therefore, this retrospective view provides insight into the past contributions of system thinkers, researchers, and educators to the evolutionary development and application of the concept of systems in different fields of knowledge.

The article aims to review the concept of system, analyze the definitions of “system” in dictionaries and scientific research, compare the ontological, epistemological, and methodological interpretation of the term “system” from general to special, trace the genesis of the system; evaluate different concepts.

In the research, data collection and analysis were used to trace the development of the concept of a system. Concept review, as a study type, was used to evaluate different meanings of the concept of a system to figure out which one is the most appropriate in the system of higher education. The analysis was structured around the theoretical and methodological foundations of the concept of a system.
An analysis of the interpretation of the concept of “system” in the scientific literature in different time periods was carried out. Having undergone a long historical evolution, the concept of “system” from the middle of the 20th century becomes one of the key philosophical, methodological, and scientific concepts. The concept of “system” is a fundamental and universal category. There exist numerous interpretations of the concept of “system”, which displays active explorations of a new approach to scientific research. Current areas of further development of the outlined problem are the study of classification and types of systems.

**Keywords:** concept of system, systems approach, scientific research.

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**EVOLЮЦІЯ ПОНЯТТЯ СИСТЕМИ ТА СИСТЕМНОГО ПІДХОДУ**

**Анотація.** Беручи до уваги, що всі системи функціонують однаково, автори підкреслюють важливість глибокого розуміння поняття системи для здійснення будь-якого наукового дослідження. Цілісне бачення поняття системи, його розвитку та застосування дає розуміння, як ефективно організувати процес наукового дослідження. Таким чином, цей ретроспективний аналіз висвітлює внесок античних мислителів, дослідників і педагогів в еволюційний розвиток і застосування концепції «система» у різних галузях знань.

В статті розглянуто та проаналізовано визначення поняття «система» в словниках і наукових дослідженнях; здійснено порівняння онтологічного, гносеологічного та методологічного трактування терміну «система» від загального до специфічного, простежено генезу поняття «система».
Здійснивши типологічний аналіз різних визначень поняття системи, авторами виділено три групи: (1) визначення систем як певних класів математичних моделей; (2) визначення систем через поняття «елементи», «відношення», «зв’язки», «ціле», «цілісність»; і (3) визначення систем з використанням термінів «вхід», «вихід», «обробка інформації», «управління».

У дослідженні використано метод збору та аналізу даних, щоб простежити розвиток концепції системи. Розгляд концепції, як тип дослідження, використовувався для оцінки різних значень концепції системи, щоб з’ясувати, яка з них є найбільш прийнятною в системі вищої освіти. Аналіз структуровано навколо теоретико-методологічних основ поняття системи.

Проведено аналіз трактування поняття «система» в науковій літературі в різні часові періоди. В дослідженні відстежено тривалу історично еволюцію поняття «система», яке з середини XX століття стає одним із ключових філософсько-методологічних і наукових понять. Поняття «система» є фундаментальною і універсальною категорією. Існують численні трактування поняття «система», що свідчить про активні пошуки нового підходу до наукового дослідження. Актуальними напрямами подальшого розвитку окресленої проблеми є вивчення класифікації та типів систем.

Ключові слова: генеза поняття «система», системний підхід, наукове дослідження.
more complex systems while traditional research is based on breaking the whole system down and analyzing its components. Systems thinking is to be used in different environments including education to provide efficiency of the research. It is applied to describe an object that is being studied or designed as something whole, complex, and when it is impossible to get a simple idea of it at once.

**The article aims** to review the concept of system, analyze the definitions of “system” in dictionaries and scientific research, compare the ontological, epistemological, and methodological interpretation of the term “system” from general to special, trace the genesis of system; evaluate different concepts.

**Methods.** In the research, data collection and analysis were used to trace the development of the concept of system. Concept review, as a study type, was used to evaluate different meanings of the concept of system to figure out which one is the most appropriate in the system of higher education. The analysis was structured around the theoretical and methodological foundations of the concept of system.

**Results and Discussion.**

1. **Definitions of the concept of system in dictionaries and their analysis**

   The concept of system is not new. Back in 1828, the American Dictionary of the English Language defines a system as “an assemblage of things adjusted into a regular whole; or a whole plan or scheme consisting of many parts connected in such a manner as to create a chain of mutual dependencies; or a regular union of principles or parts forming one entire thing.”

   Webster's Revised Unabridged Dictionary in 1913 defines a system as “an assemblage of objects arranged in regular subordination, or after some distinct method, usually logical or scientific; a complete whole of objects related by some common law, principle, or end; a complete exhibition of essential principles or facts, arranged in a rational dependence or connection; a regular union of principles or parts forming one entire thing.”

   In the middle of the XIX century, Dahl's explanatory dictionary defines the system as a plan, the order of the parts of the whole, the intended arrangement of parts of the whole, the course of something in sequential, coherent order. As per Merriam-Webster dictionary, a system is “a regularly interacting or interdependent group of items forming a unified whole”. The Comprehensive Dictionary of the Ukrainian Language defines a system as the order caused by the correct systematic arrangement and interconnection of parts of something or the set of any elements, units, parts, united by a common feature, purpose. The Universal dictionary-encyclopedia presents system as 1) an internally ordered structure of elements that constitutes integrity; 2) a set of organizational principles, norms, and rules related to a particular sphere; 3) a structure, which is the unity of naturally located and functioning parts. Macmillan Dictionary considers a system as “a set of connected
things that work together for a particular purpose”. A basic principle of a system is that it is something more than a collection of its parts [1].

The analysis of the pre-cited dictionaries and encyclopedias makes it possible to identify the main general features of the category “system”: integrity, unity of elements, complexity (set of elements), orderliness, and interconnectedness of its components. The semantics of the general definition of “system” are related to the terms “whole”, “unity”, “element”, “connection”, “structure”, and “arrangement”. Therefore, there are many definitions of “system” depending on the context, goals, and field of knowledge where it is used. The term is widely used as a lot of different things can be described as systems. It has ancient roots, and its modern interpretations are based on medieval research.

It becomes evident that most definitions present “system” as a set of interconnections between the components. “To the extent that the definition focuses on the totality of the interrelationships and not on the elements per se, “system” is synonymous with the psychologist's “gestalt”, and emphasizes the idea that a system is a conceptual entity apart from the mere summation of its elements” [2].

2. Ancient thinkers about the concept of system

As “no conception can be properly understood except through its history” [3, 4], to trace the genesis of system, it is appropriate to study the ancient thinkers and investigate the development of the concept of system from the very beginning. Ancient philosophy gives an ontological interpretation of “system” as the orderliness and integrity of being. In those days, the universe was perceived as a natural order created by the gods. The postulate of Anaxagoras “everything in everything”, the Leucippus and Democritus atomist doctrine; the Cicero's statement that “the world organism is an inseparable whole and all elements of the universe are harmoniously interconnected”; the Epicurean Theories of Knowledge; ideas of systematic knowledge in the ancient Greek philosophy of Euclid, Plato, Aristotle, and the Stoicism contributed to the genesis of the concept of “system”.

Aristotle systematized the knowledge of the ancient world. He considered the state as an ideal system with its structure and functions, a synthesis of all forms of communication for the sake of the highest good. In medieval philosophy, the concepts of “part” and “whole” emerged. Plato attempted to unite the state and the individual into a single whole to rid society of the contradictions between them. The idea of the systemic nature of being was developed in the system-ontological concepts of Spinoza and Leibniz, and Linnaeus's “System of Nature”.

The interconnection of didactical, methodical, gnoseological, and ontological aspects can be seen in Bartholomäus Keckermann’s concept of system. “The unity of these aspects is guaranteed by ontological prerequisites, in particular by the view of nature as the most harmonious whole, which defines the order of any system” [5].
In the Renaissance, the interpretation of “being” as “cosmos” is transformed into an understanding of it as a human independent world system, which has its type of organization, hierarchy, immanent laws, and structure. Science has developed a certain conceptual basis, the most important categories of which are the whole and part, object and property, substance and attribute, form and content. The unity and integrity of nature become the main theses of the philosophical doctrines of the Renaissance. Immanuel Kant used the concept of “system” not only in the ontological sense but also in the epistemological sense, understanding the system as the unity of various knowledge related to a common idea. The systematic nature of scientific knowledge was recognized but simplified to the systematic form instead of content [6].

Georg Wilhelm Friedrich Hegel considered objects as an organic whole: any object is something whole. As a whole, it consists of parts, and parts consist of the elements. Accordingly, to cognize something, all its parts and elements are to be identified and then mentally linked together to understand the whole. The parts do not exist in isolation from the rest of the world. They create an organized system. This system is also a whole and therefore determines the content of all its parts and elements. Therefore, to obtain a comprehensive understanding of a subject, it is necessary to study not only the subject itself but also the system it belongs to. Different approaches are used [7, 8], but systems approach is the only one that defines the concept of the subject both by its uniqueness and generality.

3. The concept of system in modern philosophy

In other words, we may gain a deeper understanding by comprehension sub-systemic components, abstraction, and systematicity of those conceptual systems [9]; a whole is greater than the sum of its parts [10]. It means that “a whole has emergent properties, i.e. properties that cannot be reduced to the properties of the parts” [11]. Utopian socialists Fourier, Saint-Simon, and Owen developed the ideas of interconnection and social harmony, integration, design, and construction of social systems [12]. Having created a holistic system of knowledge about society, Karl Marx considered the system from the standpoint of materialism. Friedrich Engels formulated the idea of the world as an infinitely large, eternal, inhomogeneous self-developing system; determined the existence of an objective relationship and interdependence in nature.

In modern philosophy, the concept of system was used in scientific studies in a wide range: from Étienne Bonnot de Kondilyak’s denial of the systemic nature of scientific and theoretical knowledge to the first attempts to philosophically substantiate the logical-deductive nature of knowledge-based systems made by Johann Heinrich Lambert and others. The German classical philosophy developed the principles of the systemic nature of knowledge: I. Kant (scientific knowledge is a system in which the whole dominates the parts), F. Schelling, and G. Hegel (systematic cognition is the most important requirement of dialectical thinking).
The resurgence of the knowledge systematicity with the conceptualization of the concept of system began in the 18th century when the confrontation between the two opposite approaches to systematization of science in the theory of cognition (empirical and rationalist) intensified.

In the 19th century, some theorists completely abandoned the ontological basis of cognition. They considered that knowledge in general, as well as the world as a whole, is an infinite object and therefore cannot be related to the concept of system. From the current point of view, it is clear that this concept is a way of the final representation of an infinitely complex object, and this is its epistemological essence. Therefore, the ESP system is considered to be based on the epistemological approach that establishes the interdependence of the teaching and learning process on the logic of the cognition process.

Even though the epistemological interpretation of knowledge systematicity has significantly advanced the development of the concept of system, it did not result in the understanding of systematicity of the object of knowledge. At the same time, the mathematization of scientific knowledge led to a simplification of the concept of system and such a division of the object into separate parts that the object as a whole disappeared from the field of view of science.

In the 20th century, Karl Ludwig von Bertalanffy’s general theory of systems retrieved the ontological understanding of a system, but in a different logical and methodological aspect, and gave start to the discussion about the variety of properties of “organic wholes”. The object is again considered to be complex with many properties, qualities, and relationships.

In the late 19th and early 20th centuries, the principle of integrity has become very popular in scientific research. This period was marked by the rejection of elementarism (complex phenomena can be understood only through their elementary components) and mechanism (understanding the whole as the sum of parts).

Integrity is a generalized characteristic of an object, a unity of parts in their various connections. The focus on the principle of integrity is intended to detract from the limited methods of research: elementarism, mechanism, and reductionism (reducing a complex to a simple). The study of these categories contributed to the development of a systematic approach to cognition of various objects and such categories as “element”, “structure” and “system”. The ideas about the ways of ordering various objects were developed.

In Sociology, one of the first holistic concepts of the social system is based on a mechanistic understanding of society, which consists of a set of individuals like a natural system built of atoms and molecules. Society is a system that is in a state of equilibrium, but relative equilibrium, because it is constantly disturbed and restored.

Two approaches in systems theory were highlighted. “The first approach assumes that systems are common in (or near) equilibrium, which negates the need
to examine dynamic relationships and nonlinear interactions among the systems' elements and instead focuses on isolating and parameterizing stable, individual components” [13]. Although the “simple” systems approach is appropriate for explaining the behavior of some types of systems, a second approach used by a variety of disciplines, including biology, ecology, chemistry, economics, and management [14], suggests that there is a second type of system that does not operate at equilibrium. There is a subset of these non-equilibrium systems – complex adaptive systems (CAS) – that cannot be explained using general systems theory” [15].

Back in the early 1900s, Pareto considers all parts of the social system to be closely interconnected and mechanically affect each other. Therefore, elementarism and mechanism were replaced by organicism, a methodological principle according to which social phenomena were considered by analogy with natural ones. Organicism has also been used to characterize notions put forth by various late 19th century social scientists who considered human society to be analogous to an organism, and individual humans to be analogous to the cells of an organism. This sort of organicist sociology was articulated by Alfred Espinas, Paul von Lilienfeld, Jacques Novicow, Albert Schäffle, Herbert Spencer, and René Worms.

Nevertheless, the elementary approach was still of great methodological importance in scientific research, for example, cybernetics, which adds information to such “atoms” as matter and energy.

The inclusion of mythological ideas about the Cosmos, the World Order, and the All in the context of philosophical and methodological considerations is important for understanding the genesis of the concept of system. The system gradually becomes the subject of knowledge.

4. **Evolution of the meaning of the concept of system**

The concept of system had been changing its meaning from epistemological and methodological to a pure epistemological Euclid’s and Kant’s interpretation in the 1700s up to the beginning of the 19th century when it got the ontological and naturalistic clarification. The focus was not just on the formation of a system of knowledge, but the object was reproduced in knowledge as a system.

The development of engineering approaches and technology in the 20th century was connected with the artificial and technical period of cognition of systems. It was not only researched but also designed and constructed. In the mid-20th century, the concept of system started to be widely applied in interprofessional and intersystem research. Consequently, a system is defined as a category that denotes an object organized as a whole, where the energy of connections between the elements of the system exceeds the energy of their connections with elements of other systems, and sets the ontological core of the system approach. The forms of objectification of this category in different versions of the approach are different and are determined by the theoretical and methodological concepts and means used.
In 1948, the Norbert Wiener’s book “Cybernetics” contributed to the development of systemic ideas as cybernetics is the science of managing complex dynamic systems. Researchers examined complex systems mathematically and concluded that the terms “systems theory” and “cybernetics” were used as synonyms.

Cybernetics is associated with the typology of system models, identifying the special role of feedback in systems, definition, and application of the principle of optimality in their management and synthesis, awareness of the information as a general property of systems, and development of methods of its quantitative description, development of the methodology of mathematical modeling and mathematical experiment using a computer [16]. Unlike Karl Ludwig von Bertalanffy, who studied how system exchanges matter, energy, or information with its surroundings, the Wiener’s approach involved the study of feedback within the system, and the functioning of the system is a response to external influences.

Contradictory definitions of the concept of system are explained by the fact that different researchers have developed it in different senses: ontological, epistemological, or methodological. The ontological meaning of the term “system” in ancient Greece is due to the identification of the reality with the ontological and the knowledge about it with the epistemological aspects. In the ontological approach, there are two ways to define the term “system”: 1) awareness of systems as integral and simultaneously dismembered fragments of the real world and 2) the use of the term “system” not for a dismembered whole, but, conversely, for the integrity defined by a certain community that organizes such a whole. That is, the system is both a set of objects and a set of properties. It means a lot that the development of the concept of system from the term “system” is due to the awareness of the integrity and dismemberment of both natural and artificial objects. This is reflected in the interpretation of the system as a whole composed of parts (Galileo Galilei, Isaac Newton, William Hamilton, Pierre-Simon Laplace, Baron d'Holbach, René Descartes, Benedict de Spinoza, Karl Ludwig von Bertalanffy).

The main disadvantage of the ontological understanding of a system is its identification with the object or simply with a fragment of reality; understanding of system is associated with the concept of the thing. It is reflected in the following definition: a system in the broadest sense can be anything that can be considered as a separate entity [17].

However, the use of the term “system” concerning a material object can only act as a metaphor. Any fragment of reality has an infinite number of manifestations; its cognition is broken down into many aspects. Therefore, even for a naturally dismembered object, we can only state the fact of the existence of interactions without their specification because it is not determined which properties of the object are involved in the interactions.
The epistemological meaning of the term “system” is defined in two ways by Euclid and Plato: one of them is related to the interpretation of the system of knowledge itself, first philosophical, then scientific; and the other, even though the term “system” concerning knowledge has never been used, its deepest core is developed.

Gradually ontological and epistemological understandings of the concept of system are intertwined. The combination of ontological and epistemological meanings in the understanding of the system and one of the first attempts to methodologically generalize system concepts were reflected in the system definition: “The system is a set of objects together with relationships between the objects and between their attributes”. Systems can “consist of physical parts: atoms, stars, switches, masses, springs, wires, bones, neurons, genes, muscles, gases, etc” [18]. Such a veiled combination of ontological and epistemological understanding can be found in many definitions.

All the considered definitions tend to analyze systems from different points of view. Having carried out the typological analysis of different definitions of the concept of system, three groups were identified: (1) definitions of systems as certain classes of mathematical models; (2) definitions of systems through the concepts of “elements”, “relations”, “connections”, “whole”, “integrity”; and (3) definition of systems using the terms “input”, “output”, “information processing”, “management”.

**Conclusion.** An analysis of the interpretation of the concept of “system” in the scientific literature in different time periods was carried out. Having undergone a long historical evolution, the concept of “system” from the middle of the 20th century becomes one of the key philosophical, methodological, and scientific concepts. The concept of “system” is a fundamental and universal category. There exist numerous interpretations of the concept of “system”, which displays active explorations of a new approach to scientific research. Current areas of further development of the outlined problem are the study of classification and types of systems.

**References:**


Література:


