MINISTRY OF EDUCATION OF THE REPUBLIC OF BELARUS
Belarusian National Technical University

Faculty of Management Technologies and Humanitarization
Department of "Philosophical Teachings"

PHILOSOPHY OF INFORMATION

Textbook for general educational discipline "Philosophy and Methodology of Science"

For students, listeners mastering the content of the educational program of higher education of the II stage

For all specialties full-time and part-time forms of education

E-learning material

Minsk
BNTU
2021

Compiled by:

Loiko A.I. Sci., professor, head department "Philosophical teachings"

Reviewers:

Volnistaya M.G., professor of the Department of Philosophy and Methodology of University Education, Republican Institute of Higher Education.

Khomich E.V. Associate Professor of the Department of Philosophy and Methodology of Science, Belarusian State University

The teaching aid on the philosophy and methodology of science supplements the lecture material with topical issues of the philosophy of information. The section "Philosophy and Values of Modern Civilization" discloses questions from the field of information metaphysics, philosophy of consciousness and social philosophy. The section "Philosophical and methodological analysis of science" describes the applied aspects of the philosophy of information, as well as the features of the use of digital technologies in research activities. The section "Philosophy of Natural Science and Technology" sets out the natural science aspects of information and technological features of the convergent structures of digital ecosystems. The section "Philosophy, Science, Man at the Beginning of the III Millennium" analyzes the evolution of system and computer engineering.

1 INTRODUCTION

In a smart society, the role of digital components of activities is growing. They are used in the educational process and professional activities. Most of the participants in various forms of activity are actively working with such a resource as information. Strengthening the role of the information component in the professional activity and lifestyle of a modern person has made the concept of an information society relevant. It is surprising that humanity has been constantly in the information environment since the beginning of its history. But the significance of information has grown so much that it has become one of the key components of the technological environment, has created, through information technology, the phenomenon of constant human contact with artificial intelligence. At the beginning of the 21st century, human capital, oil and information constitute the three main resources of humankind.

Information philosophy studies the general characteristics of information in the categories of ontology, anthropology, philosophy of mind, epistemology, and social philosophy. It forms the fundamental component of the description of information. Its applied consequences are in the subject field of neural philosophy and the theory of artificial intelligence, research of cognitive sciences, philosophy of computer science, computational philosophy, philosophy of social communication, philosophy of management, political philosophy.

L. Floridi made a great contribution to the actualization of the term "philosophy of information", who, within the framework of the evolution of analytical philosophy and philosophy of mind, was able to formulate key questions concerning the metaphysics of information. As a result ontology began to form, in the space of which the names of both foreign and domestic philosophers and methodologists were found. In addition to aspects of the theory of artificial intelligence, epistemological aspects of the analysis of a digital thesaurus through the prism of value topics have acquired relevance in the philosophy of information.

This is due to the shift in the analysis of information towards its semantic aspects.

The information society faced the need to develop components of legal and economic information, institutional structures of historical memory, which contain clear rules of activity and its continuity. They contain the dialectic of the rights of citizens and their responsibility to comply with the norms of the dynamic balance of the social system, guarantees of security and personal interests of citizens, accepted in society. Cyber security has become one of the key directions in the evolution of the information society.

Digital technologies are being introduced into the agricultural and industrial complexes. Reindustrialization has become a priority. The deployment of the converged infrastructure of the digital economy and social networks is reflected in the phenomenon of a new sociality. This phenomenon has become typical for the Republic of Belarus as well. Convergent synergy has formed the subject field of philosophical and methodological understanding of social dynamics in the categories of cognitive sciences.

1. PHILOSOPHY AND VALUES OF MODERN CIVILIZATION

1.1. Metaphysics of information

Philosophy considers information through the categorical structures of the fundamental sections that form its subject field. These sections constitute the content of metaphysics. In such a section as ontology, information appears in an extremely broad categorical presentation of the concepts of objective (material) and subjective being, existence, space, time, dynamic diversity and dynamic balance. The condition of information is the relationship and interaction of object structures and the environment, as well as their inherent internal and external dynamics. Within the framework of natural systems, object structures are carriers of potential information about themselves and their environment. They send potential messages to the external environment on carriers of various ranges of waves, radiation, particles and, within the framework of the reflection mechanism, react to each other, creating ensembles of dynamic structures in the Universe.

The interaction of information messages occurs through the reflection of object structures of each other. The architecture of the interaction of object structures is created by four interactions (gravitational, electromagnetic, nuclear - weak and strong). Physics studies the features of information processes on a light basis (optics), an energy basis (electricity and magnetism), a thermal basis (thermodynamics), and a nuclear basis (atomic physics and elementary particle physics).

At the level of interaction of object structures in inanimate nature, there is potential information on physical and chemical carriers in the form of radiation, wave oscillations, catastrophes (catastrophe theory) and reactions. From the point of view of astrophysics, the carriers of potential information are meteorites, comets, planetary satellites and the planets themselves. Neutrinos and gravitational waves contain actual potential information. In geology, the function of a carrier of potential information is performed by geological processes that have created the phenomenon of geological epochs.

In the inanimate nature that arose naturally, information remained potential, since there was no recipient of this information capable of responding to it in the mode of adaptation and adaptation to constantly changing environmental conditions. The situation has changed since the beginning of the history of wildlife. Philosophy judges the features of living nature by a local example within the Earth. This example was created by the biosphere over billions of years of evolution in the solar system. Only one planet was in the zone of acceptable temperature fluctuations for wildlife. This is facilitated by the presence of water, the earth's crust.

Living nature has evolved organisms in the form of populations capable of responding to information from the external environment and using it for adaptation, survival, and food. The studied forms of reflection in living nature were irritability characteristic of unicellular organisms, sensitivity characteristic of multicellular organisms heredity in the form of a cumulative mechanism of reproduction of communities of living organisms. As a result of the described evolution, potential information has become relevant information for representatives of wildlife. Living organisms have developed functions of inherited memory (information), which reflect data on the identity of organisms. At the same time, mutations caused by geophysical changes (feedback from the external environment) are not excluded.

Geophysical cataclysms on Earth with the participation of space aliens (meteorites, comets, fireballs) were accompanied by mass death of populations and suggested the evolution of their tolerance range. As a result, living organisms have evolved to form a nervous system integrated with the periphery of the organs of vision, touch, smell, tactile sensation, and ultrasonic location. The nervous system was transformed into a system for receiving information, processing it promptly and generating an adequate response to the information received. Some of these reactions are designated as unconditioned (inherited). It forms the content of the instinct. Another part of the reactions - conditional - is adapted to the factor of the individual experience of the organism, formed in specific constantly changing local conditions. Nerve endings (receptors), the spinal cord and the brain have become elements of the nervous system in living organisms. From the periphery, information flows are directed through the vascular system to the brain.

Vital factors of adaptation, survival ensuring heredity pushed the nervous system of marine and land animals to the need for social organization in herds and communities. As a result, the volume of transformation of potential information into actual information has increased.

Thus, at the level of categorical structures of material existence, the interaction of objects and the environment has created the phenomenon of potential information in the form of a sufficiently large variety of physical, chemical, geological, cosmic, and biological carriers. Living organisms began to translate potential information into actual information (reactions of irritability, excitability, sensitivity). To this they were motivated by external factors of adaptation, the struggle for existence, heredity. Organisms actualize only that potential information that is localized by their living space and heredity.

Most of the information is produced and is in a potential state. Objects of inanimate nature are in the mode of light, thermal, electromagnetic reflection of energy flows, particles on a reciprocal basis. The design of these flows is formed by the gravitational interactions of object, wave and energy structures, for example, the northern lights.

At the level of fundamental ideas about information, philosophy adheres to three concepts - substantial, attributive and functional. According to the substantial concept, information, along with matter, is an independent foundation of objective and subjective reality. The attributive concept considers information as a universal property of objective and subjective reality. The owners of this attribute are material objects and the material environment. They form material systems. Information as a reflection initiates the external self-organization of material systems. This is confirmed in synergetic (works by I. Prigogine and G. Hakken). The phenomenon of self-organization in inorganic nature has received a natural scientific basis. Thanks to synergetic, the idea of the universal nature of the processes of self-organization of matter is linked to ideas about the attributive nature of the phenomenon of information. The role of this phenomenon in the process of generating stable material structures from chaos is shown. The phenomenon of information appears as an irreversible process of the formation of a structure in an open none quilibrium system, starting with a random memorized choice that this system makes, passing from chaos to order, and ending with a purposeful action according to an algorithm or program that corresponds to the semantics of choice.

The complementary nature of the attributive and functional approaches to understanding the nature of information processes has created an argument for recognizing the existence of various levels and forms of information organization and their dependence on the levels of organization of matter. The more complex the form of matter, the more diverse information it contains. On a philosophical basis, numerous discussions began about the nature and essence of information, the development of a general theory of information. Within the framework of the theory, local forms of the systemic organization of information are identified. This is a pattern.

The functional concept of information proceeds from the fact that information is actualized by a person in the course of solving problems of activity, behavior, communication. The dependence of information on human activity brings it into the space of anthropology and social environment.

1.2. Philosophy of Mind

The subject of the philosophy of consciousness is a person with his characteristic attributes. Among these attributes, there is a reflection in the modification of consciousness, which actualizes potential information based on the tasks of social activity, behavior, communication. The physiological carrier of consciousness in the human body is the nervous system. It has a periphery in the form of receptors, a spinal cord, and a center for processing external and internal information in the form of the brain (neurons and spins). The cumulative function of storing and translating genetic information about the body is performed by DNA.

A person in the status of an individual is a correspondent and respondent for information. The individual status of a person creates local features of receiving, processing, storing and using information. Moreover, they must inevitably be integrated into the space of a social community. Outside the social environment, individual consciousness cannot be formed. There are enough examples that anthropological similarity with humans is not a guarantee of consciousness.

According to archaeological data, man as a generic creature was actualized by evolution from the communities of higher primates. Marxism notes the role in this process of evolution of the great apes of tool activity, which transformed the human body in order to free the hands for other tasks. The complex of unconditioned and conditioned reflexes in the human brain was supplemented by thinking and such a means of communication as verbal speech, represented by a system of sounds.

People had to live in natural conditions that were fraught with risks. These risks required their minimization through a dialogue with external nature, the environment. Rock painting has become a reflection of the mental work of people to personify the participants in the dialogue. These participants were natural forces in the form of spirits, as well as animals that were the object of hunting and fishing. Cosmic phenomena were also the subject of comprehension. Information was recorded in the form of rock paintings. Hunting objects were displayed especially carefully. Hunter figures are more likely to have a symbolic designation.

Shamans, sorcerers, priests have been and are still conducting an informational dialogue with the spirits. These are special institutions of dialogue with external nature. They involved sacrifices. They have become part of many traditional cultures. They retained their influence under the conditions of humanity's specialization in nomadic animal husbandry and agricultural cultures (civilizations).

At the stage of agricultural civilizations, human consciousness evolved to the level of abstract logical thinking, which was modified by mathematics. This abstract thinking singled out a quantitative area of information in the form of arithmetic and created a digital language to designate this area. As a result, relevant quantitative information has acquired a digital presentation. Mathematical thinking also began to operate with ideal objects the components of geometry were abstract graphic modifications of space, axioms (assumptions) and theorems.

The qualitative side of information has also become the subject of abstract thinking. For her, a version of the written text (sign system) was developed, adapted to the sound features of the verbal speech of specific communities of people. The information began to correlate with state law and economic statistics. In the agricultural civilizations of Egypt, Mesopotamia, India, China, the Mediterranean, the graphics of symbolic systems were created, adequate to the tasks of public administration and education.

In traditional civilizations, under the influence of critical thinking of natural philosophers, there has been a tendency to increase the role of knowledge in relation to information. Aristotle actualized such a branch of philosophy as logic. It gives priority to thinking. It persisted until the end of the 19th century, even after traditional agricultural civilizations were replaced by technogenic civilizations.

For a long time, access to internal information about the human body was limited by prohibitions, which hindered the development of medicine and its capabilities in the fight against epidemics. Human consciousness was mainly the subject of speculative reflections of philosophers. This situation continued until the moment when the representatives of Marxism formulated the hypothesis that consciousness is a function of the human brain, which it needs to reflect objective reality. The thesis was formulated about the primacy of matter and the productivity of consciousness.

M. Sechenov and I.P. Pavlov proved that the human brain possesses the function of consciousness, which is characterized by reflex activity based on unconditioned and conditioned reflexes. Unconditioned reflexes are inherited. Conditioned reflexes are produced by the brain during the life of an individual. Reflexes (reactions) form the physiological core of the psyche of animals and humans. In this form, they are consonant with the function of reflection, characteristic of material objects of inanimate and living nature.

Marxism structured the philosophy of consciousness on the basis of a categorical structure, which includes the subject (person), reflection, individual and social consciousness, forms of social consciousness, systematically represented by the worldview. Forms of public consciousness law, morality, ideology, art, science, politics, economics, religion structure the content components of individual consciousness. They have a regulatory impact on them. Historically, they evolve in the space of culture, civilization, and state. Ideology in the worldview is associated with the psychological components of character, temperament, mentality, identity.

The tendency to reduce consciousness to thinking was not supported by all philosophers. In a number of philosophical schools of empiricism, the content components of consciousness are associated with experience, common sense and intuition. Psychoanalytic philosophy in a loose form formulated the thesis that human consciousness, in addition to a meaningful rational component of thinking, contains an unconscious component of reflexes (instincts) and a subconscious component in the form of dreams. K.G. Jung extended this model to social consciousness through the concept of the collective unconscious.

As a result of the release of people's thinking to the abstract level of operating with ideal objects, the information resources of mankind began to perform the function of an empirical substantiation of theoretical constructions (rationalism). Empiricism did not agree with this approach and began to give priority to sensory forms of obtaining information. But in the process of analyzing the movement of information to the logical components of thinking, grounds for agnosticism (I. Kant), skepticism (D. Hume), and solipsism (J. Berkeley) were found.

Interest in the philosophy of consciousness, already in the context of the pragmatic tasks of creating artificial intelligence, arose in the second half of the twentieth century. The role of the analytical tradition is important in this transition.

1.3. Analytical philosophy and philosophy of mind

Analytical philosophy represents the tradition of philosophical empiricism and is associated with the region of the British Commonwealth of Nations, the United States and Scandinavia. It became relevant in the middle of the 20th century. Analytical philosophy was formed on the basis of British neorealism by J. Moore and B. Russell, Austrian positivism, Lvov-Warsaw school and pragmatism.

Analytical philosophy is characterized by criticism of speculative philosophy, scientism (connection with science) and empiricism (trust only in facts), pragmatism (emphasis on the practical benefits of knowledge). The ideals of clarity, precision and logical rigor of thinking are cultivated. The main goal is seen in the preservation of the original empirical information from distortions. These distortions can be created at the stage of obtaining information, its language and digital presentation.

Initially, representatives of the analytical tradition were in the paradigm of scientism. They aimed to realize the ideal of a rigorous and accurate scientific presentation of data. The subject of the analysis was sentences in the structure of a scientific language.

The origins of analytical philosophy in: the logical developments of the Stoics, Aristotle's "Analytics", the semantic ideas of the sophists, the British scholasticism of D. Scott and Ockham. In modern times, attention to linguistic and epistemological topics has become a priority in British philosophy. Continental philosophy of Europe also showed interest in the phenomenon of consciousness (R. Descartes, G. Leibniz, I. Kant).

The basis of the analytical tradition was formulated by the works of the logician G. Frege, the logical-semantic analysis and philosophy of common sense J. Moore, the logical atomism of B. Russell, the logical positivism of the Vienna circle, the Lvov-Warsaw school, the philosophy of the everyday language of the Oxford school, as well as the concepts of early and late L. Wittgenstein. The assassination of the head of the Vienna Circle by the Nazis in Vienna during the Second World War, the Anschluss of Austria and the occupation of Poland led to the emigration of representatives of analytical philosophy to English-speaking countries.

At the second stage of evolution, analytical philosophy made the analysis of everyday language and language games the subject of its research. A thorough analysis of this period in the evolution of analytical philosophy was carried out by N.V. Rozhin, who worked in the second half of the 20th century at the Belarusian State University.

In the 70s XX century analytical philosophy has been criticized by postmodernism. As a result, she focused on the problems of the philosophy of mind. The main representatives of the third wave of analytical philosophy were John Searle, Daniel Dennett and David Chalmers. Based on intentionality, J. Searle in his book "Rediscovery of Consciousness" (1992) showed that philosophy found itself in the position of a wrong dichotomy on the one hand, the world consists only of objective particles, on the other hand, consciousness has a subjective experience in the first person. Both positions are correct: consciousness is a real subjective experience associated with physical processes in the brain. This position came to be called biological naturalism.

D. Denett advocated the philosophy of consciousness, which would have a basis in empirical research. In his dissertation "Content and Consciousness, he divided the problem of explaining reason into the need for a theory of content and a theory of consciousness». He published a collection of essays on the content of consciousness.

D. Chalmers put forward the thesis about the difficult problem of consciousness. He established a distinction between the easy problems of consciousness and the difficult problem of consciousness, which can be expressed by the question: "Why is there a perception of sensory information at all?" The research focused on the difference between biological brain function and behavior, and mental experience, which is considered separately from behavior as qualia. In his opinion, there is still no comprehensive explanation of the differences between the two systems. He criticized the materialistic explanation of mental experience. As evidence, he hypothesized a philosophical zombie who is a normal person, but does not have qualia and the ability to sense. He argues that since the existence of zombies is possible, the concepts of qualia and the ability to sense have not yet been fully explained in terms of physical properties.

D. Chalmers admitted that consciousness originates in any information system and took the position of preanimism. According to this position, any physical object has consciousness.

In analytical philosophy, much attention is paid to moral and ethical issues. This is due to the shift in attention from the analysis of language to the analysis of everyday language, where there is a significant amount of value judgments. Two approaches to the interpretation of moral and ethical statements have been identified. The cognitive approach involves the verification of statements and their reduction to material interests. The non-cognitive approach is based on subjective-emotional attitudes (emotivism) and long-term behavior (prescriptivism). The only constituent feature of analytical ethics is the analytical style of thinking, the rejection of the metaphorical-suggestive way of presentation. This presupposes a careful definition of key concepts, the identification of the semantic shades of the natural language of morality, the striving for the logical transparency of ethical reasoning.

In Finland, the proponents of analytic philosophy were Georg Henrik von Wright and JaakkoHintikka. The philosophy of Australia is associated with analytical philosophy. She is represented by Arthur Prior, David Armstrong, J. Smart, Frank Jackson, Passmore, John, Peter Singer, Genevieve Lloyd andFuta-Helu.

Analytical philosophy occupies the strongest position in the United States. A special role in this was played by the pragmatism of Charles Sanders Pierce, William James and John Dewey, George Santayana. Analytical philosophy in the United States was formed under the influence of representatives of European neo positivism who migrated to this country. This position was adopted by Quine. He supported the thesis that philosophy and science together should strive for intellectual clarity and understanding of the world. Quine's student at Harvard University was Saul Kripke, who became one of the most famous contemporary philosophers and analysts. He was occupied with the fields of modal logic and semantics, philosophy of language, set theory. Another student of Quine was David Lewis. He is considered one of the greatest philosophers of the 20th century as he developed the theory of modal realism. Thomas Kuhn is known for his works in the history of science and the philosophy of science. After strengthening the philosophy of consciousness in the analytic tradition, the works of Hilary Putnam, Donald Davidson, Daniel Dennett, Douglas Hofstadter, John Rogers Searle, Patricia and Paul Churchland gained fame.

Canada has become a center for research in the philosophy of mind and cognitive sciences, in particular, the Center for Cognitive Sciences of the University of Western Ontario. The research was carried out by Patricia and Paul Churchlands, ZenonPilishin and AusonioMarras. Bas Van Fraassen, William Roseboom, and Alasder Urquhart specialize in the semantics of logic. Hans Herzberger and William Harper study the nature of preference. John Woods explored concepts related to relevance and paradox. Charles Morgan focuses on modal logic and probabilistic semantics. Anil Gupta develops the semantics of truth and paradox. Paul R. Tagard of the University of Waterloo studies the potential of cognitive function and coherence. ZenonPilishin, a psychologist and computer scientist at the University of Western Ontario from 1964 to 1994, made significant contributions to cognitive science.

The problem of the demarcation of scientific knowledge was resolved through the development of criteria for verifiability (experimental testability) of scientific judgments and their falsifiability (the readiness of science to abandon outdated theories refuted by newly discovered facts). Representatives of emotivism B. Russell (1872 - 1970), A. Iyer (1910 - 1989), R. Carnap (1891 - 1970) found that ethical-normative judgments based on religious commandments are in fact not verifiable, since the existence of God as a source of morality is not empirically provable, is the subject of irrational belief.

The negative attitude towards the scientific status of ethics was overcome by the school of linguistic analysis (S. Tulmin, R. Hear, P. Strawson). The direction turned to everyday use of words, the usual and generally accepted combination of individual words and sentences as a reflection of moral relations in society. An increased interest in the space of natural language, which is characteristic of most philosophical trends of the 20th century has developed.

In its modern form, the analytical philosophy of consciousness is closely related to the cognitive sciences, in particular, with logic and the theory of artificial intelligence.

1.4. Synergetic information theory

Being in relationships and connections, system objects reflect information, the quantitative assessment of which is of scientific and practical interest. Attempts to determine the amount of information using traditional approaches to quantifying information of combinatorial, probabilistic, algorithmic approaches are not effective. The analysis of information and quantitative aspects of the reflection of systemic formations was carried out.

Initially, the research was of an empirical nature and was carried out on the basis of the elementary apparatus of the theory of probability with the use of the information measure of R. Hartley. The result was a formula for the negentropy of the reflection of the information-quantitative characteristics of information about a system object obtained when observing its attribute, as well as the establishment of the information law of reflection of system objects. It expresses the balance between reflected information, reflected (negentropy) and non-reflected (entropy) information.

There was a rethinking, reproduction and development of the results obtained on a qualitatively different axiomatic basis. The carried out information-theoretical research was freed from the use of the apparatus of the theory of probability and the traditional theory of information. The thesis was used that the theory of information should precede the theory of probability, and not be based on it.

A new direction of information-theoretical research is called synergetic information theory. The subject of knowledge of the synergetic theory of information is the information-quantitative aspects of the reflection of systemic formations, including such aspects as order and chaos. The features of the relationship between chaos and order are also studied under various structural transformations. Both reflective and reflective objects are considered as a whole. Their elements take part in the reflection processes.

Within the framework of the synergetic theory of information, quantitative criteria for assessing the structural organization of systemic formations are established and their classification is given according to the parameter of the ratio in their structure of chaos and order.

Synergetic and traditional information theories are fundamentally different from each other in two respects. - First, traditional and synergetic theories deal with different types of information. With attributive information related to management and existing independently of it. Secondly, in the synergetic theory of information, the term information is interpreted as information about the system object as a single whole. In traditional information theory, the term information is isolated from the semantics of messages.

There is a certain relationship between the theories, which consists in the fact that within the framework of the synergetic theory, the fundamental mathematical expressions of the traditional information theory are obtained in a natural (unbiased) way. However, they have a completely different interpretation.

In traditional informatics, based on the mathematical theory of communication, there are no questions about the emergence of valuable information and its evolution. The value of information is discussed under the assumption that the goal is set from the outside. The question of the spontaneous emergence of a goal within the system is not posed. In the language of the theory of dynamic systems, the reception of information means the transfer of the system to one definite state, regardless of what state it was in earlier. In modern technical devices, reception is carried out using electrical or light pulses. In all cases, the pulse energy must be greater than the barrier between states.

In the theory of dynamical systems, such switching due to external forces is called force. Along with it, another parametric switching method exists and is used. The bottom line is that for some finite time the parameters of the system change so much that it becomes monostable. One of the states becomes unstable and then disappears. Regardless of what state the system was in, it falls into the remaining stable state. After that, the parameters are returned to their previous values. The system becomes bistable. But it remains in a new state.

Parametric switching, like power switching, is the reception of information. Only the switching mechanisms, that is, the reception, differ. In modern electronics, information reception is used due to power switching. In biological systems, parametric switching is used. In both cases of reception and generation, the ability to perceive or generate depends on the information that the receptor or generator contains.

Valuable information belongs to the top level. To perceive or generate it, it is necessary to have a command of the language and knowledge, to have a thesaurus. This is information contained in the system at this level, necessary for reception, generation of information at the next level. In a developing system, the need for choice arises when it comes to an unstable state. It is located at the bifurcation point. The choice is made from many different options, the power and character of which is determined by the type of bifurcation. In the simplest case, the choice is made from two options.

After the choice has been made, the system develops steadily up to the next bifurcation. A choice is made again, but from a different set of options. This set depends on the outcome of the first choice. If the system in its development has not yet reached the first stage then the question of choosing an option at the second stage loses its meaning, since the information of the first level is a thesaurus for the second and all subsequent levels. Without a thesaurus, there is no set from which to choose. Choosing from any other set will have zero value. The situation is somewhat more complicated in the case of information reception. In the simplest case, the information coming from the outside is defined on the same set of options from which the choice is made.

At higher levels, information coming from the outside is relevant to all levels, and not to this level. The thesaurus is necessary in order to extract from it valuable information related to this level.

Particularly noteworthy is the situation when many options at the next level have not yet been formed, although the goal has already been set. This is exactly the case when it comes to researching and describing a new phenomenon. Then the information coming from the outside does not help to make a choice, since there is nothing to choose from, but it can help to form the required set.

The object that has recorded this or that information is its carrier. Information, being neither matter nor energy, can exist only in a fixed state. Record commit methods can be conditional, not related to semantics. Hence, it becomes necessary to divide information into conditional and unconditional information. An example of conditional information is code used to encrypt a message. The code is the correspondence between conventional symbols and real objects or actions.

The choice of the code variant is made randomly and is remembered by both the transmitting and receiving sides. Valuable code information can be if it is owned by several people. Information is related to collective behavior and social activities.

Information about real events is unconditional. It does not need approval. It can be received by the information system without human intervention. This information does not arise by chance. It is received from the surrounding reality.

Messages can contain both conditional and unconditional information. Conditional information tends to be unified as it increases its value and efficiency. This tendency is more pronounced at the lower levels as evolutionarily more ancient. For example, the mathematical formalism is unified at the lower levels of the hierarchical information ladder.

Unified conditional information is often perceived as unconditional. Thus, mathematics unified at the lower level, including arithmetic, creates an opinion that it could not be otherwise. The unification of the mathematical apparatus has occurred as a result of evolution. There were options in use that differed from its modern version.

At higher levels, there are several different options for describing the same objects: continual description, dynamic equations, probabilistic models, cellular automata. The choice of the mathematical apparatus reflects the act of generating valuable conditional information. Symbols are of fundamental importance to mathematicians. This is because symbols are final objects and should not be used to denote anything other than themselves.

1.5. Philosophy of Social Information

The philosophy of social information outlines the subject field by the boundaries of society (humanity), within which the information component plays an important role. Social information includes information that characterizes society as a system, structure, dynamic integrity of diversity and balance, and as uncertainty. For the concept of the uncertainty of a random object, it was possible to introduce a quantitative measure called entropy. To characterize the diffusion of the distribution, the variance or confidence interval is used. These values are meaningful only for random numerical values and cannot be applied to random objects, the states of which differ qualitatively. It follows from this that the measure of the uncertainty associated with the distribution should be some of its numerical characteristics, a functional of the distribution, in no way connected with the scale in which the realizations of a random object are measured.

Entropy acquires special significance due to the fact that it is associated with deep, fundamental properties of random processes. Only the functional called entropy can serve as a measure. With some difficulties, the entropy approach was successfully generalized to continuous random variables by introducing differential entropy and to discrete random processes. The process of obtaining information can be interpreted as a change in uncertainty as a result of receiving a signal. Before the next character is received, the situation is characterized by uncertainty about which character will be sent, i.e. a priori entropy. After receiving a symbol, the uncertainty about which symbol was sent changes. In the absence of noise, it disappears altogether. The posterior entropy is zero because it is known for sure that the symbol was transmitted. In the presence of noise, we cannot be sure that the received character is the transmitted character. Uncertainty arises, characterized by a posteriori entropy.

Information is a reflection of one object to another, manifesting itself in accordance with their states. One object can be reflected by several others, often some better than others. The average amount of information is a numerical characteristic of the degree of reflection, the degree of conformity. Reflected and reflective objects are completely equal. This emphasizes the reciprocity of the reflection. Each of them contains information about each other. One phenomenon appears as a cause. Another phenomenon appears as a consequence. This is not taken into account in the quantitative description of information in any way.

Specific methods of information theory make it possible to carry out a number of quantitative studies of information flows in the studied or projected system. But more important is the heuristic meaning of the basic concepts of information theory. These are the concepts of uncertainty, entropy amount of information, redundancy and bandwidth. Their use is just as important for understanding systemic processes as the use of concepts related to temporal, energy processes. System analysis inevitably goes to the study of the resources that will be required to solve the problem being analyzed.

The main properties of information resources include: codifiability, identifiability, standardization, measurability. Interaction is an important characteristic of information processes and information systems. The analysis of information systems can be carried out by different methods, which include the method of system information. Entropy plays a major role in statistical information theory because it is one of the tools for analyzing information and information systems.

Statistical information theory postulates that information is transmitted as a sequence of signals that make up an information message. The physical meaning of the signal through which information is transmitted may not coincide with the meaning of the transmitted information. The perception of information is unthinkable without certain preliminary agreements and knowledge, without which the signal will be perceived only as a message about some fact that is not clear how to interpret. To achieve mutual understanding, a preliminary agreement on the meanings of the signals is required. Information processing involves the process of converting existing information into the information field.

The transformation of information can be associated with a change in its content or form of presentation. In the latter case, one speaks of encoding information. Information processing can include information encryption or translation of texts into another language. Information entropy reflects the measure of information per one elementary message of a source that generates statistically independent messages. K. Shannon suggested that the increase in information received by the system during the transition from state 1 to state 2 is equal to the lost uncertainty. He set requirements for its measurement. The measure must be continuous. This means that a small change in the value of the probability value should cause a small resultant change in the function. In the case where all the options are, increasing the number of options should always increase the value of the function. It should be possible to make a choice in two steps, in which the value of the output function should be the sum of the output functions.

It is necessary to calculate the mathematical expectation of the amount of information contained in the symbol. K. Shannon considered a symbol as an information unit without introducing this concept. The measure of entropy expresses the uncertainty of the implementation of a random variable. Information entropy is the difference between the information contained in a message and that piece of information that is precisely known and well predictable. Additive systems are additive in relation to their constituent parts. Information sets of identified classes and attributes overlap in such systems. This makes it possible to identify an object in different systems, while the set of functional and additional classes of attributes of such objects differ.

Additive systems correspond to the principle of addition of entropy contributions and implement the transfer function in the form of a complex variable, where the real part is the enthalpy, and the imaginary part is the probabilistic entropy characteristic. Transactional systems are an example of simple additive systems. They are characterized by their unambiguous, predictable and always repeatable response to the impact of single transactions. Subtractive systems containing general combined information about diverse or dissimilar objects can be viewed as a set of identified attribute classes. Examples are multimedia and computer graphics systems, educational and descriptive systems, geographic information systems, connectors. Multiplicative systems possess both subtractive and additive properties acquired as a result of interaction in the process of systems integration.

The more elements in the system, the greater the proportion of all information contained in it is the system information contained not in the elements, but in subsystems of varying complexity and levels of hierarchy. The fewer elements in the system, the faster the share of information contained in the interconnections of elements increases with an increase in the level of consistency. The use of the system theory of information and information entropy allows solving problems of cognitive modeling and assessing the measure of cognition, that is, cognitive entropy. However, when using this theory, it is required to analyze the situation, states and type of the system.

In this context, ecology forms a special database on society, since society is located within the boundaries of the Earth's biosphere and exerts anthropogenic pressure on it. This pressure is fraught with global and local climate changes and catastrophic consequences in the form of droughts, increased fire hazard, floods, hurricanes, tornadoes, and smog.

Environmental information formed the basis of international practice of legal and regulatory regulation of technological activities of mankind, the transfer of industrial structures to energy conservation standards, the use of alternative energy sources, and the development of a green economy. But environmental concerns remain. This is evidenced by the annual increase in the temperature background on the planet, the melting of glaciers, the increase in the strength and frequency of hurricanes and floods. As a result, the co-evolution of the biosphere and humanity is taking place under conditions of growing risks.

An important source of information for humanity is data on the growth of the planet's population and its desire to concentrate in megalopolises and states with a high level of living wage. As a result, migration is an urgent problem. The risks arising from it are complemented by political factors destabilizing states. As a result, flows of forced migration (refugees) are formed. In conditions of high concentration of the population (urbanization) and migration, the risks of epidemics are growing.

Information plays an important role in the international economy. Based on it, forecasts are made that affect investment activity and the actions of financial market regulators. In this segment of society, the laws of a market economy operate, coupled with the concept of economic cycles, the completion of which is accompanied by crisis phenomena and attempts by states to mitigate their social consequences.

World energy prices are significantly influenced by information about local military conflicts, since hostilities threaten stable supplies of oil and gas to consumers. Investors also take into account the sanctions pressure on individual states. In the political sphere, the practice of information warfare has developed. This means that information resources are designed for specific tasks of geopolitical competition, ideology of geopolitical superiority. The reliability of historical information about the events of world wars increasingly presupposes reliance on facts, field and archival research, the results of the investigation of crimes against humanity and their legal assessment.

In the social space, information requires legal protection. There are practices of legal protection of copyright, personal information (confidentiality), information field of the state. Social information is archived by society (humanity) through the institutions of libraries, archives, electronic resources. This is facilitated by alphabetic, digital and graphic writing, as well as technologies for creating visual information (photography, cinematography). The digital technologies of the Internet have created a mechanism for the convergence of information flows into digital platforms through the systems of mobile devices.

At the level of civil society and common sense, information is an element of everyday communication between people. This communication includes the exchange of messages between people about personal and family life, acquaintances, prices, health, dreams. The need to be in the mode of constant information contact is so high among people that mobile technical devices have become one of the key elements of their lives.

Social information is included in all the contradictions inherent in modern society. This gave rise to the introduction of the term "information society". There is a steady trend of convergence of social information with technical devices and technological processes. In this form, society is designated as a technogenic civilization. The geography of these civilizations is in the dynamics of formation and evolution. Each of the technogenic civilizations protects its information space from cybernetics attacks, fights against hackers and crime in the field of digital relations between individuals and legal entities.

Social information is being transformed under the influence of such a phenomenon as industrial revolutions. This methodology is based on convergent technologies and the level of cooperation and structuring achieved by computer technologies. The network has highlighted a category of individual cloud microservices focused on solving specific computing problems,

There has been a trend towards an increase in the number of network nodes and types of devices through which a person interacts with information (computers, laptops, phones, tablets, devices). A single information space has created the phenomenon of a smart society.

The term "smart" is used in management to denote a well-thought-out tactics for achieving a goal based on its concreteness, measurability, assignability and control of performers, realism, temporality (time criterion). In this sense, "smart" means rationalism brought to perfection in making and implementing decisions. In light of such criteria, this rationalism meets the criterion of smart decision. Realizing the potential of such rationalism makes the economy and public administration more efficient. Since the bearer of this rationalism is not only man, but also artificial intelligence, a hybrid environment of modern society and economy is formed in the form of man-machine systems.

Ideally, a smart society is an ecological socio-economic system based on knowledge resources and communication technologies. The professional level of using information and communication technologies is a key condition for the inclusion of individuals in a smart society. They meet this criterion. They are smart citizens.

In terms of the characteristics of the processes of activity, a smart society is a “smart” work based on “smart” infrastructure and communications and “smart” citizens. Together they make up the space of smart culture.

In terms of the characteristics of creative processes, a smart society is a self-governing, motivated, flexible, technological society. At the level of strategic forecasting, the term “smart society” is concretized by the applied term “smart country”. Within the boundaries of this term, the peculiarities of national states and their evolutionary models of the information society at the stage of a smart society are localized.

Anticipating the inevitability of a smart society, nation states focus on the analysis of educational strategies and their digital transformation.

The infrastructure basis of smart education is formed by schools, colleges, universities, which in their structure have integrated digital platforms of electronic libraries and educational platforms for delivering lecture courses. Electronic libraries have open educational resources, electronic textbooks. Teachers and students can use cloud educational systems and Internet services, digital video communications. You can use a portfolio resource and a personal email account.

In the structure of smart education, the role of guided independent work is growing, which involves the formation of students' skills in working with electronic resources. These resources are created by teachers in the form of multimedia educational complexes. University programmers form an intellectual environment for distance learning support for students, as well as support systems for the research work of teachers and research work of students. They also create university portals. On the basis of university techno parks students study and master technologies of coworking centers and crowdsourcing.

One of the directions of work of NIRS is interactive smart textbooks. They function in the form of hypertext. Students supplement conceptual provisions of topics with applied hyperlinks to technologies. As a result, the principle of feedback is implemented. The virtual educational world functions in the same format. Students have the opportunity to post presentations on patriotic and social events in text and visual presentation formats on university information news portals. Hyperlinks supplement the meaningful context of the message, introduce it into the context of systemic work.

The status of a smart citizen is acquired as a result of the socialization of an individual. In modern society, socialization ends with the receipt of secondary specialized or higher education and is characterized by the beginning of professional activity, the acquisition of an independent social status through the institutions of marriage and family, career.

For personal ambitions to be realized, an individual must learn himself and create new knowledge, develop innovations (commercial developments), create employment itself and provide jobs for other individuals. Knowledge of computer technology is important, as well as the skills to create new business models.

The smart citizen cultivates collaborative social life practices focused on joint improvement of the ecological environment of the city, home, and his own family. It supports the smart city strategy, as its consequences are the improvement of the city's utilities and energy services, the transport complex.

A smart citizen lives in the legal field of social networks, which minimize the risks of spreading to him the activities of the shadow economy (drug trafficking, slave trade, terrorism) of technologies for manipulating individual consciousness in the form of extortion, blackmail, threats, deception. A factor in the transformation of the cognitive structures of thinking of generations of the Internet is the hypertextuality of the increasing amount of information.

The term "hypertext" was introduced by T. Nelson to describe documents that express a non-linear structure of ideas, as opposed to the linear structure of books, films and speech. The key was the thesis that the processing and generation of ideas by the human brain occurs associatively, and not linearly. The information is presented on the Internet with many links. Consequently, the text contains an indication of the contexts in which it is included. It is like a rhizome. There is no clear structure in it.

The composition of the text is represented by a list of facts, opinions, quotes, details, information. There was an evolution of speech practices of hypertext and communication. It is characterized by the rejection of the accepted spelling norms, the simplification and brevity of grammatical structures, the use of abbreviated verbal forms, the dominance of slang forms of the language, the combination of words from different languages. To indicate the timbre of the voice and accentuate part of the utterance, caps are used - writing a phrase or part of it in capital letters.

B.L. Whorf formulated a hypothesis according to which the basis of the linguistic system, grammar, is a means of forming thoughts, a program and guidance of an individual's mental activity, a means of analysis. The language system, assimilated by human consciousness, structures the world around and systematizes. To characterize the thought processes occurring under the influence of information technology, a number of modern researchers suggest using the concept of "Net thinking" - clip thinking. The changes affect attention, memory and analytical thinking. The ability to concentrate and analyze began to be lost. The ability to perceive voluminous texts that require prolonged concentration of attention and independent highlighting of the main thoughts is lost. The dominant attitude is to receive new information. The grounds for attention deficit are forming.

Technological modernization of the industrial sector of activity, including the Industry 4.0 strategy, has created a tendency to increase the role of non-standard forms of employment in the labor market. The categories of full standard employment and non-standard forms of employment are identified.

The expansion of the role of non-standard forms of employment is influenced by the factors of the economic crisis, the epidemiological situation, the development of technologies, the desire of companies to reduce production costs, and changes in organizational strategies. Based on these tendencies, the flexicurity policy has been formulated. It presupposes flexibility in the legal regulation of labor through the modernization of existing social employment models.

One of the directions for the development of non-standard forms of employment in the digital economy has become e-employment (distance employment). It involves finding an employee at a distance from the employer and using information technology for communication, control, transfer of tasks, labor results and remuneration.

E-employment is presented as a permanent job in a specific organization or as freelance. Institutional support for freelancing requires legal support. Most freelancers would like to work, pay taxes and have retirement guarantees. The creation of an effective system of enforcement of legislation in the field of e-employment is urgent.

There is a need for the development of electronic payment systems, improvement of electronic signature technologies and electronic document management. The use of an electronic labor contract may become promising.

Institutionalization of labor market information platforms has been implemented. Networked labor market institutions bring together many actors. Their status is formed by the establishment of a set of stably functioning rules.

Institutions arise because people have a need for them. A group of people participating in the virtual labor market unites with a common interest in the form of specific information, as well as systematized processed information suitable for solving practical problems.

Network labor market institutions imply: the division of roles, the formation of communication rules, internal forms of sanctions for violators of generally accepted norms. The Network Labor Market Institute is a network where each node can simultaneously act as a client (recipient of information) and a server (provider of data).

The infrastructure of the virtual labor market is represented by a network of institutions. These are networked information institutions of the labor market. They are linked by search engines. These are institutions in the form of a labor exchange for IT specialists, resources for students and alumni, social networks and communities, for various professions, cities in the form of government websites, electronic bulletin boards. Networked consulting educational institutions of the labor market play an important role. This is a distance market for educational services operating on the basis of higher professional, postgraduate education.

It became possible to connect the network with physical reality via the Internet of Things. This was facilitated by the introduction of sensor-equipped and networked computing devices into all aspects of human activity through the means of creation and navigation in virtual and augmented reality,

Highly saturated information systems have been developed that describe both virtual and physical reality (graph knowledge bases). Systems for processing ultra-large volumes of data in real mode have been created,

Network principles are used in deep machine learning systems for highly intelligent information analysis systems (analysis of natural language, handwriting, speech, images and video), increasing the accuracy of autonomous transport devices, robotics and industrial automation. The goal of the developers is quantum computing systems.

Social information is classified by type. Thus, a discrete form of social information is represented by a sequence of characters of a discontinuous, changing value. These are quantitative indicators of services, incidents. The analog form of presentation of social information is expressed in a quantity that does not have gaps.

According to the way a person perceives, social information is divided into visual visual and auditory information. As well as tactile (sensation), olfactory (reflection), gustatory (taste) information. A modification of machine (computer + sensors and cameras) information has been created.

According to the method of broadcasting, social information is divided into symbolic, textual, numerical, graphic, and sound information. By focus on the audience, social information is divided into mass, special, personal information.

1.6. Philosophy of Social Communication

Information and communication have always played an important role in human history. This is evidenced by the emergence of writing and arithmetic, as the main ways of broadcasting and operating with information. Typography has strengthened the role of the information component in the structure of society. The natives of Belarus made a significant contribution to the development of world traditions of book printing. Among them are F. Skorina, S. Budny, M. Smotrytsky.

The industrial revolutions accentuated the role of energy, transport, industrial, and communal communications. In the twentieth century, the role of information technologies was manifested with renewed vigor. The attention of philosophers to the content of communicative action was constantly growing. The features of the dialogue were studied. The tradition comes from Socrates and Plato's dialogues. The dialogue was studied by M. Buber and M. Bakhtin. J. Habermas developed the theory of communicative action.

The Internet forms a special space for communications. Technological determinism has shaped the information environment of human communication faster than the institutional framework of law and ethics on the Internet has been formed.

The lack of an institutional foundation did not bother users, as they thought they had found a place where freedom was the highest value, where responsibility and long-term consequences were meaningless. Hackers, manipulators of individual and social consciousness, programmers, groups representing the shadow economy and political interests were influenced by mercantile temptations.

Being a member of a networked society deprives the bulk of Internet users of a sense of security. Therefore, in virtual communication, netiquette issues come to the fore, since many of the subtleties of communication are unfamiliar to users. The old features are added to the new features. They are associated with the inability of the communication participants to conduct a productive dialogue based on national values and identity. This can be seen in the example of the functioning of the forums.

They contain text, hypertext, graphics, sound and video. The functioning of the forums is accompanied by overclocking. It structures the communication content of the feedback in the form of a response. The received text of the letter is fully cited. The answer is posted behind it. This allows the rest of the communication participants to understand the topic of the dialogue. The attitude towards overclocking is ambiguous in terms of the amount of citation by the user of the received letter.

Letters received by one user can be automatically sent within the inner circle of communication for constant information about each other's affairs and possible discussion of information. Flood in the form of messages that have no semantic load can be integrated into this constructive atmosphere of maintaining the information space. In this way, individual participants in communication attract attention to themselves and keep attention on themselves, which is one of the manifestations of egoism, inadequate self-esteem.

The visual part of the flood is a selfie. Self-photographing and posting images of yourself in unlimited quantities on Instagram has become one of the manifestations of the selfish need to keep constant attention on oneself.

This is actively used by participants in network communication with pronounced narcissistic inclinations. A separate issue is the problem of their safety, since for the sake of constant attention to themselves they expose almost all information about their specific location, sources of income, material and financial expenses, close people through whom you can get additional information about them and use it to implement practical actions in for selfish purposes. One of the forms of attracting attention to oneself in the network communication space has become a flame (an argument for the sake of an argument). In order to keep the attention on himself, the communicator provokes a scandal, behaves unbalanced, and allows personal insults. Such people are called flamers.

Network communication has actualized the phenomenon of computer addiction, one of the manifestations of which is group addiction, the right to belong to a certain group, within which the user delegates to the group moderator the right to dispose of this user. This phenomenon reflects the broader problem of totalitarian psychology. This problem manifested itself at the level of big politics within the ideology of ultra-right movements, at the level of the movement of religious sects and religious terrorist organizations.

Features of age identity play an important role in the actualization of the psychology of group dependence. Adolescents and young people are the main risk groups. An informal moderator can use their behavioral resource in the game genre of an extreme situation. The tendency of adolescents and young people to such submission is due to the lack of a sense of real danger. This is due to the fact that the rules of virtual games are transferred to physical space. It is rather difficult to identify the risk zones of young people because of the role duality inherent in their psyche. This means that relationships with different groups of people are carried out through a set of images of communicative action. In relationships with parents, this is one model of self-actualization. A guy with a girl haves a different game model of self-actualization.

Adolescence contains high risks of deviant behavior, which is masked by the heroism of secret affairs. It is for this reason that adolescents and young people become participants in provocative actions. In addition to individual informal moderators, network subcultures and network communities play an important role in the realization of the phenomenon of psychological dependence.

Against the background of psychological defects existing in the individual and group consciousness, the problem of the relationship in the network space of psychology and ethics is urgent. Moral norms, even if they are postulated, like legal norms, are not always respected by participants in a communicative action, since these participants cannot control their behavior under the influence of external factors, informational influence. An ethics of software engineering has been developed for programmers. Corporate ethical standards are integrated into the mentality and identity of a particular people.

The effectiveness of the implementation of regulatory procedures is largely determined by culture models. The most favorable for ethics and law is a postfigurative culture, in which the authority of elders plays the main role. As a result, the experience of generations is not questioned. The principle of continuity and solidarity between generations operates. Bearers of knowledge and experience in the image of older generations determine the long-term perspective of social activity and communication.

Cofigurative culture is based on the values of modernity. Contemporaries are becoming the main teacher. Learning in the form of socialization is carried out through information exchange processes. A representative of any generation can become a teacher if he has mastered a specific skill of the modern lifestyle. In such a situation, institutional authority gives way to competence authority. Everyone learns from each other, regardless of age.

Prefigurative culture almost completely levels the authority of the older generations on the grounds that old age deprives people of intellectual mobility and efficiency in mastering technological practices. Risks of social conflicts between generations of people are formed.

1.7. Philosophy and theory of information

Information theory or mathematical communication theory is a branch of applied mathematics. This section defines the concept of information, its properties and limiting relationships for data transmission systems. Information theory operates with mathematical models, and not with sources and communication channels. The mathematical apparatus of the theory of probability and mathematical statistics is used.

The main sections of information theory include source coding (compressive coding) and channel (error-correcting) coding. Information theory is closely related to cryptography. The theory gave communication engineers a methodology for determining the capacity of a communication channel in terms of the number of bits. The transmitting part of the theory is not concerned with the semantics of the transmitted message. A complementary piece of information theory draws attention to content through compression of the subject of the message. Accuracy criterion is used.

The concept of information entropy was defined by K. Shannon for the case of discrete data. It is similar to the concept of thermodynamic entropy. This is a value that indicates the amount of information contained in a given message, or a sequence of signals. Information theory is used in coding theory, cryptography and cryptanalysis, data transmission, data compression, detection theory, and valuation theory.

In a relatively short time, information theory has expanded its subject space. In addition to the applied level of solving engineering communication problems, a level of fundamental generalizations has appeared which is designated as general information theory. Within the framework of this theory, generalizations appeared consonant with the themes of philosophy. Mathematical logic became the methodological basis for the synthesis of information theory and philosophy. The choice is due to the fact that this logic is most consistent with the requirements of the exact sciences. t is on this logic that analytical philosophy and philosophy of mind are based.

1.8. Philosophy of language

At the level of technical systems of social communication, the practice of coding natural language statements into a signal form acceptable for transmission to the respondent has historically been used. One technical device transmitted an information message in the form of a signal another technical device received it and decoded it into the form of sentences in a natural or digital language understandable to the address user.

In the second half of the 19th century, philosophers with the participation of linguistic sciences turned to the phenomenon of language in the modification of a written text. This was due to the need for a clear demarcation of philosophical and scientific texts based on the criteria of empiricism. As they studied the issue, neo positivists came to the conclusion that it was necessary to create a strict system of criteria for the language of scientific research. Natural languages did not meet these criteria. The emphasis was on the logic of algebra and artificial languages.

As a result of studying the sign systems of natural languages, semiotics appeared. It analyzed syntax, semantics and pragmatics of sign structures. The structural unit of the language was a sign with a characteristic semantic meaning and pragmatics. For technical communication systems, the syntax was of interest, which is focused on the problem of pairing it with relay devices. The ideal solution for the pairing of information and signal was found on the basis of binary code. Shannon's methodology triumphed. But there was a position of N. Wiener, which implied taking into account the semantics and feedback formed by this semantics in decision-making information systems.

As a result, mathematical logic, thanks to the efforts of representatives of analytical philosophy and the philosophy of consciousness, based on the theory of possible worlds, acquired a wide range of subject ontologies. It has become part of the Artificial Intelligence and Cognitive Sciences program. In this program, linguistics plays an important role, which is integrated with psychology, neural physiology, neural biology and the theory of artificial intelligence.

As a result, a peculiarity of the language associated with the knowledge base was revealed. This base determines the transformation of messages into information. At one time, I. Kant formulated a clear understanding of the human knowledge base. It has a priori and a posteriori components. A priori components are similar to an algorithm, frame, habit, cognitive map, unconditioned reflex. A posteriori forms are close to the model of self-organization, self-learning, transformation and modernization.

1.9. Social media philosophy

Social media has become a new form of social communication. Information processes related to communication have moved to them. They were especially in demand among young people. Subcultures, dating, the industry of organizing free time and services, and neuromarketing have moved into the space of social networks. Scientists, based on network analysis, have made social networks a subject of study. The beginning was laid by the work of J.L. Moreno and the method of sociometry developed by him, which he practiced to study small social groups. At the first stage, network research was carried out by a small group of sociologists, psychologists and political scientists. Two magazines were published: "Connections" and "Social Network". In 1978, the International Association for Social Network Analysis Researchers was formed.

James Barnes in 1954 defined the social network as a space of communication, as the world of communication between an individual and friends who do not always know each other. They highlight the special role of structural anthropology and sociology of small groups for the development of this research paradigm. A distinctive feature of the network approach is that the mathematical apparatus of graph theory has been applied in it. As a result, the network approach began to be based on the methods of discrete mathematics.

Network theory describes the strength of a node in a network through the quantity and quality of its connections. Connections and exchanges have increased the value of some nodes at the expense of the fall of others. Along with software for statistical processing of research data, additional computer programs specially adapted for network analysis became available. This contributed to the development of research.

It is necessary to highlight two irreducible concepts that are generic features of any network research. These are the concepts of knot and connection. The nodes in society are social actors, who, depending on the level and objectives of the research, can be represented both in the form of separate individuals and in the form of formal organizations or informal groups. There are certain relationships or connections between nodes. The collection of nodes and connections between them form a network that structures social relationships. The units of network analysis can be both separate individuals and groups of individuals, organizations, countries. It can also be friendship, kinship, influence, economic relations.

The most important characteristic of digraphs is reachability, the fundamental possibility of getting from one vertex to another. Connectivity and reachability are integral parts of the most important characteristics of any graph, social network. Graph connectivity is how well vertices are connected. The most important characteristic of a graph is its density. This parameter characterizes the graph in terms of whether the nodes are directly connected to each other. Therefore, the densest graph has the highest possible connectivity. The graph can split into several tightly connected vertices. In this case, the density of the graph will be relatively high, but the connectivity will not.

Social networks tend to form highly connected groups within them. This is the effect of clustering. Once in such a cluster, an individual inevitably gets to know and makes connections with the rest of the network clan. This is due to the role of centrality. An important role in the social sciences is played by the concept of the intermediate centrality of mediation. The network subject is all the more central, the greater the number of subjects between which it is located, it controls.

Various classifications of networks can be made according to the basic characteristics of social networks. In accordance with the connectivity indicator, we can talk about three types of networks: unconnected; loosely connected; tied tightly. You can also distinguish three groups of networks: high density; medium density; low density. According to the criterion of centralization, social networks can be distinguished as centralized, multipolar with several centers and decentralized without pronounced centers. Social media gravitates towards some form of centralization.

The classification of social networks depends not only on the configuration of their connections, but also on the probabilistic nature of the implementation of these connections. Networks consisting of links, the implementation of which does not have one hundred percent probability, operate in a different mode than deterministic networks. The use of methods for analyzing neural networks in the social sciences is based on the practical application of some of the basic principles of the work of human thinking.

These are two kinds of neural networks. First, these are layered networks (feedforward networks). In them, neurons are arranged in layers. Each node of one layer is linked to the nodes of the next layer. Complete communication networks are distinguished, when all nodes of the neural network are connected to each other. Social networking services resemble artificial neural networks. In this case, the participants act as neurons with autonomous memory and the ability to learn. At the same time, social networks, in contrast to artificial neural networks, cannot be attributed to their two varieties. In the first case, the principle of layers does not work, and in the second case, there is no connection of all nodes with each other with full communication neural networks.

The network approach takes into account the cultural foundations of the emerging solidarities. These are specific practices and rituals, political ideologies, cultural discourses and practices. Their significance and influence on the actions of individuals is studied.

Network theory is synthesized with a modified rational choice model, which considers not only material resources, but also collective identities as potential stimuli for action: Integration into activist networks increases the possibility that the individual will value the activist's identity and choose to act in accordance with it. Interaction is expressed in the form of a frame and a network.

1.10. Philosophy of dialogue

The communicative basis of the existence and evolution of social information is created by dialogue between people in the form of communication and business relations. Verbal dialogue, thanks to the creation of writing, was supplemented by dialogue through written messages. Writing is a unique cultural phenomenon. At the moment, it has been transformed into a digital SMS message, visual communication via SKYPE.

Fiction, fine arts, philosophy, photography, cinema also actively use the phenomenon of the author's dialogue with the reader and viewer. Plato was one of the first in philosophy to use the genre of dialogue.

External dialogue is often associated with an internal dialogue of the personality within the boundaries of a space called the soul. In this inner world is existence, which has become the subject of study of existentialism and psyche (soul), which has become the subject of study of psychoanalytic philosophy. The heroes of F.M. Dostoevsky novels live in a space of dialogue not only with the outside world, but also with their own consciences. This dialogue includes criminals, idiots and speculators. The theme of their conscience includes not only bad, but also everyday sensory experience, which they speak through dialogue.

This means that the convergence of the psychological and ethical components of the world perception retains its position in the mind.

MM. Bakhtin in the space of dialogue conceptualized the formulated by F.M. Dostoevsky, the aesthetic component of dialogue in the space of folk culture. This was the period of his life in Vitebsk.

Since 1920, M. Bakhtin taught at the Pedagogical Institute and the Conservatory, gave public lectures on philosophy, aesthetics, and literature. In 1920-1924 he worked on philosophical treatises and an early edition of a book about F. Dostoevsky. In 1924 he left Vitebsk.

After his death, M. Bakhtin's works became widely known in the West. There is a Bakhtin Center at Sheffield University. In France, his works were promoted by T. Todorov and Y. Kristeva. In Japan, published the world's first collection of works, as well as published a large number of monographs and works about him.

The interpretation of the ideas of theatricality, the metaphor "world - theater" was considered by M. Bakhtin on the basis of the concept of the dialogic nature of culture. He showed this by the example of the analysis of F. Dostoevsky's work as polyphony. The being of concrete reality is interpreted by him as an event that is inconceivable without an act and a person. Outside of concrete events, there are only empty possibilities and non-rooted being. Rationalism is a prejudice, and the perception of the essence is possible only through intuition.

M. Bakhtin developed a philosophical theory of the phenomenological type. In it, a special place is occupied by the study of laughter culture on the example of carnival. Laughter and carnival showcase events.

In the field of art, his intellectual interest was attracted by verbal creativity. According to M. Bakhtin, humanitarian thought is always aimed at working with other people's thoughts, dealing with the text in its various presentations. Behind each text is a language system consisting of the languages of many social groups. The researcher works with the text, intending to create his own assessment text. As a result, a dialogue arises between the author and the reader. The author assumes the presence of a reciprocal understanding. This expectation is due to the dialogical nature of the text.

Working with text involves a linguistic method, which is part of a comprehensive aesthetic analysis. The word is studied in linguistics based on general aesthetic theory, epistemology and other philosophical disciplines.

The emotional and volitional intensity of the literary form testifies to the value value of art as a source of information. The artistic value activity of the author is aimed at transforming the material in order to convey a certain content. The content of a work of art shows how individuation, concretization of the reality of cognition and ethical deed find unification in the form of an aesthetic object. The work captures reality in aesthetic intuition. A special role belongs to the literary genre of the novel. This is a very stylish, contradictory, discordant phenomenon. It is represented by heterogeneous stylistic unities sometimes lying in different linguistic plans and subject to different stylistic patterns.

Diverse stylistic unity is combined in the novel into a coherent artistic system. They are subject to the highest stylistic unity of the whole. It cannot be identified with any of the entities subordinate to it.

The language of the novel is represented by a system of languages. The prerequisite for novel prose is the internal stratification of the language, social inconsistency and individual discord in it. The dialogical orientation of the word among other people's words creates new and significant artistic possibilities of the word, its prosaic artistry.

M. Bakhtin compared the novel and poetic word. It follows from it that the world of poetry is illuminated by a single and indisputable word. All conflicts, doubts and experiences do not pass into the final result of creative activity. They remain at the stage of working with the material. The language of poetic genres, approaching the stylistic limit, becomes authoritarian and conservative, closing itself off from non-literary social dialects. The indisputable basis for poetry is the direct intention of poetic creativity.

The novel preserves the divergence and contributes to its deepening. The author plays on contradictions and multilingualism, building his own style. At the same time, he maintains the unity of his creative personality and the unity of style. M. Bakhtin identified two stylistic lines of the European novel. One is represented by a sophistic novel. Its features are monolingualism and monostyle. Divergence becomes its dialogizing background, thanks to which it is value-correlated with the language and the world of the novel. The chivalrous prose novel possesses similar features. The pastoral and baroque novels also belong to the stylistic line of the sophistic novel.

The novels of the second line introduce social differences into the composition of the work. The novel is subject to transformation within the framework of the processes of canonization and reaccentuation. Provincial dialect or professional jargon can be legitimized by literature. It is not always clear whether the author considers a particular language to be literary or whether he places a moment of contradiction in it. There is a change in the level of some roles. A character who once occupied a secondary role can become the first person of a novel, unnoticed by the reader. This happens as a result of the change of eras and the dialogizing background. M. Bakhtin's theoretical conclusions were based on the analysis of F. Dostoevsky's works. The structure of the dialogue is implemented in the writer's novels. In the speeches of the heroes, there is a deep and unfinished conflict with someone else's word. The writer's novels are internally incomplete dialogues between characters. They create a long-term perspective for reflection on information and its carriers.

1.11. Management philosophy and cybernetics

Control is part of all systems of activity, machines and organisms. The founder of cybernetics (the science of control) N. Wiener proceeded from this thesis. Management is necessary for organisms, people and machines in order to promptly collect information processing and accept adequate information received (assessing the situation) of an action plan. It can be a frame (algorithm) of an action, or it can be a situational scenario of a reaction to the information received. As a result, N. Wiener began to proceed from the principle of feedback between the recipient of information and the correspondent of the information (environment or object media).

Description of the information process based on the feedback principle was necessary for N. Wiener to consider the technical possibility of using computers for the functions of preparing operational decisions by managers and politicians. This preparatory part includes the operational collection of information and the preparation of analytical information necessary for making a decision. N. Wiener was motivated to do such research by the situation of information deadlock that arose in control systems. Such situations began to arise in the management and state decision-making system, in particular, in matters of management, control and military security of the national air, water and ground space. After the developers managed to create a single communication network on the basis of several computers, the subject of technical cybernetics included the tasks of improving electronic computers, creating software for management and control processes.

In management, automated control systems and automated control and monitoring systems began to be used. As a result, the functions of round-the-clock monitoring, operational analysis of information and decision-making in accordance with the scenarios of normal and emergency situations laid down by the developers in the program were transferred to computer systems. These programs began to be used by the military, and they were also installed on technical complexes with a large territory and large amounts of data about these complexes.

In technical cybernetics, the processes of creating supercomputer systems for working with large amounts of data were under way. Another direction was the maximum transfer of control functions to a computer program in flying (drones), ground (taxi without a driver), space and industrial systems (unmanned production). For this purpose, robotics and automated systems are being developed.

Satellite navigation systems (navigators) and digital platforms have become a qualitatively new step in the development of technical cybernetics. As a result, the efficiency of corporate and state governance has increased. This is facilitated by expert systems, cognitive map methodology, crowd funding, and legal information resources.

A management toolkit has been created, which includes management methods by goals, a sales performance management system, continuous equipment maintenance, production resource planning, and product lifecycle management. Business intelligence and Data science are used. They perform the functions of supporting the Internet of things, machine learning, process large amounts of data in RAM, and solve business problems that were previously not available to the operating system. Planning for a complete logistics network is ensured using the same master data and in one system.

1.12. Philosophy of the digital economy

The digital economy consists of the digitized sectors of financial services, internet commerce, industrial internet, and logistics. The dominant trend in the evolution of these sectors is co-evolution on a single integrated digital platform. This new organizational state of the digital economy is termed “ecosystem”.

The term "ecosystem" is borrowed by the digital economy from biology. In relation to nature, an ecosystem is defined as a functional unity of living organisms and their habitat. Unity is formed due to the competition and fitness of all elements of the ecosystem. Analogies have been found between biological and economic ecosystems, as well as information technology ecosystems.

The digital ecosystem is represented by the environment and elements of computer programs, where on the basis of the computer network infrastructure software there is competition, which is the driving force. This selection is the driving force behind the evolution of computer programs. An ecosystem agent is an internal or external factor, an ecosystem participant whose actions are aimed at maintaining, developing the ecosystem, or for their own needs.

The digital economic ecosystem consists of organizational, operational, marketing, HR platforms. The organizational platform is based on business processes, the operational, marketing, HR platforms are based on information technology.

The information technology ecosystem consists of a set of services, devices, other products supported and developed by one company, or services, devices, other products of different companies, which are linked into a single network by certain organizational and technological processes. The development of ecosystems determines the behavior of individual participants.

Ecosystems adhere to the principle of self-organization. It is the ability of the system to support the organization through internal resources, as well as through the relationships between the participants that make up the system. Ecosystems function efficiently through internal interactions. The interactions between the elements of the system lead to the emergence of patterns of coordination and the growth of the organization. A systemic effect of the emergence of new properties in the system is formed due to the interaction of the platforms that make up the system.

The economic ecosystem is made up of a network of organizations that form around a single technology platform to create a broad customer base of services. Apple, Google, Amazon, Alibaba, Yandex carry out commercial activities on the basis of their own ecosystems. Through a system of open interfaces, they have allowed many partners to integrate services into many of their business processes.

The use of information technology in the form of economic ecosystems has become possible due to the shift of ecosystems from solving technological engineering issues towards social engineering. This means that software solutions, equipment have been created, the use of which is available for the implementation of private and various user tasks. Manufacturers of software and hardware have begun to consider the need to reduce the requirements for administrative and customization skills.

Ecosystems that no longer impose specialized requirements on users, or these requirements are minimal, and these ecosystems to a greater extent solve problems of a commercial, organizational nature: commerce, various services, automation of enterprise processes. The concept of an information technology ecosystem is being transformed and transformed into an ecosystem, the value of which for the agents of such an ecosystem is not that there is information technology, but that the needs of agents in various values become available and easy to use. The user independently selects and digitizes content, stores it on his own computer, catalogs, archives.

By purchasing a smartphone, the user becomes an agent of the ecosystem of this manufacturer, automatically gets the opportunity to listen to an almost unlimited list of musical content, having the ability to quickly modify the content at will. At the same time, there is no need for digitization, storage, cataloging, archiving of the product. The ecosystem independently implements these functions using software and hardware without user participation in these auxiliary processes.

Information technology ecosystems include e-commerce, technology services, and business process automation. Ecosystems solve problems of data accumulation, processing, and analytics. Information technology represents services and services that are easy to use. The Internet of Things has become an example of how an ecosystem independently, without human participation, maintains its existence and development, leaving a person the role of a user, who may not even understand that he is unwittingly an agent of a particular information ecosystem.

The functions of professionals are being transferred to the economic ecosystem itself. With its help, the user independently conducts business analytics, having a set of such functions in the ecosystem itself. The ecosystem is transforming from user-level competency management to tool-level competency management. The development of ecosystems goes to the level of competence management at the action level. The issue of information security is becoming topical. Users must learn to assess the risks and threats that may arise as new opportunities emerge. The role of the state is important through legislative regulation. The value of information technologies will increase, also because the intensification of technological progress, individualization and expansion of the range of user needs will require more and more participation of automated, universal, quickly and self-customizable processes in the management of created and distributed values.

Integration with external ecosystems will force companies to interact with many partners, covering a wide range of functions, from customer search to social advertising and payment solutions. This is because the low cost of technology and the dynamic startup environment have dramatically increased the rate at which new services are introduced. By making system components available as services, convergence actors provide integration with the ecosystem. Interfaces need to be open, dynamic and functional in real time so that they can integrate partners, technologies and applications as needed.

A consequence of this process is the need to develop a lightweight technology architecture based on microservices and APIs to enable third parties to easily connect to the new ecosystem. Managers need to think in terms of platforms and their architectures to drive updates across the ecosystem. Since you will need to provide users with an application service so that they can choose the options they want. The infrastructure must be reliable and secure.

Telecommunications companies are using this practice to expand their range of interconnected services to include music, insurance, healthcare, education, media and smart homes. The services are integrated into an ecosystem, offering the customer several services through the telecommunications company's backbone. A cloud environment is used in which developers can create and release their own applications.

The introduction of external technologies is aimed at opening internal information systems so that the business can include external opportunities in the ecosystem, to better serve its own customers, support its employees, or create new products and opportunities. An example of this approach is integrating a third-party point-of-sale application into a company's internal payment systems to simplify the shopping process. As well as the integration of a third-party customer support service into the company's website.

This approach changes the way information technology designs and manages systems. The process goes beyond buying software packages and creating customized solutions, or working with multiple system integrators to deliver business solutions. The priority is to master the interaction with customers along its entire length, figuring out how external and already available services can be used in combination with internal solutions to form a complete, unique offer.

Companies complement their in-house skills with an external specialization that is deeply integrated into the current application development and infrastructure management process. A round-the-clock environment of offering to millions of customers is being created.

Companies have to modernize information technology to match innovation and scale services. This allows you to create partnerships or alliances with vendors and service providers to understand and evaluate how technology can be used in a business environment. But there are problems. Startups often use technologies that cannot scale. They use external cloud services that may be incompatible with the cloud infrastructure of the customer's company. Therefore, it is important for such companies to think about how to ensure the smooth integration of new tools, both from the technical side and from the work culture side, in order to take full advantage of the products offered by startups. Evaluating and ensuring the interoperability of external technologies is important.

The choice of a method or a combination of methods to interact with different ecosystems, or to create your own ecosystem, depends on the company's strategy, market environment and the enterprise's overall risk appetite. It is important to shape the business strategy by identifying new technologies and ecosystems that can change the market situation, determining where future sources of value are located, and developing the necessary strategic actions. An assessment of feasibility and threats is important.

Technology integration is dynamic. It takes place in real time. The process requires companies to create an integration architecture that can support the processes and to establish open standards that can be easily adopted by external parties. The company's existing master data management catalog also needs to be expanded to include third-party data and to accommodate potential integration with external master data providers. For systems to work there must be a clear data architecture and governance scheme to ensure it is cleaned, rationalized, and standardized.

In an ecosystem, it is difficult to determine exactly where the points of failure are - in the company's systems, third-party services, cloud storage, the network, or some combination of them. This situation determines a fundamental rethinking of infrastructure support processes. Service Level Agreements clearly define escalation and resolution protocols that all parties agree to. The creation of standard identifiers and their integration into partner services participating in the ecosystem and applied technologies is important for the rapid detection and resolution of emerging technical problems.

As the infrastructure expands, internal cyber security policies and processes will extend to third-party partners and vendors. It is important to define and agree on a new set of security standards that would clearly articulate how the integration will take place and what types of data can be exchanged in what directions.

Dealing with outside parties raises legal issues of intellectual property, liability, confidentiality, profit sharing, and resolution of complexities. Licensing issues have already arisen in interactions between cloud service providers and on-premises hardware and software companies due to competing business models. Data ownership and customer management are critical. What matters is an app marketing approach that clearly states standards, provides tools, and makes agreements before starting work.

Interacting with the supplier network also requires changes in certification skills and their performance management. Companies must clearly define the standards and procedures by which suppliers must operate, and outline guidelines that will determine how the supplier will be included in the delivery lifecycle. Companies that interact with suppliers effectively view vendor relationships as partnerships with a high degree of transparency. This requires restructuring internal sourcing and supplier management processes so that companies can integrate new partners or create new alliances quickly and efficiently.

As companies increasingly embrace external ecosystem technologies, they need full stack architects and converged infrastructure engineers who can provide third-party software expertise, be fluent in best-in-class technologies, and share experience in integrating multiple technologies. This is critical to bridging the gap between business goals and technology requirements in the ecosystem.

A new feature in enterprise architecture needs to work closely with the business to understand how external services can be integrated with products to enhance the customer's value proposition. With the development of cloud computing and infrastructure, the required resources (networks, servers, storage systems, applications and services) can be provided more quickly and can also be managed and used with minimal effort. This requires the integration of development and operations, as well as cloud engineers who have experience navigating the rapidly changing cloud computing ecosystem and software, as well as data scientists, automation engineers, and corporate architects.

It is important for companies to have several senior developers on staff who can set development standards in the app store. Many of these capabilities are often outsourced to companies due to the increased importance of design and automation skills. Many are rethinking this approach as information technology moves from a supporting element to an influencing element. The company's integration with third-party capabilities opens up new ways to obtain additional sources of value. But until information technology becomes ecosystem technology, the vast majority of new opportunities remain beyond our reach.

The Industrial Internet means integration into the network space based on a single platform. The condition for this unification is the compatibility of platforms and languages in which corporate structures communicate.

The basic building block of the industrial Internet is the smart enterprise. An enterprise can become such in terms of its status if it meets the criteria of interoperability, information transparency, technical support, and the ability of technological processes of cyber-physical systems to make decisions independently. A methodology for managing industrial enterprises has been developed. It is formed by software packages.

Scientific directions were formed on the basis of the methodology of artificial intelligence, within which the human cognitive system is associated with a machine for receiving, processing, storing information, and making decisions. The cognitive processes of long-term and short-term scenarios of activity are analyzed. The interdisciplinary basis is formed by cognitive psychology, cognitive linguistics, neuroscience, logic, neuromarketing.

Integrated human-machine systems are especially relevant in the field of management, where there are risks in the decision-making process due to a lack of information. It is important for a person to deal with computer programs that have integrated functions of self-control and self-development on the basis of semantic resources provided to them by a person. Intelligent systems assume functioning in a feedback mode based on constant contact with information and decision-making algorithms that form a spectrum of sustainable activities of technical infrastructure and communications.

Companies attribute the growth of production profitability, optimization of personnel labor costs, an increase in equipment productivity, the quality of the final product, and a decrease in energy and material costs with the introduction of the industrial Internet of Things.

The robotization of conveyors in factories marked the beginning of an era of new industrialization of production. The purpose of the transformation is to change the basic principles of organizing the industrial sector of the economy in the context of using the methodology of the industrial Internet.

The evolution of the economies of Belarus and Russia into Industry 4.0 is carried out on the basis of national programs. Different factors of influence played in the formation of the national legal systems of the digital economy of both states. For Belarus, the need to develop non-material-intensive segments of the national economy has become an internal factor of influence. On this basis, a decision was made to create a High-Tech Park in 2005 (Decree of the President of the Republic of Belarus No. 12). It was supposed to integrate Belarus into the high-tech sector of the world economy and at the same time solve the problem of the "brain drain" in the field of programming.

The tasks of the Park were defined as 1) software development and publishing, and consulting in this area; 2) data processing; 3) activities related to databases. For a certain period of time they looked closely at the functioning of the Park, and when it began to reach rather high profitability indicators, the political leadership of the Belarusian state formed a belief in the possibility of using this institution in order to modernize the national economy.

Belarus has adopted a state program for the development of the digital economy and information society for 2016-2020. In 2017, experts from Germany held a series of seminars for heads of Belarusian enterprises on the topic of Industry 4.0. They noted the existence of the necessary conditions for the implementation of the industrial Internet program in the Belarusian economy. These conditions can be provided by the Hi-Tech Park.

In the format of the first German-Belarusian forum on the topic "The fourth industrial revolution (Industrie 4.0): digital transformation of the economy", which took place in 2017, the representative office of the German economy in the Republic of Belarus and the Information Center of the German Economy FLLC held a meeting of the working group "Industrial Cooperation and innovation ”. The issues of developing Industry 4.0 standards for creating a "smart" industrial enterprise with full digital control of production processes, as well as the experience of Siemens and the Great Stone industrial park were considered. A round table was held on the topic Legal bases and priorities for the implementation of digital transformation of the economy and industrial policy of Germany and the Republic of Belarus.

On December 21, 2017, the Decree of the President of the Republic of Belarus "On the Development of the Digital Economy" came into force. The decree created a legal instrument for the development of the digital economy. A concept for the development of electronic government in the Republic of Belarus is being prepared. The digitalization of activities is carried out in the spheres of industry, agriculture, energy.

The industry plans to automate the production cycle, introduce ERP systems for automating production management, personnel and company assets, use CALS technologies for information support for deliveries and the life cycle of products, MES systems for coordinating and synchronizing the release of intermediate and final products. The energy complex implements information technologies in the field of energy efficiency, energy conservation and energy audit, joint use of digital infrastructures.

In the field of agriculture, a common integration platform is being created, including electronic trading platforms, a unified digital system of state administration of the agro-industrial complex, control of product movement, accounting and identification of trade and technical barriers.

Changes are taking place in the banking sector. The topic of using electronic money in calculations is discussed. The lack of sufficient volumes of the market for the sale of goods and services for cryptocurrency, the high cost of transactions do not yet allow them to be considered as a universal means of payment.

There are two main motivations for implementing the industrial Internet strategy - a qualitative change in manufactured products, its customer orientation, and, as a consequence, the need to transform enterprises and companies into flexible production structures. These features shape the direction of change in business processes. Ideology is taken as a basis. According to it, the existing and future needs of the market determine goods and services, methods of their delivery to customers, the composition of fixed assets, requirements for suppliers of raw materials and materials, skills and qualifications of personnel. As a consequence, more attention is paid to modernizing the product range and customer services. There was an interpenetration of business processes of production, marketing, logistics, service and advertising. The integrated value-added product chain has a priority role as it coordinates the activities of its participants.

Enterprises quickly realized that their competitiveness would be determined by industrial services. Services for the development and introduction of products into production (R&D, design) have acquired particular importance. Engineering companies focused on these tasks. Another block of industrial services was formed by marketing, design, consulting companies, as well as companies focused on professional training and crowdfunding.

Industrial enterprises, in addition to the manufacturing sector, have created distribution networks, dealerships, and trade representations. Their activities are associated with the activities of regional chambers of commerce and industry.

All these structures are integrated with a common goal of production, sales and a stable presence through service centers in the product markets.

Basic elements of production and services of an industrial nature are potential areas of digitalization. A high level of digitalization is characteristic of design and engineering work. The transformation of the industrial services sector is being carried out at a high rate. Its digitalization results in networked corporate decision support structures.

Businesses are moving towards clustering and networked coordination. The priority role is played by cooperation in collaborative forms based on the interactive coordination of the actions of the team of participants. Through information networks, partners and competitors combine resources and knowledge to work together on specific projects in a mode of mutual completeness and information, while continuing to compete in other areas.

The concept of "hybrid economy" is being developed, within the framework of which the convergence of artificial intelligence resources with the resources of the cognitive economy is assumed. According to this position, cognitive economics studies the processes of assessment, choice and decision-making in economic activity. It examines the evolution of organizations and social institutions in the face of uncertainty.

It is related to the methods of artificial intelligence and knowledge management in economics. Economic modeling is based on knowledge and models of cognitive business intelligence. Intelligent information systems, decision support systems, intelligent data processing, intelligent production planning systems, dynamic expert systems for enterprise dispatch management, financial analysis and planning using neural networks and evolutionary algorithms, intelligent investment portfolio management and risk management systems are used. Models of making economic decisions in the mind of a manager, as well as models of behavioral economics are being developed. The concept of the processes occurring in dynamic situations based on directed sign graphs is used.

The main task remains to modernize production processes based on additive technologies, autonomous robotics, new materials and methods for collecting and analyzing information in the segment of the Internet of things, cyber-physical systems. The modernization of industrial robots is taking place.

Advertisers of construction, energy, and utility companies are actively using the terminology of the digital economy. They operate with the concepts and models of a smart city, smart home, smart enterprise and smart career.

A program for the development of the digital economy of Belarus and Russia until 2025 has been formed. It involves the creation of digital platforms for the interaction of enterprises, a network of technology transfer and industrial co-operation and subcontracting, industry modernization. This is facilitated by the high level of convergence of technology companies. Large media holdings operate on the market, which occupy positions in the segments of advertising, news sites, Internet trade in intellectual products.

Each of the changes plays a role in the scientific and technological development of the economy. The digital economy has been complemented by the networked economy. Companies operating in the rental markets of goods and services, such as AirBnB (housing), Uber (taxi services), have become the leading players in the shared economy. The fundamental principle of operation of these companies is a network approach that allows, bypassing traditional hierarchies, to directly connect producers and consumers of goods and services, bypassing intermediaries.

Networking principles have led to a fundamental rethinking of the traditional hierarchical model of interaction between universities, government, and business. In this model, each side takes on tasks traditionally inherent in other players, creating together new cluster-network systems with horizontal links and a collaboration mechanism. Universities become founders of business incubators, where students and professors create new firms based on technologies developed within the walls of universities. The state takes over the functions of a venture investor and regulator.

The business community has become part of the universities, developing fundamental and applied research in their own laboratories or in common with universities. Collaboration facilitates the natural formation of the innovation dynamics and creative renewal that emerges in each of the three institutional domains: university, industrial, and government.

In contrast to automated production, Internet technologies are becoming the central element in the functioning of production systems, providing communication between people, machines and products.

Industry 4.0 refers to a set of technologies and concepts for organizing a value chain that integrates cyber-physical systems, the Internet of things and Internet services. It defines the vision and principles of a smart enterprise. Such an enterprise uses a modular structure. Cyber-physical systems control physical processes, creating a kind of virtual copy of the real world, and make decentralized decisions. Through the Internet of Things, cyber-physical systems connect and interact with each other and with people in real time. Through the Internet of services, internal and third-party services are selected and disposed of by participants in the value chain.

Interoperability refers to the ability of machines, devices, sensors and people to exchange information and interact with each other through the Internet of Things. Information transparency means the ability of information systems to create virtual copies of the physical world, supplementing digital models of enterprise functioning with data coming from various sensors. This requires nesting raw data from primitive devices into a higher-level information context that is valuable in processed form.

Technical support provides the ability of systems to assist a person in making informed decisions and solving urgent problems in a short time by processing, aggregating and visualizing the initial data. Secondly, the ability of cyber-physical systems to take on part of the tasks, the solution of which by a person is too ineffective, labor-intensive or unreliable.

Decentralization of decision-making means the ability of cyber-physical systems to independently make the decisions required to perform tasks autonomously as much as possible. The solution should be delegated to a higher level only in exceptional situations involving cross-dependency or conflict in goals and objectives.

Industry 4.0 has accumulated lean manufacturing practices, integrated electronic and software automation tools, and the manufacturing outsourcing phenomenon. The global automation of enterprise management with the use of information technologies has become a part of it.

The networked approach to economics was developed by a group of researchers dealing with the problems of distribution and marketing interaction between organizations. The network approach is based on the idea that any organization operates within a certain network, consisting of a small number of suppliers, buyers and other counterparties, called network actors. These subjects interact with each other, forming a network of long-term relationships and interdependencies among themselves, which allows them to control and access each other's resources.

Technical support provides the ability of systems to assist a person in making informed decisions and solving urgent problems in a short time by processing, aggregating and visualizing the initial data. Secondly, the ability of cyber-physical systems to take on part of the tasks, the solution of which by a person is too ineffective, labor-intensive or unreliable.

Decentralization of decision-making means the ability of cyber-physical systems to independently make the decisions required to perform tasks autonomously as much as possible. The solution should be delegated to a higher level only in exceptional situations involving cross-dependency or conflict in goals and objectives.

Industry 4.0 has accumulated lean manufacturing practices, integrated electronic and software automation tools, and the manufacturing outsourcing phenomenon. The global automation of enterprise management with the use of information technologies has become a part of it.

The networked approach to economics was developed by a group of researchers dealing with the problems of distribution and marketing interaction between organizations. The network approach is based on the idea that any organization operates within a certain network, consisting of a small number of suppliers, buyers and other counterparties, called network actors. These subjects interact with each other, forming a network of long-term relationships and interdependencies among themselves, which allows them to control and access each other's resources.

The network approach is based on the concept of trust. The ability and willingness of subjects to trust each other allows them to reduce transaction costs. Competition in the network approach appears as a struggle for resources within the network. Therefore, one of the most important categories in the theory of networks is the concept of a network position. It is linked to the strategic analysis process. The strategy is built in accordance with the desire of the subject to change, protect, gain or get rid of any network position.

The network approach assumes that the organization, in the process of daily interaction with the subjects, analyzes what is happening and, based on this, adjusts its actions.

An ecosystem is an environment where all existing and newly created elements are inter connected. It is important that synergy arises within it. It is necessary that each element develops as quickly and independently as possible. It is necessary to build an information technology landscape that contributes to the solution of these tasks. This requires elements that are built into all services of the ecosystem and services, such as the product catalog, a single data platform that allows to parts of the ecosystem and their interaction. It is important that the services are as easy to integrate as possible and have uniform technological parameters. This requires the creation of platform solutions. These solutions accelerate the creation and development of the ecosystem through the reuse of services. The infrastructure must be resilient and reliable to minimize wasted time by providing resources on demand, in code or instantly.

One of the main difficulties lies in non-complementarity of goals, quick launch of new products and services, and achievement of a synergistic effect. To resolve this contradiction, an appropriate management system is needed that can ensure the harmonization of different products and services with the fastest growth and decentralization of decision-making. It is important to build a competent management system in advance.

It builds several technology strategies, redesigns their landscape architecturally, and implements technology platforms. The new architecture allows users to enjoy any type of audio content from listening to songs to karaoke. The system processes billions of events per second, builds dynamic logistics routes, predicts delivery times for each element of the supply chain and predicts deviations.

It is important to give the client a service that will be useful so that he wants to use it. There are many technological possibilities for this, for example, building a reactive architecture that provides an on demand service, or using data analysis from all services to understand and predict customer needs. A generalized approach to customer experience is essential. It is important to develop a single set of user interfaces, create similar scenarios and tools for their implementation. Unifying elements such as uniform IDs and payment instruments help.

Organizational hard skill and advanced soft skills are required. The ability to convey and defend your idea, to establish cooperation at all levels is one of the most important conditions for creating an ecosystem. The phone has become a single channel of interaction that takes place within large ecosystems. These ecosystems operate with petabytes of data, hundreds and thousands of transactions per second. The systems are based on technological platforms that have similar requirements, namely: customer-centricity, open mechanism, machine learning and automated customer service, data processing in RAM.

Centralization on the client assumes complete customer information. The ecosystem assumes a single information space. Flexible mechanisms for configuring network products and processes are important. The ecosystem platform must be open. It is important to use machine learning mechanisms. Maximum reliability must be ensured. Horizontal scaling of the entire logistics cycle is assumed, as well as storage and processing of customer data, cyber security.

New generation ecosystems include four layers. The first layer represents a one-stop shop for all digital channels that is the same for all digital channels in terms of customer experience. It allows the customer to start a purchase in one channel, continue in another, and end in a third channel. At the second level of business logic, the client is offered a service. At the third level are the products and services of the players participating in this ecosystem. The fourth level of big data, where the storage and analytics are located, on the basis of which machine learning mechanisms work.

To build a new generation ecosystem, new development and implementation processes are required, which allows testing and installing new releases in an automatic mode. There are large investments in machine learning, automated decision making. Open source technologies are used. Ultimately, the goals are to increase efficiency, reduce TCO, create a dynamic infrastructure, robotize, train engineers who know both analytics and testing, and business processes, as well as reduce the cost of operations with an increase in transaction load.

No vendor can provide a complete IT solution for every customer. Likewise, it makes no sense for an organization to develop a specific IT solution for itself. Optimally design a vertical solution based on proven horizontal modules, architectures, or platforms that can be deployed across the enterprise.

Most in demand are partnerships within the ecosystem. There are many startups, but they lack experience in their chosen field. Companies that are considering adopting information technology can partner with these startups and complement their advanced technical capabilities with their accumulated experience, which will provide benefits to both parties.

IT is best implemented through a network of partners, each of whom contributes to the final solution. The introduction of information technology leads to a rapid growth in the number of partner ecosystems and opportunities for attracting customers to cooperation. Many companies work with customers to develop optimal solutions with reusable horizontal modules that are characterized by openness and interoperability. This is a challenging strategic transition for both suppliers and users of technology solutions. The result will be an open ecosystem of standards-based information technology solution developers. It is a collaborative economy.

Partnerships with key players that provide all parties with technological and market knowledge advantages lead to faster cost-effective solutions. If an important element is missing, a startup can fill the gap. Once all of the key partners have been assembled, you can add vertical specialists and vertical integrators who can combine components from different vendors and combine them with the customer's existing or new business processes to create a single business solution. Build a logical ecosystem of complementary skills and know-how. Non-binding collaboration will evolve into an alliance, then into a set of strategic partnerships, and finally into a symbiotic information technology ecosystem.

The first-tier manufacturer has ditched its own embedded information technology in favor of standards-based systems that are compatible with competing information technology applications. This allowed the company to build a vast ecosystem of applications and partnerships. As a result, the manufacturer saw great opportunities in a wider space, especially given the astonishing growth rate of the information technology market.

In forming your own set

Superapp plays an important role in the formation of your own network of partnerships. It is a multifunctional mobile application that provides access to products and services of the digital ecosystem. It is an ecosystem of in-house and third-party services packaged into one application. As a result, in the application, you can not only communicate, but also order a taxi, food delivery, buy movie tickets, play, read the news, make an appointment with a doctor, pay utilities, donate to charity.

A business ecosystem is a partnership of independent manufacturers of goods or services that together constitute an interconnected solution. The strengths of the ecosystem: access to external opportunities, fast scaling, flexibility and sustainability. Ecosystems do not necessarily imply a digital business model, but the largest modern ecosystems are developing on the basis of digitalization.

Superapp is a platform around which digital ecosystems are created and developed. An ecosystem can build from an existing platform, or collect existing products and services. Super apps, like ecosystems, can be open to partners and closed.

Superapps have an application with a large and loyal audience, a payment system, and mini-app. These are lightweight applications inside the superapp. Ecosystem partners present their services through mini-app. A unified methodology is important for quickly accessing the capabilities of built-in services.

Superapps help to keep the audience within the ecosystem through a large number of services. For this reason, the superapp has a higher chance of gaining a foothold on the first screen of a smartphone: more benefit for customers, a higher need for an application.

It is cheaper to attract users to one super application than to several separate ones. More and more competing applications appear, and more and more resources are required to promote each new one.

Open Ecosystem Supers save money through partnerships and third-party developers. The company creates a platform, with a successful development of events, a huge number of services appear on it. One company cannot create

It's easier to launch and test new products. Integration with superapp and development of a mini-app requires fewer resources than launching an application, and gives access to a wide audience. It is not profitable for services with a low frequency of use to develop a separate application, but you can run a mini-app. It will be in demand as it does not need to be installed separately.

Chatbots help attract potential buyers and customers, which leads to increased sales. Unlike companies that use traditional methods of service, chatbots do not overload the audience with information, and each time they provide only the data that matches user requests. Therefore, customers regularly receive extremely relevant information. For this reason, the super app has a higher chance of gaining a foothold on the first screen of a smartphone: more benefit for customers, a higher need for an application.

It is cheaper to attract users to one super application than to several separate ones. More and more competing applications appear, and more and more resources are required to promote each new one.

Open Ecosystem Supers save money through partnerships and third-party developers. The company creates a platform, with a successful development of events, a huge number of services appear on it. One company cannot create

It's easier to launch and test new products. Integration with super app and development of a mini-app requires fewer resources than launching an application, and gives access to a wide audience. It is not profitable for services with a low frequency of use to develop a separate application, but you can run a mini-app. It will be in demand as it does not need to be installed separately.

Super apps help users cover needs in one window. You don't need to install a separate application to use the new service. This saves time, device memory, screen space. Every time you do not need to register with a new service and add billing information. The general loyalty program applies to all services within the platform and allows you to earn bonuses: cash back, discounts and coupons.

But there are difficulties. Some customers do not understand why another operating system is needed inside the smartphone. Some users complain that super apps weigh more than a regular app, and not all functions are equally needed.

Personalization can enhance the user experience in super application. This is when only those services that the client needs are brought to the fore. Super apps have been built around applications across industries. The main thing is that the platform or company has a wide audience loyal to it.

The basis for creating a super app is a popular product or a large loyal audience of a company. Minis were launched when the audience was 800 million users. This is an investment sufficient to develop its own services or build a platform to attract partners or independent developers. Companies, IT corporation, banks, telecom companies, marketplaces have such resources. Startups are also announcing the creation of super apps. This is one opportunity to attract larger investments.

Chat bots play an important role in the functioning of ecosystems. 24/7 service is one of the benefits of using chat bots. With their help, companies can answer customer questions regardless of the time of day, and this improves the quality of service and affects the success of the business. They help you reach more customers. If a company wants to convey information about its products and services to a large audience, using this channel makes economic sense. Chat bots are characterized by Effective customer engagement, frugality, tracking the deliverability of content and customer data, generating, qualifying and nurturing leads, and ease of use. Chat bots help attract potential buyers and customers, which leads to increased sales. Unlike companies that use traditional methods of service, chat bots do not overload the audience with information, and each time they provide only the data that matches user requests. Therefore, customers regularly receive extremely relevant information. This approach helps keep your audience engaged for longer thanks to an automated message chain.

Business owners need to pay employees for customer service. And as the company grows, so does the cost. Chat bots are a one-time investment that helps brands reduce staff costs. Companies can easily integrate chat bots to answer simple questions from potential buyers and outsource more complex ones to service managers. Chat bots collect customer reviews that help brands improve their services and optimize low-level pages. Based on the actions performed by the client, you can segment the audience.

Chat bots receive information about users, which allows you to personalize the delivery of messages to customers at different stages of the sale. Bots can ask relevant questions, generate leads convince potential buyers. They help companies find unqualified leads through KPIs. This eliminates time-consuming interactions with leads. Chat bots help companies deliver quality customer service in multiple languages. This allows the brand to expand into new markets.

Chat bots mainly use artificial intelligence to communicate with users, so they provide relevant content and relevant offers. They operate on the basis of a set of instructions or use machine learning. The functionality of the chat bot, which works on the basis of instructions, is rather limited. It is often designed to answer fixed questions. Thus, if a person asks a question not in the way provided by the program, the bot will not be able to answer.

The intelligence level of a chat bot depends solely on how it is programmed. A machine learning chat bot works better because it understands not only commands, but also the language. Therefore, in order to get relevant answers, the user does not need to enter the exact words. In addition, the bot learns from customer interactions and is free to deal with similar situations when they arise. The chat bot gets smarter after every dialogue.

Besides the AI-powered chat bot, there is another one that is useful for marketers. It is simpler, so any enthusiast and even a marketing novice can work with it. This chat bot makes bulk mailings. Brands use these bots to empower email marketing and web push strategies. Investment in technology enables industrial companies to reduce costs and improve service quality. In particular, the insurance market participants have high hopes. Real-time vehicle driving data transmitted to the insurance company helps to objectively assess risks and determine insurance rates. Information technology technologies are being actively implemented in the transport and logistics spheres of activity. The automotive industry has built ecosystems of software solutions that allow, for example to monitor the level of traffic congestion, and also changed the taxi market. Intelligent monitoring systems make it possible to control the use of vehicles, the movement of goods inside and outside logistics complexes, and optimize routes. A toll payment system for large trucks has been designed.

Despite the need to transform processes, revise regulations, optimize workflow, revise approaches to collecting and processing information, ecosystems are being built. At the forefront are smart healthcare, smart grids, connected cars and smart cities.

Integration of operational information online is a basic prerequisite for operational management decisions, regardless of the field of activity, be it a business selling coffee, delivering goods or transporting passengers.

The company's task is to ensure the optimal operation of all areas and find synergies between projects, tying them with a common infrastructure and service products. This problem can be broken down into three directions. Search for new vectors of growth and a plan for their development. It is important to find out whether it is more effective to invest in a promising startup, launch a project on your own, or join forces with strategic partners.

The complex includes sales, processing, infrastructure, a single ID, a common loyalty system, values, model, strategy At the center of the ecosystem is a person and his needs, as well as diversification of sales and services. Four business models have been created for the next generation of organizations. They differ in closeness to the user, work to create a better customer experience, and participation (or, conversely, non-participation) in the ecosystem.

An ecosystem is a collection of products and services in non-overlapping verticals: mobile communications, banking, food tech, streaming, e-commerce. They benefit from the network effect of a single customer base, cross-selling, brand and digital. The growth of digital density has already led to the fact that the share of ecosystems has surpassed traditional industries: the total capitalization of the top 10 ecosystems in the world (Apple, Amazon, Google) is three times higher than the capitalization of the top 10 oil and gas corporations (BP, Shell).

The consumer paradigm is changing. The user wants to get everything in one place, and if possible, with one click in the smartphone. The business model that reflects this approach is called the "ecosystem driver" and combines full integration into the ecosystem and maximum proximity to the user.

Ecosystems scale easily with virtually no physical constraints. They keep up with the digital user. Online companies are starting to go offline in order to meet the growing needs of shareholders, to capture more and more segments of the economy, and even to occupy industries that are not typical for themselves. Huge financial reserves and consumer confidence are driving large digital ecosystems to monopolize entire industries.

By analyzing data that is collected through various programs and offered to the user as favorable subscriptions, conditions, the company knows the habits of its consumers which means it can be ahead of potential competitors. They do not have the opportunity and access to a huge amount of information. The company sees services that are likely to appeal to their customers or attract new users to the platform. Another area of activity is attracting retailers. Small companies can integrate with the platform sell their products on their own behalf, but within the platform. This enables small companies to participate in the processes. The flip side of cooperation is related to the data that the digital platform collects. Ultimately, retailers are crowded out, because the platform is able to meet the needs of customers, to offer them something new.

Digital platforms have included cloud technologies, online commerce, a geek platform for outsourcing employees, digital media, and offline retailing in their space. One of the success factors is the integration of software and hardware.

1.13. Political philosophy of social communication

Information plays an important role in the modern political activity of state and party structures. On this basis, the activities of the media and news agencies received the status of the fourth estate.

Political information contains information about facts, events trends in the political and legal spheres of the state, which are built, evaluated, interpreted and broadcast to a mass audience. In a liberal society and market economy, political information reflects a wide range of ideological modifications of civil society.

As a result, the state through the law implements the requirements for the activities of information institutions, determining the procedure for the establishment, state registration, distribution of products, the peculiarity of the activity, the legal status of the subjects of legal relations, their relations with state bodies, legal entities and individuals, international cooperation, responsibility for violation of the law.

The state is interested in effective information support for its foreign policy. This is due to the presence in the international information space of forces seeking to undermine the image of a modern state. Noopolitics is one of the tools. This is an information policy of manipulating international processes through the formation of an attitude towards the foreign and domestic policy of the state. The digital option is represented by no policy. The event for a specific state is placed in the created negative template.

Spin doctoring is also used. This is a political technology of changing public opinion in accordance with the policy of the state of the customer. The provision of unconfirmed, false information, the publication of articles of the desired orientation is carried out. It is part of political media framing, the purpose of which is to construct the image of the enemy. Cyber bullying through the technology of vintiblaming is not excluded.

Much depends on the objectivity of the analytical materials of bloggers who have a significant impact on the audience. They, for the sake of popularity, use entertainment analytics. Infotainment and storytelling are used. This is the art of constructing a story from real practice in the form of a parable, a myth. Attention is paid to the process of creating and telling stories. In this case, the blogger's subjectivity borders on fake technologies. The aim is to attract attention to one self and create emotional expectations of readiness to participate in political flash mobs. In this context, the topic of social conflict inevitably arises.

1.14. Information in the subject field of conflict management

Conflict management studies the patterns of the emergence and development of conflicts, as well as technologies for managing them. The theory of social and political conflicts was developed by K. Marx and F. Engels. Emil Durkheim, Max Weber formulated the sociological aspect of conflict management. Sigmund Freud introduced conflict management into the field of psychology. Ralph Dahrendorf developed a model of a conflict society

In the formation of conflict management practice, a special place was taken by negotiation techniques for resolving the conflict. The Harvard method of principled negotiations between R. Fischer and W. Urey gained fame. Three approaches to the study of the conflict have emerged. Within the framework of the organizational approach, the conflict is considered as a process or as a consequence of certain mismatches in the functioning of the organization, as a violation of the links that ensure the stability of the system. The activity approach explores the manifestation in conflicts of subject-business ties characteristic of joint activities. With a personal approach, the personality is considered as the central link in conflict interaction.

The study of the conflict is based on the basic provisions of the system-situational model of the study of conflicts and optimization of interpersonal interaction; development of measures for the prevention of conflict and crisis situations. There are three types of interaction: cooperation, cooperation and competition. The basis for the proposed typology is the differences in the parameters of the goal and the means. In cooperation, its participants want not only to solve the problem, but also to come to an agreement, to come to an understanding. In cooperation, they solve the problem. In competition, they strive for advantages. Types of interaction in specific situations are implemented in a specific style of behavior.

The understanding of social conflict in social philosophy is traditionally carried out from two points of view. According to T. Hobbes's model, enmity and conflict are accepted as the natural state of society. In the Aristotelian dialectical model, social conflict appears as a consequence of some cause and as a cause of some effect. The institution of negotiation mediation in an interpersonal conflict can fulfill the function of its settlement if it turns out to be able to introduce the conflicting parties into the framework of the rule of law and mutual obligations. If the institution of negotiated mediation is tasked with eliminating the conflict, then it must identify the cause of the conflict and be able to eliminate this cause.

It is advisable to highlight the psychological moments that will prevent the development of a conflict situation. In a conflict, as a rule, positive processes that provide effective interpersonal interaction are reduced and deformed. The method of studying the image of a conflict situation allows one to diagnose the content of the image of a conflict situation and to correct the conflict behavior of the leader.

The word "conflict" came from the Latin language (from the Latin conflictus - literally collision), in Russian it appeared in the XIX century and is first encountered in the explanatory dictionary of the Russian language by S. I. Ozhegov. Due to the variety of conflicts and their specificity, different branches of scientific knowledge endow the concept of conflict with their own, specific content. Economists identify it with competition, psychologists - with difficulties and tensions in communication, sociologists - with the opposition, the military - with war, armed conflict. Conflicts can be latent or overt, but they are always based on a lack of agreement between two or more parties.

An essential aspect of the conflict is that these actors operate within the framework of some broader system of connections, which is modified, strengthened or destroyed under the influence of the conflict. If interests are multidirectional and opposed, then their opposition will be found in a mass of very different assessments - they themselves will find a "field of collision" for themselves, while the degree of rationality of the claims put forward will be very conditional and limited. Thus, the conflict can be viewed as a socio-psychological phenomenon, a way of social interaction.

In the conflict management literature there are different definitions of conflict. As a consequence, the question of the classical definition of the conflict remains open. The structure of the conflict defines: 1) the struggle for: values, resources; 2) claims for: status, power. Goals of the conflict: achieving the desired, neutralizing the opponent, causing damage, eliminating the opponent. Conflict is a form of interaction driven by opposing values, norms, interests and needs. This is a clash of opposing goals, positions and subjects of interaction. It is the most important aspect of the interaction of people in society. It is a form of relationship between potential or actual subjects of social action, the motivation of which is due to opposing values and norms, interests and needs.

Communication barriers mainly arise from the object or situation of interaction: communication is conducted in different languages. There is a difference in culturally determined norms of communication when representatives of different cultures, classes, nations communicate, especially those with persistent prejudices, attitudes and stereotypes. The psychological side of difficulties and hindrances is associated with the personal factor, the motivational and content side of communication and covers various phenomena, from alienation and autism to superficial contact, redundancy and meaninglessness of communication. Difficulties associated with personality traits are less correctable, more stable. We can talk about the inability to establish contact and about the inability to establish contact associated with the personality.

Socio-psychological conflict reflects a violation of joint communicative activity, which is characterized by an irreconcilable contradiction that arises between the participants in the situation; aggravation of the conflict of motives, disruption of the coordination of the goals and interests of the participants, the desire of one or both parties to return to a conflicting method of interaction, the distancing of the achievement of the result of the activity, and is also characterized by the possible loss of the achieved psychological contact and trust in the relationship; the growth of affective manifestations and opposition.

The interaction of the subjects is disrupted and a confrontational confrontation arises. If the subjects resist, but do not experience negative emotions, or experience, but outwardly do not show them, or do not oppose each other, then the situation is in the pre-crisis zone. The psychological content of the conflict is a complex of mental states of both or one of the parties to the negotiation process. This is when all the proposed ways of resolving the situation are subjectively rejected or violent actions are considered as the only way to resolve it.

The typology of conflicts is of great importance for their recognition and management. The classification is based on the following parameters of conflicts: the duration of the conflict, the content of the conflict, the source of occurrence, the object of the conflict, the force of influence on the participants, the form of manifestation, the expected and real consequences, the characteristics of the parties involved in the crisis.

In recognizing the conflict, the assessment of the interrelation of problems and the key characteristics of the assessment of the conflict are of great importance. The existence and nature of such a relationship can tell a lot about the danger of conflict and its nature. This is the control of the development processes of negotiations and tracking their tendencies according to the criteria of anti-crisis management of interpersonal interaction. The causes of conflict are the nature of social life; the nature and essence of social interaction; a way of self-satisfaction. Consider

The specifics of interpersonal interaction should be taken into account. Based on the basic theoretical premises, specific characteristics of the conflict can be identified: low predictability, systemic inconsistency, uncertainty, non-linearity, cyclicality, high emotionality, mutual reflection. The low predictability of the conflict is the impossibility of accurately predicting the moment of occurrence and development of the conflict. Difficulties in forecasting arise not because there are not enough logical, mathematical or some other methods, but because of the uncertainty about what should be predicted. Low predictability is also noted in relation to the actions of the subjects of interaction. There is a systemic mismatch.

Under the influence of the conflict, the structure of the dialogue changes in two opposite directions: differentiation of separation and integration of unification. As a result of integration, the system, which is in a state of no crisis, acquires integrity and inertia, and the dialogue is successful, the parties reach mutual understanding. The alternative option creates a stable development of the conflict, gives rise to a crisis state and a mismatch of motivational, communicative, perceptual, emotional and behavioral components.

The uncertainty of a conflict is characterized by the fact that its subjects never have complete information about the intentions, plans, available resources and possible strategies for the behavior of the opposing side. Uncertainty is associated with the difficulties of reliable assessment by the subjects of the conflict not only of the results of the outcome of the conflict, but also of the next step of the opposing subject.

The difficulties are due to the poor predictability of crisis processes. High emotionality is characteristic of a conflict already at the stage of its occurrence. An increase in emotionality, tone, and the appearance of harsh statements can be an accurate conflict-defining property. The opposing sides not only react to each other, but also try to impose a strategy of behavior that is beneficial to them. Specific factors external conditions, psychological characteristics of the subjects lead to a conflict that turns into a crisis. Conflict factors causing disturbances are of exogenous or endogenous nature. Exogenous conflict-generating factors can be specific indicators of external conditions that provoke conflict and crisis.

Endogenous conflict management factors are divided into primary and secondary factors. The primary factors include the manifestation of the activity of one of the subjects of interaction, provoking a conflict. Secondary factors include a distorted perception of the activity of one of the subjects, which is perceived by the subject not in the way expected by the other subject. As a result, a contradiction arises, insurmountable difficulties in achieving the goal.

Within personal conflicts are understood as contradictions that manifest themselves in the clash of various personal components of motives, goals, interests, abilities presented in the consciousness of the individual by the corresponding experiences. The reason for the emergence of contradictions may be disharmony in the self-consciousness of the individual. The severity of the course of a personal conflict depends on the subjective perception of the significance of the situation and personal stability. Specific intra-personal conflicts affect the diverse aspects of the personality and predetermine the characteristics of personal and professional growth, the completeness of self-realization.

Internally, a personal conflict has a number of features that distinguish it from other conflicts. In the structure of this type of conflict, there are no subjects of conflict interaction it is intra-subjective, and also characterized by latency. The individual enters into a dialogue with himself. There are two groups of conditions for the emergence of a personal conflict. Personal conditions include the presence of a complex inner world, the development of the hierarchies of the motional sphere and the system of feelings, a tendency to introspection and reflection.

Situational conditions are external, namely, objective obstacles, the requirements of society and others, and internal conditions in the form of an awareness of the subjective unresolvedness of an internal contradiction that has arisen. There is a close connection within a personal conflict with neuroses, internal contradictions and personality crises. Inside, the personal conflict of a mentally healthy person and the conflicts of a neurotic are similar in external manifestations, but different in origin.

Internally, a personal conflict seems to be a more extensive phenomenon, the course of which depends on the subjective perception of a difficult situation and the psychological stability of the individual. Inside, personal crises are characterized by sharp psychological changes, to get out of which requires the concentration of all spiritual forces. The emergence within a personal conflict occurs with the awareness of internal contradictions, and, due to them, it arises during the period of their exacerbation, accompanied by an acute emotional experience. Protraction within a personal conflict develops into a crisis.

Internally, personal crises are viewed as special phenomena that arise in the process of accumulating various contradictions and cause cardinal changes in the consciousness and activity of the individual. Being a kind of turning points in the life of an individual, they require the concentration of all the spiritual forces of a person, and therefore often, when they are resolved, there is a reorientation to new values and goals.

A situation within a personal conflict can initiate a crisis, and a crisis is accompanied by conflicts. The potential stage within a personal conflict is characterized by a weak manifestation of contradictions in the activity of the individual. The compensated stage within a personal conflict occurs at the moment of realizing the contradiction. There is an awareness of the need to make a decision, to choose one of the alternatives. The decompensated stage within a personal conflict arises as a result of a decision.

Strengthening within a personal conflict is characterized by an exacerbation of the contradictory tendencies underlying within the personal conflict, as a result of which discomfort increases. Its strengthening either leads to a decision, or does not, but in the latter case, the conflict remains unresolved. Making a decision means choosing an alternative or domination of one of the poles of the fundamental contradiction within a personal conflict. If the adopted decision is not put into effect, then it remains unresolved.

The conflict of loss of meaning is associated with changes in the hierarchy of motives. It is based on the contradictory relationship between the manifestation of new types of activity and the readiness to carry it out in real life. Role within personal conflict is determined by the contradiction between the social role, and the willingness, and the possibility of its implementation. The conflict is characterized by a contradiction between subjective requirements for oneself and the possibilities of realizing these requirements. The conflict of overestimated claims is due to the discrepancy between the increased claims of the individual and the underestimation of objective factors.

There are two interrelated mechanisms of constructive conflict resolution: 1) the presence of freedom of choice - the willingness to see possible options for behavior that differ from the usual stereotypical position in the conflict; 2) behavioral flexibility (the leading indicator of behavioral creativity) - the ability to produce and use different strategies. The constructive resolution of an intrapersonal conflict depends on its type and is carried out by optimizing the underlying leading contradiction through the use of the personality's abilities to comprehend negative factors. It is necessary to be aware of your internal contradictions and their constituent sides, and the confrontation between them.

It is important to take an active position of the individual, leading to the restructuring of the hierarchy of values and the formation of the inner world of the individual; the orientation of this activity towards the constructive transformation of the components within the personal conflict, and not adaptation to it, which leads to the gradual accumulation of conscious and unconscious unresolved contradictions in the inner world of the individual. It is necessary to develop the skills of personal reflection so that in the future it will be possible to independently overcome such psychological problems.

Group conflicts are more extensive in their consequences than interpersonal conflicts. Confrontation arises on the basis of a clash of opposing group motives. Sources of conflict are both objective and subjective. Objective reasons for the conflict include circumstances that led to a clash of interests, opinions, attitudes of the conflicting parties. Among the objective causes of conflicts one can single out organizational and managerial reasons associated with the creation and functioning of organizations, teams and groups.

Structural and organizational reasons lie in the inconsistency of the structure of the organization with the requirements of the activities in which it is engaged. Functional and organizational causes of the conflict are generated by the inaccuracy of the functional relationships of the organization with the external environment, between the structural elements of the organization, between individual employees. The personal and functional causes of the conflict are associated with the incomplete correspondence of the employee in terms of professional, moral and other qualities presented to the position held. Situational and managerial causes of conflicts are due to mistakes made by managers and subordinates in the process of solving official tasks.

Conflicts can arise due to misconceptions about what is said or implied by the other party, due to differences in values, beliefs, manifest themselves on general issues, due to different interests, due to individual differences. There is a complex of objectively subjective reasons for conflict interaction. Any objective reason is accompanied by a number of subjective reasons.

Intragroup conflict is driven by group dynamics. These conflicts are negative for the group. The group contains the potential for conflict due to the recurring rivalry between the demands of the individual. The nature of the group also affects the characteristics of the conflict. The high frequency of interaction contributes to the intensification of the emotional manifestations of the individual.

Conflict is perceived as a threat to the relationship. The more united the group, the more the conflict is perceived as threatening the group, as a result of which the aggression is suppressed, and in such groups the conflict can be destructive. The duration of the conflict is determined by the clarity of the goals of the conflict groups, the degree of their agreement on the meaning of victory or defeat, the ability of leaders to understand what victory is worth and to convince their supporters that it is desirable to end the conflict. Conflicts that serve to resolve contradictions are an important stabilizing mechanism and a mechanism for adapting group norms to new condition.

The real conflict of interests of different groups causes intergroup conflict. Intergroup conflict will be especially intense if the real conflict of interest is significant, and the expected gain for the parties is large. A real conflict of interest, as well as an explicit, active or past intergroup conflict and the presence of hostility, threat and competition from neighboring groups determine the perception of threat by individual members of the group.

A real threat leads to the hostility of individual members of the group to the source of the threat. It leads to intragroup solidarity. It increases the impenetrability of group boundaries and reduces the deviation of individuals from group norms. It increases the degree of punishment and the degree of rejection of those who have violated their loyalty to their group and leads to the need for punishment and ostracism of group members who deviate from group norms.

The mistaken perception by group members of the threat from the out group leads to increased intragroup solidarity and hostility towards the out group. The threat leads to a more complete awareness by the individual of his own group belonging and the impenetrability of group boundaries. It creates the hostility of individual members of the group to the source of the threat and intragroup solidarity. It reduces the deviation of individuals from group norms. Ostrakism (from the Greek. Ostracon - shell) is rejection, ridicule from the surrounding society. There is a conscious use of the identified patterns to enhance the cohesion of the group or to preserve it.

The greater the value of the threatened value, the greater the goal towards which competing groups are striving, and the more serious the obstacle to achievement, the greater the hostility. That is, the conflict is rational in the sense that certain groups really have incompatible goals and compete in an effort to seize resources that are not unlimited. An external threat, like intergroup competition, leads group members to exaggerate their own merits and other people's shortcomings.

If the participants are emotional, then the conflict is more acute. The earlier the groups were involved in the conflict, the more they are emotionally involved in it. The earlier the enmity between the groups participating in the conflict was stronger, the stronger their emotions caused by the conflict. The stronger the rivalry of those involved in the conflict, the stronger their emotions caused by the conflict. The better grouped the groups involved in the conflict, the more acute it is. The higher the relative cohesion of the groups involved in the conflict, the more acute the conflict.

The stronger the earlier consent of the groups involved in the conflict, the sharper the conflict. The less isolated and detached conflicting groups are due to the broader social structure, the more acute the conflict. The less the conflict is simply a means to an end and the more it becomes an end in itself, the sharper it is.

Group cohesion limits the release of negative feelings of group members. In this regard, disagreements and tensions between them find their way out in outgroup manifestations, in particular, in hostility to other groups. Significance for intragroup conflicts is the nature of the group's relationship with the external environment. Groups that are in a state of constant confrontation with other groups tend to more complete personal involvement of their members in common activities, to suppress the deviations of group unity and diversity.

For groups that are characterized by more or less harmonious relations with the environment, a more tolerant attitude towards intragroup conflicts is characteristic. Realistic conflicts are means of achieving concrete results and can be replaced by alternative ways of interaction that are more adequate to achieve a result. Conflict can be a means of transforming existing norms to fit new conditions. Intergroup conflicts help shape new norms. In rigid groups, this mechanism is complicated. The intragroup conflict serves as a means of identifying conflicting interests among the members of the group, which contributes to the possibility of a new agreement, provides the necessary balance.

Conflicts often lead to the formation of coalitions or microgroups, resulting in group structuring. An important factor in determining the frequency of conflicts in a group is the general level of tension in which a person and a group exist. The conflict depends on the social relations in the group.

The causes of conflicts arising on professional grounds are closely related to the motives that induce a person to work. There is a contradiction between the increasing potential capabilities of the group and its actual activity, as well as between the growing desire of the group for self-realization and self-affirmation and, at the same time, the increasing tendencies of the inclusion of the individual in the group structure. The development of the group has a spasmodic character, and as a result of the exacerbation of contradictions and their subsequent resolution, the group moves from one level to another.

Contradictions can move from the subject area into interpersonal relationships, and, as a result, negative consequences arise when making decisions. In groups of different levels, ideas about the conflict are different. In groups of a high level of development, the concept of conflict has a synonymous series of weak emotional stress, and the conflict situations themselves are described within the framework of a social norm. In groups of a low level of development, synonyms of conflict have a load. As a result, conflict situations go beyond the social norm.

The group's interpersonal conflict is integrated into the business relationship within it. Of course, Conflicts complicate the management process. Opposing motives, interests, positions act as driving forces of conflicts and are accompanied by emotions. Conflicts between an individual and a group arise in the environment of group relationships and differ in some features that should be taken into account in the management of these conflicts. Conflicts between an individual and a group arise in the environment of group relationships and differ in some features that must be taken into account when faced with a conflict. The conflict is characterized by a discrepancy in such concepts as position - official, position determined by the position; status - the real position of the individual in the system of intragroup relations, the degree of its authority.

The social role reflects the functions that the individual performs in a specific system of relations. The normative role is associated with the requirements of instructions for the rules of behavior in society. An inter role captures such behavior as the individual considers necessary and possible. Status denotes the place occupied by an individual in the hierarchy of relations in the performance of a given role. Social position reflects the attitude of the individual to their roles and their statuses.

The reasons for the conflicts that arise between the individual and the group are associated with the violation of role expectations, as well as with the inadequacy of the internal attitude to the status of the individual. Conflict of a person with a group is observed when her internal attitude is overestimated, in violation of group norms.

The conflict between the leader and the team usually arises as a result of low competence an unacceptable management style the appointment of a new leader, which has specific requirements. Conflict between an ordinary employee and a team can develop when someone deviates from the established group norms of behavior. The cause of the conflict is the presence in the team of a personality with a pronounced conflict orientation. A conflict between an individual and a micro group can arise as a result of changes in the group consciousness, the leader exceeding his powers, low professional training.

Intergroup conflict assumes that the conflict arises in the interaction between different groups and it can be carried out for various reasons, in different conditions and forms, and with varying degrees of tension. In an inter-group conflict, the opposing sides are small and medium-sized groups. This confrontation is based on a clash of oppositely directed group motives, interests, values, goals. In group opinions, one's own group is valued higher, and the merits of the opposing group are underestimated. The positive behavior of one's own group and the negative behavior of the outgroup are explained by internal reasons. Negative behavior of one's own group and positive behavior of a stranger are explained by external circumstances.

Intergroup conflicts are caused by intergroup hostility, conflict of interest, and intragroup favoritism. As a result of tension in the group, the group goal is changed or a common goal is fixed, the conflict is resolved through the formulation of a new goal of the subgroup and the personal responsibilities of its members, changes in the plan of action, and the use of new means of achieving an already set goal. Among the methods of managing the process of resolving a conflict situation, structural methods are distinguished, involving the creation of conditions and impact through organizational factors, which are aimed at eliminating the conflict environment, weakening or eliminating sources of conflict, and preventing its escalation. It is planned to improve the clarity of the formulation of requirements for interaction, the formation of corporate values and goals, the use of coordinating mechanisms, and specialization in the incentive system.

Personal methods, involving the individual influence of the head on conflicting employees through a change in their motivation, the use of power, and their separation as parties. Expert mediation methods based on the involvement of specialists from consulting firms in conflict resolution, who analyze the state of affairs in the organization and managers on resolving existing conflicts, as well as contribute to the implementation of a system of conflict prevention measures.

When attracting specialists from consulting firms to conflict resolution, the latter can demonstrate one of two styles of mediation: 1) traditional, consisting in equidistant interaction with the parties to the conflict and orienting them towards compromise cooperation through stimulating behavior that anticipates the improvement of the conflict situation; 2) innovative, orienting the parties to the conflict towards mutual openness and joint research of the processes in which they participate, so that they eventually master the methods of diagnosis, management and prevention of conflicts.

In the definition of the concept of negotiations, two meanings are distinguished: 1) exchange of views for any business purpose; 2) the same as conversation Negotiations often take on the character of rivalry and cooperation at the same time. The results largely depend not only on professional training, but also on the personal qualities of the negotiators, their abilities, which gives reason to consider negotiations not only as a science, but also as an art. Essential for negotiation skills lies in the negotiation technique, in the methods of promoting one's position, in the methods of influencing the partner and neutralizing the influence on his part - these are techniques that contribute to the achievement of the goal.

A positive aspect of the negotiation process is that interests are coordinated or clarified in a reciprocal order, a common point of view on some issues is sought, joint actions are organized or the partner's behavior changes without the use of "force" coercion. The negotiation process is based on the ability of the subjects to find mutually acceptable solutions through the exchange of information. In negotiations, the engine for achieving a certain result is the interest (will) of the participants. Efficiency is determined by the degree of interest of the parties, the desire to resolve the conflict through settlement.

Finding out the essence of the actual existence of interest creates a movement from one stage of negotiations to another. Activity is realized in the behavior of participants in a conflict interaction, which is called conflict behavior. A potential conflict environment can be enhanced by information impact. To minimize this negative impact, the state and corporate structures resort to the help of the law.

1.15. Media philosophy

Media philosophy reflects the features of the professional activity of journalists, taking into account the specifics of organizational structures. These traditionally included the editorial offices of newspapers, where journalists worked as correspondents. The commercial component in the activities of these structures presupposed professional skills in the prompt collection of information and its skillful presentation. An important role in the activities of newspaper editorial offices was played by work with potential customers for advertising placement. It was taken into account that the placement of information in newspapers was supposed to keep the reader's constant interest in newspaper publications.

In the second half of the 19th century and the beginning of the 20th century, newspapers had competitors in the form of telegraphs and radio. TV news channels have been added to these competitors. By the end of the twentieth century, the convergence methodology began to play an important role in the field of information communications. As a result, newspapers and television news channels went digital. Large information holdings have been created that use digital platforms and offer a wide range of not only information, but also advertising services.

Ethical aspects of journalism at the stage of constructing information messages related to issues of political activity and the objectivity of messages have become a special topic in media philosophy. This topic has an epistemological basis in the form of the problem of the reliability of information, and its interpretation in news reports. This topic has been updated by the widespread use of fake technologies. These technologies do not adhere to the criteria for the reliability and objectivity of information. Priority is given to the customer who uses information tools to achieve subjective goals.

1.16. Philosophy of law and information technology

Philosophy of law studies the normative components of legal consciousness, universal and local features of legal creativity, as well as law enforcement. Historically, the first normative form of law was taboos (prohibitions). At the stage of ancient civilizations, written law appeared which regulated civil and economic disputes, responsibility for crimes. In a systematic way, legal norms were formulated as a single document. One of these documents was Russkaya Pravda. In Christianity and Islam, law has become a part of their theology. During the Renaissance, the position was restored by natural law, the source of which is the people. It acquired the status of national state law. This right regulates the entire range of legal relations within specific territorial structures.

The problem, however, is that the information space has become transnational and questions have arisen of its legal regulation at the national level. In states, at the legislative level, they began to create a regulatory framework for regulating the information space. A similar process is taking place in the Republic of Belarus. It resulted in the Law of the Republic of Belarus on Information and Protection of Information dated November 10, 2008 No. 455-3. Adopted by the House of Representatives on October 9, 2008. The law was approved by the Council of the Republic on October 22, 2008. Its provisions were developed in the form of legislative activity. They are reflected in the Law of the Republic of Belarus dated January 4, 2014 No. 102-3 and the Law of the Republic of Belarus dated May 11, 2016 No. 362-3. Amendments and additions have been made that entered into force on May 18, 2016. Except for changes and additions that entered into force on July 1, 2017, as well as the Law of the Republic of Belarus dated May 11, 2016 No. 362-3 - changes and additions have been made, entered into force on May 18, 2016 and July 1, 2017.

Terms and definitions are used in legal documents. A database is defined as a set of structured and interconnected information, organized according to certain rules on tangible media, as well as an organizational and technical system that includes one or more databases and a system for managing them.

The owner of software and hardware, information resources, information systems and information networks is defined as the subject of information relations, exercising the rights of ownership, use and disposal of software and hardware, information resources, information systems and information networks within the limits and in the manner determined by their owner in accordance with the legislation of the Republic of Belarus.

The state information system is formulated as a system created and (or) acquired at the expense of the republican or local budgets, state extra-budgetary funds, as well as funds of state legal entities. A state information resource is defined as an information resource formed or acquired at the expense of the republican or local budgets, state non-budgetary funds, as well as funds of state legal entities.

Documented information is information recorded on a tangible medium with details that allow it to be identified. Access to information, information system and information network regulates the possibility of obtaining information and using it.

Information protection involves a set of legal, organizational and technical measures aimed at ensuring confidentiality, integrity, authenticity, accessibility and safety of information.

Digital is defined as an organizational, socio-economic, scientific and technical process that provides conditions for the formation and use of information resources and the implementation of information relations. The information contains information about persons, objects, facts, events, phenomena and processes, regardless of the form of their presentation;

The information network reflects the totality of information systems or complexes of software and hardware of the information system, interacting through telecommunication networks. Information system means a set of data banks, information technologies and complexes of software and hardware tools. Information technology records a set of processes, methods of searching, receiving, transferring, collecting, processing, accumulating, storing, distributing and providing information, as well as using information and protecting information.

Information service means the activity of searching, receiving, transmitting, collecting, processing, accumulating, storing, distributing and providing information, as well as protecting information. Information relations arise when searching, receiving, transferring, collecting, processing, accumulating, storing, distributing and providing information.

An information intermediary is a subject of information relations that provides information services to the owners and (or) users of information. An information resource is presented as an organized collection of documented information, including databases, other collections of interrelated information in information systems.

A complex of software and hardware means a set of software and hardware that ensure the implementation of information relations using information technology. Confidentiality of information reflects the requirement to prevent the dissemination and (or) provision of information without the consent of its owner or other grounds provided for by the legislative acts of the Republic of Belarus.

The owner of information is a subject of information relations that has received the rights of the owner of information on the grounds established by acts of legislation of the Republic of Belarus, or under an agreement. The operator of an information system is a subject of information relations that operates the information system and (or) provides information services through it.

Personal data includes basic and additional personal data of an individual, subject to entry in the population register in accordance with the legislative acts of the Republic of Belarus, as well as other data that allow identification of such a person. A user of information and an information network is a subject of information relations who receives, distributes and (or) provides information, exercises the right to use it, who has gained access to the information system and (or) information network and uses them.

Provision of information means actions aimed at acquainting with the information of a certain circle of persons. Dissemination of information means actions aimed at acquaintance with information of an indefinite circle of persons. The owner of software and hardware, information resources, information systems and information networks is the subject of information relations, exercising the rights of ownership, use and disposal of software and hardware, information resources, information systems and information networks.

Article 6 of the Law of the Republic of Belarus on Information, Digital and Protection of Information dated November 10, 2008 No. 455-3 states that citizens of the Republic of Belarus are guaranteed the right to receive, store and disseminate complete, reliable and timely information in the manner prescribed by this Law and other acts of legislation of the Republic of Belarus. The right to information cannot be used to promote war or extremist activity, as well as to commit other illegal acts.

Chapter 3 of the Law of the Republic of Belarus on Information, Digital and Protection of Information dated November 10, 2008 No. 455-3 defines the legal regime of information. Article 15 defines that, depending on the category of access, information is divided into publicly available information and information, the dissemination and (or) provision of which is limited. This includes information about the private life of an individual and personal data; information constituting state secrets; proprietary information of limited distribution; information constituting commercial, professional, banking and other secrets protected by law. As well as information contained in cases of administrative offenses, materials and criminal cases of the criminal prosecution authorities and the court before the completion of the proceedings; other information, access to which is limited by legislative acts of the Republic of Belarus.

Article 18 states that no one has the right to require an individual to provide information about private life and personal data. This refers to information constituting personal and family secrets, secrecy of telephone conversations, postal and other messages concerning the state of his health, or to receive such information in any other way against the will of this individual, except for cases established by legislative acts of the Republic of Belarus.

Collection, processing, storage of information about the private life of an individual and personal data, as well as their use, are carried out with the written consent of this individual, unless otherwise provided by legislative acts of the Republic of Belarus.

The procedure for receiving, transferring, collecting, processing, accumulating, storing and providing information about the private life of an individual and personal data, as well as using them, is established by legislative acts of the Republic of Belarus. Article 19 states that documenting information is carried out by its owner in accordance with the requirements of office work established by the legislation of the Republic of Belarus.

The procedure for documenting information, processing, storing, distributing and providing documented information, as well as using it, is established by acts of the legislation of the Republic of Belarus, including technical regulatory legal acts.

Article 20 of Chapter 4 states that the information disseminated and provided must contain reliable information about its owner, as well as about the person disseminating and providing information, in a form and volume sufficient to identify such persons.

When using technical means to provide information to familiarize a certain circle of people with information, the owner of the information and the information intermediary are obliged to provide information users with the opportunity to freely refuse to receive information provided in this way. When distributing and providing information by mail, telecommunication networks, persons distributing and providing information are obliged to comply with the requirements of the legislation of the Republic of Belarus on postal services, on telecommunications and advertising.

Article 24 of Chapter 5 states that the state registration of information resources is carried out in order to create a unified system for recording and preserving information resources, creating conditions for their transfer to state archival storage, informing state bodies, individuals and legal entities about the composition and content of information resources in the Republic of Belarus ...

State registration of information resources is carried out by the Ministry of Communications and Digital of the Republic of Belarus by entering information about information resources into the State Register of Information Resources. Non-state information resources are registered in the State Register of Information Resources on a voluntary basis, unless otherwise provided by legislative acts of the Republic of Belarus.

Article 27 of Chapter 7 states that the goals of information protection are to ensure national security, the sovereignty of the Republic of Belarus; preservation and non-disclosure of information about the private life of individuals and personal data contained in information systems.

Article 29 of Chapter 7 states that legal measures for the protection of information include agreements concluded by the owner of the information with the user of information. Which establish the conditions for the use of information, as well as the liability of the parties under the agreement for violation of conditions.

Organizational measures for the protection of information include ensuring a special admission regime on the territory (premises) where access to information (material media) can be carried out, as well as delimiting access to information by the circle of persons and the nature of the information.

Technical measures to protect information include measures to use means of technical and cryptographic protection of information, as well as measures to control the security of information. State bodies and legal entities that process information, the dissemination and (or) provision of which is limited, determine the appropriate divisions or officials responsible for ensuring the protection of information.

Article 32 of Chapter 7 states that measures to protect personal data from disclosure must be taken from the moment when the personal data was provided by the individual to whom they belong to another person, or when the provision of personal data is carried out in accordance with the legislative acts of the Republic of Belarus. The subsequent transfer of personal data is allowed only with the written consent of the individual to whom they refer, or in accordance with the legislative acts of the Republic of Belarus.

The measures specified in the first part of this article must be taken before the destruction of personal data, or before their depersonalization, or before obtaining the written consent of the individual to whom these data refer to their disclosure. Subjects of information relations who have received personal data in violation of the requirements of this Law and other legislative acts of the Republic of Belarus are not entitled to use them.

Thus, the legal documents clearly define the key aspects of the functioning of the information social space, as well as the rights, obligations and legal responsibility of the subjects of legal relations. The Criminal Code of the Republic of Belarus provides definitions of cyber offenses and defines the measures of legal responsibility of participants in information relations. The definitions include hacker attacks on information resources of citizens and corporate structures, as well as cyber bullying in the form of threats and slander. The definition of terrorist activity includes propaganda of neo-Nazism, calls to action that are incompatible with the values of state sovereignty and national security. Subjects of information activity are obliged to follow national legislation and promptly eliminate information.

1.17. Information in the categories of philosophy of culture

Structures working in the field of social and cultural activities, such as museums, publishing houses, entertainment and recreation centers, tourist services bureaus use information technology telecommunication systems, multimedia technologies, as well as systems for managing the activities of cultural institutions based on the use of web technologies and Internet resources. These are the means of operational communication, coordination of activities. In particular, these include e-mail, electronic message boards, mailing lists, news sections of sites. Distributed resources and means of access to them, tools for searching for resources and partners, standard and specialized software tools (databases, Internet portals, terminals of computer networks) are used; feedback forms and organization of cooperation (forums, e-polls, guest books, teleconferences).

Information technology in the socio-cultural sphere is focused on art-related organization of creative processes, with its inherent psychological characteristics and perception of information. In the process of creating such information technologies and systems, in addition to professional developers, groups of specialists in the subject area are involved, for which a particular solution is being created. These specialists include an art critic, artist, historian, representative of show business, who is directly related to the subject area and topics of development; literary, technical, video and music editors; independent expert.

Every employee in a museum, archive and library, wardrobe department of an opera or drama theater is glad that there is software that allows you to quickly and flexibly register and replenish funds; any cultural department can draw up a financial statement in a clear and transparent manner. The museum can get acquainted with the funds of another museum via the Internet. A library can speed up the exchange of information and books because you can quickly find out which library contains the information or book you are looking for. Scientists can quickly gather information on their topic, since many scientific journals are published only on the Internet. One culture department can quickly exchange data from the culture department with another.

Children's and opera theaters are better attended than ever, libraries are full of readers, there are queues to museums, people go to the movies, and they even show great interest in literary readings and alternative dances. New means of communication increase interest, make traditional types of cultural activities more accessible, and contribute to better awareness of them. The Internet forces people to read, but read shorter, faster, more fragmentary, less detailed. The challenge for public libraries is to combine traditional reading with Internet reading.

We are talking about new forms of culture presentation. First of all, it is the problem of providing access to new information technologies to people who cannot afford to have them at home. Public libraries play a huge role in the closest collaboration with schools. Libraries have become cultural information centers for all segments of the population. Many librarians, especially the older generation, find it difficult to get used to this role, but the young have coped with it, they work with passion.

International museum biennials have become one of the brightest events in the international museum business. One of the first multimedia materials created in the field of St. Petersburg culture was the CD "Excursions in the State Russian Museum". The user can choose the hall he is interested in by planning the halls, orienting himself on the hanging and arrangement of the exhibits, choose any of them, familiarize himself with his image in the middle ground and several close-ups (fragments), the history of creation, as well as the biography of the author, characteristics of the direction, to to which he belonged. The CD "100 Contemporary Artists of St. Petersburg" is in high demand. Each artist is represented in it by 10 paintings (special photography from the original), biography, direction characteristics, graphic exhibition and expert feedback.

Multiframing, entertaining animation, virtual reality, real audio, interactive multimedia, in real time create unique opportunities for cultural activities. Information sites about theatrical life have become relevant: information about premieres, expert materials, a monthly poster by theaters and by dates. Through the digital programs of the performances, it is possible to receive photographs of the artists involved in these performances. The menu is supplemented by the layout of the hall and electronic ordering and purchasing of tickets. As a result, not only residents of one city, but residents of other cities and countries received the opportunity to purchase or book tickets.

The Düsseldorf Central Public Library project shows how much imagination and creativity can be displayed by children and adolescents aged 9 to 15 when developing their own computer programs that reflect their views of the world. Young reporters surveyed their rather poor urban area, where the city for financial reasons deprived them of a playground. They collected information and compiled a rather critical program under the guidance of teachers, placing it on the Internet. It had such a big impact that the city had to rebuild the playground. At the same time, children simultaneously learned to act from an active position in solving their own problems, to work in a team, which, in turn, increased the motivation for mastering a computer.

Through a project developed in close collaboration with Dutch libraries and educational institutions, schools are providing curricula and homework questions. The central service of public libraries collects and processes the relevant information, selects and prepares the necessary software. Using these simple search engines, students can find information adapted to the school curriculum and compiled in understandable language. They learn not only to work with a computer, but also to choose the necessary information, that is, to evaluate how they understood it, and whether it is generally needed for their purposes or not. At school, this information needed to complete homework is discussed again in class.

As part of a project by the Dutch National Association of Librarians, which has published a book review program for children and young people on the Internet, children and adolescents use simple questions to review their favorite books. Other young site visitors can comment on these reviews.

Numerous informational, bibliographic and scientific CDs are available to visitors to computerized reading rooms. So, for example, in the Russian State Library (RSL) there are over 600 CD-ROM 170 titles at the service of readers, in the State Public Scientific and Technical Library of Russia (GPNTL) - 500 CD-ROM 80 titles, in the All-Russian State Library of Foreign Literature - 100 databases on CD-ROM.

The electronic resources of the library of the Institute of Scientific Information amount to more than 2 million records. The Scientific Library of Moscow State University has opened its electronic catalog. The global market for licensed artwork has reached $ 2 billion.

1.18. Information in categories philosophy of history

A marginal person has become a product of the technological development of society. Its role became noticeable already in the nineteenth century. We are talking about a person who does not fully identify himself with any order of traditions and moral norms. In the United States, the marginal personality was perceived as constructive precisely because it is not completely connected with any order of traditions and moral norms. This feature was used to derive the advantage associated with mobility, adaptability in the face of constant changes in lifestyle.

In Europe, the attitude towards the marginalization of society is completely opposite. Z. Freud in this case operates with the concept of a crowd. H. Ortega writes about the uprising of the masses. In Russian literary practice, one of the key places is occupied by a nihilist. It is characterized by conflict psychology, opposition to the existing institutional tradition. The danger of this type of person is depicted by F. Dostoevsky, I. Turgenev. The First World War provided extensive material on the psychology of the marginalized strata of society. In the conditions of the great depression of the thirties of the twentieth century, German politicians took advantage of the resources of a marginal crowd, endowing it with the exclusive status of the Aryan race. Not bound by traditions, this human mass turned into a machine of mass murder of the civilian population of the occupied territories. The marginal strata of society from different countries and the political elites of Germany, Italy, Spain, Hungary, Romania, Bulgaria, Slovakia, and Finland found themselves under the banner of a single Nazi ideology.

The USSR had to confront a coalition of fascist states. On the side of the fascist coalition were also the nationalist organizations of Western Ukraine, Croatia, Lithuania, Latvia and Estonia. The Great Patriotic War became the key front of the Second World War, since the largest military forces of Nazi Germany and its allies were involved in a direct military clash. This coalition was opposed by the Soviet Army. The victory of the Soviet Army at Stalingrad and at the Kursk Bulge prompted the United States and Great Britain to take more decisive military action in Europe. The soldiers and officers of these armies freed concentration camp prisoners and saw the scale of the Nazi mass destruction of the civilian population of the old continent. They took pictures of these places, took notes. The Nuremberg trial became possible due to the fact that lawyers had the necessary evidence of mass killings of civilians and prisoners of war.

Post-war Germany made a lot of efforts to restore the status of humanism values in society. Psychologists, sociologists, political scientists worked. In the FRG, the key reflexive positions were taken by representatives of the Frankfurt school who returned from migration. Their popularity was explained by preventive work in the field of political sociology, which solved the problem of overcoming the authoritarian attitudes of public consciousness, totalitarianism. At the same time, representatives of this school remained within the boundaries of crisis consciousness, as evidenced by their criticism of the Western way of life, which stimulated student protests in France in the sixties of the twentieth century. T. Adorno, G. Marcuse, J. Habermas had to correct their views in a more constructive form associated with the formation of a methodology of communicative action that integrates public opinion and legitimate structures of democratic power by identifying the positive role of language.

It seemed that society had acquired the necessary institutional value basis. But, as the era of the Internet showed, these were illusions. Marginal consciousness did not cease, and could not cease, to exist. It was unable to speak. In the computer information space, the institutional framework, as such, was absent. There was a situation of unlimited freedoms and rights, but there was no responsibility. As a result, for the sake of positioning, the social network began to use any ways to stand out in the context of relevant topics. One of these topics was the historical memory of the Great Patriotic War. Within its boundaries, "new approaches", "new interpretations", "truth", "a new look at history" are being constructed. The unrestricted marginal consciousness turned out to be consonant with the US geopolitical strategy of the clash of civilizations.

The political elites of the Baltic States and Poland were especially active in this strategy. The emphasis is on the marginal strata of society and the information war unleashed against the historical memory of the Great Patriotic War. In such conditions, information security issues become relevant. They are not limited to censorship mechanisms. Basically, we should talk about the legal responsibility of those who in the network space allow interpretations of historical events that undermine the values of humanism, intercultural dialogue, and tolerance. But it is difficult to implement the strategy of institutionalizing the Internet space because of the emerging phenomenon of mosaic perception. As a result, social reality is not just moving away, meaningless or reified, but seems to be lost, and along with it the substrate of human experience is lost, being replaced by a multitude of arbitrary pictures of the world.

Thus, historical memory has become an object of manipulation. This situation requires pairing its status with the national security strategy. The risks and threats posed by marginal consciousness only reinforce the relevance of a well-thought-out policy in the field of historical memory.

Many actions characteristic of military operations have moved to the information space. This gave rise to talk about network wars. The point is that social networks make available the impact on the individual consciousness, the youth audience, which is influenced by various subcultures and countercultures of the technocratic type. The sacrifice of the global space of the world wide is often the spiritual and moral identity of the national culture, on which the value structures of patriotism are based.

The spiritual and moral identity of a people is formed historically and has a certain historical point of genesis. For the Russian world, such a starting point was the year 988, when Prince Vladimir baptized Russia according to the Eastern rite. Orthodoxy has become a space for the long-term moral evolution of the Russian people. A. Nevsky and S. Radonezhsky played an important role in this evolution. The seven-hundred-year presence of the Monk Sergius of Radonezh in the spiritual life of the people was celebrated in 2014 by the great Orthodox Russian world. When morality is connected directly with the religious life of a person, then the atheist has an argument to say that morality is not applicable to his way of life. But in the case of identity, we are not talking about a theocratic interpretation of values, but a cultural one, based on traditions of spirituality and morality.

There is every reason to talk about spirituality and morality in the categories of patriotism, love for the Fatherland. Patriotism, unlike other qualities, does not depend on external factors of social impact. The peasants who had been in poverty for centuries in the most difficult times devoted their lives to the Fatherland, as I. Susanin did. Dissatisfaction with social injustice against the background of real threats emanating from the outside world gave way to the values of love for the Fatherland. The image of the people became one of the central ones in Russian literature and music of the golden age. F. Dostoevsky was interested in individual psychology and its role in interpersonal dialogue. L. Tolstoy not only tried to show the depths of the soul through literary means, but also to master this way of life in practice.

S. Diaghilev in Paris organized unique concerts of Russian seasons in order to show the European audience the inner wealth of Russian culture. A special role was played by the poetry of A. Pushkin, through the prism of which various characters became visible, reflecting the essence of Russian culture. S. Diaghilev and L. Bakst collaborated in the implementation of the project. The image of a person has retained its relevance in Soviet literature and culture thanks to A. Tolstoy and M. Sholokhov.

The change of historical epochs turned out to be not easy for the people, but within its borders, he retained morality, adherence to values. This circumstance played an important role in the initial period of the Great Patriotic War, when the political elite was not ready to repel the invasion of the German fascist invaders. K. Simonov was one of the first to observe the emerging potential of the heroism of the Soviet people during heavy battles in the Moscow direction near the Belarusian city of Mogilev. Moscow became the border beyond which the invaders were unable to pass. It was a great victory in the face of continuous defeat and failure. In these conditions, culture, in particular, cinema, played an important role. The directors managed to reproduce on the screen the images of ordinary soldiers and sailors, tankers, pilots with their own world of feelings and experiences. Suffice it to recall the image of a soldier created by K. Paustovsky. L. Utesov, M. Bernes gave this image a musical orientation of interest in life.

In post-war domestic literature and cinema, the theme of the Great Patriotic War remained one of the central and fruitful ones. This was due to the fact that art revealed the enormous wealth of the inner world of the Russian person. In this world, there is a clear demarcation between justice and injustice, courage and betrayal, responsibility and irresponsibility. Heroism consists of many actions that do not always give an idea of the hero. We are talking about the mass heroism of Soviet soldiers, whose special status has come to be symbolized by the tomb of the unknown soldier. It is important that the spiritual and moral component of the identity of the Russian person remains in the space of modernity.

In the context of the third world network war, the emphasis of political technologists is focused on the implementation of the generation gap program. In such conditions, it is easy to manipulate the minds of young people, to westernize their way of life. But these technologies are not so productive, since the spiritual and moral component has an ontological basis in the individual consciousness. Therefore, any threat actualizes the mechanism of internal mobilization of national consciousness to solve problems related to ensuring the sovereignty of the Belarusian state.

2 2. PHILOSOPHICAL AND METHODOLOGICAL ANALYSIS OF SCIENCE

2.1 2.1. Information in the categories of epistemology

Epistemology focuses on cognitive processes, during which information becomes scientific knowledge according to specific criteria of reliability. The knowledge gained in science is transformed into information services of consulting companies, and also finds application in engineering (design activity) and reengineering (industrial management), the media sphere and the information space of the Internet.

Under the conditions of the information society, digital economy, innovation activity, understanding information as data plays a special role. In the early twentieth century, data began to be spoken of as new oil. In the future, data will take a higher position in the economy than hydrocarbons. It is no coincidence that the term "data-driven" has come into use when applied to economics, programming, journalism, science and other areas.

It has become the norm to make decisions based on data rather than intuition or personal experience. The practice of "data-driven" emerged when it became possible to collect sufficient data and analyze it to make objective decisions. It has become promising to deal with big data, data and text mining technologies. These values do not have. The added value is obtained by analyzing them for the emergence of information that is useful and consumed by a person.

Data science has emerged. The specialty of a data scientist has become relevant. Under the name Data Science, many different, not yet systematized methods and technologies for analyzing large amounts of data coexist. Data Science is a generic term for the sum of technologies for the production of data products.

Specialists solve four main tasks:

- transformation of the initial data into a form suitable for analysis;
- data analysis;
- data interpretation.
- application of data to practice.

Unlike natural raw materials, when using data, their number does not decrease, but on the contrary increases, which is a qualitatively new phenomenon. Creation of technologies for working with data is creating an avalanche-like need for new technologies. Humanity has not yet known such a phenomenon of positive feedback. By analogy with electrification and computerization, the era of dating began.

If information in the form of data is in demand in applied applications, then knowledge forms the content of the formation of professional competencies and their effective use based on the received higher education.

Knowledge is the subject of epistemology, which studies their correspondence to objective reality within the framework of the relationship between knowledge about an object and the object itself. Epistemology studies the process of acquiring knowledge from the position of the subject of knowledge. The actions of the subject, conditions, means of knowledge, which ensure the achievement of the result in the form of knowledge, are studied.

Cognitive philosophy studies how cognitive processes are structured in the consciousness of the knower on the basis of sensation, perception, representation, memory, logical components of the individual's thinking.

The theory of cognition includes a description of the processes and boundaries of human cognitive activity with an output to the result in the form of reliable knowledge (truth), an analysis of the language of presentation of the results of cognition. The applied modification of the theory of knowledge is the methodology of scientific research.

The description of the processes of cognitive activity at the level of human thinking has become the subject of logic. Its founder is Aristotle. The discussion of the boundaries of cognitive activity was carried out in the 17th-19th centuries and then in the 20th century.

In the 17th-19th centuries, the cognizability of the world was discussed in the context of the availability of objective reality, not only in terms of physical, but also subjective parameters of human thinking. The positions of skepticism (D. Hume) and agnosticism (I. Kant), which introduce the boundaries of the cognizability of the world, were revealed. K. Marx and F. Engels formulated the results of the discussion in the form of the main question of philosophy, the second side of which is devoted to the cognizability of the world. Their position is to assert the thesis about the knowability of the world.

In the twentieth century, the problem of the cognizability of the world was again actualized due to the concern of civil society about the possible consequences of the development of technologies in the field of genetic engineering. However, the intensity of cognitive activity does not decrease.

At the beginning of the XXI century, the main parameters of human activity began to be measured by information technologies, which are actively used for the tasks of manipulating individual and public consciousness for the purpose of neuromarketing, the implementation of criminal and political tasks. As a result, social customers abandoned the value priority of reliable knowledge in favor of the criteria of profit, globalism. Genres of viral Internet content have spread.

In addition to subjective factors that affect the reliability of knowledge and the way it is presented, it is important to take into account objective factors that create distortions in the perception of information. The reasons for these distortions can be atmospheric optical phenomena of land (imaginary oasis) and sea-based (Flying Dutchman).

2.2 2.2. Information philosophy

Computer science has two meanings. In a narrow sense, its tasks are reduced to programming. The main character is the programmer. Its task is to create programs for electronic computing devices. A special role is assigned to the creation of formalized rules for achieving the goal (algorithms). These programs are used in management (ACS), design (CAD, MKAD). The genre of expert systems and machine learning has been developed. The demand for programming has grown so much that mass training of programmers has begun. In the Republic of Belarus, for the accumulation of intellectual resources within the country, a High Technologies Park has been created. It has shown high efficiency and has become a basic element for the implementation of smart industry programs, the use of digital technologies in various fields of activity.

In a broad sense, computer science, in addition to the applied component of programming, includes information theory. Its tasks include the study of the nature and properties of information, the creation of methods for processing and converting information into programs for electronic computing devices.

The mathematical theory of information works with quantitative parameters of information. It includes the theory of coding, algorithms and automata, descriptions, evaluations of methods for extracting, transferring, storing, and classifying information. Information theory describes information carriers as elements of an abstract set, and interaction as a way of arranging elements in this set. This allows you to describe the information code, define an abstract code and explore it by mathematical methods of probability theory, mathematical statistics, linear algebra, game theory. E. Hartley played a great role in the development of this informatics toolkit. As a result, the tasks of describing the information process at the stages of input information, archiving (memory), output information, and self-learning have been implemented.

Another applied aspect of computer science is more clearly linked to technical computing devices. In this context, information theory is regarded as synonymous with the theory of information transmission over communication channels. According to R. Hartley, information denotes a measure of quantitative measurement of information disseminated by technical communication channels. This thesis was formulated by him in 1928. Based on this context, information appears in the form of data. They are a collection of information recorded on a medium in a form suitable for storage, transmission and processing. Data transformation and processing gives access to information (message).

Data is fixed information about events stored on media. Upon request, they are updated and become information. Within the framework of the information technical system, information is combined with the knowledge of a specialist (expert system). In this case, the knowledge of a specialist in a specific subject area is recorded. On the basis of knowledge, a logical inference process is implemented. As a consequence, computer science is associated with logic.

From the standpoint of technological determinism, informatics is defined as the science of expedient information processing carried out by technical means. Hardware and software tools, methods, models, algorithms are used.

Prospects for the development of computer science were formulated by E. Fredkin. According to this author, all information has digital means of its presentation. This thesis is applicable to all sciences and their subject areas (biology, physics). Digital ontology has become an important basis for giving universal status to computer science. This status is concretized by the theory of cellular automata. It was developed by analogy with the monadology of G. Leibniz.

In terms of research, information theory has the status of a branch of mathematics. It examines the processes of storing, transforming and transmitting information, deals not with the specific content of the message, but with the physical, which expresses quantitatively through a certain way of measuring the amount of information. And also carries out the description of the information transmission channel.

However, not all scientists agree with the definition of information theory only as a mathematical (probabilistic-statistical) theory. An increasing role is played by the emphasis on the analysis of the content (semantic) aspects of information (L. Floridi). In the sixties of the twentieth century, the semantic aspects of information became the subject of consideration in the studies of the Belarusian scientist V.V. Martynov. He set the task of creating a semantic basis for the representation of knowledge. Linguistic diversity, in his opinion, contains a common semantic basis. One and the same verb with small national pronunciation peculiarities denotes the same action.

V.V. Martynov used the achievements of cybernetics, systems theory, semiotics, logic, mathematics. His research interests were focused on methods of building a knowledge system and its presentation, functioning in a feedback mode. The task of constructing an analogue of a semantic language in the theory of artificial intelligence was realized. This language has the functions of representing knowledge and producing new knowledge. The axioms of knowledge transformation were formulated. The main method for constructing cognitive systems was deduction and its axiomatic modification. The emphasis was on deductive semiotics and topological linguistics. The information was endowed with a semiotic basis in the form of a universal semiotic code, which made it possible to generate new knowledge and conduct a dialogue with the user. At the same time, stable decision-making structures (algorithms) were formed in the system of the universal semantic code.

The efficiency of the algorithms was ensured by the decision-making logic in the system of the universal semantic code. Logical analysis included a semantic classification of nominative units. The task was to develop a knowledge representation system capable of forming new concepts, building hypotheses about the causes and consequences of various situations. As a result, the scientist created a universal theory of the calculus of meaning. The theory prescribes to classify the verbs "shares" in order to convey change, evolution. A three-member structure is taken as a basis - a subject, an action, an object.

Without the structuring of knowledge, their formal presentation and transformation, artificial intelligence cannot function. Giving the functions of intelligent systems to computer programs has led to the emergence of two areas of research. One is based on digital technologies that mimic the functions of human thinking. The second direction of imitation modeling is represented by neurophilosophy, within which attempts are made to decipher functional processes in the human brain in order to develop intelligent systems that copy and replace a person. V.V. Martynov proposed a shorter way, connected not with copying a person, but with the creation of semantic resources accumulated in the concepts of action, change.

Developed by A.M. Chomsky, semantic grammatology allowed informatics to reach the level of qualitative analysis of information. The essence of grammatology is that a limited number of alphabetic characters gives a computer program the ability to unlimitedly combine semantic units in the form of keywords with a context characteristic of them. Using these keywords, the program finds information resources corresponding to the request.

Mental information, which is constructed by the “internal code” of individual consciousness (J. Fodor), has a special status. In this context, information is not a characteristic of a message, but of the relationship between the message and its consumer. Information is not updated without a consumer.

Since information is represented using languages, operations with signs play an important role in computer science. In this case, semiotics (the science of signs and sign systems) is integrated into the tasks of informatics. Structurally, semiotics includes syntax, semantics, and pragmatics.

The syntax is focused on the way information is presented, on the medium (signal). Semantics studies the content (semantic) components of sign structures. The subject field of pragmatics includes the study of the influence of information on consumer behavior (branding, neuromarket).

2.3 2.3. Computational philosophy

L. Burkholder formulated the thesis about the information turn in society and the beginning of the era of computational philosophy. P. Tagarde defined computer modeling as the main method of constructing philosophical theories and ideas. According to this view, scientific theories are complex data structures in computing systems that consist of highly organized packages of rules, concepts, and problem-solving patterns.

In the subject field of computational philosophy, such sections as philosophy of computing, philosophy of computer science, cyber philosophy, philosophy of artificial intelligence, philosophy of information technology are highlighted.

Computing philosophy studies the specifics of the existence of computing systems, as well as methodological aspects of data modeling. The philosophy of computer science studies information processes in the aspect of their convergence with computing technical devices. Methodologically, the possibilities of mathematical logic in the presentation of information and knowledge, their coding and decoding are studied.

Cyber philosophy studies the ontological status of virtual and augmented reality and their hybrid modification in terms of the functioning of digital human-machine systems. The philosophy of artificial intelligence studies the possibilities and limitations of artificial intelligence in terms of computational processes of simulation modeling. The philosophy of information technology analyzes the evolution of computing.

The categorical apparatus of computational philosophy is formed by such keywords as computation, algorithm, computability, provability, computational complexity.

The idea of computational philosophy was formulated by G. Leibniz. He viewed computation as a formal calculus. To implement the formal calculus methodology, complex knowledge is spread over simple knowledge. For each of the elementary units of knowledge in the form of a natural language, through formalization, we find a digital symbol, and also formulate the organizing rules of symbolism (the use and combination of symbols). On this basis, formal logic developed with the participation of G. Frege and B. Russell.

Computability creates a single series (A. Turing). From the standpoint of cybernetics, computation is based on the transformation of one state of the system (data, signals, structure) into another state of the system. By transforming data, computation creates new information. From the point of view of the technical process, the computation transforms any input signals into output signals, regardless of the specifics of the transformations themselves.

The original philosophy of computing was based on the quantitative concept of information. According to this concept, computations can be defined in terms of a finite number of symbols and rules combining the order of these symbols. Computations can be reduced to algorithm and step-by-step instructions available for machine execution. Calculations can be generalized by logical-arithmetic methods.

But computational philosophy also faces difficulties in formalizing statements due to the fact that the properties of semantics do not always follow from the properties of syntax. This methodological situation has created a dialogue between the supporters of internalism and externalism. Intentional states of consciousness are of particular concern to computational philosophy, since they are difficult to model because of the variety of symbolic expressions that can be reduced to a single implicatory content. This aspect was dealt with by P. Grice and J. Searle. A special topic is the question of how mental states are encoded.

Theories solve some engineering problems, but they do not explain the phenomenon of mental states. In addition, there are methodological restrictions on the application of formal systems and set theory (Gödel's incompleteness theorem, Levenheim-Skolem theorem). As a result, the question of the non-computability of cognitive processes remains relevant. As a result, the problem of the ontological status of semantic processes remains for computational philosophy. In this aspect, a special role in computational models is assigned to the semantic interpretation of the syntactic states of the system.

The dominant trend is the interpenetration of all types of modeling, the symbiosis of various information technologies in the field of modeling, especially for complex applications and complex modeling projects. So, simulation modeling includes conceptual modeling at the early stages of the formation of a simulation model, logical and mathematical modeling, including artificial intelligence methods - for the purpose of describing individual subsystems of the model, as well as in the procedures for processing and analyzing the results of a computational experiment and decision-making.

The technology of conducting, planning a computational experiment with appropriate mathematical methods is integrated into simulation from physical (full-scale) modeling. Structural and functional modeling is used to create a stratified description of many model complexes.

The use of formal logic makes it possible to form an unambiguous context. Thinking according to the laws of formal logic guarantees a specific, consistent, unambiguous result that automatically excludes alternative solutions. But such a makes sense only if the entity eliminated by this method can be ignored.

Research in the field of computational technologies is developing in the direction of creating expert systems and developing self-learning neural networks. Priority is given to the development of problem-oriented neural networks. Expert systems that also perform similar tasks have a number of disadvantages associated with their lack of self-learning ability. The key problem is the definition of demarcation lines that limit the possibility of self-modification for self-learning systems, guiding the process of their self-learning in a well-defined, specific application area.

Practice requires the development of new generations of computing systems. This puts forward new requirements for the way knowledge is represented in computer systems. At the present stage of development of information technologies, the problem of representing knowledge from a purely mathematical one has moved to the field of psychology and philosophy. It is possible to formalize only those characteristics of a person's mental activity, that information for which the actualization of any aspect does not lead to its disappearance. If each property is necessary for the existence of information, then it cannot be objectified and, accordingly, formalized. Consequently, the more abstract the information, the higher the degree of its objectification, the more realistic it is to formalize it, respectively, the greater the possibility of its machine processing.

2.4 2.4. Neural philosophy and artificial intelligence theory

The term neural philosophy was actualized by P. Churchland. She proposed using the capabilities of neural sciences to solve classical philosophical problems, taking into account the achievements of the physiology of higher nervous activity and experimental psychology. From philosophy, the theory of artificial intelligence receives definitions of processes in the human brain, which, through the means of logic, can be formalized and used to transfer to a strong artificial intelligence in order to ensure its self-learning abilities.

Neural sciences include a complex of natural science disciplines. These are neuro-mathematics, neurobiology, neurophysiology, neuromedicine, They also include a complex of technical disciplines (cybernetics, neurocomputing in image processing systems, control of dynamic systems, quantum computing) and a complex of social disciplines (neuroeconomics, neuromarketing, neuro-management).

P. Churchland considers consciousness, thinking as neurophysiological processes in the human brain and takes the position of eliminative materialism. The computer analogs of neural networks in the human brain are referred to as neural networks. These networks are developed based on simulation modeling methodology. They belong to strong artificial intelligence, since they can solve specific problems of the functioning of the human brain and nervous system.

Simulation models contain knowledge about neurons and neural networks. They are used as formal models for solving economic, managerial, and engineering problems. Neural philosophy involves harnessing the potential of the humanities.

Fundamentally important is the question of the permissible limits of the creation of hybrid human-machine systems. This topic was actualized by trans-humanism. She became the subject of consideration of the philosophy of artificial intelligence. This philosophy studies the prospects of transferring the functions of human thinking to computer programs. The question "Can a computer program think?" Was formulated by A. Turing.

In the China Room thought experiment, John Searle showed that passing the Turing test may not be a sufficient criterion for a computer program to think. Roger Penrose takes a similar position.

Based on the fact that there are risks for humanity, a number of issues have become the subject of consideration. If in the future computer programs can reason, be aware of themselves and have feelings, then what will remain the criterion of a person? If computer programs can be self-aware and have feelings, will it be possible to exploit them, or will they have to be given legal status? These questions are more about the strong artificial intelligence hypothesis. This hypothesis assumes that computer programs will be endowed with the function of thinking and awareness of their individuality.

The term "strong artificial intelligence" was coined by John Searle. The scientist showed that what is meant by this term is unattainable for any computer program. As evidence, he analyzed the Chinese room thought experiment. This refutes the Turing test as a criterion for artificial intelligence. Despite the ambiguity of the situation with the term "artificial intelligence", the term is actively used. Its content characteristics include decision making, strategy use, puzzle solving, and acting under uncertainty; representation of knowledge, including a general understanding of reality; planning; self-study; communication in natural language; achievements of goals. Strong artificial intelligence is supposed to be sensitive to the environment; understand your own thoughts; feel; have your own motivation.

Attention is paid to humanizing strong artificial intelligence. To this end, the concept of friendly artificial intelligence has been developed. A hypothetical type of artificial intelligence that does not have a negative impact on humanity is described. He will provide material and information support to people, up to the full provision of the desires and needs of each person. Elon Musk and Sam Altman founded OpenAI with the goal of fostering friendly artificial intelligence.

When developing the concept of strong artificial intelligence, scientists proceed from the description of risks in the future. For this, the term "technological singularity" is used. This is a hypothetical moment in the future when technological development becomes uncontrollable and irreversible, which will generate radical change.

A computer program with strong artificial intelligence can enter the self-improvement stage. Each new generation of artificial intelligence will emerge faster, generating an explosion of intelligence and superintelligence that surpasses the intelligence of all mankind.

The term "singularity" in the technological context was used by John von Neumann and StanislavUlam. It is assumed that artificial superintelligence will be developed by 2040-2050.

Technically, artificial intelligence is a field of computer science focused on creating intelligent computers and machines that mimic human actions and reactions through machine learning, speech recognition, and problem solving.

This requires finding ways to give computers, with their binary logic, the ability to mimic human thinking, which is more abstract and reinforced by the ability to learn and adapt. This area of development integrates not only computer programming, but also linguistics, biology, mathematics, engineering psychology.

Artificial Intelligence combines big data, computing resources and specially designed algorithms to teach programs to learn and adapt based on the content of the data - patterns, aberrations, special information.

So far, artificial intelligence does not have a computerized consciousness. It requires human intervention in software algorithms, data retrieval, or otherwise issuing instructions to a computer program. With the development of technologies that form the foundation of artificial intelligence, such programmable properties as knowledge, reasoning and learning are being implemented in the form of simulation.

New opportunities are emerging through enhancements such as natural language processing and machine learning. This information, namely its arrays play a key role. Computer programs process data recognize patterns in them and perform various actions with the information received. The key component of machine learning requires human participation.

Artificial intelligence is mainly used to improve existing applications. The emergence of speech recognition technology using large amounts of data adds new functionality to applications.

The organizational structure of artificial intelligence is undergoing evolution. The practice of distributed artificial intelligence has been implemented. It is a way to ensure optimal use of all computing resources through independent centers in geographic locations with efficient connections between them. Distributed artificial intelligence uses significant processing power, which makes it convenient for working with large data stores. Centers can analyze different pieces of information. As a result, huge amounts of data can be processed faster than other methods.

The independence of the centers enhances the adaptability and reliability of the distributed artificial intelligence system. If one of the centers fails, the other centers may still function and the system does not need to be completely redeployed after the data files have changed.

Artificial superintelligence implies the intellectual superiority of computer programs over humans. At the moment, computer programs have not reached this level of reflection. Weak artificial intelligence, also known as narrow artificial intelligence, exists, for example, in a video game, but does not go beyond it. Technology will always be just an imitation of human cognition, capable of acting according to given rules, but never outside of them. Weak artificial intelligence can act by rules, but at the same time is bound by them and does not have human cognitive capabilities.

At this stage, strong artificial intelligence is more of a philosophy than a practical approach to technology. Strong artificial intelligence, also known as full artificial intelligence, is a design that mimics the human brain.

Philosophically strong artificial intelligence makes no distinction between software and artificial intelligence, accurately mimicking the human brain and the actions of the person himself. The philosophy is that a computer can be programmed to reproduce all the characteristics of the human brain as we understand them, with mental and cognitive abilities that are currently considered exclusively human. But since it is still not clear what human intelligence is and how it develops, the guidelines for developing strong artificial intelligence are still not clear.

There are several subsections of artificial intelligence: deep learning, neural networks, machine learning, natural language processing, cognitive computing, and computer vision. All of them can be considered as members of the artificial intelligence family. Sometimes the term "artificial intelligence" and the names of these subsections are used interchangeably.

Deep learning uses the computational resources of neural networks and computing devices of different levels to find patterns in large amounts of data (for example, to detect images). These models, which fall under the heading of machine learning, learn from the data they provide, so there must be a lot of data to be effective and accurate.

A neural network as a type of machine learning is made up of interconnected blocks that process information taking into account external data and send this information between blocks. The blocks work together like neurons, hence the name.

Robert Hecht-Nielsen, who developed the first neurocomputer, defined a neural network as a computing system made up of simple, deeply interconnected processing elements that process information by dynamically responding to external inputs.

Sometimes the terms "machine learning" and "artificial intelligence" are used interchangeably, which shows how important the former is to the latter. They are not the same thing. Machine learning is developing the most actively.

Just as artificial intelligence encompasses a variety of technologies, techniques such as statistics, physics, neural networks, and operations research are combined in machine learning to find hidden patterns in data, especially ones that the machine was not programmed to find. Machine learning has become a key element of artificial intelligence as it can prepare access to Big Data. There is a difference between a server that simply stores large amounts of information, and a computer that uses this information to find patterns, complete tasks, and respond to changes in data.

Natural language refers to the language used by humans in conversational practice, as opposed to a programming language. During natural language processing, such a language is used to communicate with a programmable artificial intelligence system. Natural language processing has two components: understanding and generation. Comprehension is about matching natural language input with useful representations and analyzing various aspects of natural languages. Generation reflects the process of forming meaningful output in the form of words and sentences; it consists in planning text and sentences, as well as implementing the text.

Artificial intelligence and signal amplification are at the core of cognitive computing. Cognitive computing can be encountered when using a messenger-based assistant; their purpose is to organize interaction by imitating communication processes. Cognitive computing brings together different subsets of artificial intelligence, including machine learning and natural language processing.

Computer vision is part of an interdisciplinary field in the field of artificial intelligence. It allows computers to learn from images and videos, automating tasks that humans use their eyes to accomplish, such as looking at a photograph and identifying what is on it. In doing so, you need to collect, process, analyze and understand digital images and the data they contain.

A computer program needs information to act and respond. The owner will not get much benefit simply by having a lot of information for which there is no use. Finding such an application involves identifying the best ways to process, analyze and manipulate data.

General data protection requirements may limit the amount of data available to artificial intelligence systems for machine learning. Some technicians are calling for rules for the use of facial recognition technology.

The mobile version of artificial intelligence is associated with a robot. For the first time in the English language the word "robot" was used when Karel-Chapek's play "Rossum Universal Robots" was staged in London, and in 1945 the term "robotics" was first used by Isaac Asimov. The term "artificial intelligence" has been used since 1956. It was coined by McCarthy, who created the LISP programming language for artificial intelligence.

In 1964, a dissertation was published showing that computer programs can understand natural language sufficiently to solve algebraic problems. In the 60s in the twentieth century, an interactive program ELIZA and a robot Shakey were created to solve problems.

The computer-controlled self-driving car has been developed using digital technology. Work in this area of artificial intelligence can be divided into two areas - applied and generalized artificial intelligence.

Applied artificial intelligence has the task of imitating human mental activity. The advantage of applied artificial intelligence lies in the ability to use technology to analyze huge amounts of data and take subsequent actions much faster than humans do. Applied artificial intelligence can be used to detect fraud in the financial industry, allowing machines to process and analyze large amounts of computerized financial data to find patterns and deviations from these patterns.

In the shipping industry, Applied Artificial Intelligence is able to process data from thousands of ship manifests and records that are populated around the world every day to optimize port utilization and ultimately reduce shipping times.

Generalized artificial intelligence has not yet become a reality, since the enormous computational capabilities of the human brain are still unattainable for computer programs.

Practical applications of artificial intelligence in the consumer sphere and in enterprises are focused on narrow tasks.

There is a growing understanding of the role that human subjectivity plays in programmable technology and how artificial intelligence can both exacerbate and mitigate the effects of that subjectivity.

The fourth industrial revolution concretizes the opportunities created by the third industrial revolution. They lie in the convergence of technologies. The industry is merging computer and additive technologies. The fourth industrial revolution emphasizes artificial intelligence resources combined with nano and biotechnology. Hybrid technologies are being actively developed. Robotics play an important role in them. Against the background of the risks of employment reduction, the potential of the creative industry, which accumulates creative professions in the field of art, the game market, design, architecture, and social work, is being actively discussed. For this purpose, an adjustment has been made in the understanding of many types of activities.

This paradigm presupposes the imparting of artificial intelligence functions to all elements of production. The participation of smart things in their own design, production and repair is laid. The service industry has transformed into an artificial intelligence network powered by big data. Electronic trading systems have been created, blockchain technology has been developed.

Against the background of a decrease in human participation in production processes (interactions between things), institutions and infrastructure of augmented reality and protocols for its communication with devices are being intensively created.

2.5 2.5. Philosophy of Convergence in Cognitive Sciences

An urgent task is the system analysis of computer technology based on the achievements of cognitive psychology, neurophysiology, and the theory of artificial intelligence.

The paradigm of cognitive sciences unites the subject areas of anthropology, linguistics, logic, neurobiology, neurophysiology, neurophilosophy, psychology, behavioral economics, and the theory of artificial intelligence. The cognitive processes that take place in the human brain, psyche language are comprehensively studied with the aim of imitating these processes in the form of artificial intelligence, as well as for use in marketing strategies (neuromarketing).

The subject of anthropology is man in the unity of his bodily, sensual and intellectual essence. Cognitive linguistics focuses on the speech factors of a person's life, including cognitive function. At the origins of cognitive linguistics in Belarus was V.V. Martynov. He set a goal to study the universal semantic code of a natural language with the aim of transforming it into a universal language of artificial intelligence.

The research was carried out at the intersection of cybernetics, semiotics and linguistics. The task was to construct an analogue of a semantic language in the theory of artificial intelligence. This language was endowed with the functions of representing knowledge and producing new knowledge. To implement the second function, it was necessary to formulate the axioms of knowledge transformation.

The main method for constructing cognitive systems was deduction and its axiomatic modification. The emphasis was on deductive semiotics and topological linguistics. Information was endowed with a semiotic basis in the form of a universal semiotic code that allowed the machine to generate new knowledge and conduct a dialogue with the user. Stable decision-making structures (algorithms) were formed in the system of the universal semantic code.

The development of algorithms was based on the logic of decision making in the system of the universal semantic code. Logical analysis included a semantic classification of nominative units. The function of the intelligent system was used.

The task was to develop a knowledge representation system capable of forming new concepts, building hypotheses about the causes and consequences of various situations. As a result, the scientist created a universal theory of the calculus of meaning. The theory prescribes to classify the verbs "shares" in order to convey change, evolution. A three-member structure is taken as a basis - a subject, an action, an object. The decision-making logic in the system of the universal semantic code is consonant with the generative grammar developed by N. Chomsky, a native of Belarus.

In cognitive psychology, it has become relevant to study the subjective (cultural-historical) aspects of the functioning of unconscious thinking and ensure decision-making under conditions of uncertainty in behavioral practices determined by cognitive distortions.

Cultural-historical theory of L.S. Vygotsky turned out to be in demand, since in its subject field there is the problem of cultural and historical constructivism. It is characteristic of neuroarcheology, L. Malafuris's theory of material involvement, E. Clarke's expanded knowledge and predictive coding, and the theory of culture as cognition rooted in D. Oizerman's environment.

Based on the concepts of "metaplasticity" and "material sign" L. Malafuris analyzes the co-evolution of the psyche and the material environment in the history of mankind. E. Clarke proceeds from the fact that the human cognitive system at all stages of the formation of mankind is open to the material world. The model of intellectual function functioning at the level of mental structures of consciousness is conceptually described. Units are concepts that form the atomic structure of the content of consciousness. Concepts find themselves in a system of stable links, designated as frames. This is a kind of analogue of unconditioned reflexes (algorithms). Concepts in a system of less stable semantic connections form scenarios that are characterized by the mobility of the reaction of the individual's consciousness to the dynamics of the social environment.

In neurophysiology and neurobiology, the bodily conditioning of cognition, its environmental rootedness, emotional and motivational regulation along with the processing of emotional information, the distributed ("dialogical") nature of cognition, its evolutionary roots and social and cultural determination are taken into account.

In the development of methods for recording brain activity, there is a shift in scientists' interest in the brain substrate of the bodily, social and cultural conditioning of cognition. L. Malafuris belongs to a new formulation of the problem of mediation, based on the interpretation of the brain as a bio-artifact that creates culture and is formed by it. The psychological mechanisms of the behavior of a historical person were embodied in material culture. Hence M. Cole's thesis that cultural anthropology should come to the fore in cognitive research.

Representatives of cultural neuroscience are based on the idea of co-evolution of genes and culture. It is stated in the theory of double inheritance by P. Richerson and R. Boyd. The theory of material involvement uses the conceptual apparatus of J. Gibson's enactivism. This implies a sign structure primary in relation to the speech apparatus. This is the cognitive projection of the subject into the external world, with the direct participation of which he solves cognitive and communicative tasks. Material signification has a formative effect on the brain.

Enactivism as a philosophical and psychological direction is fed by radical constructivism and the theory of autopoiesis by U. Maturana and F. Varela.

They put a sign of identity between knowledge and action. Any motional act in relation to a material object performs a predictive function for the subsequent act in relation to this object.

D. Oizerman calls his approach the theory of culture as cognition rooted in the environment. In this theory, culture appears as a tool for solving universal human problems, a certain mindset, or mentality, and as a set of specific cultural practices characteristic of a certain society at a certain moment in time and in a certain place.

Experimental data show that both individualistic and collectivist features of cognition are potentially available to a representative of any culture and can be brought to life with the help of special pre-adjustment procedures. But in different cultures, the evolutionary tasks of preserving the group and the individual are solved in different ways. Any situation and any environment form certain expectations (predictions) about how events should develop further. If they develop differently, cultural difficulties experienced by a person lead to the formation of stable attitudes in behavior.

Culture itself selects appropriate forms of behavior and cognition, using the metacognitive mechanism of regulation based on feedback, which allows in the future to movement along the path of least resistance. The leading role in individual sociocultural development is played by metacognitive experience regarding how certain attitudes and behaviors are more easily and effectively implemented in culture. Initially, a representative of any culture has a complete, redundant set of cognitive features.

E. Clark develops the constructivist principle of predictive coding. This principle allows us to get closer to explaining the inextricable connection between perception and action. R. Millikan's research is devoted to the study of the objective foundations of cognition, the conditions of true knowledge and the problem of representation. Considering these issues, it includes the study of intentionality and the problem of reference of various sign systems in the evolutionary (historical) and practical context of their functioning.

The idea was expressed in the concept of biosemantics. As a condition for the reliability of knowledge (intentionality, representation), their practical functionality is considered, which makes it possible to solve the problems facing a living organism or the scientific community. The property of truth or falsity belongs not to the cognitive or linguistic representation in question, but to the effectiveness or compliance with the functions that they perform.

Language as a cultural phenomenon, as not a cognitive competence, is subject not so much to formal rules as to the convenience and efficiency of communication and coordination of actions. Stability in a language is not achieved through universal grammar, but through social conventions. As a result, the established elements of the language acquire new meanings or functions in different contexts. The distinction between semantics and pragmatics, semantic and pragmatic meanings of utterances, is fluid and not amenable to a clear definition or set of linguistic rules.

Knowledge, including the most fundamental ideas about social reality that form the so-called common sense, occurs and is maintained through social interactions. In social interaction, people proceed from the premise of the similarity of perceptions of reality and common sense. Their general ideas and understanding of the reality of everyday life are reproduced and consolidated. Human typologies and value systems, social formations are perceived by people as an objective reality.

One of the tasks is to study the processes by which a person forms, institutionalizes, comprehends and integrates social phenomena into tradition and social values. In this context, one should distinguish between social constructionism and social constructivism. Social constructionism explores the dynamics of a phenomenon in relation to a social context. Social constructivism studies the personal processes of making sense of knowledge and experience in a social context.

Cognitive psychology studies the following forms of sensory cognition. Feeling provides a reflection of individual sides, properties of the object. Perception allows you to realize the reflection of the object as a whole. The presentation contains the ability to reproduce, based on the mechanisms of visual memory, previously seen people, objects, natural and social landscapes. It contains an element of generalization and is directly related to thinking, on the basis of which rational forms of cognition, which logic studies, function.

The forms of rational cognition include keywords (concepts, concepts, categories, cultural universals). They are operated by abstract thinking. Key words are a building material for judgments, statements, definitions, axioms, postulates, principles, laws. All these elements of the text are formulated in the form of sentences, which in turn are the basis for obtaining new knowledge in the form of proving theorems, theories and inferences.

In cognitive psychology, an ambivalent research practice has emerged, the evolution of which affects the prospects for the theory of strong artificial intelligence. This is a division into researchers close to the humanities and supporters of scientific psychology, which still considers itself a natural science. The reaction to this dualism is most often attempts to absorb one of the approaches to another. Natural psychologists argue that all questions related to experience will eventually enter neurophysiology. Such reductionism cannot but evoke a response from the opposite side - extreme spiritualism, which treats neurophysiology as an epiphenomenon of consciousness. Harry Hunt studied the history of this methodological ambivalence. He found its origins in the Würzburg controversy, which played a fatal role in the development of instrojectionism. Two introspectionist laboratories of the early twentieth century Würzburg and Cornell decided to extend introspection to more complex processes of symbolic thinking and inference.

At the Würzburg laboratory, the observers found nothing. The thought just comes. This is imperceptible awareness. While there is something there that is detectable through introspection, it defies further definition. Cornell researchers suspected the Würzburg observers of error and reported a variety of sensory-figurative qualities in the process of thinking, although they agreed that they often turned out to be irrelevant to its explicit topic. It followed from the dispute that if the same method leads to such different results - thought as an intangible state and thought as a play of images - the method should be invalidated. From this point on, cognitive science and psychology adopted an attitude to deal only with externally measurable human behavior.

Radical reductionists and supporters of the theory of artificial intelligence, (Humphrey, Marcel and Bars), considered this controversy as a reason for refusing to ascribe any constructive role in cognitive activity to the sense of meaning. They defined consciousness as a formal system associated with the management, choice and synthesis of unconscious processes. This definition is extremely important for the creation of artificial intelligence. If conscious awareness were necessary to understand symbolic cognition, then computer models of cognition would inevitably have to be limited to those partial functions that can remain fully automated.

The rehabilitation of consciousness as an acting cognitive factor and the scientific significance of the phenomenological approach to its description is inextricably linked with the criticism of the idea that consciousness does not depend on the hardware environment (neurosubstrate), being a derivative of the level of complexity of the system, and can be obtained on any basis suitable for this ... Based on the lack of a working model among the supporters of strong artificial intelligence, capable of at least approximately outline the ways of achieving consciousness and following J. Searle's reproduction of the "China room" argument, H. gestures, there is syntax, but no semantics. Programs contain rules for manipulating signs, but even when such manipulations pass the Turing test, only the programmer can assign a value to the result. G. Hunt notes that computer models may reflect the further evolution of the separated cognitive unconscious, but have nothing to do with the actual functions of consciousness. Consciousness cannot spontaneously arise from a system incapable of feeling, regardless of its recursive complexity.

Harry Hunt proposes to abandon bias in the study of consciousness, and to consider it in a comprehensive manner. It proceeds from the separation of presentational and representational consciousness, as two fundamental forms of symbolic cognition. This distinction was developed by Susan Langer, Marshall Edelson, and Robber Haskell. In representational symbolism, represented by natural language, developed in mathematics, a specific intentional assignment is of paramount importance, and the automated unconscious code is the means of expression.

In this case, the relationship between signifier and referent is arbitrary. Characters are defined only in relation to other characters. In presentational symbolism, meaning arises as a result of empirical attribution to the patterns of the environment. It arises in the form of a play of images and is developed in the expressive means of art. The possibility of such meaning arising is provided by the attitude oriented towards passive perception, common to aesthetics, meditation and classical introspection. The usual communication situation is filled with intonations, gestures and accents as its presentational aspect.

A normal speech act necessarily also presupposes a representative act. To be completely carried away by the timbre of the interlocutor's voice means to lose the correlative thread of discourse. At the same time, the presentation aspect is genetically initial for the appearance of the primary subtle sense of meaning. The main explanatory principle of the conceptualization of consciousness is synesthesia. It reveals an intrinsic aspect of the capacity for intermodal translation that underlies symbolic cognition. Thus, it combines the understanding of thinking as the logic of statements and as an abstract spatial play of images. The duality of presentational and representational consciousness is removed in the corresponding unity of synesthesia, which, as the experiments of Wheeler, Catsfort, Gendlin and Hunt himself showed, can be described both as a specific sensory effect, and as an association of one modality with another.

Thus, through the concept of awareness as emergent synesthesia, Harry Hunt rehabilitates the methodology of describing consciousness in analytical philosophy as a method necessary in the experimental psychological study of consciousness, offering a serious alternative to functionalism in a protracted conceptual crisis. One of the solutions was a modular approach.

Modularity is used in the study of technological and organizational systems. Product systems are considered modular when they can be decomposed into a number of components that can be mixed and matched in different configurations. Components can in any way connect, interact or exchange resources such as energy or data, adhering to a standardized interface. Unlike an integrated product, in which each component is designed to work specifically and exclusively with other specific components in a tightly coupled system, modular products represent systems of components that are loosely coupled. Modularity is used wherever there is numeric representation, automation, variability, and transcoding. The modular methodology presents new systems as composed of several separate, self-contained modules that can act independently or together in synchronization. One image can consist of many layers, each of which can be considered as a completely independent and separate object. Websites can be defined as modular. Their structure is formed in a format that allows you to change, delete or edit their content, while maintaining the structure of the website.

The content of the website operates separately from the website and does not determine the structure of the website. The web has a modular structure consisting of independent sites and pages, and each web page itself is made up of elements and code that can be changed independently.

Organizational systems become modular when they replace loosely coupled forms with tightly integrated hierarchical structures. When a firm uses contract manufacturing rather than in-house manufacturing, it uses an organizational component. He is more independent than creating such opportunities on his own. A firm can switch between contract manufacturers that perform different functions, and may work the same way for different firms.

As firms in a given industry begin to replace activities that were once within the firm with loosely coupled organizational components outside the firm, the entire production system, which can span multiple firms, becomes modular. Firms are becoming more specialized components. The use of loosely coupled structures allows firms to achieve greater flexibility, both in scope and scale. A firm can switch between different contracted providers of these activities or alliance partners versus creating opportunities for all activities within the company, thereby responding more quickly to different market needs.

Modularization results in a structure in which modules combine interdependent tasks, while interdependencies between modules are weak. The proliferation of modular organizational forms has been facilitated by the efforts of large firms to reorganize, reorient and restructure. The service delivery business process is broken down into sub-processes, which can then be handled autonomously within organizational modules.

Coordination of modules is carried out using the mechanisms of the internal market through the introduction of profit centers. Modularity provides a more flexible and faster response to changing general or market conditions.

Domain-specific computational engines are called vertical capabilities. This is Jerry Fodor's main idea. They are modular. Modules only respond to inputs of a specific class. The structure is integral and is not formed in the learning process. Modules are not assembled from a set of atomic processes. Their virtual architecture maps directly to their neural implementation. Modules are associated with specific, localized and carefully structured neural systems, not interchangeable neural mechanisms.

Cognitive systems characterized by some of the distinguished functions will be characterized by all of them. Such systems can be considered modular. Neural biology data does not indicate a system of organization like the theory of modularity. Neural imaging and lesion studies have shown that there are certain areas that do certain functions and other areas that do not.

2.6 2.6. Logic and computer science

Logic plays one of the key roles in computer science, since the choice of information description, information units, information structures and information models depends on it. The role of logic in computer science is associated with the identification of unstructured systems, the development of methods for the logical structuring of information descriptions, the construction of their logical structures. This role is also manifested in the application of cognitive factors in analysis systems, formalization of the semantic content of information, transformation of information into information resources, functional use of the logical laws of self-organization.

For informatics, the informative of logical procedures is important, expressing in the transformation of their forms, reducing uncertainty, and obtaining new knowledge. Based on the classification of information systems, logic distinguishes procedural, descriptive, attributive systems, databases, classifiers, and inference systems.

Information units are used in computer science as the basis for logical construction. A logical procedure is relevant as an informational unit of analysis.

Logic is an applied branch of philosophy. In a systemic form, it was presented by Aristotle. In the 17th century, the subject matter of logic was supplemented by the logic of scientific research, in which a special role was assigned to induction and deduction. In the 19th century, the subject matter of formal logic was expanded by J. Boole, O. de Morgan, B. Russell. The foundation of mathematical logic was formed. The logic of syntax was developed. She deals with the quantitative aspects of information presentation and is not interested in the qualitative aspects of information.

One of the key methods of informatics is the formulation and solution of problems through formal, computer languages. For the subject area of interest, a formal language is chosen in which it is possible to describe the class of problems to be solved. After the formalization stage, the possibility of solving a class of problems is studied at the level of a formal language using the methods of mathematics and computer science. The properties of the language as mathematical objects are investigated. As a result, logical programming, methods of representing knowledge, methods of reasoning about knowledge were developed. The study of the computational complexity of typical problems in formal languages with the semantics of truth problems, the consistency of logical inference of statements in logical formalisms made it possible to outline the limits of applicability of a number of approaches in the field of informatics and gave impetus to the creation of effective methods for solving algorithmically complex problems.

Logic methods are a rich toolkit for computer science. A number of information technologies that have changed the world were created through the use of methods of formal logic. For example, algorithmic results on checking the properties of Boolean formulas and methods for their optimization are the foundation in the development of electronic components, allowing you to create compact and energy-efficient circuits, microprocessors. The use of first-order logic, as a formalism of queries and data integrity constraints, made it possible to obtain a number of fundamental algorithmic results that determined the development of database technologies and their implementation in the framework of relational algebra. The possibility of evidentiary verification of properties formulated in a number of applied logics opened the way for the verification of programs, communication protocols and provided the basis for the development of critical software systems such as compilers, onboard software, protocols for the interaction of autonomous stations and robotic systems.

The symbiosis of logic and computer science gave methods of automated theorem proving, which are not only applied in the indicated directions, but also offer new tools for educational and research activities for mathematics itself. Reasoning automation traditionally belongs to the field of artificial intelligence, a significant part of research and development is devoted to it. Modern advances and challenges in automation in areas that were previously available only to humans are leading to the creation of increasingly powerful intelligent systems. Without denying the positive aspects of this process, it should be noted that progress here, too, largely depends on the improvement of the methods of logic. One of the key issues remains the question of combining computations on data of a numerical nature and symbolic nature within the framework of uniform formalisms. Associated with this, among other things, are the problems of constructing formal systems that connect logic and probability.

Algebra of logic (Boolean algebra) is a branch of mathematics that arose in the 19th century thanks to George Boole. The subject of this section is the correct construction of inferences. This is a sequence of judgments that are proven one from another. Unlike classical mathematics, which operates with variables that can take on an infinite number of values, mathematical logic most often operates with binary variables that can take true or false values. In intelligent systems, two types of logic are most often used: propositional logic and first-order logic.

Propositional logic (zero-order logic) operates with binary statements, which can take the meaning of true or false, from the internal structure, which we abstract from. A propositional formula consists of atoms and logical connectives, including conjunction, disjunction, negation, as well as parentheses that determine the order in which logical connectives are applied.

First-order logic operates on binary statements (predicates) that have one or more arguments. The number of arguments of a predicate is called its arity. The fundamental difference between first-order logic and propositional logic is that a predicate represents a set of instances, which are determined by the values of the arguments. It is necessary to use quantifiers of existence and universality.

The laws and apparatus of the algebra of logic began to be applied in the design of parts of computers, in particular, memory and processor. Algebra of Logic studies methods of determining the truth or falsity of complex logical statements using algebraic methods.

A complex logical statement is described by a function, the result of which can be either true or false. Truth is compared with 1, falsehood - 0. The arguments of functions are simple statements, which can also have only two values - 0 or 1. The algebra of logic is engaged in calculating the result of complex logical statements based on the previously known meanings of simple statements. Boolean algebra formalized the statements of natural language, introduced strict rules for obtaining an unambiguous result. Unions began to be called logical operators. The basic operations are conjunction, disjunction and a negation. Electronic computers use various devices, the operation of which is described by the algebra of logic. Such devices include groups of switches, triggers, adders. The connection between Boolean algebra and a computer is provided by the number system used in electronic computers. She is binary. Therefore, both numbers and values of logical variables can be stored and converted in computer devices.

Electronic computers use electrical circuits consisting of many switches. One switch can only be in two states - closed and open. In the first case, the current passes, in the second, it does not. It is convenient to describe the operation of such circuits using the algebra of logic. Depending on the position of the switches, you may or may not receive signals at the outputs. A gate represents a logical element that accepts some binary values and outputs others depending on its implementation. There are gates that implement logical multiplication (conjunction), addition (disjunction), and negation. Triggers and adders, as complex devices, consist of gates. The flip-flop can store one binary bit, due to the fact that it can be in two stable states. Triggers are used in processor registers. Adders are used in the arithmetic logic devices of the processor and perform the summation of binary digits.

G. Frege developed two types of quantifiers. K. Gödel proved two incompleteness theorems, describing the impossibility of combining the set of provable statements with the set of true statements. The thesis was formulated that the proofs of mathematics depend on initial assumptions, and not the fundamental truth from which the answers originate. No set of axioms is capable of proving its consistency.

Classical formal logic began to use the language of equations. Informal logic has shifted to the subject field of rhetoric. Regulatory laws apply to two kinds of logic. The law of identity states that one cannot replace one concept with another concept. The law of consistency states that the same statement cannot be true and false at the same time. The third law of exclusion states that a statement can be either true or false. Of the principles, the normative role is played by the principle of sufficient justification. It states that such factual and theoretical grounds are sufficient, from which this judgment follows with logical necessity.

Sentential logic (propositional algebra) includes basic operations, which include negation, conjunction, disjunction, implication, and equivalence. After the development of predicate logic under the influence of the works of G. Leibniz and G.Frege, programming languages began to be based on it. Informatics has become in demand in computing as the science of storing, processing and transmitting information. It consists of sections that study algorithmic, software and hardware.

The author of the concept of an algorithm is Aristotle. The theory of algorithms is related to program control. V. M. Glushkov in 1965 defined algorithmic algebra as a modification of algorithmic logics. F. Engeler in 1967 proposed the use of languages with infinitely long formulas to express the infinite variety of possibilities arising from different executions of a computer program. The languages of algorithmic logic were developed by R.W. Floyd (1967), C.A.R. Hoare (1969), A. Salvitsky (1970). They are used as one of the ways to move from specification to algorithm. This is done in the form of reasoning in a logical system with predicates.

Assertions {A} 5 {B} are written in the logic of predicates. The execution of the operator S is preceded by the definition of the initial state of the program A. B is a postcondition state. PreconditionsA are axioms of a logical system and are defined by the constructs of the programming language. The synthesized program is obtained in the form of a statement output in dynamic logic. The result of the program execution satisfies the given postcondition if the task arguments satisfy the given precondition.

The law of the excluded third formulated as the law of complement, in an equivalent formulation, as the law of double negation, states that only the statement P or the inverse statement -iP can be true. Laws deny the existence of a third or other true solution and limit the language's ability to define the process of constructing an algorithm.

A. N. Kolmogorov considered logic as a calculus of problems. He assumed a constructive interpretation of predicate logic. Logical connectives are understood as a means of constructing more complex problem statements from simpler problems. Axioms are understood as problems whose solutions are given. Inference rules are understood as ways of transforming solutions to some problems into solutions to other problems. The solution to the problem proves that the solution meets the requirements.

AA Voronkov defined the conditions under which classical logic can be regarded as constructive. Its completeness is a prerequisite. This means deducibility in logic of either the formula F itself or its negation iF. Examples of classical theories that have a constructive interpretation are elementary geometry and the algebraic theory of real numbers. The complete system of constructive inference rules (logic Q,) allows constructing a proof of the transformation A into B based on the given functions.

Intuitionistic logic has retained the language of predicate calculus and logical connectives of classical logic. The descriptive power of this logic is higher than that of propositional logic (sentence logic). In predicate logic, capital letters denote predicates, not whole statements. A predicate is a mathematical function that maps many subjects to many statements. There are two operations used in predicate logic: universal and existential quantifiers. The peculiarity of quantifiers is that you can write the expression true for all possible variables "x" or at least for one true value. With the introduction of the existential quantifier, predicate logic became a complete system.

Elements of mathematical logic are integrated into logical elements and logical devices of electronic computers, in the basics of algorithms and programming languages, in data retrieval procedures, and logical programming systems. The relevance of logic in computer science is due to the presence of errors in algorithms and programs, as well as the inability of specialists to identify and correct errors in algorithms and programs.

Software testing can reveal the presence of errors in computer programs, but cannot guarantee their absence. The guarantees of the absence of errors in algorithms and programs can only provide proof of their correctness. An algorithm is error-free if it gives correct solutions for all valid data. To overcome these problems, it is important to teach systematic methods of compiling algorithms and programs with a simultaneous analysis of their correctness in the framework of evidence-based programming from the very beginning of learning the basics of algorithms and programming.

The difficulty for professional programmers lies in the fact that they must be able to write not only algorithms and programs without errors, but also at the same time write proofs of the correctness of their algorithms and programs. Weak evidence base leads programmers to write programs with a large number of errors that they can neither identify nor fix. The logical approach to the creation of artificial intelligence systems is aimed at creating expert systems with logical models of knowledge bases using the predicate language. The language and the logical programming system are taken as a basis.

The logical model of knowledge bases allows you to record not only specific information and data in the form of facts, but also generalized information using the rules and procedures of logical inference, including logical rules for defining concepts that express certain knowledge as specific and generalized information. The study of the problems of artificial intelligence in computer science within the framework of a logical approach to the design of knowledge bases and expert systems is aimed at the creation, development and operation of intelligent information systems, including the issues of teaching students, as well as training users and developers of intelligent information systems

Logic programming is based on automatic theorem proving, using inference mechanisms based on given facts and inference rules. The language and logic programming system are based on the predicate calculus language, which is a subset of first-order logic. The main concepts are the concepts of facts and rules of inference, as well as requests for searching and displaying information in knowledge bases.

Facts are described by logical predicates with specific values. Rules are written in the form of inference rules with logical conclusions and a list of logical conditions. A database is an objective form of presentation and organization of a collection of data, systematized in such a way that this data can be found and processed. Databases are used in all areas of activity where accounting and storage of information is important. There are flat databases in which information is located in a single table. Each record contains the identifier of a specific object and relational databases consisting of several tables. The connection between them is established using the matching values of the fields of the same name.

Relational databases store data as tables of rows and columns. Each table has its own predefined set of named fields. Columns of tables in a relational database can contain scalar data of a fixed type, such as numbers, strings, or dates.

Information search in relational databases is carried out using the query language. It is a universal computer language used to create, search, and modify information in databases. It consists of operators for determining, searching and processing information in databases. Information search operators contain logical search terms, which can be simple or compound terms. Simple conditions are in the form of equalities and inequalities of the type name = value, where name is the name of a column in the table, and value is a specific numeric or symbolic value (depending on the type of the column in the table).

Compound conditions in queries are written using logical connectives expressing logical statements - conditions for searching for information in relational databases. The search terms in queries are fully consistent with the propositional calculus (with equalities) - fully equivalent to the logic of Aristotle's propositions. Knowledge in databases represents specific and generalized information about people, things, events, properties, processes and phenomena of the objective world.

Information about things and people, like any information, can be reliable and unreliable. Reliable information is perceived as true, and inaccurate information is perceived as a lie. From a logical point of view, knowledge bases in expert systems represent applied logical theories within the framework of which false and true conclusions can be drawn. Knowledge bases of expert systems become logical models of human experts with reliable and unreliable knowledge. So computer science faced the problem of formalizing ambiguous statements the quality side of information. The problem of the experts' fuzzy reasoning was discovered.

In order to expand the possibilities of informatics in the creation of programs, the semantic logic was updated. By means of it, the relations of language expressions to denoted objects are studied on the basis of languages built for the purposes of logic. This is done through the use of semantic rules in the form of a metalanguage.

G. Frege, A. Tarski, K. Gödel played an important role in the development of semantic logic. Semantics for modal logics have been developed. This is the merit of S. Kripke, J. Hintikka, S. Kanger, R. Montague. And also developed semantics for intuitionistic (E. Beth, S. Kripke) logic. The semantics of epistemic contexts are being developed. Non-semantic predicates are considered definite, and semantic predicates are indefinite. According to S. Kripke, it is possible to construct self-applied statements that assert their own truth. In this case, paradoxes do not arise, since the truth predicate is not everywhere definite.

Fuzzy logic began to be used, which is a generalization of classical set theory and classical formal logic. Fuzzy logic (theory of fuzzy sets) operates on a linguistic variable, in which the variable is able to take on the values of phrases. As a result, physical quantities are described that require more positions than just 0 or 1. Using this approach, computing systems can work with fuzzy definitions, which is typical for human thinking.

According to L. Zadeh, the membership function grades the degree of membership of the elements of the fundamental set to a fuzzy set. So, the value 0 means that the element is not included in the fuzzy set, 1 describes the fully included element. A value between 0 and 1 is not clear about the included elements. L. Zadeh operated with linguistic variables and compositional conclusions based on the mathematical apparatus of the theory of fuzzy sets. He proved that such a method allows one to form an approximate, but still adequate way of describing the functioning of nontrivial fuzzy systems, for the description of which it is impossible to use rigorous mathematical methods.

This is especially true in studies that are conducted in the humanities and are related to the study of society. Since there are no mathematical methods for measuring the behavior of such a complex system as society, the application of this method today is practically the only effective way to study a complex dynamic system of society. A fuzzy set and a classical, clear set is a set of some non-rigid principles that, in order to achieve the assigned tasks, operate with various concepts, assumptions on an intuitive basis, or, for example, expert opinion in a certain area of knowledge. Fuzzy judgments involve abandoning rigid rules. Artificial intelligence, neural networks and expert systems are the most common areas of application of L. Zade's theory.

A set of variables “true”, “false”, “probably”, “at times”, “forgot”, “vaguely”, “let's try”, “give me time”, “refrain” is applied. According to L. Zadeh, the task of fuzzy logic is to develop a methodology for performing calculations in words. There is no other methodology for this yet.

Expert systems capable of partially or completely replacing a human specialist in resolving a problem situation are also based on methods. The construction of models of approximate human reasoning opens up new possibilities in the application of artificial intelligence technologies in robotics. The expert system facilitates the exchange of data between users through the computing environment and between users and the computing environment. Language facilities and input languages are a special case of external specifications. We will call a program heuristic if there is no single exact algorithm that it implements. It is also proposed to call an algorithm fuzzy if it is used for operations with fuzzy variables, or it is used to describe fuzzy relations. The choice of a more or less strict definition of "expert system in general" is made further.

The most common definition of an expert system, made on the basis of an external specification, is the statement that it is a computing system operating with the knowledge of specialists in a certain subject area and capable of making a subject area and capable of making decisions at the level of these specialists.

In this definition, it remains unclear what should be understood by the term "knowledge" and what means the ability to make decisions by a computing system at the level of these specialists. This ambiguity disappears if the term "computing system" is taken strictly.

An expert system, like any computing system, at no point in time of its creation and functioning is inseparable from the user and the developer accompanying the system from its conception to its complete obsolescence. The first essential feature that allows considering an expert system as an independent class of computing systems is that it should not become obsolete. Knowledge is often understood as a set of rules that determine the nature of data processing, as a result of which a new set of rules can be produced. The above definitions operate with the concepts of "knowledge" and "data".

Data in computing systems represent, with a predetermined accuracy, encoded images of objects in the real world that have a quantitative measure. The presence of a quantitative measure indicates the possibility of matching objects. Based on the definition of data, it is possible to formulate a definition of the term "knowledge". It is about knowledge in computing systems, not knowledge in general. If the measurability of objects in the real world follows from the possibility of establishing relations between them, then among these relations it is always possible to single out a subset that unites knowledge.

Data is a special case of knowledge. The existence of data about an object presupposes its comparability with some other object conventionally taken as a standard. This mapping allows you to establish a relationship between objects that can be encoded and represented in the computing system. If the result of this comparison is encoded by constants, variables or functions, then we are talking about data representation. If in a computing system the method and result of the comparison are encoded and the essence of this information is the relationship between data, which can also be encoded by constants, variables and functions, then such data is knowledge.

The most common forms of knowledge representation are logical, semantic, production models and fuzzy systems. These systems contain the ability to 1) operate with fuzzy input data: for example, values continuously changing in time (dynamic tasks), values that cannot be set unambiguously (results of statistical surveys, advertising campaigns, etc.); 2) fuzzy formalization of the evaluation and comparison criteria: operating with the criteria "majority", "possibly", "predominantly"; 3) conducting qualitative assessments of both input data and output results: you operate not only with data values, but also with their degree of reliability and its distribution; 4) fast modeling of complex dynamic systems and their comparative analysis with a given degree of accuracy: using the principles of system behavior described by fuzzy methods

The apparatus of the theory of fuzzy sets, having demonstrated a number of promising applications - from aircraft control systems to predicting election results, turned out to be difficult to implement. Given the current level of technology, fuzzy logic has taken its place among other special scientific disciplines between expert systems and neural networks. The development of the theory of fuzzy logic took place in the early eighties of the twentieth century, when several groups of researchers from the United States and Japan created electronic systems for various applications using fuzzy control algorithms. The shift in the center of research on fuzzy systems towards practical applications has led to the formulation of a number of problems. These include new computer architectures for fuzzy computing; element base of fuzzy computers and controllers; development tools; engineering methods of calculation and the development of fuzzy control systems. Fuzzy logic works with natural language. This language has evolved over hundreds of years as a means of communication and as a structure that reflects the objective world. Cognition of the world is based on thinking, and thinking, in turn, is impossible without a certain sign system of natural language. This language is capable of operating with contradictory, complex and ambiguous concepts.

In the course of making a decision, the expert takes control of the situation, dividing it into events, finds solutions in difficult situations using the decision-making rules. The language the expert uses is fuzzy natural language. The resulting model of the system is not unified: it either describes the properties of fragments of an object, or is a set of several local models set in certain conditions. Local models do not use numeric values. Having some generality, they are easy to understand at a natural level.

There is an intensive development and practical application of fuzzy systems for the purposes of control and regulation of technical objects. For the first time, the theory of fuzzy sets and fuzzy logic was applied by E. Mamdani. He used a fuzzy controller to control the steam engine. In Japan, the first fuzzy controller was developed by Sugeno for water purification. F. Cosco proved the fuzzy approximation theorem, according to which any mathematical system can be approximated by a fuzzy logic system. As a result, using the statements "if - then", with their subsequent formalization by means of the theory of fuzzy sets, it is possible to reflect an arbitrary relationship "output - input" without using the complex apparatus of differential and integral calculus used in control and identification.

The fuzzy language is included in the International standard for programmable controllers IEC 1131-7. The conceptual apparatus of fuzzy logic is used to solve problems in which the initial data are unreliable and poorly formalized. The mathematical theory of fuzzy sets allows you to describe fuzzy concepts and knowledge, operate with these descriptions and make fuzzy conclusions. Fuzzy control is useful when the processes under investigation are difficult to analyze using generally accepted methods.

Fuzzy logic, which represents a means of displaying the uncertainties and inaccuracies of the real world, is closer to human thinking and natural languages than traditional logical thinking. The main reason for the emergence of a new theory was the presence of fuzzy and approximate reasoning when a person describes processes, systems, objects. Fuzzy logic is a multi-valued logic, which made it possible to determine intermediate values for evaluations yes - no, true - false. Fuzzy methods based on fuzzy set theory are characterized by: the use of linguistic variables instead of numeric variables. Simple relationships between variables are described using fuzzy statements; complex relationships are described by fuzzy algorithms.

Fuzzy expert systems for decision support are used in medicine and economics. Software packages have been developed for building fuzzy expert systems. They are used in the automotive, aerospace, transportation, home appliance, finance, analysis and management industries. The number of fuzzy applications is in the thousands. The characteristic of a fuzzy set is the membership function. Basic logical operations are defined for fuzzy sets. Necessary for calculations are intersection and union.

In the theory of fuzzy sets, a general approach to the execution of intersection, union and complement operators has been developed, implemented in triangular norms and conorms. The given implementations of intersection and union operations are the most common cases of t-norm and t-conorm. To describe fuzzy sets, the concepts of fuzzy and linguistic variables are introduced. A fuzzy variable is described by a set (N, X, A), where N is the name of the variable, X is a universal set (area of reasoning), A is a fuzzy set on X. The values of a linguistic variable can be fuzzy variables. This means that the linguistic variable is at a higher level than the fuzzy variable. Each linguistic variable consists of a name and a set of its values, which is called the base term-set T. Elements of the base term-set represent the names of fuzzy variables.

The linguistic variable consists of a universal set X; syntactic rule G, according to which new terms are generated using words of natural or formal language; semantic rule P, which assigns a fuzzy subset of the set X to each value of a linguistic variable.

There are over ten typical curve shapes for assigning membership functions. The most widespread are: triangular, trapezoidal and Gaussian membership functions. A triangular membership function is defined by a triple of numbers (a, b, c). For (b-a) = (c-b), we have the case of a symmetric triangular membership function, which can be uniquely specified by two parameters from the triple (a, b, c). To set the trapezoidal membership function, you need four numbers (a, b, c, d). When (b-a) = (d-c), the trapezoidal membership function takes on a symmetric form. The membership function of the Gaussian type operates with two parameters. The parameter c denotes the center of the fuzzy set, and the parameter {\ sigma} σ stands for the steepness of the function.

The number of terms in a linguistic variable rarely exceeds 7. The basis for the operation of fuzzy inference is a rule base containing fuzzy statements in the form "If-then" and membership functions for the corresponding linguistic terms. The following conditions must be met. There is at least one rule for every linguistic term in the output variable. For any term in an input variable, there is at least one rule in which this term is used as a prerequisite (the left side of the rule). Otherwise, there is an incomplete fuzzy rule base.

The result of fuzzy inference is the crisp value of the variable based on the defined crisp values. The inference mechanism includes four stages: fuzzy introduction (fuzzification), fuzzy inference, composition and reduction to clarity, or defuzzification. Fuzzy inference algorithms differ in the type of rules used, logical operations and a type of defuzzification method. Fuzzy inference models for Mamdani, Sugeno, Larsen and Tsukamoto have been developed.

The Mamdani mechanism is the most common way of inference in fuzzy systems. It uses minimax composition of fuzzy sets. The mechanism assumes the following sequence of actions. The first step is the phasification procedure. It determines the degrees of truth - the values of the membership functions for the left sides of each rule (prerequisites). The second action is fuzzy inference. The third action is composition, or combining, of the resulting truncated functions.

The fourth action is defuzzification, bringing to clarity. There are several methods of defasification.

As a result of combining several artificial intelligence technologies, the term “soft computing” appeared, which was introduced by L. Zadeh in 1994. Soft computing combines areas such as fuzzy logic, artificial neural networks, probabilistic reasoning, and evolutionary algorithms. They complement each other and are used in various combinations to create hybrid intelligent systems.

Fuzzy logic has become the basis of most Data Mining methods, endowing them with functionality. So, fuzzy neural networks make inferences based on the apparatus of fuzzy logic. Membership function parameters are tuned using learning algorithms. To select the parameters of such networks, we will apply the error backpropagation method proposed for training a multilayer perceptron. For this, the fuzzy control module is presented in the form of a multilayer network. A fuzzy neural network consists of four layers: a phasification layer for input variables, a condition activation value aggregation layer, a fuzzy rule aggregation layer, and an output layer.

Fast learning algorithms and the interpretability of accumulated knowledge have made fuzzy neural networks one of the most promising and effective soft computing tools. In adaptive fuzzy systems, the selection of parameters of a fuzzy system is carried out in the learning process on experimental data. Learning algorithms for adaptive fuzzy systems are laborious and complex compared to learning algorithms for neural networks. They consist of the stages of generating linguistic rules and adjusting membership functions. The first stage refers to an enumerated type problem. The second stage is towards optimization in continuous spaces. In this case, a certain contradiction arises. Membership functions are required to generate fuzzy rules. And to draw a fuzzy inference, you need rules. When generating fuzzy rules automatically, it is important to ensure their completeness and consistency.

A significant part of the methods of training fuzzy systems use genetic algorithms. Fuzzy database queries are an important trend in information processing systems. This tool makes it possible to formulate queries in natural language. For this purpose, fuzzy relational algebra and special extensions of the SQL languages for fuzzy queries have been developed. Most of the research belongs to D. Dubois and G. Prade. Fuzzy association rules is a methodology for extracting patterns from databases that are formulated in the form of linguistic statements. The special concepts of fuzzy transaction, support, and reliability of a fuzzy association rule have been introduced.

Fuzzy cognitive maps were proposed by B. Kosko in 1986 and are used to model the causal relationships identified between the concepts of a certain area. Unlike simple cognitive maps, fuzzy cognitive maps are a fuzzy directed graph, the nodes of which are fuzzy sets. The directed edges of the graph not only reflect the causal relationships between concepts, but also determine the degree of influence (weight) of the related concepts.

The active use of fuzzy cognitive maps as a means of modeling systems is due to the possibility of a visual representation of the analyzed system and the ease of interpretation of cause-and-effect relationships between concepts. The main problems are associated with the process of building a cognitive map, which does not lend itself to formalization. It is also necessary to prove that the constructed cognitive map is adequate to the real modeled system. To solve these problems, algorithms have been developed for the automatic construction of cognitive maps based on data sampling.

Fuzzy clustering methods, in contrast to clear methods, for example, Kohonen's neural networks, allow one and the same object to belong simultaneously to several clusters, but with varying degrees. Fuzzy clustering in many situations is more natural than clear-cut, for example, for objects located on the border of clusters. The c-means fuzzy self-organization algorithm and its generalization in the form of the Gustafson-Kessel algorithm, fuzzy decision trees, fuzzy Petri nets, fuzzy associative memory, fuzzy self-organizing maps and other hybrid methods are actively used.

Expansion of the subject of logic determined the relevance of metalology. This is a section of modern logic, which examines the ways of constructing various logical theories, the properties inherent in them, as well as the relationships that exist between them. The rudiments of metalological problems can be found already in the Analytics of Aristotle, who tried to substantiate the completeness of his assertive syllogistic by syntactic methods. However, in the true sense, metalology began to actively develop in connection with the construction of various logical systems and their use in the substantiation of mathematics (in metamathematics).

Logic is understood as a set of sentences interconnected by a meaningful (semantic) relationship of logical consequence. Logic studies the possibilities of constructing a logical theory in which this relation would be given by some formal analogue of it. In the theory, the derivability relation acts as such a formal analogue. Logical theories are built in several basic forms - in the form of axiomatic calculus, natural calculus, or in the form of sequent calculus. For theories, there are their deductively equivalent representations in all the indicated forms. For a number of logicians, the question of one form or another of their formalization remains open and constitutes the content of the corresponding metalological studies.

In metalogics, each logical theory is tested for its semantic and syntactic consistency. A logical theory is considered semantically consistent if every statement proved in it is generally valid in the given logic, i.e. is its law. On the other hand, a logical theory is considered syntactically consistent if it cannot prove some statement and its negation. For some logical theories, other concepts of syntactic consistency are used. Metalogic proves the meta-statement that a theory is semantically consistent if and only if it has a model. A theory that has no models does not describe anything, and therefore this kind of theory is of no scientific interest. The same applies to syntactically contradictory theories, since any statement becomes provable. When constructing a theory, the goal is to separate the being from the non-being.

Consistency metatheorems have been proved for a number of logical theories. In particular, the theorems are proved for the first order predicate calculus. The proof of relatively stronger theories is limited by the result that in such proofs it is necessary to use more powerful deductive means than those that are formalized in the theory itself. For some logical theories, other concepts of syntactic consistency are used. Metalogic proves the meta-statement that a theory is semantically consistent if and only if it has a model. A theory that has no models does not describe anything, and therefore this kind of theory is of no scientific interest. The same applies to syntactically contradictory theories, since any statement becomes provable. When constructing a theory, the goal is to separate the being from the non-being.

Consistency metatheorems have been proved for a number of logical theories. In particular, the theorems are proved for the first order predicate calculus. The proof of relatively stronger theories is limited by the result that in such proofs it is necessary to use more powerful deductive means than those that are formalized in the theory itself. For many theories, metatheorems about their relative consistency are often proved.

The concepts of syntactic and semantic completeness of theories are important for metalology. A logical theory is considered semantically complete if every sentence formulated in its language and which is the law of a given logic is provable in it. The fulfillment of this condition for some logical theory, together with the fulfillment of the condition of its semantic consistency, means that this logical theory adequately formalizes the corresponding logic. The semantics of the theory is adequate to its syntax.

A theory is syntactically complete if no sentence formulated in its language and unprovable in it can be included in the theory without contradiction. Syntactically complete theories do not allow new statements to be added to themselves as deductive means. Syntactically and semantically complete theory is the classical propositional calculus. The classical first-order predicate calculus is semantically complete. But it does not possess the property of maximality. This means that it allows the addition of new statements to itself as axioms.

Non-maximal classical first-order predicate calculus can be supplemented with special axioms. As a result, some non-logical theory will be syntactically complete. Such a theory is the theory of partial order. Second-order predicate calculus is not only a syntactically incomplete system, but also semantically incomplete. The class of logical laws of classical second-order logic is not formalized. Non-formalizability, in the light of Gödel's theory of the incompleteness of formal arithmetic, is of a fundamental nature. This theory is not only semantically incomplete, but in principle it cannot be made complete.

In metalogics, the concept of categorical theory is considered. A theory is considered categorical if all its interpretations (models) are isomorphic. The classical logic of propositions is categorical. The categorical nature of theories is the exception rather than the rule. The non-categorical nature of the theory speaks of the ambiguity of the description within its framework of the class of interpretations.

Another important property of logical theories is the property of their decidability. A theory is considered decidable if there is a certain algorithmic procedure that gives an answer to the question whether a certain statement is a theorem of the theory or not. The decidability property is possessed by the classical propositional calculus. The procedure for constructing truth tables is used as a permissive procedure. Some simple mathematical theories also have the property of decidability. As A. Church proved, the classical first-order predicate calculus is not a decidable theory.

For a fairly wide class of theories, including logical ones, A. Tarski proved a metatheorem about the indefinability of the predicate "truth" by logical means formalized in these theories. This result is similar to the result of K. Gödel on the unprovability of the statement about the consistency of formal arithmetic by the means that are formalized by this theory.

Another testable property of logical theories is the property of independence from each other of their deductive principles. In metalogics, the problem arose of proving metatheorems about the normalization of inferences, the removability of a special cut rule in sequential calculus, the algorithmization on this basis of proof processes in various logical systems and the construction of computer implementations of these algorithms for automatic theorem search. Various computer implementations of algorithms for automatic search of theorem proofs have been constructed.

Since theories are classes of sentences, all the operations that are performed on sets can be performed on them. The only condition is that the result of these operations must be a theory. Tarski showed that the class of all theories formulated in the same language on the basis of classical logic forms a Brauer algebra. If we restrict ourselves to considering only finitely axiomatizable theories, then the class of all such theories forms a Boolean algebra.

Metalogic refers to the consideration of the various relationships that exist between logical theories. A huge number of such relationships have been identified and investigated. The most important are the relations of deductive equivalence of the two theories.

Thus, different formulations of the classical propositional calculus, given by a different set of axioms, are equivalent theories. Intuitionistic propositional logic is under the theory of classical propositional logic. The classical first-order predicate calculus is a non-creative (from the Greek, creation - creation) extension of the classical propositional calculus. The concept of translatability of one theory into another is important. Various relations between theories are introduced, in particular, the concept of immersion of one theory into another. A large number of theorems have been proved that substantiate the immersion of one theory into another. A result is obtained on the immersion of the classical propositional calculus in intuitionistic logic.

2.7 2.7. System analysis

Systems analysis includes the principles, methods and tools for the study of systems and the analysis of these systems. Any object is considered as a complex of interrelated constituent elements, their properties and processes. Systems analysis is used in the study of artificial systems in which human activities play an important role. System analysis was applied in the theory and practice of management in the development, adoption and substantiation of decisions related to the design, creation and management of complex, multi-level and multi-component artificial systems.

When developing, designing and operating systems, problems arise that relate not only to the properties of their constituent parts, but also to the regularities of the functioning of the system object and ensuring its life cycle. This is a complex of specific management tasks that are solved using the methods of system analysis. Systems analysis belongs to the field of systems engineering.

System analysis involves a complex of general scientific, special scientific, experimental, statistical, mathematical methods. The theoretical and methodological basis of the analysis is the systems approach and general systems theory. Methods of mathematical logic, mathematical statistics, algorithm theory, game theory, situation theory, information theory, heuristic programming, and simulation are also used.

Systems analysis involves the use of rigorous formalized methods and procedures and non-formalized tools and research methods. Systems research is integrated with cybernetics, operations research, decision theory, expert analysis, simulation modeling, situational management, structural-linguistic modeling.

The use of computers as a tool for solving complex problems made it possible to move from the construction of theoretical models of systems to their practical application. System analysis is closely related to target-oriented management methods. There are schools of systems analysis that apply systems theory to the areas of strategic planning and enterprise management, project management of technical complexes and decision-making on certain types of activities in the event of various problem situations in the process of functioning of socio-economic and technical objects. In 1972, the International Institute for Applied Systems Analysis was established.

The predecessor of the school of systems analysis was A.A. Bogdanov. He called the concept of general organizational science tectology. The concept states that existing objects and processes have a certain level of organization, which is the higher, the more the properties of the whole differ from the simple sum of the properties of the component elements. The analysis of the properties of the whole and its parts was laid down as the main characteristic of the concept of a system. A.A. Bogdanov studied not only the static state of structures, but also the dynamic behavior of objects, the development of an organization. He emphasized the importance of feedbacks, pointed out the need to take into account the organization's own goals, noted the role of open systems. He paid particular attention to the role of modeling and mathematical analysis as potential methods for solving problems of organization theory.

System analysis is designed to research and design large-scale systems, to manage them in conditions of incompleteness of information, limited resources and lack of time. Such systems are characterized by a significant number of elements with the same type of multilevel connections. These are spatially distributed systems of a high degree of complexity. Their constituent parts are complex structures. Additional features of the systems are large dimensions; complex hierarchical structure; circulation in the system of large information, energy and material flows; high level of uncertainty in the description of the system.

Complex systems are distinguished by multidimensionality, heterogeneity of structure, diversity of the nature of elements and connections, organizational resistance and sensitivity to influences, asymmetry of the potential for the implementation of functional and dysfunctional changes.

A complex system has properties that none of its constituent elements possesses. It functions under conditions of uncertainty and the impact of the environment on it, which determines the random nature of changes in its indicators. She makes a purposeful choice of her behavior.

The methods and procedures of system analysis involve identifying goals, proposing alternative solutions to problems, identifying the scale of uncertainty for each of the options and comparing options according to performance criteria, as well as related organizational tasks.

System analysis involves studying a problem situation, finding out its causes, developing options for its elimination, making a decision and organizing the further functioning of the system. The initial stage of a systemic study is the study of the object of the system analysis being carried out with its subsequent formalization. On the one hand, it is necessary to formalize the object of systemic research, on the other hand, the process of studying the system, the process of formulating and solving a problem, is subject to formalization.

The next task of systems analysis is the problem of decision making. The problem of making a decision is associated with the choice of a certain alternative for the development of the system in conditions of various kinds of uncertainty. Uncertainty can be due to the presence of many factors that cannot be accurately estimated. They are formed by the influence of unknown factors on the system, the multicriteria of optimization problems, insufficient certainty of the development goals of the systems, the ambiguity of the system development scenarios, insufficient initial information about the system, the influence of random factors in the course of the dynamic development of the system.

It is important to take into account the uncertainty associated with the subsequent influence of the results of the decision made on the problem situation. Complex systems behave ambiguously. After making a decision, various options for the system's behavior are possible. Evaluation of these options, the likelihood of their occurrence is one of the main tasks of system analysis. In conditions of uncertainty, the choice of an alternative requires an analysis of information. The purpose of the application of system analysis is to increase the degree of validity of the decision made, to expand the set of options, among which a reasoned choice is made. For this, decision-making models, methods for choosing decisions and justifying criteria that characterize the quality of decisions are being developed.

At the stage of development and decision-making, it is important to take into account the interaction of the system with its subsystems, combine the goals of the system with the goals of subsystems, and single out global and secondary goals. An important task is to study the processes of goal formation and study them. It is supposed to develop means of working with goals through the formulation, structuring, or decomposition of target structures, programs and plans, as well as links between them.

System analysis is defined as a methodology for the study of purposeful systems. The formulation of a goal in solving problems of system analysis is one of the key procedures, because the goal is an object that determines the formulation of the problem of systemic research. The subject of system analysis is the organization tasks and management problems in hierarchical systems, the choice of the optimal structure, optimal modes of operation, the optimal organization of interaction between subsystems and elements.

The simulation models are created using computer simulation methods. The study provides a basis for a meaningful understanding of the situations of interaction and the structure of relationships that determine the place of the system under study in the structure of the super system, of which it is a component.

A separate group of tasks of system analysis is made up of the tasks of studying the complex of interactions of the analyzed objects with the external environment. Solving such problems involves drawing a boundary between the system under study and the external environment, which predetermines the maximum depth of influence of the interactions under consideration, which limits the consideration, determination of the real resources of such interaction, consideration of the interactions of the system under study with a higher-level system. Problems of this type are associated with the design of alternatives for the interaction of the system with the external environment, alternatives for the development of the system in time and space.

System analysis is based on a number of applied logical and mathematical disciplines, technical procedures and methods used in management activities, including formalized and non-formalized research tools, as well as on a set of principles and rules that are used as a basis for constructing analysis methods. The methodological basis of systems analysis is a systematic approach. To organize the research process during the system analysis, a set of methods is developed that determine the sequence of the analysis stages and the procedure for their implementation.

Common to all methods of system analysis is the determination of the regularities of the functioning of the system, the formation of variants of the structure of the system of several alternative algorithms that implement the given law of functioning and the choice of the best option, carried out by solving the problems of decomposition, analyzing the system under study and synthesizing the system, and eliminating the problem of practice.

The basis for constructing a methodology for analyzing and synthesizing systems in specific conditions is a list of principles of systems analysis, which represent a generalization of the practice of working with complex systems. The principle of the final goal implies the priority of the final (global) goal, the achievement of which must be subordinated to the activity of the system. The goal is defined as the state of the organization, which must be achieved by a certain point in time, spending certain limited resources on it. The measurement principle states that the quality of the functioning of a system can only be judged in relation to a system of a higher order. To determine the efficiency of the functioning of the system, it should be presented as part of a more general one and the external properties of the system under study should be assessed in relation to the goals and objectives of the supersystem.

The principle of finality shows that the system can reach the required final state, which is independent of time and is determined by the intrinsic characteristics of the system under different initial conditions and in different ways. It is a form of stability with respect to initial and boundary conditions. According to the principle of unity, the system should be considered as a whole, consisting of separate elements interconnected by certain relationships. The principle of connectivity implies a procedure for identifying connections between the elements of the system under consideration and connections with the external environment. In accordance with the principle of modular construction, the modules in the system under study are distinguished and considered as a set of modules.

A module is a group of system elements described only by its input and output. The division of the system into interacting modules depends on the purpose of the study and can have a different basis, including material, functional, algorithmic and informational. The division of the system into modules contributes to a more efficient organization of the analysis and synthesis of systems. It turns out to be possible, abstracting from the minor details, to understand the essence of the basic relationships that exist in the system and determine the outcomes of the system.

In accordance with the principle of hierarchy, a hierarchy of parts of the system under consideration is introduced and ranked, which simplifies the development of the system and establishes the order of consideration of parts. Hierarchy is inherent in all complex systems. The hierarchy in the structures of organizational systems is ambiguously associated with the nature of management in the system, the degree of decentralization of management. In linear hierarchical organizational structures, the idea of complete centralization of management is realized. In complex nonlinear hierarchically structured systems, any degree of decentralization can be implemented.

According to the principle of functionality, structure and functions in the system under study are considered together with the priority of function over structure. The principle states that any structure is closely related to the function of the system and its constituent parts. When giving the system new functions, its structure is revised. The functions performed are processes. They boil down to the analysis of the main flows in the system. These are material flows, flows of energy and information, change of states.

The structure represents many restrictions on flows in space and in time. In organizational systems, the structure is created after defining a set of functions and is implemented in the form of a set of personnel, methods, algorithms, technical devices for various purposes. When new tasks and functions appear, it may be necessary to adjust the structure. After the creation of the system, it is possible to clarify the structure of the system and individual functions within the framework of existing goals and objectives.

The reverse effect of the structure on the functions is possible. Sometimes an organization and its structure are created before the goals and objectives of the system are clarified. This is followed by optimization of the structure. The principle of development implies taking into account the variability of the system, its ability to develop, adapt, expand, replace parts, and accumulate information. The synthesized system is based on the possibility of development, build-up and improvement. Expansion of functions is provided by providing the ability to include new modules that are compatible with existing modules.

When analyzing, the development principle focuses on the need to take into account the prehistory of the development of the system and trends in order to reveal the patterns of its functioning. One way to accommodate this principle is to consider the system in relation to its life cycle. The conventional phases of the life cycle of a system are design, manufacture, commissioning, operation, modernization and termination of operation or use.

The principle of centralization and decentralization implies a combination in complex systems of centralized and decentralized management, which means that the degree of centralization should be minimal, ensuring the achievement of the set goal. The main disadvantage of decentralized management is the increased adaptation time of the system. It affects the functioning of the system in rapidly changing environments.

The uncertainty principle implies taking into account uncertainties and chances in the system and is one of the basic principles of the systems approach. It is believed that one can deal with a system in which the structure, functioning, external influences are not fully defined. Complex open systems do not obey probabilistic laws. When analyzing such systems, probabilistic estimates of forecasted situations can be obtained if these estimates objectively exist. Uncertainties can be taken into account using the guaranteed result method, statistical estimates, clarification of structures, and expansion of the set of goals. These methods are used when uncertainties and chances are not described by the mathematical apparatus of the theory of probability.

If there is information about the probabilistic characteristics of randomness, it is possible to determine the probabilistic characteristics of the outputs in the system. In cases of incomplete knowledge about the subject of research, fuzzy or stochastic input information, research results will be fuzzy or probabilistic, and decisions made on the basis of research may lead to ambiguous consequences. It is necessary to strive to identify and evaluate all possible, seemingly unlikely consequences of decisions made, to provide feedback that will ensure timely disclosure and localization of undesirable developments.

Methods of systems analysis help to formulate a problem, identify goals, propose alternative solutions to problems, identify the extent of uncertainty and compare options according to performance criteria. The problematic situation is revealed as the inconsistency of the existing situation with the required position. To resolve the problem situation, a systemic study is carried out through the methods of decomposition, analysis and synthesis of the system.

At the stage of decomposition of the system, the determination and decomposition of the research goals and the main function of the system is carried out as a limitation of the trajectory in the state space of the system of admissible situations. There is a separation of the system from the environment: the definition of the near and distant environment of the system, the identification and description of influencing factors, as well as the description of development trends, limitations and uncertainties. Compliance with the principles of completeness and simplicity, gradual detailing of the model is required.

The problem of decomposition is that in complex systems there is no one-to-one correspondence between the law of functioning of subsystems and the algorithm that implements it. Therefore, the formation of several variants or one variant is carried out if the system is displayed in the form of a hierarchical structure of the system decomposition. Functional decomposition is based on the analysis of system functions. The division into functional subsystems is based on the generality of functions performed by groups of elements.

In the production life cycle in accordance with ISO 9000, marketing stages are distinguished; design; preparation and development; production; control and testing; packaging and storage; sales and distribution; installation and operation; technical service assistance; recycling.

In the life cycle of management of the organizational and economic system, the stages of planning are distinguished; initiation; coordination; control; regulation. In the life cycle of information systems, its stages correspond to the stages of information processing. This is registration; collection; broadcast; treatment; display; storage; protection; destruction.

At the stage of analyzing the system, which ensures the formation of its detailed representation, a number of methods are used. Cognitive analysis focuses on knowledge in a specific subject area, on the processes of their representation, storage, processing, interpretation and production of new knowledge. It is used when the volume and quality of information does not allow the use of traditional methods, and it is required to extract the knowledge of experts, study the processes of understanding the problem and additional structuring of the data.

Structural analysis allows you to look at an existing system in order to formulate the requirements for the system being created. It includes clarifying the composition and regularities of the functioning of elements, algorithms for the functioning and interactions of subsystems, separating controlled and uncontrolled characteristics, setting the state space and parametric space in which the behavior of the system is specified, analyzing the integrity of the system, and formulating requirements for the system being created.

Morphological analysis allows you to select a group of basic features in the analyzed system. The elements of the structure of the system or the functions of the elements can be taken as signs. For each feature, various alternative options for its implementation are proposed. The proposed options are combined with each other. Acceptable combinations are selected from the set of obtained combinations. The most effective options are selected based on quality criteria.

Efficiency analysis allows evaluating the system in terms of efficiency, resource intensity, and efficiency. It includes the choice of a measurement scale, the formation of performance indicators, justification and formation of performance criteria, direct assessment and analysis of the estimates obtained. Formation of requirements allows you to formulate requirements for the system being created, including the choice of evaluation criteria and restrictions.

At the stage of system synthesis, a model of the required system is developed. This stage includes the choice of a mathematical apparatus corresponding to the study, modeling the system, evaluating the model according to the criteria of adequacy, simplicity, correspondence between accuracy and complexity, balance of errors, multivariance of implementations, modularity of construction.

The resulting model is investigated in order to find out the proximity of the result of applying one or another of the options for its implementation to the expected result, the comparative costs of resources for each of the options, the degree of sensitivity of the model to various undesirable external influences.

At the stage of synthesis of alternative structures of the system, the results of structural and morphological analysis are actively used to generate alternatives. At the stage of synthesis of system parameters, qualitative and quantitative characteristics of the functional elements of the structure and a description of their functions are used, as well as the main characteristics of flows entering and leaving the system and the parameters of their interaction with the external environment.

Evaluation of alternative variants of the synthesized system is carried out with the involvement of experts, and includes the justification of the scheme for evaluating the options for implementing the system model, conducting an evaluation experiment, processing the evaluation results, analyzing the results, and choosing the best option.

When carrying out a system analysis, a set of procedures is used. They are aimed at formulating a problem situation and determining the general goal of the system, the goals of its individual subsystems. It is also supposed to put forward many alternatives to achieve these goals, which are compared according to the criteria of efficiency, as well as to build a generalized model that reflects the factors and relationships of the real situation that may appear in the process of implementing decisions. As a result, an acceptable way of solving the problem situation, achieving the required target state of the system is selected.

One of the most important characteristics of artificial systems is the goal-oriented nature of their activity. In systems analysis, the goal is understood as a subjective image (abstract model) of a non-existent, but desired state of the system. The goal can be set by the requirements for performance indicators, resource intensity operational efficiency of the system, or for the trajectory of achieving a given result. The discrepancy between the existing and target state of the system under a certain state of the external environment is called a problem situation.

The starting point for defining goals in systems analysis is related to problem formulation. There are a number of features of the associated system analysis tasks. The need for system analysis arises when the customer has already formulated his problem. The problem not only exists, but also requires a solution. But the problem formulated by the customer represents a rough working version. When formulating a problem for the system under consideration, it is necessary to take into account how the solution to this problem will affect the systems with which this system is connected. The planned changes will affect the subsystems that are part of this system, and the supersystem that contains this system.

The starting point for defining goals in systems analysis is related to problem formulation. There are a number of features of the associated system analysis tasks. The need for system analysis arises when the customer has already formulated his problem. The problem not only exists, but also requires a solution. But the problem formulated by the customer represents a rough working version. When formulating a problem for the system under consideration, it is necessary to take into account how the solution to this problem will affect the systems with which this system is connected. The planned changes will affect the subsystems that are part of this system, and the supersystem that contains this system.

The goal is determined after the work has been done to structure the initial problem and the problem situation that needs to be overcome in the course of the system analysis has been formulated. In order to determine the purpose of the system analysis, you should answer the question of what needs to be done to resolve the problem. To formulate a goal means to indicate the direction in which to move in order to solve an existing problem, and to identify paths that lead away from the existing problem situation. The purpose of the research is assumed to be an external factor in relation to the system and becomes an independent object of research.

Ultimate goals characterize a certain result that can be obtained in a given time and space. In this case, the goal can be set in the form of an area of desired values of the system parameters. The ultimate goal can be represented as some point in the state space. Endless goals define the overall direction of action. An infinite goal can be specified as a vector in the state space of the system, for example, in the form of functions of maximizing or minimizing state parameters.

The choice of this or that class of goals depends on the nature of the problem being solved. When defining goals, it is necessary to proceed from the general interests of the system. The formulation of goals can be expressed in both qualitative and quantitative form. In relation to the target parameter, the system can be in modes of functioning and development. In the first case, the system fully satisfies the needs of the external environment and the process of its transition and its individual elements from state to state occurs the constancy of the set goals. In the second case, it is considered that the system at some point in time ceases to meet the needs of the external environment and an adjustment of the previous target settings is required. Targeting is carried out using the method of constructing a tree of goals. The idea of the method was proposed by W. Churchman in the framework of his study of decision-making processes in industry. A complex and global goal is being transferred to a final set of relatively simple subgoals, for the implementation of which specific tasks and procedures for their solution can be defined.

The next stage of the system analysis is the creation of many possible ways to achieve the formulated goal. It is important to generate many alternatives, from which the choice of the best path for the development of the system will be carried out. If the set of alternatives does not include the best of them, then even the most advanced methods of analysis will not help to calculate it. The difficulty of this stage is due to the need to generate a sufficiently complete set of alternatives, including even the most unrealizable ones. The search for alternatives is carried out using methods of collective idea generation. Expert recommendations are used.

2.8 2.8. Collective idea generation techniques

A special role in the collective generation of ideas is assigned to the methods of "brainstorming", "brainstorming", "conference of ideas", "collective generation of ideas".

For the effective return of methods, it is important to provide as much freedom of thinking as possible for the participants in the collective generation of ideas and their expression of new ideas; welcome any ideas, even if at first they seem dubious or absurd (discussion and evaluation of ideas is carried out later); do not allow criticism of any idea, do not declare it false and do not stop the discussion; try to express as many ideas as possible, especially non-trivial ones; with a significant number of alternatives, it is recommended to carry out a preliminary "rough" classification (for example, easily implemented, the most promising and effective, others).

Depending on the adopted rules and the severity of their implementation, there are direct "brainstorming", the method of exchange of opinions and other types of collective discussion of ideas and decision-making options. Participants are not allowed to read out lists of proposals that they have prepared in advance. When organizing sessions of collective idea generation in advance or before the beginning of the session the participants are provided with some preliminary information about the discussed problem in writing or orally. Constructorates, meetings of scientific councils on problems, meetings of specially created temporary commissions can be considered similar to sessions of collective idea generation. In the recommendations for the method, it is proposed to generalize the formulations of the goal and the goals-alternatives; functional principles of goal achievement; structural principles for the implementation of the function; descriptions of technical devices that implement a specific physical principle.

Ideas are selected by a group of expert analysts. In the analysis process, all ideas are equal. It is advisable to involve competent specialists without requiring their mandatory presence at meetings of collective idea generation and oral expression at the first stage of the system analysis when forming preliminary options.

The methods of preparing and agreeing on formalized representations about the problem or the object being analyzed, set out in writing, are called the scenario method. Initially, this method involved preparing a text containing a logical sequence of events or possible solutions to a problem, ordered in time. However, the requirement for time coordinates was later dropped. Any document containing an analysis of the problem under consideration or proposals for its solution, regardless of the form in which it is presented, began to be called a scenario. Proposals for the preparation of such documents are first written by experts individually, and then an agreed text is formed.

The scenario not only provides reasoning that helps not to miss details that are not taken into account in the formal presentation of the system, but also contains the results of a quantitative technical and economic statistical analysis with preliminary conclusions that can be obtained on their basis. The group of experts preparing the scenarios enjoys the right to obtain the necessary certificates from organizations, expert advice. The concept of scenarios is expanding in the direction of both areas of application and forms of presentation and methods of their development. The script not only introduces quantitative parameters and establishes their interrelationships, but also suggests scripting techniques using machine calculations.

The script allows you to create a preliminary view of the problem in the system in situations that cannot be displayed by the formal model. This is a text that contains synonymy, homonymy and paradoxes. Therefore, there is a possibility of its ambiguous interpretation. Therefore, it should be considered as the basis for the development of a formalized view of the future system or problem to be solved.

It is important to define the limiting cases between which the possible future may lie. This allows you to express the uncertainties associated with predicting the future. It is useful to include an imaginary actively opposing element in the scenario, thereby simulating the worst situation. Unreliable and impractical scenarios that are too sensitive to small deviations in the early stages should not be developed in detail.

In the study of complex systems, problems arise that cannot be solved only by formal mathematical methods. In this case, the opinion of experts with developed intuition is important. This contributes to the solution of poorly formalized problems. This involves organizing the work of experts and processing their opinions. The factor that determines the work of the expert group is the identification of the characteristics of the purpose of the work, what result is needed, as well as the information provided to the decision-maker, or the draft of the decision itself.

The group should collect as much information as possible, arguments for and against certain options for decisions, without developing an agreed draft decision. The work can be structured in such a way as to reveal evaluations, original and unexpected opinions. The expert group should propose a draft of some solution. To reconcile different opinions, it is necessary to apply special methods of education.

It should be assumed that experts have different opinions on the set of criteria. They have different opinions about the relative importance of the criteria. They give different assessments of alternatives according to the criteria. Methods for processing expert opinions allow you to structure many alternatives. To assess the comparative significance of the criteria, a compromise ranking is used. Each expert gives a ranking of criteria by importance. A generalized version is built on the basis of individual proposals. This can be done by different methods, in particular, the Kemeny median is used. To find the median, it is necessary to determine the metric in the rankings space and build a ranking, the total distance from which to all the given expert rankings would be minimal. The desired ranking will be Kemeny's median.

The Delphi method, in contrast to traditional methods of peer review, involves a complete rejection of collective discussions. This is done in order to reduce the influence of such psychological factors as adherence to the opinion of the most authoritative specialist, unwillingness to abandon a publicly expressed opinion, following the opinion of the majority.

In the Delphi method, direct debate is replaced by a program of sequential individual interviews conducted in the form of a questionnaire. The answers are summarized and, together with new additional information, are made available to the experts, after which they refine their initial answers. The procedure is repeated several times until an acceptable convergence of the set of opinions expressed is achieved. The results of the experiment showed acceptable convergence of the experts' assessments after five rounds of the survey.

The Delphi method was proposed by O. Helmer as an iterative brainstorming procedure, which should help to reduce the influence of psychological factors and increase the objectivity of the results. Delphi has become the main vehicle for enhancing the objectivity of quantitative expert surveys. It is effective in evaluating goal trees and in developing scenarios by using feedback, familiarizing experts with the results of the previous round of the survey, and taking these results into account when assessing the significance of expert opinions.

The Delphi method procedure looks like this. A sequence of brainstorming cycles is organized. A program of sequential individual interviews with the help of questionnaires is being developed, excluding contacts between experts, but providing for their familiarization with each other's opinions between rounds. Questionnaires from round to round can be specified. In the most developed methods, experts are assigned weight coefficients of the significance of their opinions, calculated on the basis of previous surveys, refined from round to round and taken into account when obtaining generalized assessment results. The method has drawbacks associated with a significant amount of time spent on the examination. It is formed by a large number of consecutive repetitions of assessments.

The main idea of the methods of morphological analysis is to systematically find all conceivable options for solving a problem or implementing a system by combining the selected elements or their features. The morphological approach was developed and first applied by F. Zwicky. The most widespread method is the morphological matrix. Its idea is to determine all conceivable parameters on which the solution to the problem may depend. Represent them in the form of matrix-columns of the table. Determine in the morphological matrix all possible combinations of parameters, one from each column. The resulting options can be evaluated and analyzed in order to select the best option. The morphological matrix can be not only two-dimensional.

Using the idea of a morphological approach for modeling organizational systems, modeling languages are being developed that are used to generate possible situations in the system, possible solutions, and as an auxiliary means of forming the lower levels of the hierarchical structure when modeling the structure of goals and organizational structures. Examples of languages are the language of function and types of structure, the nominally structural language, the language of situational management, and the languages of structural and linguistic modeling.

After constructing the matrix, the functional value of the decision options is determined based on the criteria of cost and conditional utility. In the process of analyzing all possible options, the best option for specific conditions is selected. To keep the number of options reasonable, it is important to articulate the goal and limitations as precisely as possible.

The most difficult quality of the system is self-organization. A self-organizing system is capable of changing its structure, parameters, algorithms of functioning and behavior to increase efficiency. The fundamentally important properties of this level are freedom of choice of decisions, adaptability, self-learning the ability to recognize situations.

The system efficiency criteria correspond to the complex operational property of the system functioning process, which characterizes its adaptability to the achievement of the operation goal (the fulfillment of the system task). These can be criteria of efficiency, resource intensity and efficiency in terms of the outcome of the operation and the quality of the algorithm that ensures the receipt of results: The efficiency of the operation is determined by the obtained target effect for which the system functions. Resource intensity is characterized by all types of resources used to obtain the target effect.

Efficiency is determined by the amount of time required to achieve the goal of the operation. Evaluation of the outcome of the operation takes into account that the operation is carried out to achieve a specific goal of the outcome of the operation. The outcome of the operation is understood as the state of the system and the external environment at the time of its completion. The evaluation of the functioning algorithm is the leading one in evaluating the effectiveness. Having a good algorithm for the functioning of the system increases confidence in obtaining the required results. The desired results can be obtained without a good algorithm, but the probability of the result is low. This provision is especially important for organizational and technical systems and systems in which the results of the operation are used in real time.

Efficiency, resource intensity and efficiency give rise to the efficiency of the process, the degree of its adaptability to the achievement of the goal. This property, inherent only in operations, manifests itself during the functioning of the system and depends both on the properties of the system itself and on the external environment.

The method of choice based on binary relations is based on the fact that in practice it can be difficult to evaluate a single alternative. But if we consider it not separately, but in tandem with another alternative, then there are reasons to say which of them is more preferable. The standalone alternative is not evaluated. For each pair of alternatives, it can be established in some way that one of them is preferable to the other or that they are equivalent. The preference relation within any pair of alternatives does not depend on other elements of the set of alternatives.

The function-based selection method has arisen because the preference between two alternatives often depends on the other alternatives. Such situations of choice are possible when the concept of preference does not make sense. The choice of a particular solution is influenced by the system of conditions identified in the problem, reflecting the influence of external and internal factors that must be taken into account in the decision-making problem. Consistency requirements when considering an issue require taking into account all possible restrictions: organizational, economic, legal, technical, environmental, psychological. Qualitative restrictions are formulated in terms of "not allowed", "not allowed", and quantitative restrictions in terms of "no more", "no less", "in the range from-to". Constraints concretize previously formulated goals and can make goals unrealizable. It is important, through a series of iterative procedures, to remove some of the restrictions or to reformulate the goals.

The pairwise comparison selection method contains selection items based on criteria and binary relationships.

It involves weighing the goals and determining the criteria corresponding to them; weighing and determining the specific weights of the criteria; conducting pairwise comparisons of alternatives for each criterion; drawing up a final matrix for evaluating alternatives and determining the relative total value of each alternative; choosing the alternative with the highest relative value.

2.9 2.9. Digital pattern

The central procedure in systems analysis is modeling. This is the process of studying a real system, including the construction of models that reflect the main properties, characteristics, phenomena and processes, the relationship of a real system. The procedure involves formalizing the system under study, building a model of the system, studying its properties and transferring the information obtained to the modeled system. The resulting model is investigated in order to clarify the proximity of the result of applying one or another of the alternative options to the desired result, the degree of sensitivity of the model to unwanted external influences. Modeling functions are description, explanation and prediction of the behavior of a real system. The purpose of modeling is to find optimal solutions, assess the effectiveness of solutions, and determine the properties of the system. The result of the entire system analysis depends on the quality of the model. The quality of the model is determined by the correspondence of the performed description to those requirements that are imposed on the study, and the correspondence of the results obtained using the model to the course of the observed process or phenomenon.

Modeling is understood as a process of adequate display of the essential aspects of the object under study with the accuracy that is necessary for practical needs. Modeling can also be called a special form of mediation, the basis of which is a formalized approach to the study of a complex system. The theoretical basis for modeling is the theory of similarity. Similarity reflects a one-to-one correspondence between two objects, in which the functions of transition from the parameters of one object to the parameters of another object are known. The mathematical descriptions of these objects can be converted into identical descriptions. The theory of similarity makes it possible to establish the presence of similarity or allows you to develop a way to obtain it. As a result, modeling is the process of representing the research object with an adequate (similar) model and conducting experiments with the model to obtain information about the research object.

The model is analogous to the object. This analogue is similar to the prototype and serves as a means of describing, explaining, predicting the behavior of the prototype in accordance with the objectives of the study. An important quality of the model is that it gives a simplified image that reflects the properties of the prototype that are essential for research. It is a physical or informational object that replaces the original. The model reflects only some aspects of the original. In order to gain more knowledge about the original, a set of models is used. The complexity of modeling as a process lies in the appropriate choice of such a set of models that replace a real device or object.

Complex systems are characterized by functions performed by processes, structure and behavior over time. For adequate modeling of these aspects in complex systems, functional, informational and behavioral models are distinguished. The functional model of the system describes the set of functions performed by the system. It characterizes the morphology of the system and its construction, the composition of functional subsystems, their interconnection. The information model of the system reflects the relationships between the elements of the system in the form of data structures of composition and relationships. The behavioral model of the system describes information processes and the dynamics of their functioning. It includes such categories as system state, event, transition from one state to another, transition conditions, sequence of events.

The level of structural or simulation modeling of complex systems using their algorithmic models (modeling algorithms) is in demand. It involves the use of specialized modeling languages, set theories, algorithms, formal grammars, graphs, queuing and statistical modeling. At the level of logical modeling of functional circuits of elements and nodes of complex systems, models are represented in the form of equations of direct connections (logical equations). They are constructed using the apparatus of two-valued or multivalued algebra of logic. At the level of quantitative modeling and analysis of schematic diagrams of elements of complex systems, the models are presented in the form of systems of nonlinear algebraic, integral-differential equations. They are investigated by the methods of functional analysis, the theory of differential equations, and mathematical statistics.

The set of object models at the structural, logical and quantitative levels of modeling represents a hierarchical system. It reflects the interconnection of various aspects of the object's description and provides the systemic connectivity of its elements and properties at all stages of the design process. When moving to a higher level of abstraction, the data on the modeled object is folded. When moving to a more detailed level of description, a sweep of this data is given. At each of the levels of modeling, descriptions of the object are possible with varying degrees of completeness and generalization. This is due to the fact that there are different degrees of detailing of structural, logical and quantitative properties and relationships.

The abstract level of the description of the system is the black box model. The methodology for using the black box arose from the lack of information about the internal structure of the system. Therefore, the system is depicted as an opaque black box. It reflects the properties of its integrity and isolation from the environment. The system symbolized by the black box is not isolated. It is connected with the external environment through a set of inputs and outputs. The outputs of the black box model describe the outputs of the system. Inputs describe its resources and limitations. At the same time, we do not know anything and cannot know about the internal content of the system.

The black box model does not consider the internals of the system. To detail the description of the system, it is required to create a model of the composition of the system. The model describes the main components of the system. For a deeper study of systems, it is necessary to establish in the model the composition of the communication system between its constituent elements and subsystems. We left only the general for each communication scheme. A meaningful graph theory was built, which received practical applications.

As a result, a number of research situations were formulated in the modeling methodology. The system is simple and transparent enough that it can be examined and understood by observing or interviewing people working with the system. Directly based on the results of studying the system, you can construct its model. If the structure of the system is obvious, but the methods of description are not clear, you can use the similarity of the system under study with another system, the description of which is known. The structure of the system is unknown, but it can be determined by analyzing data on the functioning of the system. A hypothesis about the structure will be obtained, which then needs to be verified experimentally. Analysis of data on system performance does not allow us to determine the effect of individual variables on the performance of the system. It becomes necessary to conduct an experiment in order to identify the relevant factors and their influence on the operation of the system. The possibility of carrying out an experiment on the system is assumed. Sufficient descriptive information about the system is not available. Experimenting on the system is not allowed. A sufficiently detailed model of artificial reality can be built, which is used to accumulate statistics on the possible functioning of the system by means of statistical tests of hypotheses about the real world.

Deterministic modeling displays processes in which the absence of random influences is assumed. Stochastic modeling takes into account probabilistic processes and events. Static modeling is used to describe the state of an object at a fixed point in time. Dynamic modeling is used to study an object over time.

Mental modeling is used when models are not realizable in a given time interval or there are no conditions for their physical creation. With visual modeling, models are created that reflect the phenomena and processes occurring in the object. Diagrams and diagrams are examples of models. The hypothetical modeling is based on the hypothesis about the regularities of the process in a real object. It reflects the level of knowledge of the researcher about the object and is based on the cause-and-effect relationships between the input and output of the object under study. This type of modeling is used when knowledge about the object is not enough to build formal models.

Analog modeling is based on the application of analogies at different levels. For fairly simple objects, the highest level is complete analogy. As the system becomes more complex, analogies of subsequent levels are used, when the analog model displays several sides of the object's functioning. Prototyping is used when the processes occurring in a real object cannot be physically modeled or may precede other types of modeling. The construction of mental models is based on analogies based on causal relationships between phenomena and processes in an object.

Symbolic modeling represents the artificial process of creating a logical object that replaces the real one and expresses its basic properties using a certain system of signs and symbols of a certain language. The language modeling is based on the thesaurus, which is formed from a set of concepts of the studied subject area, and this set must be fixed. A thesaurus is understood as a dictionary that reflects connections between words or other elements of a given language, designed to search for words by their meaning. If you introduce a conventional designation of individual concepts, signs, as well as certain operations between these signs, then you can implement sign modeling and use signs to compose separate chains of words and sentences. Using the operations of union, intersection and addition of set theory, it is possible to describe a real object in separate symbols.

Mathematical modeling reflects the process of establishing correspondence to a given real object of a certain mathematical object. To study the characteristics of any system by mathematical methods, formalization of this process should be carried out a mathematical model should be built.

The mathematical description of the model begins when a system of axioms is formulated that describes not only the object itself, but some algebra of the set of rules that determine the permissible operations on the object. The type of mathematical model depends both on the nature of the real object and on the tasks of studying the object, on the required reliability and accuracy of solving the problem. A mathematical model describes a real object with some degree of approximation.

The model can be represented as a collection of inputs, outputs, state variables and global equations of the system. In analytical form, models represent explicit expressions for output parameters as functions of inputs and state variables. In analytical modeling, only the functional aspect of the system is modeled. In this case, the global equations of the system, which describe the law (algorithm) of its functioning, are written in the form of some analytical relations (algebraic, integro-differential, finite-difference) or logical conditions. The analytical model is investigated by several methods. An analytical method, when they seek to obtain dependencies connecting the required characteristics with the initial conditions, parameters and state variables of the system. By the numerical method, when they seek to obtain numerical results for specific initial data. A qualitative method can be used to find some properties of the solution and evaluate the stability of the solution. To implement a computer mathematical model, it is necessary to build an appropriate modeling algorithm. We need to record the relationships between the model and the selected numerical solution method in the form of an algorithm. Among algorithmic models, an important class is made up of simulation models designed to simulate physical or information processes under various external influences. Simulation of processes is called simulation.

In this simulation, the algorithm of the system's functioning in time is reproduced. The elementary phenomena that make up the process are simulated, while maintaining their logical structure and sequence of flow. This makes it possible to obtain information about the states of the process at certain points in time using the initial data. They provide an opportunity to evaluate the characteristics of the system. The main advantage of simulation is the ability to solve more complex problems. Simulation models make it possible to take into account such factors as the presence of discrete and continuous elements, nonlinear characteristics of system elements, and numerous random influences. They often create difficulties in analytical research. In simulation, a distinction is made between the Monte Carlo statistical test method and the statistical modeling method. The numerical method is used to simulate random variables and functions, the probabilistic characteristics of which coincide with the solutions of analytical problems. It consists in multiple reproduction of processes that are realizations of random variables and functions, followed by information processing by methods of mathematical statistics.

The simulation method is used to assess the options for the structure of the system, the effectiveness of various algorithms for controlling the system, the effect of changing various parameters of the system. Simulation modeling can be used as the basis for structural, algorithmic and parametric synthesis of systems, when it is required to create a system with given characteristics under certain constraints.

Combined analytical and simulation modeling allows you to combine the advantages of analytical and simulation modeling. When constructing combined models, a preliminary decomposition of the object's functioning process into its constituent sub-processes is performed. Analytical models are used. Simulation models are built for the subprocesses. This approach makes it possible to cover qualitatively new classes of systems that cannot be investigated using analytical or simulation modeling separately.

Information models are based on the reflection of some information management processes, which makes it possible to assess the behavior of a real object. To build a model, it is necessary to select the investigated function of a real object. Try to formalize this function in the form of some telecom operators between input and output. Reproduce this function on a simulation model in another mathematical language and another physical implementation of the process.

Structural modeling is based on specific features of structures that are used as a means of studying systems or serve to develop specific approaches to modeling using other methods of formalized representation of systems (set-theoretic, linguistic, cybernetic). Object-oriented modeling is a development of structural modeling.

Structural modeling of systems analysis includes methods of network modeling; combination of structuring methods with linguistic methods. As well as a structural approach to formalizing the construction and study of hierarchical, matrix structures and arbitrary graphs based on set-theoretic representations and the concept of a nominal scale of measurement theory.

The structure of the model can be applied to both functions and system elements. The structures are called functional and morphological. Object Oriented Modeling combines both types of structures into a class hierarchy that includes both elements and functions.

Situational modeling is based on the model theory of thinking. On its basis, it is possible to describe the main mechanisms for regulating decision-making processes. At the center of the model theory of thinking is the idea of the formation in the structures of the brain of the information model of the object and the external world. This information is perceived by a person on the basis of the knowledge and experience he already has. Reasonable human behavior is built by forming a target situation and mentally transforming the initial situation into a target situation. The basis for building a model is the description of an object in the form of a set of elements interconnected by certain relationships that reflect the semantics of the subject area. The object model has a multi-level structure and represents an information context against which control processes take place. The richer the information models of the object and the higher the possibility of manipulating it, the better and more diverse the quality of the decisions made during management.

In real modeling, the ability to study the characteristics either on a real object as a whole or on a part of it is used. Research is carried out both on objects operating in normal modes and when organizing special modes to assess the characteristics of interest to the researcher. The values of variables parameters, in a different time scale. Real modeling is the most adequate, but its capabilities are significantly limited.

One of the most common types of real-world modeling is full-scale modeling. It involves conducting research on a real object with the subsequent processing of the experimental results based on the theory of similarity. Full-scale modeling is subdivided into scientific experiment, complex testing and production experiment. A scientific experiment is characterized by the widespread use of automation tools, the use of a variety of information processing tools, the possibility of human intervention in the experiment. In the course of complex tests, general patterns are revealed about the characteristics of the quality and reliability of objects. Modeling is carried out by processing and generalizing information about homogeneous phenomena. It is possible to implement full-scale modeling by generalizing the experience gained during the production process. On the basis of the theory of similarity, statistical material on the production process is processed and its generalized characteristics are obtained.

Physical modeling is carried out on devices that preserve the nature of phenomena and have physical similarity. Some characteristics of the external environment are set, and the behavior of either a real object or its model is investigated under given or artificially created influences of the external environment. Physical simulations can be performed in real and pseudo-real time, or viewed without regard to time.

Before starting the experiment, the model must be tested, which is the last step in model development. The test is carried out to determine the plausibility of the model to ensure that it behaves as intended. There is a qualitative correspondence between the behavior of the modeled system and the model, including the order of their outcomes, as well as behavior and results.

Calibration of the model is the refinement of the coefficients of the model. This is the identification of the coefficients of the relations connecting the exogenous and endogenous variables of the model. Calibration is carried out by comparing the results obtained on models with the results obtained when testing a real system, or with the results of analytical calculations. For this, reference examples and tasks are used. The system model is validated by reference tasks covering all the properties of the model. It is advisable to construct such a set of examples in order to cover only some part of the model dependencies with the help of one example and determine a part of the coefficients. One of the tasks of the test is to test the model for sensitivity. This means how sensitive the model's outcomes are to changes in the input variables.

The tests use statistical methods such as regression, correlation and analysis of variance. Statistical methods can lead to incorrect results if the researcher does not have a clear understanding of the system being modeled and the characteristics of the information used.

To ensure the adequacy of the model, control of dimensions is provided. Only quantities of the same dimension can be compared and added. In extreme situations, the behavior of the model should coincide with the behavior of the system in similar situations. Functions must take on certain values at the boundary.

The signs and values of the model variables should not contradict the possible values of the simulated physical quantities.

Since the testing of models of complex systems is associated with significant costs, it is necessary to be extremely strict in the planning of tests. The test results should provide the required level of model adequacy at all stages of its use. With a reasonable choice of test cases and reference problems, this problem is solved with a minimum cost of funds and resources.

2.10 2.10. Information technology in scientific research

Artificial intelligence, machine learning, digital twins, and automation are defining the role of information technology in scientific research. Information technologies make it possible to use the potential of available information: to eliminate duplication and redundancy in experimental research. And also to optimize work processes, simplify the use of data, increase the efficiency of communication by mastering the method of digital storytelling. They play an important role in the field of computer modeling. In particular, predictive modeling and artificial intelligence are used in biological experiments. Robots are used. The experiments are carried out on a micro-scale in millionths of a liter. This generates a huge amount of data. The approach allows thousands of experiments to be run simultaneously, increasing the productivity of data generation.

A computerized research process requires a high-bandwidth backbone to transfer data from equipment to storage and to an advanced analytics system to process it. The backbone in the form of a network serves as a centralized data warehouse accessible to all researchers. This allows research to be carried out with the necessary information at its disposal, which allows employees to concentrate on the most important tasks. Semantic document search is used to deeply analyze and structure unstructured data to ensure its machine readability and suitability for machine learning. Through the use of algorithms and data access, the program is able to generate accurate results, taking into account the purpose of the search, the context of the query, and the relationship of words.

The trend in the field of scientific research is to improve the quality and quantity of analysis of incoming information. The use of information technology in research plays an important role. This can be seen already at the first stage of the accumulation of knowledge and facts. To review the state of the problem under consideration, the resources of electronic libraries are used. The search function is undertaken by expert systems through electronic catalogs and the internal network of libraries.

Information technology helps in the compilation of bibliography; referencing; taking notes; annotation; quoting. With the help of the text editor MS Word, you can automate all the above operations. You can use the help of translation programs using electronic dictionaries, as well as the function of storing and accumulating information. This function implies the possibility of planning the research process.

Information technology will help you get acquainted with publications know the place of work and the address for correspondence. Information technologies used at this stage include the global network, mail clients, e-mail, and search engines. Thanks to the development of multimedia technologies, the computer can collect and store not only text, but also graphic and sound information of the study. For this, digital photo and video cameras, microphones, as well as appropriate software for processing and reproducing graphics and sound are used.

To process quantitative data obtained during questioning, testing, ranking, registration, sociometry, interviews, conversations, observations and pedagogical experiment, mathematical research methods are often used using statistical applied software packages (Statistic, Stadia, SPSS, SyStat).

It is possible to use the Microsoft Excel spreadsheet editor for statistical data processing. This editor allows you to enter research data into spreadsheets, create formulas, sort, filter and group data perform quick calculations on a sheet of a table using the "Function Wizard". You can also perform statistical operations with tabular data if a data analysis package is connected to Microsoft Excel. The Microsoft Excel spreadsheet editor using the built-in chart wizard also makes it possible to build, based on the results of statistical data processing, various graphs and histograms, which can later be used at other stages of the study.

Information technology contributes to the registration, sorting, storage and processing of large amounts of information obtained during the experiment, observation, conversations, interviews, questionnaires and other methods of research activities. This allows you to save time, avoid errors in calculations and obtain objective and reliable conclusions from the experimental part of the work.

A data collection system is a set of tools designed to work in conjunction with a specialized computer, for example, a special server. It automatically collects information about the values of physical parameters at specified points of the research object from analog and digital signal sources, as well as primary processing, accumulation and transmission of data.

The data collection system forms a multichannel measuring device or a system of devices with a wide range of data collection, processing and analysis capabilities. On the basis of information-measuring systems, information-logical and information-computing complexes (automated system of scientific research) as well as information-diagnostic and information-controlling complexes and systems have been built. According to the method of interfacing with a computer, the data acquisition systems operate on the basis of embedded data acquisition boards with a standard system interface and on the basis of data acquisition modules with an external interface. Interfaces are used for groups of digital meters and smart sensors.

According to the method of obtaining information, data collection systems are divided into scanning, multiplex, multipoint, parallel, scanning. Thermal imagers, ultrasound machines, scanning tomographs and smart sensors are used. Each of the sensors is a single-channel data acquisition system with a dedicated interface. The multiplexer data acquisition system has individual means for analog signal processing for each measuring channel. It is the multiplex data acquisition systems that are actively used.

The data acquisition system includes sensors, an analog switch, an instrumentation amplifier, an analog-to-digital converter, a data acquisition controller, and an interface module. The system also includes a digital input-output line and a digital analog converter, internal universal data acquisition boards built into the computer, and external plug-in data acquisition modules. The subsystem includes a system for oscillography of fast processes and digital oscilloscopes; an automated control system for a physical installation; avionics system with interface.

A characteristic feature of the process of automation of experimental research is the use of a computer. This makes it possible to collect, store, and process a large amount of information, control an experiment in the course of its conduct, and simultaneously maintain several installations. Increased requirements for the speed of automated systems are assumed, since such systems are designed to quickly obtain and analyze data and make quick decisions.

An important role is played by high reliability, the possibility of long-term trouble-free operation, which is associated with an increase in the cost of experimental installations. As well as ease of operation and use of ready-made unified blocks. An interactive mode of operation is provided, when a person is directly connected with the system using a special language.

To control the system, a certain criterion is introduced that characterizes the operation of the system on average. This criterion can be the result of measuring a known value. If the values obtained are within acceptable limits, then the state of the system is considered satisfactory.

A computer, receiving data from the system, processes them and gives results so quickly that they can be used to influence the system, or the object of research. In experimental studies, a mixed mode is often used. Some of the data is processed in real time and used for monitoring and control. The main data array is recorded on a permanent carrier using a computer and processed after the end of data collection. The feasibility of such a regime is due to economic reasons. It is unprofitable to use high-speed expensive equipment that would have time to process the full array of data in real time. Fully automated data processing can be performed only in routine research to refine some constants, when the entire processing procedure and corrections are known.

When performing new research, it is difficult to foresee the specifics of measurements. Research can give unexpected results that need to be clarified or confirmed. To solve this problem, it is necessary to carry out preliminary data processing in the shortest possible time using approximate formulas, with worse accuracy than the final processing. The software of the automated system is developed on the basis of mathematical methods of data analysis. It is important to develop software that would be adequate for the research being performed and would not be too complicated.

A computational experiment is the calculation of a mathematical model of a phenomenon based on a scientific hypothesis. If the model is based on a rigorous theory, then a machine experiment turns out to be a calculation. In cases where the system becomes so complex that it is impossible to take into account all the connections, simplified models of the system are created and a machine experiment is carried out. It cannot serve as a proof of the model's truth, since it is based on a hypothesis that can only be verified by comparing the simulation results with experiments on a real object. But the role of a machine experiment is important, since it can result in the rejection of knowingly false options. It is also possible to compare different variants of the processes to be investigated according to the criteria.

If the data and control commands processed by the central processor are transmitted back to the measuring equipment, then we have an automated control system. She manages the experiment; preparation of reports and documentation; maintaining a database of experimental data.

The research time is reduced several times. The accuracy and reliability of the results is increased. The control of the experiment is strengthened. The number of participants in the experiment is reduced. The quality and information content of the experiment is increased by increasing the number of controlled parameters and more thorough data processing.

Research involves the registration of a large amount of data and the use of special algorithms for their analysis. The construction of an integrated information system makes it possible to automate the collection and processing of experimental data and to obtain more accurate and complete models of the objects and phenomena under study.

Building an automated research system is a complex and time-consuming process associated with information processing. Technologies for building systems of this class require a system analysis. Methods of mathematical modeling, data flow modeling, database design, cluster analysis, set theory, mathematical statistics and experiment are also used.

Any information can be considered as a search object. These can be telephones and addresses, information about goods and services, radio and television broadcasts. The most common search objects are the address of an information resource, a Web page and the elements included in it: text, multimedia data, hyperlinks, programs (applets), programs including: demo and test programs, tools for improving, updating and fixing errors in programs. And also messages in newsgroups, information from interactive databases, reference books, catalogs.

Search tools are search engines, local search tools, offline search utilities. Search directories play an important role. Global, local, specialized directories represent web-based databases with resource addresses. These databases can have a different amount of accumulated information. They are hierarchical. Each entry in the category list denotes a hyperlink. Clicking on it opens the next page of the search directory, where the selected topic is presented in more detail. As you continue to dive into the topic, you can go down to the list of Web pages and select the resource that is most suitable for solving the problem.

Search directories are created by highly skilled editors who select what is of interest and enter the addresses into the directory. The advantage of thematic catalogs is the great value of the information received by the user. Subject directories also have a drawback. Their databases cover only a small fraction of the entire Web information space. Search engines are represented by a server with a huge database of addresses. It automatically, around the clock, accesses the pages at all these addresses. He examines the content of these pages, forms and writes keywords from the pages to his database and indexes the pages. The server accesses all links found on the pages. A search engine can theoretically crawl all sites. To collect information about resources, it uses special programs called worms, spiders and crawlers. Each page found is analyzed for the title, subject, keywords, text, and composition of the Web page.

The search service produces a list of addresses that point to documents that match the user's request. Communication with the search service is carried out using the Web interface. The search service includes a Web interface, a search robot, a database management system. The search base stores links and key content of the relevant documents. A crawler robot is a program that automatically crawls Web resources, indexes for new ones, modifications to existing ones, and deletes old Web resources. As a result of scanning, the search base is updated. The search service produces a list of addresses that point to documents that match the user's request. Communication with the search service is carried out using the Web interface. The search service includes a Web interface, a search robot, a database management system. The search base stores links and key content of the relevant documents. A crawler robot is a program that automatically crawls Web resources, indexes for new ones, modifications to existing ones, and deletes old Web resources. As a result of scanning, the search base is updated. The robot is scanning Web resources; filling the database. A special form is used to indicate the request. The effectiveness of a search engine is reduced to the volume of search bases, and is also determined by the effectiveness of the algorithm for ranking documents, the presence of a query language. The query language assumes a set of commands that allow the user to refine the search query and get more accurate results for their query.

The automatic index has a separate search engine to provide a user interface. This system can, by scanning the database, for a given set of keywords, find and display on the user's computer screen addresses and brief information about all Web pages that contain this set of keywords. An automatic index consists of three parts: a robot program that the database robot collects and an interface for searching that database.

The user works with the interface. The automatic index does not classify or evaluate information. The task of the search engine is to find information that meets the information needs of the user. It is important as a result of the search conducted to find documents related to the request. A qualitative characteristic of the relevance of the search procedure has been introduced. This is the correspondence of the search results to the formulated query. Webmasters want to increase the ranking of their pages, and this is understandable: after all, for any request to a search engine, hundreds and thousands of links to documents that correspond to it can be issued.

The size of a search engine is determined by the number of indexed pages. Some search engines immediately index a page at the request of a user, and then continue to index pages that have not yet been indexed. Some search engines show the date when a particular document was indexed. Server pages appear earlier in the indexes of search engines, if they are explicitly specified. If at least one server page is specified, then search engines will definitely find the following pages by links from the specified page. However, this takes longer. Some machines index the entire server at once, but most, by writing the specified page to the index, leave the server indexing for the future.

Indexing depth shows how many pages after the specified page the search engine will index. Most search engines do not have restrictions on the depth of indexing. If the search robot does not know how to work with frame structures, then many structures with frames will be missed during indexing. Password protected directories and servers may be indexed by some search engines. Search engines can determine a document's popularity by how often it is linked on the web. If the server is updated frequently, the search engine will re-index it more often.

Indexing control shows what means can be controlled by a particular search engine. Some sites redirect visitors from one server to another. Some search engines do not include certain words in their indexes or may not include those words in user searches. These words are usually considered prepositions or very often used words. And do not include them in order to save space on the media. Search engines make sure to use the location and frequency of keywords in the document. However, the additional mechanisms for increasing relevance are different for each vehicle. Search engines should consider metadata when indexing pages. In practice, not everyone does this.

A classifier is similar to a directory, but unlike a directory, it is not tasked with collecting as much information as possible about network resources. The best sites are presented for each of the categories included in the classifier. The counter is working. After choosing a topic of interest, the user receives a list of Web sites devoted to this topic, and their popularity rating, which is measured in the number of visits over the last day. Rating involves sorting links in the order of their attendance.

Metasearch engines provide simultaneous searches for each query using multiple search engines. Such systems only allow simple search queries. This saves time. The results are worse than doing an independent search on each search engine using advanced features. Databases of different search engines do not overlap. Therefore, to search for rare information, it is advisable to refer not to one, but to several search engines.

In order not to turn to different search engines in turn and not to think about specific rules for filling out a request for each of them, metasearch engines were created. Having accepted a customer's order, specified using keywords in accordance with its own rules for its registration, the metasearch system will register it itself in the forms of various search engines, send out these forms and wait for a response. When all search engines send their search results, the metasearch program will combine them into one document and send them to the user. Standalone browsers can be useful for searching, which load Web sites without user intervention. In such programs, you can set the depth of the search for links within the site, the type and size limit of copied files, the download schedule. You can speed up manual searches by using Web site analysis tools. They provide an easy-to-use navigation map of a site that shows annotated Web page elements and their relationships.

Data collection is facilitated by modeling. It is relevant for the study of a projected system at stages when it does not yet exist. In the process of creating and operating the system for obtaining information that supplements the results of field tests, and helps to answer the questions that arise at these stages.

The objects of modeling can be processes, phenomena, objects of the real world, the system being created. These are applied models. There are also a large variety of models in the information domain that are instrumental models. Any program will be a model. There are models of data, knowledge, processes. Data is a modification of information presented in a certain form, which makes it possible to automate its collection, storage and further processing by a person or information medium. For computer technologies, data is presented as information in a discrete, fixed form, convenient for storage, processing, and also for transmission through communication channels. New formats of data organization are being developed, which allow not only storing information in a convenient form, but also provide data processing tools.

Depending on the presence of a clear structure in the data, structured data are distinguished, represented as data sets of certain types, and semi-structured and unstructured data, which require special software to work effectively. One-dimensional datasets contain only one characteristic for each object. This data allows you to determine the typical value of a characteristic, how much the values differ from each other, whether individual data require special attention.

2D datasets contain information about two characteristics for each of the objects. They contain the ability to obtain two sets of one-dimensional data, allow you to establish whether there is a relationship between two variables, how strongly the variables are related, whether it is possible to predict the value of one variable from the value of the other. Multidimensional data contains information about three or more attributes for each object. They can be used to obtain information about whether there is a simple relationship between these features, how interrelated they are, whether it is possible to predict the value of one variable based on the values of the others.

The values of variables that are recorded using numbers that have meaningful meaning are called quantitative data. A discrete variable can only take values from a certain list of specific numbers. Any variable that is not discrete will be considered continuous. It takes values from a certain interval. Data that records a certain quality that an object possesses is called qualitative data. Qualitative data are ordinal, for which there is a meaningful order, and nominal, for which there is no meaningfully interpreted order.

If the order in which data values are recorded in time has meaningful meaning, then these data are said to represent a time series. These data represent information about the object at different points in time. If the order of data recording in time is not essential, then they speak of one time slice. Raw Tier 0 data is reconciled and corrected to Tier 1 datasets, which are combined with other data to produce Tier 2 datasets. Most of the analytic work takes place on these Tier 2 datasets. If the data was collected specifically for planned analysis, it is called raw data. If the data was collected previously for other purposes, then this is secondary data.

Scientific data look like logically organized information obtained in the process of scientific knowledge and reflecting the phenomena and laws of nature, society and thinking. Scientific data impose certain requirements on the technologies for their processing and storage. They are of high volume and high quality.

To ensure the conditions for fulfilling the requirements, scientific data centers have been created that provide access to both data and applications that analyze data, develop as service stations for a certain scientific field. Each of these centers manages one or more massive datasets, as well as applications that provide access to these datasets, and maintains staff who understand the data and continually add and improve the datasets.

Metadata is used to describe scientific data. This is descriptive information about the data that explains the measured attributes, their names, units of measure, precision, data format, etc. Metadata includes information about the origin of the data, describing how the data was measured, obtained or calculated. Part of the metadata is generated automatically, reducing the intellectual burden on the scientist. Most scientific data are presented in the form of an array. With specialized technology focused on working with arrays, it is possible to outperform a system in which arrays are modeled using tables, so they create their own formats for scientific data.

Scientific users avoid commercial database management products, preferring to use specialized solutions.

There are specialized formats for the presentation of scientific knowledge. Scientific file formats provide minimal tools for searching and analyzing tabular data. The main purpose of these standards and tools is to provide the ability to place tables and subarrays in the address space of software environments in which data can be manipulated using a programming language. In each discipline, definitions of common terminology appear in the form of ontology.

In addition to standardization, computer-usable ontologies across applications are combined at the semantic level.

Procedure-oriented algorithmic languages, problem-oriented languages or automated modeling systems are used as software systems for modeling systems. It is a modeling tool covering the areas of both discrete and continuous computer modeling, with a high level of interactivity and visual presentation of information.

Checking the adequacy of the model to the system consists in analyzing its proportionality with the system under study, as well as its equivalence to the system. The adequacy of the models is checked by checking the laws that are valid for the studied models, or by matching the structure of the mathematical and machine models, matching the behavior of the modeled and the real system, and interpreting the results correctly. In practice, the assessment of the adequacy is carried out by means of an expert analysis of the reasonableness of the modeling results.

Experimental research continues the theoretical stage. Before the organization of experimental research, tasks are developed methods and programs of the experiment are selected. Its effectiveness essentially depends on the choice of measuring instruments. The accepted methodological decisions are formulated in the form of guidelines for the experiment. After the development of research methods, a work plan is drawn up, which indicates the amount of experimental work, methods, technique, labor intensity and terms.

The setting and organization of an experiment is determined by its purpose. Experiments differ in the way the conditions are formed, in the objectives of the study, in the organization of the conduct, in the structure of the objects under study and also by the nature of external influences on the object of research, by the nature of the interaction of the means of experimental research with the object of research. The type of models, controlled values, variable parameters, research tools are taken into account.

Computational experiment means a method of mental experimentation with models of complex real processes and technical systems, expressed in the language of mathematics. The aim is to test empirical generalizations, hypotheses, theories and heuristic identification of some laws of nature. A mathematical experiment is similar to mathematical modeling in that a mathematical model is constructed, then an approximate numerical method for solving the problem is found, programming, computer calculations, analysis and interpretation of the results obtained during the study of the constructed mathematical model.

A mathematical experiment differs from mathematical modeling in that the calculations are repeated again, but with a new model, until a mathematical model is found that best describes the processes under study. A mathematical experiment involves experimenting with models. Modeling goals are achieved by researching the developed model. Research consists in conducting experiments, as a result of which the output characteristics of the system are determined for different values of the controlled variable parameters of the model.

The planning of experiments in numerical and statistical computer simulation is gaining in importance. This is justified by the large number of possible combinations of the values of the controlled parameters. The experiment is carried out with a certain combination of parameter values. With limited computing and time resources, it is not possible to carry out all the experiments. It becomes necessary to select certain combinations of parameters and the sequence of experiments. This is called strategic planning.

The development of the plan begins in the early stages of model creation, when the quality characteristics and parameters are identified with the help of which it is supposed to control the quality of the system functioning. These parameters are called factors in the theory of planning experiments. Then the possible values of quantitative parameters and variants of qualitative functional parameters are highlighted. They are called levels. If the number of factors is large, then one of the methods of drawing up a plan for incomplete factor analysis is used to conduct system studies. These techniques are well established in experiment planning theory. Careful planning of experiments in the study of nonstationary systems acquires importance in connection with the need to significantly increase the total number of experiments.

The duration of one experiment is influenced by the degree of stationarity of the system, the interdependence of characteristics, and the value of the initial conditions of simulation. Most of the simulation models are used to study steady-state equilibrium modes of operation. In the initial period of operation of the system or its model, there is a transient regime even with unchanged values of the parameters of the input actions. The duration of the transient can be long.

The values of the output characteristics, measured during the transition period, bias their overall estimates. There are three main methods for reducing the initial error. The first is to increase the simulation period sufficiently. With an increase in the number of measurements, the influence of the initial bias on the statistical estimate tends to zero. The second method is to start collecting statistics not from the beginning, but after some time. The third method is to initialize a specially specified state close to the steady state. The first two methods lead to an increase in the duration of the experiment and do not guarantee a decrease in the error, since the duration of the transient mode is not known a priori. The third method can be used if there is information about a suitable initial state.

Subsequent experiments may use updated information from previous experiments to set initial states. When simulating non-stationary systems, the steady state may be completely absent. A natural method for determining the characteristics of simulation of non-stationary systems is the method of repeated experiments. In this case, the number of experiments increases significantly. This leads to special planning requirements. Computational experiment combines analytical and simulation components. The first is associated with the implementation of the identified patterns of the object in the digital model, and the performance of computational operations. The second is associated with the imitation of the unexplored sides of the object, and the imitation of the external interacting environment of the object. The organization of experiments is iterative. As the simulation and analytical experiments are carried out, the algorithmically digital model of the object is refined and generates a number of new experiments and analyzes with the processing of the results.

After the completion of theoretical and experimental studies, a general analysis of the results obtained is carried out the hypothesis is compared with the experimental results. As a result of the analysis of discrepancies, theoretical models are refined. Additional experiments are carried out if necessary. The stage implies the need to compare the theoretical and experimental stages of scientific research for the final confirmation of the hypothesis and further formulation of conclusions and consequences following from it. The result is negative then the hypothesis has to be rejected. In statistical modeling, a simulation experiment measures sets of values for each output characteristic. These samples need to be processed for the convenience of subsequent analysis and use. Since the output characteristics are random variables or functions, processing consists in calculating estimates of mathematical expectations, variances and correlation moments.

The estimates obtained as a result of statistical processing of the measurement should be consistent, unbiased and efficient. In order to eliminate the need to store all measurements in the machine, processing is carried out according to recurrent formulas, when estimates are calculated in the course of the experiment by the cumulative total method as new measurements appear. For stochastic characteristics, it is possible to construct a histogram of relative frequencies in the form of an empirical distribution density. For this purpose, the area of assumed values of the characteristic is divided into intervals. During the experiment, as measurements are taken, the number of hits of the characteristic in each interval is determined and the total number of measurements is calculated.

After the end of the experiment, for each interval, the ratio of the number of hits of the characteristic to the total number of measurements and the length of the interval is calculated. For the constructed histogram, you can try to find a theoretical distribution law. When preparing the initial modeling data, the desired characteristic is a stationary random function of time and has the property of ergodicity. To estimate it, the calculation of the average over time is replaced by the calculation of the average over a set of measurements in one sufficiently long experiment.

For random non-stationary characteristics, the simulation period is divided into segments with a constant step (runs or sections). The characteristic values are memorized at the end of each run. A series of experiments is carried out with different sequences of random parameters of the model. Then the measurements of each section are processed as when evaluating random variables. The processes of processing the measurements of the simulation experiment are aimed at obtaining integral characteristics, at data compression. Based on the results of statistical modeling, an analysis of the dependences of the characteristics on the parameters of the system and external influences can be carried out. To do this, you can use correlation, variance or regression methods.

Correlation analysis can be used to establish the presence of a relationship between two or more random variables. The correlation coefficient serves as an estimate of the relationship in the presence of a linear relationship between the quantities and the normal law of their joint distribution. The correlation coefficient equal to one in absolute value indicates the presence of a functional non-stochastic linear relationship between the analyzed values. If the correlation coefficient is equal to zero, there is no connection. Intermediate values of the correlation coefficient correspond to the presence of a linear relationship with scattering or non-linear correlation. Analysis of variance can be used to establish the relative influence of various factors on the values of the output characteristics.

The total variance of the characteristic is decomposed into components corresponding to the factors under consideration. According to the values of individual components, a conclusion is made about the degree of influence of one or another factor on the analyzed characteristic. When all factors in an experiment are quantitative, an analytical relationship between characteristics and factors can be found. For this, methods of regression analysis are used. The found dependence is called an empirical model. Regression analysis consists in choosing the type of relationship between the dependent and independent variables. According to the experimental data, the parameters of the selected dependence are calculated and the quality of the approximation of the experimental data by the model is estimated. If the quality is unsatisfactory, another type of dependence is taken, and the procedure is repeated. The analysis of simulation results includes the problem of analyzing the sensitivity of the model to variations in its parameters.

Sensitivity analysis involves checking the stability of the system characteristics to possible deviations in parameter values. Analysis of the simulation results makes it possible to clarify many informative parameters of the model. This can lead to a significant change in the original appearance of the conceptual model. This makes it possible to create analytical models of the system, to determine the weighting coefficients of the efficiency criterion.

Knowledge is the result of scientific research. They have undergone multiple checks of the research results by observations and experiments, access to statistical data. They are characterized by consistency, compliance with empirical data; the ability to describe well-known phenomena; the ability to predict new phenomena, facts. The validity of the research results is achieved by basing on the strictly proven and correctly used conclusions of the fundamental and applied sciences, the provisions of which have found application in the work;

complex use of well-known, practice-tested theoretical and empirical research methods. And also an indication that the solution of a number of new problems became possible thanks to the well-known achievements of certain scientific disciplines and does not contradict their provisions, and the methods are consistent with the experience of their creation and further improvement.

Justification of the results is carried out using well-known design procedures, methods for finding technical solutions, as well as physical and mathematical modeling; verification of theoretical provisions and new solutions, ideas by experimental research, which must be metrologically provided; - comparison of experimental and test results with known experimental data on the same problems. The necessary completeness of the solution of the problem is achieved by experimental verification of the theoretical provisions of the study, as well as the consistency of our own experimental data with the experimental data of other researchers.

The sufficiency of the solution lies in the consistency of the experimental data obtained by the researcher with the known theoretical positions of other authors and with substantiated and consistent theoretical solutions obtained by the author personally. The results are considered true if they are obtained with the help of correct logical conclusions and proofs. The final work contains an abstract and an abstract with a summary of the research tasks and the results obtained an introduction with a description of domestic and foreign achievements on the topic under study. Justification of the chosen solution method is assumed. Calculations and experimental results are presented in a form that makes it possible to analyze the validity of the results obtained. Conclusions are given with a comparison and analysis of theoretical and experimental data obtained in the process of research and a conclusion with an assessment of the results and an indication of the ways of their use. The evidence base of the study is included in the appendixes. These are detailed proofs, tables with the results of experiments, graphs, diagrams.

Specific requirements for the design of a scientific article are published in each scientific journal. The volume of the article ranges from 3 to 10 pages. Smaller text refers to theses, messages. The scientific report should contain an introduction, research methods and techniques, the results obtained conclusions and conclusions. The introduction substantiates the relevance of the research by determining the importance of the subject area, indicating insufficiently satisfactory previous solutions to problematic issues, and, as a consequence, formulating the goals and objectives of the new research.

The features of the constructed models of the investigated object, the main estimated parameters of the models are indicated. The results of mathematical experiments are shown in the form of generalized functional dependencies. Conclusions are formulated in the form of short numbered abstracts.

The introduction of fundamental and applied scientific research into production is carried out through developments carried out in experimental design bureaus, design organizations, pilot plants and workshops. Developments are formalized in the form of experimental-technological or experimental-design work, including the wording of the topic; development goals and objectives; study of literature; preparation for the technical design of an experimental sample; technical design. Development of technical design options with calculations and development of drawings is carried out; production of individual blocks, their integration into a system; approval of the technical project and its feasibility study.

A detailed study of the project is in progress; a prototype is being manufactured; it is tested, fine-tuned and adjusted; bench and production tests. The prototype is being finalized through the analysis of production tests, alteration and replacement of individual units. Successful completion of the listed stages of work makes it possible to submit a sample for testing, as a result of which the sample is mass-scaled. The implementation is completed with the registration of an act of economic efficiency of the research results.

The preliminary economic effect is calculated at the stage of a feasibility study of the feasibility of staging studies on aggregated indicators for the expected implementation object. The expected economic effect is calculated at the stage of completion of scientific research based on the results of research and development and regulatory indicators for the planned volume of implementation. The expected economic effect can be expressed as a percentage based on expert estimates. The actual economic effect is calculated after the implementation of the development according to the actual indicators of the reporting year and the current standards of the organization that carried out the implementation.

The potential economic effect reflects the amount calculated according to aggregated indicators for the possible volume of implementation. The effectiveness of the research of the team and the individual employee is assessed in different ways. The effectiveness of the work of one researcher is assessed by the number of publications, the novelty of developments. The effectiveness of a research group is assessed by indicators of economic efficiency and labor productivity, the number of implemented topics, copyright certificates and patents.

Decision support technologies take a special place. Professional mathematical packages include programs and software packages that have tools for performing various numerical and analytical mathematical calculations, from simple arithmetic calculations to solving partial differential equations, solving optimization problems, testing statistical hypotheses, constructing mathematical models and other tools necessary for carrying out various technical calculations. They have advanced scientific graphics, a convenient help system, and reporting tools. There are many programs that can support scientific research and assist in experiment design, data acquisition and data processing.

2.11 2.11. Digital Libraries

Providing users with intellectual resources in the form of information and knowledge are the most important forms of library activity. But libraries are not monopolists in this mission. Users now have a choice between library and telecommuting services. There are online e-book stores, video hosting resources that work on content. Search giants, the network encyclopedia Wikipedia, social networks (LiveJoumal, MySpace, Odnoklassniki, Vkontakte, Moy Mup@mail.Ru) settled there.

The question arose of how to properly legally secure the availability of library services, the carriers and protectors of which are libraries and librarians, and the private interest of authors and copyright holders in obtaining legitimate dividends from their intellectual rights. There is a development of information and communication technologies, technologies of librarianship, work with scientific and technical information, algorithms, methods of tracking new information, its selection, storage, classification, indexing and providing consumers with access to it are changing significantly.

Information is concentrated in digital format in a much smaller number of storage locations. The development has complicated the relationship of holders of electronic collections of scientific and technical information (electronic libraries) with copyright holders. Publishers see fair use as an open door for action that will undermine their financial viability. Librarians, on the other hand, are concerned that new technologies will be used for commercial interests, and will create conditions under which copyright holders can establish control over access to information, leading to a total monopoly on intellectual property.

In the 21st century, the legal field that defines the framework for the legitimacy of the activities of libraries is expanding. The number of problems arising in library activities and having legal parameters of their resolution is also increasing.

In a QR code, a librarian can encrypt information about a book, links to electronic resources, a virtual tour of the library, including an audio tour, links to virtual representations of the library, a website, blog, wiki, social networks. Media allows the librarian to become more accessible to the user. A video channel on Youtube allows you to share reporting data, create training materials, promote reading and library services. The viral dissemination of information allows you to increase the reach of the audience on the Internet and attract a physical visitor to the walls of the library.

Mobile applications, differing in their functionality, are becoming a full-fledged toolkit for working in projects. They provide quick solutions to problems, the creation of final products. Users learn to work effectively with electronic library systems applications. These systems provide content delivery. And also correctly search for information on the network, critically assess its reliability; create products using mobile applications; use applications to solve educational problems; to work harmoniously and productively in a team in real and virtual spaces.

Robots are involved in librarianship. A robot's neural network is a combination of data from an integrated library system and a search service. A general policy for the provision of mobile information services has been formed and a certain set of services has been developed. More opportunities for communication and without paying for using the service, in addition to the cost of Internet traffic, are provided by instant messengers. Viber and Telegram offer their subscribers a full-fledged version for a desktop computer, not tied to a telephone set. These are widely used online consulting modules on the site. A communication option is the so-called bots in the Telegram messenger. The interlocutor is a robot who can answer the right questions. The library can create a program that, in response to a request for a book, will inform about its availability in the collection.

Wi-Fi in a library offers not only a way to provide free access to the network, but also access to the library's subscription resources on the user's mobile device. The presence of an authorization form allows you to directly redirect the user to resources. A redirection option from the authorization page on the wireless network is the library website. It is important how the page will be displayed on the screen of the mobile device. The optimal approach is achieved by opening the mobile version on the phone with the obligatory preservation of the ability to switch to the full version. Sometimes the site uses technologies that cannot be reproduced on most mobile devices. To ensure that users do not have any problems with viewing, when they enter from a mobile device, they are shown a pdf version.

YouTube video hosting is an important tool for posting, publishing and popularizing video materials from libraries. The creation of their own video channel has given libraries an increase in the number of users. A free "Academy for Authors" has been created to educate and improve the skills of YouTube channel owners.

When planning your work on the network, you need to focus on the content plan - a schedule, a list of materials prepared in advance for publication in the community. It is better to have permanent columns or series of publications. You can create content calendars. For example, an editorial calendar which brings together all the content in one document. There is a social media content calendar. It includes all media posts that can be used to promote content, organized by date and time.

Content curation involves finding, collecting and displaying content on a specific topic. These are RSS aggregators for reading blog and site updates, social bookmarking services that save and organize links to Internet resources, content aggregators that present it in the form of an online newspaper. Tools for curation of visual content provide a simple and convenient service where you can create thematic pages, a kind of electronic journal, in which you can post materials offered by the service itself or found yourself. The application editor allows you to search for articles and multimedia on a topic of interest in social networks.

Content reflects any content of something. It can be text, audio, video, photos and pictures, infographics, presentations, webinars. It is desirable to have a common idea of publications, emphasize a distinctive feature or find an unusual approach. Additional services and tools can help you create content. These are services for working with text. Among them are a service for checking spelling, punctuation and stylistics, a service for checking spelling and uniqueness of text, checking shows duplicates and rewriting.

The editorial service helps to make the text clear and specific, is able to highlight words that do not carry meaning, obscure the content and make it difficult to understand. Services for posting publications on the Internet allow you to download files of the main formats - Microsoft Office, OpenOffice, Adobe PDF. Works can be inserted into a website or blog.

Services for creating a word cloud allow you to create a word cloud without registration from the entered text or link. Once a cloud is created, you can download it as an image or share it using a link. Info graphics allow you to visually present the figures of statistics, information, data. Services for creating interactive images allow you to create play casts (compositions consisting of a picture, text and a music file, which are related to each other by a specific theme, are a kind of musical cards). In this form, you can present information about books.

Service is for managing publications. It is a free information system that allows you to set up automatic publishing of content to library representations on social networks. You can create your own one-time publications. Use public sources already available in the system, or private collections created by a particular library, to which only she has access. Each entry can be published at the appointed time or use the resource's capabilities. The system updates the message.

Analytics and monitoring services collect in one place information from a number of social networks based on the user's search query. You can determine, for example, for the annual report, how many posts are published in the community. When choosing online tools, it is advisable to pay attention to: complexity (quick registration, there are instructions or a guide to action), security (availability of contact information, license agreement), availability of technical support and support for the necessary social networks.

Event technologies provide an efficient method for creating custom library events. A library blog is successful when it has new readers who come back after the first visit. The virtue of virtual book exhibitions reflects the ability to present publications without removing them from the shelf, without limiting the lifetime of the exposition itself. You can use Microsoft Office PowerPoint 2010 to create an interactive exhibit.

3 3. PHILOSOPHY OF NATURAL SCIENCE AND TECHNOLOGY

3.1 3.1. Natural science aspects of information

These aspects are studied by the natural sciences. These include astronomy, biology, geography, geology, chemistry and physics. Astronomy bases the collection of information on optical systems, radio telescopes, technical devices in a wide wavelength range. One of the key problems is the construction of powerful optical telescopes and radio telescopes on Earth, as well as the placement of telescopes in space orbits. Another area of research development is the automation of the processes of collecting and processing information. Computer modeling is actively used, in particular, in studies of black holes, quasars and neural stars.

The subject of biological informatics is information processes in biological systems, living organisms and plants. The phenomena of information interaction that occur in the process of functioning and development of objects of living nature are studied. The study of these phenomena by methods of informatics will allow not only to reveal the fundamental laws, but also to use them when creating means of technical informatics.

In geography, information technologies play an important role in the form of computer modeling of ecological processes in the biosphere. In geology, computer modeling of geological processes is used, and promising geological territories of minerals are determined.

In chemistry, the structures of the synthesis of chemicals with specific functions of application in industry, medicine, and the agricultural sector are modeled. Physical informatics and information patterns of the development of inanimate nature are in the spotlight, since they form the applied topics of nano-technology and biotechnology.

A period of development of informatics as an interdisciplinary scientific direction, which will perform the integration functions of science, is coming. Ideas and methods of fundamental informatics have become widespread in systems theory, synergetics, general physics, quantum mechanics, theoretical biology, physiology, and genetics. The phenomenon of information manifests itself in different ways in various information environments, in those specific conditions in which information processes take place.

Mechatronics received an impulse for development. This is a new technical science that studies methods of creating and functioning of autonomous subminiature cybernetic devices and robots. Qualitatively new and socially significant results should also be expected from the development of industrial production of flexible biological screens for displaying information. Their application in the field of education will allow the use of new pedagogical technologies focused on more active work of the right hemisphere of the human brain, which is responsible for spatial imagination and figurative thinking.

Bioinformatics is at the “junction” of physical and mathematical, biological, medical and agricultural sciences. It covers a wide range of problems and therefore is rightly regarded as one of the most important directions in the development of science in the 21st century. The development of physical informatics presupposes the formation of quantum informatics. This is a new scientific discipline that studies the laws of information processes at the quantum level.

A quantum computer uses the phenomena of quantum superposition, quantum entanglement, to transmit and process data. It operates not with bits (capable of taking the value either 0 or 1), but with qubits that have values of both 0 and 1 at the same time. This makes it possible to process all possible states at the same time. So far, we are talking about creating a similar generation of computers based on quantum theory in the field of many particles and complex experiments. Developments in this area are associated with the latest discoveries and achievements in physics. Only a few experimental systems have been implemented that execute fixed algorithms of low complexity. Paul Benioff proposed a quantum mechanical model of the Turing machine in 1980. One of the first models of a quantum computer was proposed by Richard Feynman in 1981. Paul Benioff described the theoretical foundations of building a quantum computer. The need for a quantum computer arises when the problem is posed to investigate complex multiparticle systems similar to biological systems using the methods of physics.

The space of quantum states of such systems grows exponentially. A quantum computer does not use conventional (classical) algorithms to compute, but quantum algorithms that use quantum parallelism and quantum entanglement. The quantum processor at each moment is simultaneously in all basic states. A quantum state is called a "quantum superposition" of these classical states. If the classical states are the spatial positions of a group of electrons in quantum dots controlled by an external field, then the unitary operation is a solution of the Schrödinger equation for this potential. Measurement is a random variable. This is Born's quantum mechanical rule. Measurement is the only way to obtain information about a quantum state. Measurement of a quantum state cannot be reduced to unitary Schrödinger evolution, since it is irreversible. When measuring, a collapse of the wave function occurs, the physical nature of which is not clear. Spontaneous harmful measurements of state during computation lead to decoherence, to deviation from unitary evolution. This is the main obstacle in building a quantum computer.

Quantum computation is a sequence of simple unitary operations controlled by a classical control computer on one, two or three qubits. At the end of the computation, the state of the quantum processor is measured. This gives the desired computation result. The gain in quantum algorithms is achieved due to the fact that when using one quantum operation, a large number of superposition coefficients of quantum states, which in virtual form contain classical information, are simultaneously transformed. Physical systems realizing qubits can be any objects that have two quantum states: polarization states of photons, electronic states of isolated atoms or ions, spin states of atomic nuclei.

A simplified scheme for computing on a quantum computer can be described as follows. A system of qubits is taken, on which the initial state is recorded. Then the state of the system or its subsystems is changed by means of unitary transformations that perform logical operations. At the end, the value is measured. This is the result of the work of the computer. The role of wires in a classical computer is played by qubits. Unitary transformations play the role of logical blocks of a classical computer. The concept of a quantum processor and quantum logic gates was proposed in 1989 by David Deutsch. In 1995, he found a universal logic block with which any quantum computation can be performed. Two basic operations are sufficient to construct any computation. The quantum system gives a result that is correct only with some probability. But due to a small increase in operations in the algorithm, you can arbitrarily bring the probability of obtaining the correct result closer to unity.

Basic quantum operations can be used to simulate the operation of ordinary logic gates that ordinary computers are made of. Therefore, any problem that is solved now, any quantum computer will solve, and in almost the same time. Most modern computers operate in the same way. In theory, the new circuit can work much faster than the classical circuit.

Thanks to its tremendous prime factorization speed, a quantum computer will be able to decrypt messages encrypted by the widely used RSA cryptographic algorithm. This algorithm is considered to be reliable, since an efficient way of factoring numbers into prime factors for a classical computer is currently unknown. Quantum computers are in theory suitable for machine learning. They manipulate large amounts of data in a single pass and are capable of simulating an exponential-sized neural network. With the help of quantum computers, accurate modeling of molecular interactions and chemical reactions will be possible. Chemical reactions are quantum in nature. For classical computers, the calculation of the behavior of only relatively simple molecules is available. Only limited versions of a quantum computer have been built. The largest constructed quantum registers have several dozen coupled qubits.

The practical implementation of a quantum computer is based on manipulating at the microscopic level and with tremendous precision a multielement physical system with continuous degrees of freedom. Obviously, for a sufficiently large system, quantum or classical, this task becomes impossible, which is why such systems are moving from the conduct of microscopic physics to the field of statistical physics. As logical qubits, either charge states (the presence or absence of an electron at a certain point) or the direction of the electron and nuclear spin in a given quantum dot are used. Control via external potentials or laser pulse. The presence / absence of a Cooper pair in a certain spatial region are also used as logical qubits. The ground excited state of an external electron in an ion is used as logical qubits. Control is provided by classical laser pulses along the trap axis or directed at individual ions plus vibrational modes of the ion ensemble. Optical technologies: the use of the generation of quantum states of light, fast and reconfigurable control of these states and their detection.

The main problems associated with the creation and use of quantum computers: it is necessary to ensure high accuracy of measurements; external influences (including the transmission of the results obtained) can destroy the quantum system or introduce distortions into it. The more qubits are in a bound state, the less stable the system is. The question of to what extent such a device can be scaled (the so-called "scaling problem") is the subject of an intensively developing field of many-particle quantum mechanics. The central issue is the collapse of the wave function, which still remains open. Single-qubit quantum processors, controlled two-level systems, which could be assumed to be scalable to many qubits, have been created.

3.2 3.2. Information in the structure of engineering activities

For engineers, the fact is obvious that the development of information technology is not limited to the penetration of connected devices into all areas of activity. It is important to form a technology ecosystem in which solutions for collecting, transferring and analyzing data circulate on a platform that allows you to extract knowledge and use it to implement solutions.

The development of information technology is determined by several trends. First, the cost of computing power has dropped. Processors, memory, and storage are cheaper. Secondly, data transmission costs have decreased. Companies have invested in processing systems. Thirdly, there is a rapid growth in the number of connected devices and sensors. Fourthly, cloud technologies provide flexibility for storage and analysis as the amount of accumulated data increases.

A technology ecosystem, a set of relevant tools and a platform allows you to use data to implement smart solutions. The creation of such largely depends on the effectiveness of the introduction of technologies and the benefits that companies representing a particular field of activity expect. The effectiveness of this work depends on the technical departments. They function in the structure of corporate organizations. Their task is to protect current operations through gateways and data encryption.

The intersection of digital ecosystems is used. For example, cash payment programs have transformed into a full-fledged element of the ecosystem of mobile, social, information and banking services. The Internet of Things has also become an ecosystem as a number of applications interact with each other. Access to one ecosystem makes it possible to connect to other network components, expanding the customer base with new sources of information.

The nature of the digital ecosystem precludes focusing solely on securing a central database, as this tactic limits the company's ability to exploit new opportunities. Digital adaptation provides for the simultaneous convergence of external technologies, means of protection and methods of managing technological protocols

It is important for engineers to use a simplified version of the company's technological architecture based on microservices and application programming interfaces (APIs), which will allow third parties to connect to the new ecosystem. On the app platform, consumers will be able to choose the options they want when they have robust data privacy tools.

Ideally, all services should be connected into a single ecosystem that will offer the user a package of services through the universal technological backbone of the telecommunications company. Cloud development creates the ability to create authoring applications.

The internalization of external information technology systems focuses on analyzing the internal technological resources of an enterprise in order to connect the external capabilities available in the ecosystem to improve customer service, maintain a corporate atmosphere, or create new products, often through software services and application programming. This allows a third-party POS application to be included in the firm's internal payment systems to facilitate online shopping. Implementation of a third-party customer support chat feature on a company website.

The challenge for engineers is to think about how external, already available services can be used by internal assets of the enterprise to create a new unique market proposition. It is important to complement the developed current processes with external specialization by changing the structure of information technology applications.

It is the responsibility of engineers to test new technologies so that they can be prepared to use them if positive results are achieved. Their role is great in the formation of partnerships and alliances with suppliers of software or other digital services in order to adequately assess the usefulness of technology in a particular industry.

To this end, financial services companies have formed internal corporate venture funds to promote tools such as block chain and the Internet of Things.

When developing a technology platform, it is important to take into account the economic objectives of the corporate structure. The company's master data management catalog should be expanded to include information from third parties, as well as care should be taken to introduce uniform database management standards.

In the case of a technical call from users, it is very problematic to identify the location of the points of failure in the digital ecosystem, which will require the enterprise to restructure the infrastructure support processes. Agreeing on service principles with clear protocols for resolving conflicts and escalating risks is paramount to the stability of the enterprise. The creation of standard identifying tags, as well as their implementation in existing services of the digital ecosystem and third parties, is valuable for quickly identifying problems and making appropriate adjustments.

Increasing the internal information technology infrastructure through the inclusion of third-party partners and vendors involves the development of a new set of cyber security standards that clearly define the integration process itself and the types of data available for exchange. Working with a wide range of third parties involves other legal issues. There are already known licensing issues between cloud providers and local firms due to competing business models. Resolving conflicts requires negotiation skills and a wide range of information technology standards to avoid the constant rethinking of internal systems due to the emergence of a new partner.

Forging partnerships with a network of suppliers requires changes in skills certification and performance management. It is important to clearly define the rules and procedures by which suppliers are required to operate, with the introduction of the guidelines into the partner's internal policy. The digital environment provides for more active interaction with the outside world to understand competitive threats and price policy factors. Therefore, wasting time developing complex and confusing IT systems is counterproductive. You should start by building an external application that is compatible with the internal IT infrastructure, while testing online platforms should not take more than a few weeks.

As banks and companies rely on tools from external ecosystems, people with expertise in third-party software and experience in integrating technology into internal company resources are important. The presence of such experts is essential to bridge the imbalance between an organization's business objectives and the technological requirements of the digital ecosystem. Many companies have outsourced their integration functions, but given the value of design and automation skills, firm leaders are rethinking legacy tactics in favor of building an in-house IT architecture team.

Integration of the company's internal IT systems with external digital resources opens up new horizons for obtaining significant competitive advantages and scaling its own activities. Until IT departments expand into digital ecosystems, most of the opportunities will remain unrealized. Ecosystem means the interconnection of all the services of a company with each other. All devices are connected to each other by a common design, IT platform, services, accessories, stores. All brand elements are united by a single value.

The design and development of the product was dominated by the concept of developing platforms to increase their functionality without creating unnecessary things. Companies created value by allowing other companies to use their products or create new products based on their services. Thanks to this, most of the large companies were formed. But platform methodology has boundaries. The main idea of the platform is to allow third parties to use the infrastructure as a vehicle for the distribution of value. However, this creates limitations. A good idea may not be implemented on existing platforms due to their locality. To overcome this limitation, information technology hubs are needed. Their essence is that products as they evolve open interchangeable interfaces that allow other products to integrate with them, creating value for people. This allows other products to use the product interface as an intermediary that will deliver value to the end user. Companies committed to providing a specific solution to meet people's needs do so with a product. This has two benefits.

The cost of the product rises without the efforts of the developers. Users can use more functions. At the same time, there is no need to allocate resources for their development, support, promotion and continuous improvement. According to the logic of ecosystems, value creation and profit making are separate. Value is the priority. It is formed through interaction. The creator of the ecosystem, by allowing other products to use its user interface, creates new functions for users. They learn to do more things, spend more time in the service, leave data that will allow the creator of the ecosystem to make the product even better and turn it into a part of their daily life. This is what products need to grow.

By allowing other products to integrate with its main user interface, the ecosystem offers features that its own developers would otherwise have to create. This significantly increases the value of the ecosystem for users. With it, they can do a lot of things otherwise they would have to use other applications and services. But this is not necessary. Users can read analytics reports, respond to customer requests, and even call Uber using the same interface. Once accustomed to command logic, they can do almost anything they need to do. They get into the habit of constantly using the digital ecosystem.

This will require designing an interface and creating a minimum reasonable UX, followed by a marketing effort to raise awareness and convince potential users to try the product. Developers can focus on building core functionality. This approach allows access to product functionality through any user interface.

The idea of convergence of information and operational technologies arose not in connection with the implementation of Industry 4.0. Companies are promoting ideas such as consolidating workloads for enterprises, which will allow the latter to optimize production and technological processes at the same time as management systems and thereby become more competitive in their industries. Convergence benefits from industrial applications include greater openness, real-time deterministic control using multi-core processors, web technologies, and machine learning.

Technology convergence benefits machine control architectures. Advances in this area have led to changes in standardized chipsets, board designs and have given impetus to the development of complex operating systems. At the end of the 20th century, a new operating system was developed. She began to be actively used. Microsoft's product line, which includes an integrated software development environment (IDE) and a variety of other tools, has combined several programming languages into one convenient environment. This product continues to evolve and remains relevant. The latest version, 16.4.3, was released on January 14, 2020. The companies got an advantage by placing their bets not on industrial controllers, but on personal computers with standardized operating systems.

Automation vendors have done the necessary research and released computer controls. Developments in the field of software and multi-core processors became available. A number of companies involved in the development and supply of automation systems continued to integrate them with information technology to improve the performance of hardware and software in real time, which far exceeded the capabilities of traditional PLCs. The event was the creation of enterprise networks.

The introduction of industrial protocols has led to significant productivity gains. They have become one example of the convergence of automation technology and the industrial network. The technology eliminates the complexities and costs associated with switches and additional equipment for users, while providing deterministic device management. This approach differs from creating workarounds, such as expensive managed switches for legacy fieldbus protocols, without considering bandwidth usage, staffing efficiency, or the number of IP addresses at the enterprise level.

There is a convergence of automation software applications on smartphones to industrial-design computers based on multi-core processors. Examples are web-based human-machine interfaces and a simplified network protocol focused on the exchange of messages between devices on a publisher-subscriber basis and a text-based data exchange format.

Time-synchronized networks provide deterministic vertical communication to overcome fieldbus limitations. Industry is using machine learning and other artificial intelligence technologies to promote online shopping, navigate, and serve a range of smartphone apps.

Changes in consumer technology provide opportunities for faster deployment of industrial technologies, but if they fail to respond to trends in a timely manner, they increase the risks of lag. The problem is compounded if products are to be deterministic, reliable and available for many years, and implemented in an efficient manner. Done right, technology integration delivers results far beyond what these traditional platforms can do on their own.

Thus, convergence has become one of the key trends, providing a qualitatively new level of technology integration, convergence of the functional properties of systems of different classes and a significant expansion of the range of IT infrastructure.

Convergence means almost any interaction of services that are provided to consumers using different technologies and different operators. Converged service has become relevant.

In information technology, there is no such certainty because there are no rigid boundaries and a rigid need to unambiguously classify each product or service into one clearly defined category. The convergence of services is also taking place in the field of information technology. Any cloud service is a converged service in which telecom technologies are combined in the form of Internet access, network infrastructure, billing and information technologies (implementation of application functionality on the server, data center technologies supporting the service, Internet protocols).

In information technology, converged solutions mean optimized technological complexes (hardware, software and hardware) that contain everything necessary to solve certain organizational problems or configured for the efficient use of resources or to simplify the system implementation processes. SoLoMo has become one of the convergence results. It is a synergy of social networking technologies, geographic information services related to consumer location and mobile devices and technologies.

Convergent technologies are the subject area of computer engineering. In applied terms, this is the field of computer systems engineering, a discipline that combines computer science and electronic engineering. A computer engineer is a specialist in computer networking and technology. Computer engineers have professional training in electrical engineering, software, and hardware-software integration. They do computations, from designing individual microprocessors, computers and supercomputers to circular design. Computer engineering functions include writing software and firmware for embedded microcontrollers, designing VLSI circuits, analog sensors, mixed signal boards, and developing operating systems. Computer engineers conduct research for robotics, with the aim of using digital systems to control and monitor electrical systems - motors, communications systems, and sensors.

One of the areas of computer systems is software engineering. To achieve results, software engineering integrates the principles of mathematics and computer science with engineering approaches developed for the production of physical technical devices. It develops systematic models and reliable methods for the production of high-quality software.

3.3 3.3. Information in the paradigm of technological determinism

The first social modification of technological determinism dates back to the first industrial revolution. This revolution made machine technology a permanent component of business processes. To the organizers of production, this technique has demonstrated the advantages of increasing labor productivity. They turned out to be more significant than the costs of purchasing equipment and depreciation. Employment risks were realized by workers, who began to harm machines.

The situation changed even more in favor of machine technology, when the serial production of technical devices began, which formed the worldview of a society of mass consumption and comfort. In the production process itself, technologies, such as the assembly line, contributed to higher wages for workers due to their increased skills and productivity. In other areas, there has also been a reassessment of the role of technology. It was positively assessed by the military, transport companies and communications market participants.

The entry into force of the factors of technological determinism in society in the second half of the XIX - early XX century was greeted by philosophers of the humanitarian orientation with aspects of considering existential, psychoanalytic, axiological topics. To express the relevance of these topics, philosophers used the discourse of fiction. They initiated new forms of practical therapy for the psyche of the individual based on conceptual ideas about human consciousness. The extreme nature of social life under the predominance of technological determinism was associated with the acceleration of the loss of the traditional basis by society of its dynamic equilibrium.

The thesis was proclaimed about the reassessment of values and the return to the Dionysian beginning of the natural biological regulators of the competitive environment, heredity, natural selection (F. Nietzsche). Not everyone agreed with this. K.G. Jung found in the public consciousness the basis for the dynamic balance of society in the form of archetypes. At the same time, he recognized the threat of destruction of this basis. N. Berdyaev adhered to the position of spirituality and was a supporter of the values of traditional society. It has evolved from the position of proponents of technological determinism, represented by Marxism, to personalism. In his opinion, even a non-market modification of technological determinism does not guarantee freedom for an individual, since it presupposes a mechanism in fulfilling the global tasks of mankind. This observation indicated that technological determinism makes the status of an individual determined by a certain specificity of technical devices; G. Marcuse called this feature of the modification of an individual under conditions of mass production a one-dimensional person.

The mechanism of technology of the first two industrial revolutions was socialized into the status of Megamachine and became a symbol of the era of totalitarian regimes in Europe, Asia, Africa and Latin America. Representatives of neo-Marxism, in particular, E. Fromm, using the development of psychoanalytic philosophy, investigated the causes of this phenomenon, including the biographies of A. Hitler and I. Stalin. It turned out that the space of the Megamachine had an internal annihilation resource. One of the most powerful totalitarian coalitions in Europe under the leadership of Germany was opposed by a totalitarian model of society, which did not allow any possibility of losing for itself. As a result, this totalitarian communist machine was able to turn the tide of World War II in its favor. She also found in herself the internal resources of evolution towards authoritarian forms of organization of society. The personality cult of I. Stalin was condemned.

In the second half of the twentieth century technological determinism has been transformed into digital modification. There were no direct economic prerequisites for this. There were reasons in the field of decision-making, communication development. The main of the innovations were the military departments of the United States and the USSR, which, during the Cold War, were looking for ways to create global air defense systems. The integration of computers into a single space of communication gave rise to a new generation of social networks. The effectiveness of these systems was discovered in the process of using computer programs to process information and decision-making.

In the global economic space, the dominance of industrial technologies of the first industrial revolutions continued. Their productivity was supported by outsourcing. The economy of wage funds was provided by the cheap labor force of the PRC, Latin America, and a number of Asian states. There has been a global division of the world economy into regions for the production and consumption of goods. But this system began to lose its dynamic equilibrium due to the deficit of the United States in trade relations with the PRC. As a result, a contradiction arose between the consumer society with its characteristic geopolitical ambitions and the society of export-oriented economies. The United States began a trade war with the PRC. They began to use the practice of protectionism even in relation to the European Union.

Globalization has given way to glocalization. Under this paradigm, the economy began to use the achievements of the third industrial revolution. At the same time, employment remained quite high at the level of 20-25% in the industrial sector and 3-5% in the agricultural sector. The basic sector of employment has become the service sector. This gave rise to US sociologists to write about the transformation of Western mass consumption society into a post-industrial and information society.

But when outsourcing business models began to lose profit indicators, then in the Western world at the beginning of XXI century the paradigm of the second industrialization (reindustrialization) was initiated. In order for the production returning to the economic space of the Western world to be profitable, the resources of digital technologies began to be used. Digitalization has become a global trend with local implementation through national programs. The epidemiological situation has shown that this trend is justified. Countries with a large internal market and industrial infrastructure have found themselves in an advantageous position. Countries with poorly developed industrial infrastructure are in the worst position.

The digitalization of the industrial sector, economy and society means the strengthening of the rational principle of technological determinism, since all stages of activity and communication are integrated into a single information corporate network that operates with big data and the functional environment of which is filled with devices. There was no harsh public reaction to the second industrialization from humanitarian critics, since the main labor market was outside the industrial sector. After the collapse of the global system of military confrontation, an era of liberal values began. It was enjoyed by users of social networks. The topic of artificial intelligence has become one of the most popular, since it opened up new opportunities for the freedom of information space and human evolution in the categories of transhumanism.

But when network liberalization was transformed into an instrument of political technologies of geopolitical ambitions and a competitive environment, social networks became the subject of careful analysis of lawyers, specialists in the field of software engineering ethics, cybernetic security, and political conflict resolution. The tendency of transition to the space of liberal social networks of the shadow economy, terrorism, technologies of color revolutions is highlighted. Under this economy, an electronic monetary system of cryptocurrencies and financial transactions was formed. Terrorism has developed technologies for network coordination and convergence with a networked shadow economy. The technologies of color revolutions are integrated with the resource of the institutional environment of social networks. They use the peculiarities of developmental psychology, socialization, new collectivity in the form of forums, chats, flash mobs, clans, castes, platforms.

As the pressure on social networks grows, the overall picture of the assessment of scientific and technological progress in the context of the second industrialization will change. So far, there is no radical criticism of technological determinism. The prospects for the transformation of the labor market are being discussed to a greater extent, with a tendency to increase the role of remote forms of employment, freelancing, and precariat. The labor legislation of many states is oriented towards this trend. The disadvantages of such a transformation are the reduction of employers' obligations, as well as electronic inequality, since the lack of experience in working with digital technologies deprives a person of working age of competitive advantages.

The technological digital platform solves the problem of attracting financial resources for startups, business plans based on the participation of business, science, government, civil society, improving the regulatory framework in the field of scientific and technological, innovative development. Digital platforms operate in promising areas of scientific and technological business. They attract financial resources for the production of medicines, for biotechnological complexes; information and communication technologies.

The activities of technology platforms are aimed at coordinating business and the state in the modernization of existing sectors and the formation of new sectors of the economy; determination of the principal directions for improving industry regulation for the rapid spread of promising technologies; stimulation of innovation. support of scientific and technical activities and processes of modernization of enterprises, taking into account the specifics and options for the development of industries and sectors of the economy; expansion of scientific and industrial cooperation and the formation of new partnerships in the innovation field; improvement of legal regulation in the field of scientific, scientific, technical and innovative development.

The subjects of social relations are in the digital reality space of the integrated systems of the Internet of Things, databases, neuromarketing, and neurology. Through the Internet of Things, the convergence of urban communal life support systems of the population was carried out according to the criteria of efficiency. The subjects of these systems are a smart city, smart enterprise and smart home. Business planning models have evolved into a smart industry. The key role is assigned to the sale of products and the provision of industrial services through the satisfaction of aesthetic needs. The role of image management has increased. It simulates a situation when a company and its product brands are associated with a certain style. The basic components are shape, proportion, color, patterns, lines, corner designs. The visual and auditory components of the presentation are used, based on the multisensory perception of the properties of the product.

The consumer found itself at the center of cognitive science studies, in particular behavioral economics. For this, advances in neurobiology and neurophysiology are used. Neuromarketing uses the laws of visual information processing.

The management of goals is being transformed. Smart technologies have become a priority. They give priority to working goals. The criteria of concreteness, measurability, attainability, significance, temporality (limited time) are analyzed in order to see the final result.

Corporate networks combine production and warehouse systems into a single logistics with access to the consumer and his service. A model of a new production collectivity is being formed based on the uber-economy and coworking centers.

The second social modification of technological determinism is more positively perceived by the working-age population of a young age, since it, through the forms of remote work, retains the ability to avoid normative time control, office routine, enables the contractor to conduct a direct dialogue with the customer and avoid intermediaries.

The fourth industrial revolution, due to its modernization orientation, will not cause significant changes in the labor market. In fact, this revolution does not meet the criteria for innovation, since humanity will remain on the achieved energy basis of oil, gas and the atom. It is about optimizing business processes using digital platforms. The authors, inclined to criticize the fourth industrial revolution, believe that there will be a transformation of the labor market towards a reduction in its capacity (Kelly). But the real dynamics of the implementation of national programs of the digital economy shows that in the conditions of closed borders in 2020-2021 the economic systems of Russia and the European Union are experiencing a significant shortage of workers with low and medium qualifications.

A situation has emerged for the coexistence of the labor market of the digital and traditional industrial economies. The traditional industrial economy forms the food, industrial, and energy security of society. But the technological determinism associated with it does not contain liberal components and is not associated by young people with modern working conditions and the way of life of modern megacities. As a result, priority is given to a smart society, which is characterized by a high level of rationalization, optimization, mobility. Reindustrialization gives the industrial sector a modern digital basis. It claims the status of a digital trend in social dynamics, reflecting the long-term trend of modernization of systems of activity.

Automation of information technology means the implementation of a single universal communication network for institutions and industries. Higher quality parameters, lead time control and flexibility have been achieved. This is important for network planners and automation professionals.

It became possible to build unified communication channels with integrated service, covering all levels from the office to machine tools at the enterprise. Enterprise automation and office applications share the same communication space without artificially created LAN gateway boundaries. Information technology automation relies on service integration and network fusion that were previously run in parallel to meet the demands of industrial applications. The development of control systems for transport conveyors in production entailed the laying of separate networks to control conveyor mechanisms. Separate networks were laid to manage security applications as well as to integrate production management systems. MES systems act as a bridge for application integration, linking order processing at the ERP level in the business process to management systems in the manufacturing area. The result is a versatile packet-based network for office and business needs.

The functional flexibility of communication networks depends on the location of its active and passive components. The placement of the components is dictated by the selected network topology. For example, the switch is ideal for star cabling. This topology, in particular, reflects the situation typical for office applications when there are a large number of workstations of similar configuration located in close proximity to each other. In industry, the topologies of production systems are also formed on the basis of specific applications or, in terms of automation, based on the layout of production modules.

An example would be the movement of goods and parts within one enterprise, when conveyor mechanisms are connected in a common line one after another. The communications network follows this topology. With many applications, the production line cannot be wired before a certain date, as is the case in offices, because the network is controlled by a system module. This module is manufactured and tested by the supplier. In this case, the integration into the network is carried out in the production area, and in such a way that the integration algorithm is transparent and does not require an interruption in the operation of the system. In such cases, to lay the network inside and between the modules, it is necessary to have network components that allow for different installation principles.

Components with IP67 degree of protection are convenient for building distributed automation systems. They do not require the installation of a sealed cabinet or box and integrate directly into the production environment. IP67 technology allows flexible implementation of a given topology, such as linear or ring.

"In-between" allows the integration of wiring closets with the network. One device provides IP67 Ethernet connections at the interface between the cabinets and IP30 protection inside the wiring closets. Switches are installed between the automation system and the network. IP30 switches are used to network industrial modules in a star topology. When implemented in an unmanaged configuration, they represent the points of concentration and consolidation of information for transmission to the network. For ease of installation, the IP30 switches have 35mm DIN rail mounts, which are the standard option for installing modules in wiring closets.

In the first phase of the transition to Ethernet technology, the prevailing opinion was that active network components were needed for local diagnostics of the production environment and could do without advanced management functions. To solve production problems, it is necessary to manage the switches to ensure the reliable operation of applications, both for solving automation problems and for processing information. Which control functions are appropriate for each specific application depends not only on the given application, but also on the environment in which the automation system is built.

A separate, non-vertically integrated network protected by a firewall can be built on unmanaged switches. These networks are not used for automation, but for collecting operational data. As a result, the only function of the switch downstream of the firewall is a distribution function that cannot cause production downtime in the event of a malfunction. Switches with this functionality perform a very limited range of tasks. These simple switches are often used in automation applications because their simplicity appeals to users. Fieldbuses with star-couplers also comply with the standards. They are similar to switches in network topology, but are used only in certain specific cases.

In order to ensure the suitability of the network for future applications, it is useful to use the centralized diagnostic function of the network management tools. Switches with management functions support the transfer of service information via the SNMP protocol and at the same time provide solutions to automation problems using special built-in fieldbus functions. Therefore, the switch acts as a diagnostic tool and network administration tool.

The analysis shows that international standards for passive infrastructures adhere to the physical separation of automation networks and data networks. The automation system looks detached in the network structure of a production building. A single universal network "Automation IT" is built on the basis of the family of plug connectors. It is imperative to satisfy all the requirements of the information transfer and automation media.

Information systems, in addition to data, software, hardware and human resources, include communication equipment, linguistic tools and information resources. A narrow understanding of an information system limits its composition to data, programs and hardware. Integration of these components makes it possible to automate information management processes and targeted end-user activities aimed at obtaining, modifying and storing information. An information and computing system consists of a set of databases, database management systems and application programs operating on computing facilities as a single whole to solve certain problems.

Information systems in the activities of an organization act as software that implements its business strategy and business processes. The goal is to create a corporate information system that meets the information needs of employees, services and departments of the organization. In practice, an enterprise usually operates several different systems that solve certain groups of problems in production management, financial and economic activities, and electronic document management. Patchwork automation is common in many businesses.

In two-tier IS there is a database server that contains the database, the database management system and workstations that host the client applications. Client applications access the database management system directly.

Multi-tier information systems have application servers. Custom client applications do not access the database management system directly, they interact with middleware. An example is web applications that use databases. In addition to the link in the database management system and the client link running in a web browser, they have a web server with the appropriate server software.

In automated information systems, automation may be incomplete. Therefore, constant personnel intervention is required. In automatic information systems, automation is complete. This means that no personnel intervention is required.

As part of information systems, the presence of hardware and software is mandatory. By the nature of data processing, information systems are divided into information retrieval information systems, in which there are no complex data processing algorithms, and the purpose of the system is to search and provide information in a convenient form. And also on decisive information systems in which data is processed according to complex algorithms. Such systems include automated control systems and decision support systems.

Since information systems are created to meet information needs within a specific subject area, each area of application corresponds to its own type of information systems. Personal information system is designed to solve the problems of one person. The group information system is focused on the collective use of information by members of a working group or unit. The corporate information system automates the organization's business processes, achieving their complete information consistency and transparency. These are systems for complex automation of the enterprise.

Systems built on the basis of the integrated use of computer technology and communication technology ensure the interaction of information processes and provide subscribers (users) with a wide range of services for the exchange of information and processing of its various types. Networks that transfer, process and store information are called information networks. Initially, systems for collecting, storing and retrieving information based on computing means were created, where the main processes were storage and retrieval, and there were also processes of data processing and transmission. Computer networks were created; computer networks; information center networks; computer networks; teleprocessing networks; information and computer networks; information and reference networks; information networks. In terms of structure, these networks were a unification of remote computers of the same type, which differed in the types of software and hardware used for transmission and processing of information, sets of functions and implemented communication protocols, as well as in the field of application.

For the transmission of traditional types of information, such as speech, documentary information, image, sound, specialized ones for the transmission of information in a certain format of the telecommunication network have been created and improved. A modern information network is a technical system distributed in space, consisting of a functionally related set of hardware and software for processing and exchanging information, which consists of geographically distributed information processing subsystems and physical information transmission channels connecting them, together defining the physical structure of the information system.

In addition to the concept of a physical structure, to describe the principles of construction and functioning of an information system, terms such as logical and information structures are used, describing the location and relationships in the information system of information processes, as well as the concept of information system architecture, which determines the principles of information interaction in the network.

The information system consists of a transport network representing a distributed system consisting of switching nodes connected by channels of the primary network, providing information transfer between geographically distributed subscriber networks. It provides subscribers with access to the transport network for the purpose of interconnection.

It is important to single out a telecommunication network that ensures the interaction of applied processes in the information network realizes the functions of all levels of the functional architecture and includes a physical distribution medium through which signals carrying information are transmitted. A detailed and standardized architecture for information networks performing the functions of meaningful information processing in geographically distributed network nodes is the architecture of the interconnection of open systems.

Converged environments combine resources, data, and management into one custom system. They allow you to centrally manage various functions and devices. Transmit and dynamically distribute different types of traffic in one stream. Prepare and allocate computing resources in operational time. Move to private and hybrid cloud services. Flexibly respond to changes in the market and business priorities. Scale SANs efficiently. But there are drawbacks. This is a high cost compared to traditional solutions; implementation restrictions regarding data confidentiality; the high cost of human error due to the mutual influence of various subsystems and the likely incompatibility of components with partial convergence.

Hyper-Converged Infrastructure provides the following options. Ease of launch and administration from a single interface. Scale out without performance limits for SAN controllers or data interfaces. Fault tolerance due to the storage of copies on different nodes and the organization of geographically distributed clusters. Low cost of servicing the entire IT component of the business.

There is no granular upgrade to the hyperconverged infrastructure. If the amount of memory will run out, and the computing part will work with a margin, then the company will have to increase the total computing power. This is relevant for ready-made solutions, and not for creating your own platform. Transformed companies are using converged infrastructures to build data centers.

Developments in the field of creating microelectronic multisensor devices for various purposes have acquired relevance. This direction is based on the principles of constructing converters of various physical quantities into electrical signals, as well as new principles for extracting useful information from these signals, based on joint intelligent processing of a set of signals coming from a multisensor system. When developing microelectronic sensor systems, new technologies and design options are brought to the fore.

Micromechanics is a rapidly developing direction in the construction of sensor equipment. The micromechanical semiconductor membrane or beam-type sensing element has no moving or rubbing parts. The development and creation of elements with preset electromechanical parameters of resistance, sensitivity, vibration strength, shock resistance and natural resonance frequency has been carried out. This created the prerequisites for building control and measuring equipment for any range of measured values with the required and reproducible parameters.

One of the main areas of activity is the development and manufacture of microelectronic sensor elements and the construction on their basis of control and measuring equipment and multisensor diagnostic systems.

The developed and mastered technology of micro-profiling of monocrystalline silicon, combined with the technology of production of integrated circuits, provides ample opportunities for constructing multifunctional devices integrated on one or several semiconductor crystals using also elements of micro-optics and integrated optics. Such systems, which have unified output signals, can be interfaced with computers for collecting, processing and storing information. For field conditions, these systems can be developed and manufactured as stand-alone devices with transmission of measurement results to data collection centers via radio channels.

Another level of integration and reduction of weight and size characteristics is the creation of functionally complete measuring devices in the form of micro assemblies based on multilevel silicon or other commutation boards. The use of an information machine allows the collection of information to be centralized and facilitates its perception by the operator.

In information machines and control and automation tools that transform the input information for the control, regulation and control of motion, ensuring their accuracy largely depends on the technical state of friction units. In television and radio engineering, computers, an information carrier moves at high speed relative to a sensor that reads or writes this information, the wear of which regulates the operation of information technology.

With the help of an information machine, all operational and accounting and reporting documentation is maintained with the issuance of printed documents and punched cards for subsequent use in planning, accounting and analyzing the production activities of the control object. The first stage of the information machine is installed at the control room of production groups associated with technological processes. On the first stage of the information machine, the printing of absolute remarks of the control parameters and signaling of deviations of their values is carried out.

The main parameters of the technological process, necessary for the analysis of production work, are transferred to the second stage of the information machine, where the absolute values of the main parameters are printed with the issuance of signals about deviation and their processing into digital coded form.

Information in the form of coded digital signals is fed to the third stage of the calculating machine. Here the activity is analyzed, and tasks are developed for the systems of the first stage.

Information technology infrastructure consists of hardware and software. The software is required for the hardware to work. The operating system manages system resources and devices. It provides communication between applications and physical resources using network components. Hardware components include desktops, servers, data centers, hubs, routers, switches, physical infrastructure.

Software components include content management systems (CMS), customer relationship management (CRM) systems, enterprise resource planning (ERP) systems, operating systems, web servers. Physical infrastructure facilities provide the physical space to house networking equipment, servers, and data centers. This also includes the cabling in office buildings, which is necessary to link IT infrastructure components into a single system.

Networks are made up of switches, routers, hubs, and servers. Switches are designed to connect network devices such as routers, servers, and other switches on local networks. Routers provide transmission of packets and data between devices located in different local networks. Hubs combine multiple networked devices into one component.

The server is the main hardware component required for the information technology infrastructure of an enterprise. Servers represent computers that share resources for different users. To accommodate multiple servers in organizations, server rooms or data centers are provided. Data centers are the core of the network.

Information technology infrastructure consists of hardware and software components: physical infrastructure facilities, data centers, servers, network devices, desktop computers and corporate applications. This infrastructure requires more resources, physical space, and cost to set up than other types of infrastructure. Traditional infrastructure is installed locally for internal corporate or private use.

Information technology infrastructure based on cloud computing is a modification of the traditional infrastructure. The difference is that end users can access the infrastructure over the Internet and use computing resources without installing local components through virtualization. Virtualization technology links the physical servers that the service provider is responsible for maintaining, regardless of their geographic location. It then divides and abstracts resources, such as storage resources, so that they can be accessed by users virtually anywhere in the world with an Internet connection. This public cloud infrastructure is also called public cloud.

The configuration of the information technology infrastructure depends on the needs and goals of the business, but some tasks are universal for any enterprise. An optimal infrastructure can provide high performance storage, fast network response, security, optimized WAN, virtualization, and zero downtime.

High-performance storage systems provide data storage and backup and include a disaster recovery system. Fast-response networks use components of the corporate infrastructure to speed up the response time of the data stream.

A secure infrastructure includes systems that control access to information and ensure data availability. It protects businesses from data breaches and cybernetics attacks no matter where the data is located, thereby enhancing customer confidence. WANs provide network management by prioritizing transmitted data and balancing bandwidth for specific applications.

Virtualization helps accelerate server resource provisioning, increase uptime, improve disaster recovery efficiency, and reduce energy costs. Zero Downtime aims to reduce business disruptions and minimize system downtime to reduce costs and increase profits.

Technological process control systems can be represented as a set of separate combinations of hardware and software products that provide the performance of certain system functions. In an integrated architecture, system elements are used for process automation systems. The operator workstation provides an interactive graphical interface to monitor and control the process. The Engineer's Workstation provides a unified development platform that allows you to create and maintain control strategies and configure system elements. It is the centralized data repository for the configuration management system.

Application servers are responsible for performing additional system functions. They provide additional visualization tasks, batch control, collection and processing of historical process data, resource management for change control, and control and management of configuration and calibration code for field devices.

The controller is a multi-tasking, multi-product device that supports applications, process control, batch and discontinuous production, and motion control. Control strategies are divided into segments that are executed at regular intervals. The controller supports the execution of high-speed control actions and movements, uses a continuous polling mode, and can also work in the event-driven mode, performing certain operations when certain events occur.

The maintenance workstation is a laptop that can be used to locally monitor and troubleshoot system problems. Standard network hardware and software are used to implement a common system infrastructure that transfers information between process control systems and production control systems.

The architecture reflects a view of the control and software of the system, as well as the processes and disciplines that enable such a system to be effectively implemented. The architecture describes the information content of the related elements that make up the system, the relationships between these elements, as well as the rules by which these relationships are built. The attribute fixes the criterion for evaluating the system. Dependent system attributes reflect criteria that change depending on the values and settings of the independent system attributes.

The independent system attributes reflect the criteria set by the application and the most common engineering approaches for implementing a system. A component attribute of a system element captures a specific number or value that defines the functional limit or boundary of that component. A system attribute refers to a metric of system performance that can be obtained or measured and then used to define the operational boundaries or capabilities of the system.

The system boundaries exhibit a published limit that does not exceed the system limits. The boundary value of an attribute fixes the specified or measured range of values of the characteristics of an element, at which the critical attributes of the system will have the required values. Real-time data is used by the process to handle alarms. Data is aggregated on screens and operator interfaces. The trend analysis system works on their basis. Real-time data is saved. High speed support is required for withdrawal.

Integrated architecture is used to refer to a group of products that use key company technologies. Products form an automation system. The system infrastructure includes software and hardware that allows the individual system elements to work together.

Production history is a comprehensive repository of historical data. In this store, data is stored until a certain event occurs. For example, messages, operator commands, alarms. Process history stands for continuous data storage. In this storage, data is stored for a certain period of time. Historical data reflects information that is used for long-term analysis of system performance in the past. Historical data is retrieved from storage.

The client fixes the hardware and software that represent the interface for communicating with the system's application server. The client represents a computer that has real-time software installed. A component of a system element is interpreted as a characteristic functional part of a system element, which is a separate product or a feature that is provided by one or more products. The collection of such components forms a system element.

A critical system attribute is a customer-oriented characteristic that determines or indicates whether the system's performance is at the expected level. These are characteristic, visible indicators of the overall performance of the system and its suitability for work. Each of them has certain parameters that need to be maintained at a certain level, and which establish the operational requirements for the system. These parameters determine whether the system check conditions are met or not.

There are many other attributes associated with system elements. For example, controller loading, computer loading, network parameters. These attributes must be properly configured in order to comply with the specified requirements.

An independent workstation represents one platform system. It is a combination of the main functions of the workstations of the engineer and the operator, as well as the server of the process automation system. It can be used in small applications (one installation) or as an entry-level system with subsequent expansion to a centralized or distributed system.

A fault blocking area reflects a safe method of blocking a fault within a defined area and preventing it from affecting other areas. Controller-controlled batch process means a process entirely executed by a processor that uses phases of the phase manager equipment. If the batch process is controlled by the server, the recipe and sequence functions are carried out by the software and the phase control functions are carried out by the controller. Information about the phases of the phase manager equipment is sent to the server through the controller interface.

The service platform represents the server architecture. This platform reduces the customer learning curve and cuts project development time through generality and reusability. A system limit denotes the point beyond which the critical attributes of a system do not meet a specified level. A data collection system application involves collecting, storing, compressing, issuing, generating reports and analyzing. The functions of the application include data acquisition, compression, storage, output, playback, analysis, summarization and presentation (reports and screens).

Development software is represented by a program that is used to configure various components of the system and is not required while it is running. The catalog software determines where the system data will be located so that it can be accessed as quickly as possible. Directory software represents a shared address book for enterprise resources that are shared between products.

Real-time software is represented by a program that is used to run configured applications. It is a communication data server for computer programs that allows access to information from controllers. A workstation is a computer running software for development, configuration and optional system maintenance. The workstation is not a server. It provides a unified development platform that allows you to create and maintain control strategies, and customize and configure system elements.

The operator workstation provides an interactive graphical interface to monitor and control the process. The system can use a single local operator interface, or several assembled together in a central control room. The client software provides a system-wide view of variables and process status.

The technician workstation is a laptop that can be used to locally monitor and troubleshoot system-related problems. System redundancy refers to the ability of the system to continue to control the process and collect data after failure of no more than one of the critical system elements.

The server is the main hardware component required for the information technology infrastructure of an enterprise. Servers represent computers that share resources for different users. To accommodate multiple servers in organizations, server rooms or data centers are provided. Data centers are the core of the network.

Information technology infrastructure consists of hardware and software components: physical infrastructure facilities, data centers, servers, network devices, desktop computers and corporate applications. This infrastructure requires more resources, physical space, and cost to set up than other types of infrastructure. Traditional infrastructure is installed locally for internal corporate or private use.

Information technology infrastructure based on cloud computing is a modification of the traditional infrastructure. The difference is that end users can access the infrastructure over the Internet and use computing resources without installing local components through virtualization. Virtualization technology links the physical servers that the service provider is responsible for maintaining, regardless of their geographic location. It then divides and abstracts resources, such as storage resources, so that they can be accessed by users virtually anywhere in the world with an Internet connection. This public cloud infrastructure is also called public cloud.

The configuration of the information technology infrastructure depends on the needs and goals of the business, but some tasks are universal for any enterprise. An optimal infrastructure can provide high performance storage, fast network response, security, optimized WAN, virtualization, and zero downtime.

High-performance storage systems provide data storage and backup and include a disaster recovery system. Fast-response networks use components of the corporate infrastructure to speed up the response time of the data stream.

A secure infrastructure includes systems that control access to information and ensure data availability. It protects businesses from data breaches and cybernetics attacks no matter where the data is located, thereby enhancing customer confidence. WANs provide network management by prioritizing transmitted data and balancing bandwidth for specific applications.

Virtualization helps accelerate server resource provisioning, increase uptime, improve disaster recovery efficiency, and reduce energy costs. Zero

Downtime aims to reduce business disruptions and minimize system downtime to reduce costs and increase profits.

Technological process control systems can be represented as a set of separate combinations of hardware and software products that provide the performance of certain system functions. In an integrated architecture, system elements are used for process automation systems. The operator workstation provides an interactive graphical interface to monitor and control the process. The Engineer's Workstation provides a unified development platform that allows you to create and maintain control strategies and configure system elements. It is the centralized data repository for the configuration management system.

Application servers are responsible for performing additional system functions. They provide additional visualization tasks, batch control, collection and processing of historical process data, resource management for change control, and control and management of configuration and calibration code for field devices.

The controller is a multi-tasking, multi-product device that supports applications, process control, batch and discontinuous production, and motion control. Control strategies are divided into segments that are executed at regular intervals. The controller supports the execution of high-speed control actions and movements, uses a continuous polling mode, and can also work in the event-driven mode, performing certain operations when certain events occur.

The maintenance workstation is a laptop that can be used to locally monitor and troubleshoot system problems. Standard network hardware and software are used to implement a common system infrastructure that transfers information between process control systems and production control systems.

The architecture reflects a view of the control and software of the system, as well as the processes and disciplines that enable such a system to be effectively implemented. The architecture describes the information content of the related elements that make up the system, the relationships between these elements, as well as the rules by which these relationships are built. The attribute fixes the criterion for evaluating the system. Dependent system attributes reflect criteria that change depending on the values and settings of the independent system attributes.

The independent system attributes reflect the criteria set by the application and the most common engineering approaches for implementing a system. A component attribute of a system element captures a specific number or value that defines the functional limit or boundary of that component. A system attribute refers to a metric of system performance that can be obtained or measured and then used to define the operational boundaries or capabilities of the system.

The system boundaries exhibit a published limit that does not exceed the system limits. The boundary value of an attribute fixes the specified or measured range of values of the characteristics of an element, at which the critical attributes of the system will have the required values. Real-time data is used by the process to handle alarms. Data is aggregated on screens and operator interfaces. The trend analysis system works on their basis. Real-time data is saved. High speed support is required for withdrawal.

Integrated architecture is used to refer to a group of products that use key company technologies. Products form an automation system. The system infrastructure includes software and hardware that allows the individual system elements to work together.

Production history is a comprehensive repository of historical data. In this store, data is stored until a certain event occurs. For example, messages, operator commands, alarms. Process history stands for continuous data storage. In this storage, data is stored for a certain period of time. Historical data reflects information that is used for long-term analysis of system performance in the past. Historical data is retrieved from storage.

The client fixes the hardware and software that represent the interface for communicating with the system's application server. The client represents a computer that has real-time software installed. A component of a system element is interpreted as a characteristic functional part of a system element, which is a separate product or a feature that is provided by one or more products. The collection of such components forms a system element.

A critical system attribute is a customer-oriented characteristic that determines or indicates whether the system's performance is at the expected level. These are characteristic, visible indicators of the overall performance of the system and its suitability for work. Each of them has certain parameters that need to be maintained at a certain level, and which establish the operational requirements for the system. These parameters determine whether the system check conditions are met or not.

There are many other attributes associated with system elements. For example, controller loading, computer loading, network parameters. These attributes must be properly configured in order to comply with the specified requirements.

An independent workstation represents one platform system. It is a combination of the main functions of the workstations of the engineer and the operator, as well as the server of the process automation system. It can be used in small applications (one installation) or as an entry-level system with subsequent expansion to a centralized or distributed system.

A fault blocking area reflects a safe method of blocking a fault within a defined area and preventing it from affecting other areas. Controller-controlled batch process means a process entirely executed by a processor that uses phases of the phase manager equipment. If the batch process is controlled by the server, the recipe and sequence functions are carried out by the software and the phase control functions are carried out by the controller. Information about the phases of the phase manager equipment is sent to the server through the controller interface.

The service platform represents the server architecture. This platform reduces the customer learning curve and cuts project development time through generality and reusability. A system limit denotes the point beyond which the critical attributes of a system do not meet a specified level. A data collection system application involves collecting, storing, compressing, issuing, generating reports and analyzing. The functions of the application include data acquisition, compression, storage, output, playback, analysis, summarization and presentation (reports and screens).

Development software is represented by a program that is used to configure various components of the system and is not required while it is running. The catalog software determines where the system data will be located so that it can be accessed as quickly as possible. Directory software represents a shared address book for enterprise resources that are shared between products.

Real-time software is represented by a program that is used to run configured applications. It is a communication data server for computer programs that allows access to information from controllers. A workstation is a computer running software for development, configuration and optional system maintenance. The workstation is not a server. It provides a unified development platform that allows you to create and maintain control strategies, and customize and configure system elements.

The operator workstation provides an interactive graphical interface to monitor and control the process. The system can use a single local operator interface, or several assembled together in a central control room. The client software provides a system-wide view of variables and process status.

The technician workstation is a laptop that can be used to locally monitor and troubleshoot system-related problems. System redundancy refers to the ability of the system to continue to control the process and collect data after failure of no more than one of the critical system elements.

The server represents a computer system that performs certain actions and transmits data on the network. The application server is used in addition to the process automation system server. A process automation system server is a mandatory system element that provides centralized name resolution and service blocking. The alarm and event server executes the alarm generation commands for the controllers.

The server software reflects a software process that runs without an operator interface. The server software runs as a service. A remote I / O network connects unscheduled I / O devices to the controller. The remote I / O network can be redundant and supports a certain number of I / O modules. Process automation system refers to a set of products that, in combination with certain control components from other manufacturers, form a hierarchical system, and can be divided into automation levels, system elements and system infrastructure

The process automation system is built from certain groups of equipment, networks and devices, as well as system control elements. When designing a process automation system, it is important to take into account availability and operating time, special configurations for a given process and manual control with the ability to make changes, update and force parameters.

System services are software packages that are part of a system's infrastructure. Their work is indispensable for the functioning of the automation system. System services also include the required hardware. The system server expands the composition of the system by supporting additional features or functions of the system. Thus, the server of the process automation system is an indispensable component of all centralized and distributed systems.

A system element is a system unit that has certain characteristics in the form of a combination of software and hardware products that perform specific functions or tasks. The operation of system elements affects the performance of the system and its capabilities. Control strategies are used to determine a set of complex indicators of a process automation system, on the basis of which we can talk about the load of the system.

Characterization involves the collection of data on the performance of a process automation system, the purpose of which is to determine the scalability, stability and suitability of a particular system configuration for use.

3.4 3.4. Communication philosophy

Communication and interaction are basic categories of philosophy. In Russian, the term "connection" is used in different contexts. With regard to information, we are talking about how people transmit messages to each other that are relevant to them, especially if these people are separated by great distances. In the ancient civilizations of America, the postal service was provided by runners, who covered the distance between post stations and transmitted information to the next runner in the form of a document. For many centuries in Eurasia, postal functions were performed by the Great Silk Road and the merchants and travelers who followed it. Postal stagecoaches played an important role. The function of communication was performed by the book text, which, through common values, connected people over vast territories. Typography and book logistics (booksellers) played an important role. In the middle Ages, this role was played by monastic libraries. The sailors used a special language of flags and searchlights within the radius of visibility.

After the massive resettlement of Europeans to the New World, the transmission of information over long distances required greater intensity. For this purpose, knowledge from physics was involved in solving communication problems. They made it possible, on the basis of technical devices, to use electromagnetic signals as the main carriers of information. The information was previously encoded. Morse code and punched cards were used as the translation language. At the exit to the recipient, the information was decoded into the form of a written text or an audio message. Marine cable and land pole communications have been developed. Wireless technologies, in particular radio, were more economical, but their users faced the problem of noise. Additional funds were allocated for the study of radio frequencies and associated noise. These studies were carried out using radio antennas (radio telescopes). After their detection, the problems of noise minimization were solved.

The development of communication systems was also given great importance by government agencies, in particular, the Ministry of Defense, since they needed operational information and reliable communication between units, as well as reliable methods of transmitting intelligence information. For the state, communication was also important for ideological reasons. During the Cold War, radio was used as the main tool for influencing the individual and public consciousness. A lot of money was allocated for the activities of radio stations. In accordance with information threats, technologies of noise suppression of radio frequency messages were used.

In the middle of the twentieth century, the task of increasing the efficiency of communication systems became urgent. Two sides of this task have been identified. One was supposed to ensure the reliability of technical devices, and the second was focused on how much information can maximally pass through the transmitting device of the communication system. It was important to find a method for calculating the amount of information in a particular message, since the amount of information cannot exceed the capacity of the communication system. The throughput was determined by a unit of time.

At the theoretical level, the quantitative approach to information was substantiated by K. Shannon. He proposed a technique for the binary method of encoding information during transmission and processing, from which the key role of information encoding followed. According to his definition, information is removed uncertainty. Mr. Concrete added an accent of not indifferent distinction. As a result, the digital format of binary numbers has become the most efficient way to solve technical communication problems. 0 and 1 correspond to the function of the relay devices.

Computers integrated into a single network have significantly increased the efficiency of communication in the formats of text, visual and voice information. At the same time, the traditional institutions of postal communications (parcels, parcels, greeting cards, letters, and telegrams), as well as telephone communications, radio, television and retain their importance. They began to use digital technology.

There is a trend towards convergence of communication systems with digital platforms via mobile phones. As a result, communications have acquired a multifunctional focus on the provision of quality services through satellite navigation components, prompt response to the user in the context of his information expectations during work and free time. The value of information communication services has become so significant that the capitalization of mobile operators has reached the highest rates and outstripped companies in the industrial sector. In the structure of individual expenses, communication services occupy up to 30% and there is an increase in their volume, taking into account Internet trade services, adaptation of financial settlement services to mobile forms of payment through appropriate applications.

In the context of the use of communication systems by terrorists, radical movements and organizations, the shadow economy, the role of the legal component is growing for illegal activities. On the basis of legislative documents, regulators analyze the content of information in order to determine the compliance of operators' activities with national legislation. This is especially relevant in the context of the functioning on the national territory of transnational operators and their digital platforms, which include in their structure a database of users.

3.5 3.5. Systems engineering

Systems engineering studies the design, creation and operation of structurally complex, large-scale, human-machine and socio-technical systems. It offers principles, methods and tools for their development. When developing and designing systems problems arise related to the laws of the functioning of a system object and ensuring its life cycle. Responsibility for the system distinguishes systems engineering from all other engineering disciplines.

The theoretical and methodological basis of systems engineering is the systems approach and general systems theory, as well as research methods using mathematical logic, mathematical statistics, systems analysis, algorithm theory, game theory, situation theory, information theory. In systems engineering, elements of science and practice are closely intertwined. The high complexity of systems makes it difficult to use precise formalized methods when creating them. Significant advances in science, engineering and technology, along with the rapidly growing need for automation of processes and production, stimulated the beginning of the industrial creation of large-scale systems of high complexity. These systems are distinguished by a significant increase in the number of components and functions performed a high degree of automation, a significantly increased cost of the systems created and the importance of the tasks they solve. So also the qualitative indicators of organization and management, the high complexity of the functioning of the system, the need to interact with other complex systems.

The work on the creation of such systems is based on the achievements of general systems theory, systems analysis, operations research, information theory, computer technology and cybernetics. These achievements began to be purposefully used in the complex solution of engineering and organizational and managerial tasks.

Systems engineering has focused on the issues of scientific planning, design, evaluation, construction and operation of systems created by man to meet established needs, as well as the problems of organizing collective methods of work in the creation of such systems. Systems engineering proposed a set of adaptable and automated system development methods, the essence of which was the application of a systematic, systems analysis-based approach to decision-making. It provides an efficient transition from a system concept to a usable design solution to a usable system product. Hall described the systems engineering methodology.

The goal of systems engineering is to optimally draw the functional boundaries between interests, the system and its environment. The environment is represented by physical, technical, business, social components. Priority is given to researching needs. A methodological basis and means have been created for the successful implementation of coordinated, team efforts to form and implement activities to create systems of various classes that meet the established requirements, activities that cover the stages of the system life cycle from design to manufacture, operation and termination of use. Used systems analysis, cognitive systems engineering, configuration management, automatic control, industrial systems engineering, mechatronic engineering, operations research, software engineering, performance engineering, program, project management, interface design, systems planning, engineering psychology, security engineering and risk management.

An exhaustive set of processes necessary for building a system in its development has been formed and implemented. In order to determine technical solutions and create systems architecture, systems engineering turned out to be aimed at the formation of such development processes and the life cycle of systems that allow balancing the costs of time and money in the interests of achieving the required quality of products and services, thereby ensuring the competitiveness of the systems being created.

Large system projects have thousands of contractors. Each contractor has its own professional language of communication. Complex systems can only be created by large multidisciplinary teams that require an appropriate interdisciplinary organization in the division of intellectual labor. The issues of maintaining interdisciplinary integrity and organizing interdisciplinary work are also addressed by systems engineering, providing this process through the use of a common interdisciplinary language.

The process of forming an integrated system of international standards and practices to support the creation of effective systems is nearing completion. Analytical software tools are being actively developed to assist in the practical implementation of these rules and regulations.

The methodological basis of systems engineering was formed by the school of systems-thought-activity methodology associated with the name of G.P. Shchedrovitsky, close to the ideas of the Moscow Methodological Circle. Moscow logical circle represented by A.A. Zinovieva, G.P. Shchedrovitsky, B.A. Grushinaand M.K. Mamardashvili was engaged in the development of content-genetic logic, assimilation of the cultural-historical concept of L.S. Vygotsky, Cybernetics and Systems Research. The main form of activity of the SMD methodologists was the organizational activity game (ODI), which was built according to the scheme of mental activity.

The members of the circle were forced to emigrate (A.A.Zinoviev, V.Ya.Dubrovsky andV.A.Lefebvre). Systems engineering is based on a number of general abstract concepts associated with the understanding of its subject, as well as a set of initial, accepted as truth, rules that are used as a basis for reasoning and for making decisions. Systems engineering concepts guide the thinking of a systems engineer, and principles provide the necessary rules and regulations to do so.

The concepts and principles provide the knowledge and skills necessary to develop the techniques and operations of a systems engineer's practice. Systems engineering operates with concepts such as a system,

Large systems are spatially distributed systems of a high degree of complexity, in which the constituent parts also belong to complex structures. Large dimensions are additional features; complex hierarchical structure; circulation in the system of large information, energy and material flows; high level of uncertainty in the description of the system.

Complex systems are distinguished by multidimensionality, heterogeneity of structure, diversity of the nature of elements and connections, organizational different resistances and different sensitivity to influences, asymmetry of the potential for the implementation of functional and dysfunctional changes.

The concept of a system in systems engineering is related to the concepts of systems thinking and systems approach. Systems engineering focuses on engineering systems of machines, mechanisms, structures, enterprise systems, and systems of systems. In systems engineering, several points of view are necessarily used simultaneously to describe the architecture of a system.

B. Blanchard and W. Fabritzki described the life cycle approach. It has become the fundamental foundation of the practice of systems engineering. This approach assumes the use by system engineers of the concept of a system life cycle as a framework, organizational basis for engineering thinking, which, when creating complex engineering objects, allows one to consider all system aspects in their completeness and interconnection. The life cycle of a system is understood as the evolution over time of a system, product, project, or other human-created entity.

The evolution of the target system is associated in systems engineering with the passage of a sequence of certain stages, linked to a set of management decisions, for the justification of which objective evidence is used that the system at the accepted level of materialization is mature enough to move from one stage of the life cycle to another stage of the life cycle. At each stage of the life cycle, the system has a relatively stable set of characteristics.

Life cycle modeling uses sets of life cycle processes. For this, there is a number of regulatory and technical documents containing a description of the full set of processes required to simulate the life cycle of a wide range of systems created by humans.

Systems engineering involves the process of continuously adapting system requirements and solutions to deliver the results that, in a given environment, are most satisfying to stakeholders.

It is important to describe and develop the system in terms of value for stakeholders. Trust between stakeholders cannot be established in the absence of leading experts in charge of building the system. At the same time, the interested parties should be responsible for their obligations and ensure their implementation in a timely manner, as well as the adoption of the necessary decisions.

To understand needs, analyze circumstances, identify objectives and define requirements for architecture development, system design, including hardware and software, and to obtain evidence of the feasibility of a solution, it is important to adhere to the rule of concurrent rather than sequential organization of work. An important factor in making decisions is the presence of an evidence-based fact, and not a plan, schedule or calendar event.

Systems Engineering is responsible for integrating all technical aspects, domain experts, and specialized teams within the efforts of the target system development team. The work begins with identifying the needs of stakeholders and the required functionality, managing the many functional and non-functional requirements that must be transformed into a responsive system design and architecture by synthesizing design solutions. After that, the system goes through the stages of verification and validation.

The set of systems engineering processes includes providing a reliable design repository. It supports the necessary tools for multiple professionals to collaborate on multidisciplinary information while building a system and managing its life cycle. It is important to provide an accurate assessment of the information available and the identification of missing information.

A precise definition of the performance and efficiency criteria that determine the success or failure of a system project is necessary. Receiving and analyzing all initial requirements that reflect user requests and stakeholders' goals is relevant; It is advisable to conduct a system analysis to develop design solutions that reflect the behavior of the system, which must meet all functional and performance requirements;

The distribution of all behavioral elements of the system is carried out according to the elements of the architecture suitable for them. An analysis of trade-off decisions on alternative design solutions or architecture to support the decision-making process is carried out. Executable models are developed to verify and validate system performance.

Systems engineering seeks to formalize the systems development process. The totality of such typical, repetitive actions forms systems engineering processes or systems engineering methods. Systems engineering processes involve the iterative application of synthesis, analysis, and evaluation procedures:

Systems engineering standards are developed as open, universal specifications that are framework in nature and are applied on a voluntary basis. They require adaptation to the conditions of the organization or project and the high qualifications of the personnel using them, since regulations in the field of systems engineering are not developed. The main object of standardization in the field of systems engineering is the processes of creating systems. Methods for assessing the quality of processes are standardized, as well as methods for describing system artifacts. Work is underway to harmonize a set of systems engineering standards with the gradual formation of a unified information space for regulatory support for the creation of complex systems.

Internationally recognized systems engineering standards and guidelines are developed by three organizations. These include the Seventh Subcommittee of the Joint Technical Committee of the International Organization for Standardization and the International Electrotechnical Commission "System and Software Engineering", the Institute of Electrical and Electronics Engineers and the International Council for Systems Engineering.

Systems engineering specifications are not directly applicable standards. They provide guidance on what to do, leaving the decision on how to do it to the discretion of the parties setting up the system and managing the project. Many specifications are of a framework nature. It is assumed that the recommendations contained in the standards must be necessarily adapted to the conditions of a specific system engineering activity. Taking into account the recommendations of official standards, variable regulatory documents can be developed that regulate systems engineering activities.

3.6 3.6. Digital design

Digital design, mathematical modeling and product or product is life cycle management technologies. That is the implementation of the concept of digital smart design. The process is driven by the digital twin development technology. He based on the creation and application of a multi-level matrix of targets and resource constraints, on mathematical models of different classes, levels of complexity and adequacy. He described by non-stationary nonlinear partial differential equations. He based on virtual tests, the use of virtual stands and virtual testing grounds.

Particular attention is paid to the development and implementation of a digital platform for creating digital twins. It is capable of taking into account up to 150,000 targets and resource constraints. Adjacent end-to-end digital technologies of artificial intelligence, big data and distributed ledgers are used. They provide intellectual property management, expert support and first-time physical and field tests. Product lifecycle management systems are used, including competitive CAD-CAM-CAE-subsystems for design, technological preparation of production and computer, supercomputer engineering based on mathematical and simulation modeling. The systems are in demand in the aerospace, defense, and banking industries. Demand is fueled by increased attention to regulatory requirements, the need to reduce product risk, and the growing need for collaboration over the production lifecycle.

Digital technology lowers costs and enables high-performing production assets to be operated and delivered. There is a growing need to centralize business data across enterprises and track transactions across multiple enterprises through real-time data analytics.

The effects of the development and implementation of digital twin technologies are expressed in the fact that companies can reduce the time costs of the production cycle. The main task of the CAD system is to create 3D parts and assemblies of the designed object. The use of CAD systems and digital design makes it possible to reduce the development time and preparation of design documentation for a product by half in comparison with the old technology.

After creating a digital model of a future product or a separate element, computer modeling and analysis systems are used. CAE systems have various mathematical models. Using them, you can model the behavior of real objects with high accuracy. As a result, it was possible to reduce the number of real tests and replace them with computer simulations.

After product design is complete, programs are used to prepare products for production. The purpose of these systems is to simplify the mechanism of operation by transforming the 3D model into a dataset with which the machine can manufacture a given part. For CNC machines, this is the trajectory and speed of the machining tool. For selective laser fusion installations, these are the power and trajectory of the laser.

3.7 3.7. Digital engineering

Digital engineering means a set of services for digital organizational and technological design and optimization of production and logistics processes and equipment operation modes.

Services include delivery, customization, adaptation and implementation of software, engineering works. They are used in the modernization of existing or in the creation of new smart industries, logistics centers, laboratories, automated and robotic equipment and mechatronics. The basis of digital engineering lies in understanding the interconnections of physical processes occurring in a product or product at all stages of the life cycle and the ability to calculate their mutual influence on the measured characteristics.

The use of a digital information model as a tool for supporting a project at all stages of the life cycle makes it possible to increase the reliability of technical solutions, shorten the project review time and reduce operating costs. The targeted spending of funds at the stages of construction and operation and adherence to deadlines at all stages of the project.

It provides a framework to mitigate risks by participating in the early stages of the project and the possibility of a high degree of model development. The ability to control the project implementation process using digital models makes it possible to simplify the work of the project team at all stages of the examination and project support, to increase the safety of investments and the effectiveness of monitoring the investment phase.

The digital twin of a product is an analogue of a physical object in a digital environment. It is created on the basis of interconnected mathematical models of physical processes occurring in the object, based on the execution of tens of thousands of virtual tests.

The digital twin of production takes into account the technological features of production processes in the digital twin of a product within a single digital model. A smart digital twin of the first level combines the digital twin of an object / product and a digital twin of production within a single digital model. The Level 2 Smart Digital Twin combines the smart digital twin of the facility and actual operating data into a single digital model. A smart digital shadow of a product is formed on the basis of a smart model that adequately describes the behavior of a real product in all modes of operation. These are starts and stops, normal operating conditions and deviations from normal conditions, emergency situations.

Digital twin technology combines the Industrial Internet of Things and digital modeling. It is actively implemented at all stages of the product life cycle. The introduction of digital twins to simulate and evaluate various scenarios can reduce the number of equipment failures. Thanks to the use of technology, errors are corrected at an early stage of design and no breakdowns occur during testing. The quality of 3D models has improved. Reduce the time for electronic approval of design documentation and reduce the number of design errors. Companies spend less money on reworking samples for mass production.

Key digital solutions are product lifecycle management, digital product and process design, manufacturing process control systems, and the Internet of Things. The priority is to ensure the cybernetics security of systems and the development of information infrastructure.

3.8 3.8. Digital reengineering

Reengineering involves a radical revision of the organizational structure in order to optimize the activities of the enterprise. Organizations have appeared that provide reengineering support services based on their own technological developments and solutions. Solutions for digital design of enterprises and adaptive production management have been developed. A range of tasks is solved from auditing the capabilities and limitations of enterprises on the basis of their own information developments to the introduction of automated control systems, flexible production systems and machine tools in industrial enterprises.

Weaknesses before digital management were the long lead times for the enterprise model and the unique competency requirements of people who need to understand production systems and have programming skills. By the time of construction, the model was not relevant. The external conditions, the product line, and, accordingly, production cycles as well as other indicators of the enterprise's activity, have changed. There was a need for a flexible and fast solution that would allow managing an enterprise in a rapidly changing environment. Digital platforms began to emerge.

The digital platform is based on EliyahuGoldratt's theory of constraints. According to the theory, the limits limiting the development of the management system are discovered and worked out. These are capacities, demand, and the lead time of the production cycle. The platform includes a line of software products. These include an intelligent decision support system and an adaptive production management system.

3.9 3.9. Cyber security

The problem of ensuring fail safety in control systems is associated with the issues of ensuring their information security from cybernetics attacks. The use of cyber capabilities to achieve objectives in cyberspace or through cyberspace is defined as cyber operation. A cybernetics attack is a cybernetics operation, both offensive and defensive. A cybernetics attack can result in damage to human health, loss of life, property damage, or destruction of objects.

Cyber security means the ability of a control information system to perform its intended tasks in the face of destructive influences caused by cybernetics attacks, as well as technological disruptions and failures of composite technical means.

Cyber security means a complex concept of the safe functioning of information management systems.

The main threats to the violation of cyber security in information systems are created by information attacks. This is the implementation of unauthorized access of a potential adversary to the system. Threats also create undeclared capabilities in programs and systems devices; system failures and errors, including hardware and software failures and errors, operator errors, data errors.

Complete elimination of control failures is theoretically possible, but practically not feasible, since it requires economic costs that are obviously greater than the expected damage from the impact of dangerous failures. The real way to ensure security involves determining the acceptable level of risk from cybernetics attacks and creating effective protection against dangerous failures.

A successful cybernetics attack can result in a violation of the integrity or availability of information. Servers, user workstations and communication equipment of an information system can be considered as targets of an attack. When organizing cybernetics attacks, specialized software is used to automate actions performed at various stages of an attack. A cybernetics attack includes four stages of reconnaissance, invasion and attack impact and attack development.

At the stage of reconnaissance, the hacker tries to obtain as much information as possible about the object of the attack in order to plan further stages of the invasion on its basis. Information about the type and version of the operating system can serve these purposes; list of users registered in the system; information about the used application software. During the invasion phase, the hacker gains unauthorized access to the resources being attacked.

At this stage of the attacking action, the goals for which the attack was undertaken are realized. This is a malfunction of the system, deletion or modification of data. A hacker performs operations aimed at removing traces of his presence in the system. The attack is based on the presence of vulnerabilities in the management system. Using at least one of them opens the system login. After the attack, the hacker seeks to move the attack into the phase of further development. To do this, a malicious program is introduced into the system, with the help of which it is possible to organize an attack on other means of the system.

The main threats to the cyber security of information systems are created by programs such as DoS attacks. It ensures the creation of conditions under which legitimate users of the system cannot access the server resources provided by the system, or this access is difficult. The rejection of the "enemy" system can be one of the steps to mastering the system. Trojans are also used. After being introduced into the system, they violate the integrity of data and programs, activate viruses in the system. They can collect information about user profiles, passwords and other confidential information stored on a computer and then forward it to hackers. Unauthorized computer control programs are also used. These are boot viruses, software viruses, network worms.

Information attacks lead to a violation of the confidentiality and integrity of information, the availability of the information system or the data it contains. A breach of confidentiality occurs as a result of theft or loss of information. Accessibility violation occurs as a result of blocking the system or data in it, as well as a result of the destruction of access means, for example, passwords, keys, access regulations. Integrity violation is associated with the modification of programs and data, denial of the authenticity of information, the imposition of false information.

Undeclared capabilities in programs and devices of systems mean functionality of software and hardware that is not described or does not correspond to the documentation. When using them, it is possible to violate the availability, integrity, and confidentiality of the information being processed. Implementation of undeclared features are software and hardware tabs

4 4. PHILOSOPHY, SCIENCE, MAN AT THE BEGINNING OF THE III MILLENNIUM

4.1 4.1. Philosophy of digital ecosystems

At the end of the twentieth century, the concept of an ecosystem used in biology and ecology was introduced into the terminological apparatus of the economic and management spheres. J. Moore suggested using the term "business ecosystem" to denote the social environment of an enterprise, the elements of which are participants in business processes.

The enterprise was compared to a biological ecosystem. D. Eisenberg described the environment in which entrepreneurship seeks to develop. This environment is shaped by government policy on small and medium-sized businesses, financial capital, entrepreneurial culture, technical support, human capital and markets. The quality of entrepreneurship in the country depends on the level of development of the environment. The entrepreneurial ecosystem includes a startup ecosystem, a venture ecosystem, a university ecosystem. And also a business ecosystem as a set of proprietary or partner services united around one company. The ecosystem can be centered one area of the client's life or penetrate into several of them at once.

J. Moore proposed to consider economic activity as an ecosystem, where buyers and producers play complementary roles, jointly evolving in the direction set by companies that are at the center of the ecosystem. A business ecosystem is an economic community that consists of a collection of interconnected organizations and individuals. The economic community produces goods and services of value to the consumer, which are also part of the ecosystem. Any enterprise ecosystem also includes suppliers, leading manufacturers, competitors, and other stakeholders. They co-evolve their capabilities and roles and strive to align with the direction set by one or more of the leading companies. Those companies that hold leadership roles can change over time, but the ecosystem leader function is valued by the community because it allows members to move towards shared visions in order to align their investments and find mutually supportive roles. Companies have been encouraged to become proactive in developing mutually beneficial symbiotic relationships with customers, suppliers, and even competitors.

B. DeLonge defines the ecology of business as a more productive set of processes for the development and commercialization of new technologies. This involves rapid prototyping, short product development cycles, early test marketing, option-based compensation, venture funding, early corporate independence.

The application service provider industry is based on centrally managed, hosted, and provisioned applications contracted with end users. Companies inclined to coexist in an ecosystem are contributing to the inevitability of application delivery over the Internet.

Business ecology is defined as a new area for sustainable organizational management and design, based on the thesis that organizations, as living organisms, are most successful when their development and behavior are consistent with their core purpose and values. Business ecology is based on the elegant structure and principles of natural systems. To develop healthy business ecosystems, leaders and their organizations need to see themselves and their environment through the ecological environment.

Business ecology involves the study of the relationship between business and organisms and their environment. The goal of business ecology is sustainability through the complete environmental synchronization and integration of the business with the sites it inhabits, uses and touches. Platforms and digital ecosystems are promising. Ecosystems span many industries and include various sectors of industry, partners, competitors, customers, and business.

In connection with the development of digitalization and information technology, a new use of the term ecosystem has appeared. The ecosystem is the interconnection of all the services of a company. The internet has changed lives. Multifunctional mobile devices have changed the communication of people, the channels for promoting products and services. Each company strives to create its own ecosystem and make it the most demanded. Global digital ecosystem majors: Apple and Google. The Apple ecosystem includes music, storage, photo library, videos, archives, history recording and passwords. The Apple ecosystem connects services with a common design, information technology platform, accessories and stores.

Digital ecosystems use the principle of one window, working in a single mobile application. As the amount of data grows, they adapt to the client's requirements. Form a single client profile, Summarize information about purchases in the ecosystem, Form a targeted offer to the client. Allow to remove geographical restrictions for business development for small and medium-sized manufacturers of products and services. Like conventional systems of interaction, ecosystems require regulation. There are risks of unfair competition, discrimination of participants, monopolization of technologies, misuse of personal data of clients, insufficient level of information security and protection against fraud.

The digital ecosystem is a collection of platforms that provide various products and services; online and offline services; specialized ecosystems built around one or more basic needs; services not only for individuals, but also for legal entities.

Digital ecosystems are constantly expanding the number of participants. For example, retail company Amazon began by building a global server infrastructure to serve customers on its e-commerce platform. In the second phase of its evolution, the company began to lease server capacity to other enterprises.

This led to the rapid creation of services. The advantages of these services were that they were the main users and received packages faster, had access to music, and could even watch TV series and films from the main library.

In the third phase, the company attracted many third-party companies to participate in this ecosystem. It pioneered and allowed competitors to use the infrastructure of services and tools offered by the company. This was a huge success.

The digital ecosystem is focused on creating added value for customers by optimizing data and workflows from various internal departments, tools, systems, as well as from customers, suppliers and external partners. It removes barriers to the customer and enables each member of the ecosystem to use modern technologies and systems to meet their individual needs.

The ecosystem offers customers a single, easy-to-use system that delivers value through a variety of services, products and knowledge. This allows the platforms to grow exponentially and outperform the mainstream market. When scaling an ecosystem, different business models are possible.

Better understanding of the consumer and reorientation of the offered products allows to the number of offered services and products at the expense of the number of ideas received from buyers. This makes digital ecosystems so powerful and also so profitable that companies using the power of digital ecosystems topped the list of the most valuable companies in the world. Companies are leveraging their customer base and ecosystem approach to drive revenue and offer better products and services to their customers.

There is a focus not only on customer service or personalized advertising / marketing of the company's offerings, but rather on the full spectrum of customer focus that is only possible due to the scale of the business. This means holistic operations and collaboration between departments and between products and services to integrate the customer journey as best as possible.

One of the main advantages of using the digital ecosystem is the ability to collect additional information about processes, customers, transactions. This makes data a key factor in every digital ecosystem. The more you can learn about a customer, the better you can offer services, software, technology, and tools to improve the customer experience.

With the tremendous understanding that digital ecosystems receive from customers, suppliers, and third parties, it is also possible to make that understanding actionable. Automation is one of the key elements in lowering prices, increasing customer satisfaction, and proposing new services and products to increase the value stream. Digital ecosystems enable collaboration between countries, regions and languages. They remove cultural barriers.

The ecosystem participant mentality should be very dynamic. This is because ecosystems must quickly adapt and respond quickly to changing market dynamics otherwise the user base will move forward and switch platforms. Business intelligence, rapid decision making, and the use of new technologies and business models must be at the center of every decision. Before you start imagining yourself as an ecosystem builder, you need to dive deeply into your company and your offerings. It also means that you need to determine which ecosystems are important to you and what role you will play in which ecosystem. There are three different roles a company can play in an ecosystem. This is the role of the ecosystem organizer. In this case, the company takes on the risk, complexity, and challenges of building a digital ecosystem and allows others to participate in the ecosystem and sell goods and services through that system.

This is the role of the modular manufacturer. In this case, the company contributes to the ecosystem and monetizes the value in different ecosystems. Through its services, the company offers various platforms and ecosystems of services to have a single payment gateway so that customers can pay easily. A module maker can add essential services to ecosystems that meet the needs of consumers, businesses, and buyers and sellers in a certain sense. In the third modification, the customer can be a person or business that benefits from the ecosystem. By booking a digital platform, you become a customer of the ecosystem. Companies can sometimes use, sometimes organize, and sometimes add services to multiple digital ecosystems.

It is imperative that companies and individuals understand the power and implications of the growth of digital ecosystems around the world, and find ways to participate in, create, or interact with them in their own contexts to harness their power and perhaps create their own and project.

Initially, the idea of an ecosystem came from the IT business. IT companies were the first to feel the need for closer interaction between all participants in the value chain (IT product) than traditional contractual relationships. A typical example is the experience of developing a new generation of IT products - popular corporate messengers that integrate various applications into their mobile services, forming an ecosystem. The value of such an ecosystem increases for each of its participants. Business is constantly looking for new approaches and new forms of interaction with suppliers, consumers, transport and logistics companies, payment systems, with players from adjacent and competing industries.

Traditionally, a successful network business configuration has been a platform that allowed third parties to use the original infrastructure as a means of distributing value. However, the increase in the functionality of platforms faced limitations not so much of a technological as of an economic nature: many innovative ideas could not be implemented on the basis of existing platforms, since their implementation.

The ecosystem of a firm is not limited to the business network and includes both business partners and non-business partners, but those affected by the company's activities. The first ecosystems arose on the basis of innovative clusters, then in the future, multiactor networks, management of IT and social platforms, and the dynamic evolution of product service systems were involved in the formation of such structures.

The effectiveness of an ecosystem does not depend on the quality of its individual components (participants), but on the quality of their interaction with each other. The digital ecosystem is a recently emerging model for such an organization. The digital ecosystem provides for a certain industrial metabolism of the business network. Information and communication flows of the firm and business networks interact (harmoniously or not) with the surrounding economic and social environment, and this environment covers the entire global world. This evolution fundamentally changes not only business practice, but also the self-image of the essence of what a particular business is doing.

Examples are the transformation of the tourism industry into a hospitality ecosystem and fintech as a special digital ecosystem in the financial sector. An increasing number of business consultants recommend their clients to form an ecosystem or integrate into a ready-made ecosystem of business strategies. By 2025, such ecosystems will account for about 30% of the global revenues of organizations and more than 40% of their global profits.

The trend towards consolidation of players within the business ecosystem can be traced in different countries through the example of taxi aggregators, food delivery services and e-commerce. The emphasis is on network collaboration and multiplier effects in business networks as features of the behavior of modern companies. This determines the specifics of making key decisions in the business space of the modern world. Competitive collaboration (collaboration) is taking place as the dominant trend in the networked economy and as a driver for the transformation of business models.

At the same time, collaboration does not negate tough competition. A specific business configuration is being formed, within which competition and cooperation take on new forms.

The ecosystem goes beyond one firm, so it cannot be called a business model or business strategy. The ecosystem is not a traditional form of inter-firm contact. With the advent of the digital ecosystem, the interaction of companies is taking place at a qualitatively new level. The ecosystem is characterized by high dynamism and high flexibility. The ecosystem is focused on results: firms within the ecosystem do not sell a product or service, but the result that the client wants. The ecosystem is not a firm, not a business strategy, or ordinary inter-firm interactions.

The ecosystem is a fundamentally new, flexible, business configuration that includes a variety of participants, cooperating and at the same time competing.

In a digital ecosystem, the interdependence of economic actors is felt stronger and deeper than in a traditional value chain. In the networked economy, the predominant form of rivalry between companies is platform competition, and platforms can be of a very different nature: technological, social, virtual, and others. With the development of network interactions, the concept of a platform from a purely technical sphere is transferred to all other areas of interfirm relations and acquires a broad meaning as a kind of portal, a definite, real or virtual, space of common standards, acting as an intermediary that unites disparate participants that create value only when joint participation. Organizational fields and organizational networks are crystallizing into platform ecosystems. Digital platforms create space for the movement of information flows, ensuring the interchange of data between various participants.

In traditional platform competition, a pioneer firm is able to quickly reach a critical mass of users, develop a broader set of mutually complementary products, and set a lower price. All this leads to a significant superiority of the leader. Latecomers either have no chance of market penetration at all, or are forced to settle for an extremely small, marginal market share. Competition between platform-based business ecosystems shows other patterns. The winner-take-all principle only works when the platform's consumers prioritize and value the entire network as a whole.

First, the quality and competitiveness of the platform depends not only on the direct network effect - the number of users, but also on the quantity and quality of complementary resources and products (indirect network effect). When deciding which platform to choose, a potential user must carry out a complex process of processing information regarding the presence and depth of direct and indirect network effects. This requires a rare resource - attention. Concentration of attention is distributed unevenly: new information receives a stronger "dose", attention to old, already familiar information turns out to be weaker. Limited rationality of people, poor ability to attract attention, selective concentration and selectivity of user interest affect how consumers evaluate the usefulness of the platform, and, therefore, make decisions about its choice.

Second, consumers are not interested in the overall network of the platform. The small number of people who use this network product influences their choice, but the number of acquaintances, employees, colleagues, friends who recommend this platform, since they are constantly present in this particular network. Users want to be in touch not with the global platform world, but with their local community. Platform competition demonstrates a small world effect, or preference for a local network. Therefore, a firm that uses unusual, interesting, personalized, creative incentives and focuses on a local social network can be successful in platform competition, even if it is far from the first to take this path. Leader advantage is losing its former importance.

A new feature of networked platform competition is the transfer of company rivalry to virtual space. The conquest of the virtual space is a new criterion for a firm's efficiency. Social networks and the company's website are becoming part of a virtual competition. Firms are adopting platform ecosystem strategies where the main effort, assets, and investment are in related industries to gain competitive advantage in both core and complementary industries. Competition virtualization spawns an important strategy for today's networked competition - the collection and analysis of big data. The traditional concept of the firm as an unstructured data system is dying out. The exchange of data between IT applications during production, distribution, market sale and consumption creates an independent, holistic ecosystem of goods and services in the business space.

Modeling the company's network strategies within the digital ecosystem allows us to distinguish two basic options. The first option is the choice of a unique technology and / or network that is incomparable and incompatible with competitive products. The company creates technological difficulties for competitors and high switching costs for consumers. The second option is a compatible network with relatively low switching costs for consumers and the ability to use products from competing companies. In the first case, there is fierce competition, which is traditional for the network economy, at the first stage of network development for market dominance. Here, the main method of competition is aggressive pricing to achieve rapid industry dominance through escalation effects, creating an investment trap for consumers, and quickly gaining a critical mass of users. Fierce initial competition subsequently turns into monopoly or domination by one winning company.

In the second case, firms do not need to compete fiercely, the problem of obtaining a critical mass of users is not worth it. Weak non-price competition prevails here, resulting in a fragmented market. Network competition helps to develop network products of different firms, stimulates cooperation between companies and defines each business organization its place, its own niche in the overall business network.

In the neoclassical model, firms and individuals are independent in decision-making and interact with each other only through prices. The price mechanism equalizes all participants and leads to an almost endless growth in space and time of inter-firm interactions. In the digital ecosystem, as the number of web users grows, there is a small world effect. The small world effect suggests that network participants regularly enter into short-term relationships and, from time to time, long-term relationships outside of price patterns. The small world effect suggests that network participants regularly enter into short-term relationships and, from time to time, long-term relationships outside of price patterns. The average firm in such a network has short-term relationships and contacts with a wide range of partners. Social relationships turn out to be more significant than price ones.

Chaotic and random participants in the network form ordered structures (clusters), so that any two participants in the network will be connected to each other through a relatively small series of contacts. In chaotic networks, each participant has the same probability of contact with any other participant. In cluster networks, participants with a common neighbor are characterized by a higher probability of interconnection (contact). In such networks, even small initial changes have large net impacts.

The higher efficiency of the small world network is based on such factors as: joint organizational and economic evolution, intertemporal exchange of information, deeper and shorter learning effect and similarity of technological profiles of firms. The competitiveness of modern innovations is largely based not on technological innovations (although it does not exclude them), but on the flexibility of the supplier network. The cooperation of suppliers that are part of the business network of the enterprise lead to a reduction in costs for innovative projects and an increase in the quality of innovative products.

An innovation ecosystem can include a variety of actors from outside the business sector. The small world effect makes it possible to distinguish two clusters within the framework of the overall innovation ecosystem: the ecosystem of knowledge and the ecosystem of the business itself. The knowledge ecosystem includes organizations responsible for the creation of private and public (collective) goods: research institutes and educational institutions. The business ecosystem is usually represented by commercial enterprises of an industrial and commercial nature, as well as financial institutions.

Diversified open innovation platforms have allowed the development of innovative services that have been accompanied by reduced business costs and increased business efficiency based on the knowledge triangle. The efficiency of the modern economy requires the simultaneous and parallel development of both parts of the innovation ecosystem in harmonious interaction. However, unlike the second, the first is that the knowledge ecosystem requires government support for its advancement (especially in terms of creating public goods, the production of which may turn out to be underfunded, which will slow down the progress of the entire innovation ecosystem).

The emergence and development of ecosystems leads to a significant change in the purpose of the firm. It is evolving towards taking into account the needs of all stakeholders.

4.2 4.2. Systems Engineering of Digital Ecosystems

Systems engineering is based on an interdisciplinary approach. The goal is to transform customer needs and constraints into effective solutions, to support those solutions throughout the life cycle. She substantiates the methodological criteria for the activity and responsibility of a system engineer, develops a toolkit for activity.

A dedicated guide accompanies the complete lifecycle of a digital system and focuses on productive technical design solutions and technical integrity. It is a creative activity aimed at realizing new opportunities based on a combination of technical knowledge, ability to solve problems, creativity, ability to lead and to exchange knowledge and opinions.

System solutions management focuses on the use of many different technologies, participation in the work of several organizations, and complex technical activities. This is a formalized activity aimed at the development and systematization of knowledge necessary for the effective management of the development and functioning of complex systems. Good governance involves the use of a systematic, orderly, quantifiable approach that can be used recursively at different system levels, is reproducible and suitable for observation and demonstration.

Systems Engineering Thinking manages an engineering team that is tasked with a model-based systems methodology. It provides for the use of logical structural and physical numerical formal models. They can be directly processed, tested, optimized. Models are checked for errors. Not only numerical physical models are used, but also logical models with the apparatus of discrete mathematics, as well as algorithmic programming models.

Search-based systems engineering plays an important role. The calculation of optimal technical solutions for goals and contracts is carried out. After describing the goals and contracts, the synthesis and optimization of the architecture corresponding to the goals and contracts is done. Artificial imagination plays an important role. It is based on genetic algorithms and trained neural networks. Engineering modification is generative design. The technique of direct reflection on an engineering project, 3D modeling and 3D CAD systems is used. But this line of work is also associated with the synthesis of the model (3D models in this case).

A higher level of artificial imagination involves computer search. This requires the economical generation of suitable engineering options and an artificial engineering taste. It lies in the ability to evaluate options. Hybrid numerical logical computing is used. The target system is described in terms of system structures, in particular, components, modules, placements in their hierarchies and numerical parameters of physical properties. The system architecture is obtained by looking for a combination of logical / functional and physical architectures.

The conceptual apparatus of systems engineering is formed by the theories of target systems, engineering activities and management. The target system (digital ecosystem) is considered as open in the context of its interaction and adaptation to other systems that are in the functioning environment, as having open, interacting subsystems in its composition, and as a part of the system in a broader sense or an encompassing system. To obtain a solution, the parts come together to function and interact as a whole. EFFECT: increased efficiency of work as a result of connection, integration, merging of separate parts into a single system (synergistic effect). The stages of description, design, selection of components, their connection with each other so that the necessary interaction and the necessary properties of the whole are achieved are important. When making decisions, the system is considered as a whole. The properties and behavior of systems are considered in dynamics.

It is important to adapt the characteristics of a complex system to changes in its state, in the external environment and in other systems. It is also important to provide opportunities for continuous improvement in system performance to maintain optimal performance in the face of changes in the operating environment. Successful systems engineering involves the process of continually adapting system requirements and solutions to deliver the results that, in a given environment, are most satisfying to stakeholders. This includes two components.

Systems engineering seeks to formalize the systems development process. The collection of such typical, repetitive actions is called the systems engineering process and the systems engineering method.

The subject of systems engineering is an integrated, holistic view of large-scale, complex, high-tech systems that interact at the enterprise level using human-machine interfaces. The creation of such systems involves the development of systems architecture, design of systems and their elements; operations research; management of engineering activities; selection of technologies and techniques; effective management of the life cycle of the digital ecosystem.

Systems engineering is associated with organizational and management, design and management, design and engineering and technological activities. A systems analyst studies a business and determines how it can be made more efficient by implementing information systems. There is a need for specialists with a technical background and developed soft skills who can optimize the development process.

The main task of a systems analyst is to develop an information system that meets the needs of the company and allows you to establish business processes. He develops a list of tasks and communicates them to the team so that colleagues have a clear idea of the goals and methods of achieving them. The systems analyst collects and analyzes the requirements of the source programs, conducts interviews with the customer. It coordinates the requirements and manages their changes, including monitoring requirements changes to prevent inconsistencies; prepares design, technical, user documentation. It captures the flow of information to avoid confusion; presents the work to the customer; synchronizes the context of the team and the customer: ensures high-quality communication, minimizes conflicts.

To perform work tasks, the systems engineer must understand the basic principles of software development; be able to determine the boundaries of systems and their areas of responsibility to analyze opportunities and limitations. It is important for him to know how to distinguish subsystems and their functions; be able to find explicit and implicit requirements for finding solutions; have modeling skills to visualize processes.

The development process involves a constant exchange of information. To correctly request and communicate it clearly, it is important for a systems analyst to develop soft skills.

In retail, when automating processes, client-server systems are often used, so the systems analyst must understand the relevant requirements and architecture. Experience in prototyping will help you create user interfaces for easy communication between the user and the program. It is important for cyber security to understand encryption systems and data protection.

The business analyst is focused on optimizing business processes, reducing costs and increasing profits through automation. He develops the solution and passes it on to the systems analyst, who shifts this solution to the technical implementation and helps the engineers understand what should be the result of the development.

The data analyst processes the data and builds hypotheses based on this. The data analyst works with metrics, and the systems analyst works with processes. The systems analyst translates the collected requirements into development tasks. The systems engineer monitors the progress of the project, coordinates shifts in the plan manages resources and risks. He is responsible for product strategy from hypothesis to analysis of results. He knows what the user needs, and the systems analyst understands how to do it.

The systems analyst thinks over the structure of the digital ecosystem, and the architect creates it. The system architect designs the architecture in such a way that the developed system not only meets the current business requirements, but also can be flexibly expanded and modified as new needs arise.

The technical writer is responsible for the documentation. The responsibilities of a systems analyst also include the preparation of documents, but the scope of his responsibilities is much broader. Software ecosystem and related terms are widely used by software manufacturers and researchers. A survey of the websites of leading software manufacturers shows that most of them use the term “software ecosystem” to refer to systems that include the developer's enterprise, its software and partners. Ecosystems are viewed as a level of abstraction over software products and projects that can be described by analyzing the lower levels. The point is to analyze the information of the project components to obtain high-level design views that characterize the organization, software components and the conditioned social structure. There is a trend towards using ecosystem concepts to refer to socio-technical software systems. This is explained by the similarity of modern large-scale software systems to dynamic communities of independent and competing organisms in a complex changing environment. Organisms include people, computing devices, and organizations. Among the properties of ecosystem concepts that are useful when considering large software systems, such as complexity, decentralized management, complexly predictable effects of certain types, complexity of monitoring and evaluation, competition in niches, resilience, adaptability, stability and viability are distinguished.

Thus, developers and researchers have formed a new view of software as a socio-technical system with characteristics similar to biological ecosystems. The scale of such ecosystems ranges from a specific set of projects in an organization to a global set of all software. A comparative study of biological ecosystems and software ecosystems has shown that they have holistic properties that characterize the system as a whole, and merological properties that characterize the internal structure of the ecosystem. A generalized model of a software ecosystem can be thought of as an ecosystem within established boundaries, in which the environment is at the entrance and the environment is at the output.

The environments show the exchange of specialists and software. The holistic model of the software ecosystem stipulates a number of possible aspects and properties of software ecosystems to explore. First, the requirement to define the boundaries of a specific ecosystem allows us to substantively consider the exchange of an ecosystem with the environment and to establish characteristics of the size of the ecosystem. The boundary also forces the researcher to clearly separate the elements of the ecosystem from the elements of the environment. So, such elements of the ecosystem as states, educational institutions can only relate to the software ecosystem of a global format, or the scale of the state. For smaller ecosystems, most will be environments. Secondly, the definition of environments at the input and output in the model allows you to identify and describe the essential relationships of the ecosystem with the environment, the volume and composition of the exchange.

The concept of software life cycle processes makes it possible to show relationships more specifically, using known products and resources of processes and phases - programs, documentation, personnel. The merological model makes it possible to define and use a wide range of ecosystem properties, some of which are already used in software. The properties of a merological model can describe the composition, number of elements and structure of an ecosystem, the intensity of connections between elements. Software development is a gradual iterative process, each cycle of which provides new opportunities. The evolution of software cannot be considered without taking into account the development of its ecosystem, since it requires the corresponding development of other elements of the ecosystem - the qualifications and experience of developers and partners, the skills and expectations of users. Therefore, software ecosystems can become an additional tool for researching and evaluating the evolution of software.

4.3 4.3. Semantics of Possible Worlds and Representation of Knowledge

The birth of the semantics of possible worlds is associated with the theories of G. Leibniz. In one of them, he claims that the Divine mind contains a variant of an infinite number of worlds. God chooses the best of these worlds, creating him as he is. The philosopher determined the logical direction of the development of the theory. The semantics of possible worlds are used to determine the meaning of expressions. Their semantic status does not depend on a single position, but on many possible states of affairs. The prevailing direction is the structuring of the truth value, its multi-level description. Complex models are constructed that combine the concepts of a possible world, a moment in time, a subject of utterance (the worlds of the observer) and subjects of propositional attitudes (the worlds of knowing).

The concepts of S. Kripke and D. Lewis are considered to be extreme in terms of principles. S. Kripke considers the real world as one of many logically possible worlds. This set is considered as some abstract concepts that serve to interpret the laws of reality. D. Lewis's modal realism asserts the equal reality of all existing worlds. The philosopher insists that when we talk about the difference between our world and other possible ones, about its reality, we only mean that this is our world.

R. Stolnaker put forward the theory of moderate realism, according to which possible worlds exist as an alternative way of being things, in which the things themselves are no longer identical to those that exist in the real world. The uncertainty principle was asserted as a condition for the existence of possible worlds. In linguistics, the theory of possible worlds has found quite strong positions in semantics, pragmatics, and literary criticism. In a semantic context, possible worlds are used to designate entities, relative to which the truth values of propositions are determined (S. Kripke). They are described as the most consistent classes of propositions (J. Hintikka), or they are declared the reason for a person's rational activity in the form of reflection, communication and study in order to establish differences between concepts (R. Stolnaker).

Among the main directions of using the theory of possible worlds in semantics, the consideration of the semantics of the question and the pragmatics of the question-answer system of relations, the analysis of presuppositions are distinguished. The role of context and contextual changes in the interpretation of discourse is investigated. According to B.Kh. Parti, if a method is created that makes it possible to analyze propositions without appealing to possible worlds, then the theory of these worlds will cease to be in demand.

The theory of possible worlds in literary criticism sets as its task the definition of literary truth, the study of the nature of the fictional context and the establishment of links between the worlds of literature and our real world. It is especially relevant for the analysis of works with a clearly defined combination of fiction and reality - hagiographies (V. Lurie), alternative history (M. Nazarenko). In relation to fiction, the application of the theory of possible worlds was developed by U. Eco, M.-L. Ryan, L. Dolezel. Scientists have tried to classify texts according to the principle of truth (L. Dolezel), to rank worlds according to the role of the author, characters and reader (U. Eco), to explain the nature of the dynamism of the plot through the combination of character worlds (M.-L. Ryan). Methods of linguistic analysis of ways of mapping worlds turned out to be in demand.

In a narrow sense, the semantics of possible worlds is a method of logical analysis of the semantic constructions of modal and intensional concepts. It is based on the consideration of possible worlds as conceivable states of affairs (ideal alternatives, descriptions of states, points of correlation). It is based on the consideration of possible worlds as conceivable states of affairs (ideal alternatives, descriptions of states, points of correlation).

D. Scott proposed to clarify the meaning of modal concepts in the process of analyzing alternative states of affairs. Possible worlds are understood by him as an area of conceptual consistency. Among the logical possibilities, classes of equivalent areas are distinguished on the basis of the ratio of their possibilities. Of these, one class of the real world stands out. Some logical possibilities are understood as real alternatives to the real world. The idea of possible worlds by

G.V. Leibniz used to interpret the necessarily true as what takes place in all possible worlds, and incidentally true as what takes place in some of them. The classically possible world (description of the state of affairs) is a collection of elementary (atomic) statements and their negations. For each elementary statement, this totality includes either itself or its negation, but not both. An elementary statement is considered true (realizable) in a given possible world if it belongs to it. The truth of a complex statement is determined by induction on the construction of this statement.

A statement is necessarily true if it is true in all possible worlds. R. Carnap, proceeding from the ideas of G. Leibniz, constructed the first meaningful semantics for a modal language through the refinement of the concept of a possible world by the concept of "description of a state". Its logical system contains an exhaustive definition of complete and consistent descriptions of the states of atomic facts. Exact methods of semantics of possible worlds were created by S. Kanger ("classes of structures", "properties of modal operators"), R. Montague (relations between "ideal models", "points of reference", "neighborhood semantics"), B. Johnson, A. Tarski (connection between algebraic characteristics and properties of binary relations). And also J. Hintikki (“model sets”, the relation “co-resolution”, the relation of alternativeness), K. Meredita, I. Thomas, A. Pryor (“world jumps”, “world-jumping”), S. Kripke. These are works on relational semantics, in which the relation of reachability between worlds, as well as alternativeness, informativity is introduced.

The method of semantics of possible worlds is used to determine the meaning of expressions, the semantic status of which does not depend on a single state of affairs, but on many possible states of affairs, as, for example, in languages of modal logic.

Possible worlds in terms of quantity and quality are subdivided into complete (incomplete) and consistent (contradictory) worlds. The notion of a complete possible world involves the construction of models in which individual and predicate constants are defined. This means that you can calculate the value of any well-formed formula.

Semantically, there is a distinction between solid designators and non-solid designators. Contradictory descriptions of the state contain logically contradictory formulas. Incomplete and contradictory worlds can serve as examples of non-classical worlds or impossible possible worlds. The models introduce special functions that identify individuals in possible worlds. These are "transworld lines" in Hintikka's terminology.

In non-classical logics, the meanings of the concept of "possible world" vary from the field and objectives of the study. You can distinguish between logical and physical necessity. Research on non-classical logics focuses on structuring truth value. Complex models are constructed that combine the concepts of a possible world, a moment in time, a subject of utterance (worlds of an observer), subjects of propositional attitudes (worlds of cognizers). Possible worlds are distinguished as global descriptions of states, including all considered points of reference, and as local descriptions (possible worlds in the narrow sense). The structuring of meaning involves the construction of multilevel semantics of possible worlds.

One aspect is the study of information frames. The frame reflects the way knowledge is represented in artificial intelligence. This is a real-world scenario. The term was introduced by M. Minsky to designate the structure of knowledge for the perception of spatial scenes. A frame is a model for an abstract image. This is the minimum possible description of the essence of an object, phenomenon, event, situation, process. Frames are used in expert systems.

The theory of possible states is proposed, designed to describe the relationship between situations. In theory, modal operations serve as a mathematical tool for expressing which situations are possible and which are not. The key point is that the concept of the possibility of a state cannot be adequately expressed in a first-order language, it is expressible only in a second-order language. This approach was formulated by Drezke on Semantic Information Theory, to research by Stalnaker and Shannon, where it is used implicitly.

Modal logics generated by information frames are defined through semantic constructions. Barwise set the task of axiomatizing modal logics generated by information frames. The development of the general mathematical theory of information frames has become topical. Axiomatic systems are constructed for modal logics of complete information frames, correct and complete information frames, hereditary and complete information frames, complete, correct and inherited information frames, and joint and complete information frames. Weak modal logics generated by information frames became the object of research.

Logic also needs semantics to give meaning to symbols. Formal logic uses semantics that are not based on the use of words. The scope of semantics in formal logic is limited to a direction similar to the choice of meaningful names for variables in conventional programming. The topic of knowledge representation is considered one of the main areas of work in the field of artificial intelligence. The choice of the correct way to represent knowledge is no less important factor on which the successful creation of the system depends, than the development of the software itself, which uses this knowledge.

Related to the topic of knowledge representation is the topic of data representation, which is considered in such an area of computer science as database design. Databases are viewed as repositories of current data such as inventory data, accounts payable, accounts receivable, not knowledge. Companies are active in analyzing the hidden patterns in data to extract knowledge.

Analyzing hidden patterns in data seeks to use historical data in data warehouses to predict trends. The value of analyzing hidden patterns in data is that it allows you to detect trends that are not obvious to humans, but are detectable by analyzing huge amounts of historical data that are stored in the company's archive. In the process of analyzing hidden patterns in data, not only classical statistical methods are used, but also such artificial intelligence methods as artificial neural systems, genetic algorithms, evolutionary algorithms and expert systems, not only taken separately, but also in various combinations.

Expert systems are designed to use a certain type of knowledge representation based on the rules of logic, called inference methods. Usually, the term inference means obtaining logical conclusions based on facts. The representation of knowledge can do without taking into account semantics, but expert systems are designed to conduct reasoning based on logic, therefore, they should not be influenced by the emotional coloring that can be introduced into reasoning under the influence of semantics.

The purpose of inference is to arrive at a valid factual conclusion using evidence in an admissible form. The reason the representation of knowledge is important is that the entire development process, as well as the efficiency, speed and maintainability of the system, depend on the correct choice of the way of such representation. In this, the indicated position is completely analogous to the position that develops in ordinary programming, where the choice of the correct data structure is of fundamental importance when developing a program. A good program design always starts with choosing the right way to represent data, be it simple named variables, arrays, linked lists, queues, trees, graphs, networks, or even such standalone external databases.

It is necessary to separate true knowledge from semantic coloring, the influence of which may lead to invalid conclusions. One should not argue with an expert in knowledge, make impossible demands on him, and all the more, one should not seek to obtain those logical conclusions that are required under the terms of the assignment, since this is tantamount to an unsuccessful completion of the project.

An expert system can contain hundreds and thousands of small pieces of knowledge about the use cases on which it relies. Each rule in the expert system can be viewed as a micro-precedent that contributes to the solution of the problem.

Knowledge plays a very important role in expert systems. Knowledge is part of a hierarchy of ways of presenting information. At the lower level of this hierarchy is noise, consisting of information elements that are not of interest and can only complicate the perception and presentation of data. At a higher level, there is unformatted data containing data elements that, in principle, may be of some interest. The next level contains information (processed data) of interest to users.

Expert systems can separate data from noise, second, transform data into information, and third, transform information into knowledge. In a fact-based expert system, it is extremely dangerous to use unformatted data, since the reliability of the resulting conclusions may be unacceptable.

In the absence of knowledge of the sequence, it may appear to be a manifestation of noise. But if there is reason to believe that this sequence makes sense or it is reliably known, then the specified sequence is considered as data. Certain knowledge may relate to how data is to be converted into information.

Expert knowledge is a specialized kind of knowledge and skills possessed by experts. These are the tacit knowledge and skills of an expert that must be extracted and transformed into explicit knowledge so that it can be represented in the expert system. The reason that knowledge is implicit is that the true expert has such a good command of this knowledge that it has become second nature and does not require reflection.

An expert system can be designed with knowledge of several different problem areas, but this is undesirable, since as a result the system becomes less well defined. Expert systems work successfully, the use of which is limited to the smallest problem area of all possible. If the expert system is designed to detect diseases caused by bacteria, then it makes no sense to use it also for diagnosing malfunctions in cars.

In expert systems a ontology represents metaknowledge that describes everything that is known about the domain under consideration. Ideally, the ontology should be presented in a formal form so that inconsistencies and inconsistencies can be easily detected. A variety of free and commercial tools can be used to build ontologies. The construction of the ontology must be completed before the implementation of the expert system, since otherwise it may be necessary to revise the rules as additional information about the given subject area becomes available, which leads to an increase in costs. In connection with the need to reduce the need for memory and increase the speed, it would be inefficient to keep all knowledge bases in memory at the same time, since during the operation of the network, all the rules in the network are constantly being modified in the memory.

Conflicts can arise if the antecedents of a rule contain the same pattern and the conclusions are different. The work of the expert system slows down with an increase in the number of rules in the system, as the network becomes larger. And meta knowledge can be used to decide which knowledge base should be loaded into memory, and also serve as a general guide to the design and maintenance of an expert system and its ontology. A number of methods of knowledge representation have been proposed. These include rules, semantic networks, frames, scripts, logic conceptual schemas. Syntax defines form, and semantics defines meaning.

The metalanguage is intended to describe other languages. A system of linked frames can form a semantic web. Frames are used in expert systems and other intelligent systems for various purposes. The structure of a frame is understood as a way of using a scheme, a typical sequence of actions, a situational modification of a frame. A frame includes a certain default knowledge called a presumption. A frame is distinguished by the presence of a certain structure. It consists of a name and individual units called slots. It has a homogeneous structure.

The slot value can be the name of another frame. Frames are networked. Frame properties are inherited from top to bottom, that is, from upstream to downstream frames. An empty frame is called a proto frame, and a filled one is called an exo frame. The role of the proto frame as a shell in the exo frame is important. This shell allows you to carry out an internal interpretation procedure, thanks to which the data in the system memory is not faceless, but has a certain meaning known to the system.

A slot can contain not only a specific value, but also the name of a procedure that allows it to be calculated according to a given algorithm, as well as one or more heuristics that are used to determine this value. A slot can contain not one, but several values. Sometimes this slot includes a component called a facet that defines a range or a list of its possible values. The facet indicates the boundary values of the slot placeholder. In addition to a specific value, a slot can store procedures and rules that are called when this value needs to be calculated. Among them, there are demon procedures and servant procedures. The first ones start automatically when a certain condition is met, and the second ones are activated only in a special way.

A collection of frames that models a subject area represents a hierarchical structure into which frames are collected using generic relationships. At the top of the hierarchy is the frame that contains the most general information that is true for all other frames. Frames have the ability to inherit the values of the characteristics of their parents at a higher level of the hierarchy. These values can be passed by default to frames that are below them in the hierarchy, but if the latter contain their own values of these characteristics, then they are accepted as true ones. This circumstance makes it possible to easily take into account various kinds of exceptions in frame systems. A distinction is made between static and dynamic frame systems. In systems of the first type, frames cannot be changed in the process of solving a problem, while in systems of the second type, this is permissible.

Each frame corresponds to some subject area object. Slots contain data describing this object. The slots contain the values of the attributes of the objects.

A frame can be represented as a list of properties, and if using database tools, then as a record. In complex semantic networks, which include many concepts, the process of updating nodes and controlling the connections between them becomes difficult. At the same time, the number of mediated generic relations between concepts increases sharply. A frame is a data structure that represents a stereotyped situation. Several types of information are attached to each frame. At each node, concepts are defined by a set of attributes and their values, which are contained in the frame's slots.

Framework analysis is used to analyze how people understand situations and events. The method helps to select certain aspects of reality and make them more visible in the communicative text, popularizing a certain interpretation of the problem, interpretation of its causes, moral assessment and possible solution. The researcher examines the text to identify the frames. The framework is considered as a scheme for information processing. They are embodied in keywords, metaphors, concepts, symbols and visuals.

The framework analysis methodology includes logic and framing tools. Logic tools provide an explanation or reason for a main position, its consequences and adherence to principles. Concepts such as "visibility", "formatting" and "importance" facilitate analysis. Working with different systemic modifications of information has created a certain hierarchy of predicate logics. At the top is higher-order logic. This form of predicate logic differs from first-order logic in additional predicates and richer semantics. Higher-order logics with their standard semantics are more expressive, but their model-theoretical properties are more difficult to apply compared to first-order logic.

The difference is due to the fact that first-order logic only quantifies variables. Second-order logic allows for the quantification of predicates and function symbols over sets. Third-order logic uses and quantifies predicates over set predicates. Higher order logic includes lower order logic. It allows statements with predicates (over sets) of lower nesting depth.

Descriptive logic [developed a knowledge representation language that allows describing the concepts of the subject area in an unambiguous, formalized form, organized by the type of languages of mathematical logic. These logics combine rich expressiveness and good computational properties. Among them are the solvability and low computational complexity of the main logical problems. Descriptive logicians operate with the concepts of "endpoint" and "role", corresponding in other sections of mathematical logic to the concepts of "one-place predicate" (or set, class) and "two-place predicate" (binary relation). Once the ontology is built, the question arises of how it is possible to extract the knowledge resulting from the knowledge contained in the ontology, whether it can be done programmatically and what are the corresponding algorithms. These questions are solved theoretically in descriptive logic. In practice, many software systems (reasoning mechanisms) have been implemented that allow automating the derivation of knowledge from ontologies and performing other operations with ontologies. To formulate the syntax of any descriptive logic, it is necessary to specify non-empty sets of atomic concepts and atomic roles, from which expressions of the language of this logic will be built.

Concrete logic is characterized by a set of constructors and an inductive rule, with the help of which the composite concepts of a given logic are built from atomic concepts and atomic roles using these constructors. The semantics of description logics is set by interpreting its atomic concepts as sets of objects selected from a certain fixed set of atomic roles (binary relations on a domain).

4.4 4.4. Automated processing of information semantics and subject ontologies

Ontologies are an important element of modern information technologies. They allow for automated processing of the semantics of information provided via the Internet for the purpose of its effective use (presentation, transformation and search). The principle of processing Internet data is focused not on the comprehension of information by a person, but on the automated interpretation and processing of information.

Ontologies are intelligent tools for finding resources on the web with new methods for representing and processing knowledge and queries. They accurately and effectively describe the semantics of data for a certain subject area and solve the problem of incompatibility and inconsistency of concepts. Ontologies have their own means of logical inference, corresponding to the tasks of semantic information processing.

Thanks to ontologies, when accessing a search engine, the user has the opportunity to receive in response resources that are semantically relevant to the query. Therefore, ontologies have become widespread in solving problems of knowledge representation and knowledge engineering, semantic integration of information resources, information retrieval. Ontology is viewed as a formal specification of a shared conceptualization that takes place in a certain domain context. Conceptualization includes the collection of concepts and information related to concepts. These are properties, relationships, constraints, axioms and assertions about concepts that are necessary for describing and solving problems in a chosen subject area. Informally, an ontology consists of terms and rules for the use of these terms, limiting their meanings within a specific area. At the formal level, ontology is a system consisting of a set of concepts and a set of statements about these concepts, on the basis of which classes, objects, relations, functions and theories can be built.

Since there may be different understandings of the same terms in each area, an ontology defines an agreement on the meaning of terms and is an intermediary between a human and a machine-oriented level of information representation. It exists within the framework of agreements between users of some information system. Ontological modeling answers the question of how to describe the domain and corresponding type dictionaries in a declarative, reusable manner. And also how to restrict the use of this data, assuming an understanding of what can be inferred from this description.

Special cases of ontologies are a dictionary and a thesaurus, in which the number of relations between terms is limited. Ontology can be used as a component of knowledge bases, object schemas in object-oriented systems, conceptual database schema, structured glossary of interacting communities, a dictionary for communication between agents, class definitions for software systems. They allow the corresponding software tools (intelligent agents) to automatically determine the meaning of the terms used in the description of resources and compare it with the meaning of the task at hand.

Ontologies can be multiple composite. They differ in their representations of the context of the same domain. They can also identify abstract levels of ontologies. Be a level above other ontologies. Several levels of abstraction can be identified, at each of which ontologies can be defined. Thus, in the field of each scientific discipline, ontologies can be defined. At a higher level, one can describe the ontologies of scientific fields located at the junction of separate scientific disciplines. Let us put the ontology of a scientific discipline in general even higher. The next level of abstraction will be general categories of knowledge structures. Generalization leads to the need to distinguish the types of ontologies in order to organize them into ontology libraries.

The key point in ontology design is the choice of an appropriate ontology specification language. The purpose of the language is to create the ability to indicate additional machine-interpreted semantics of resources, to make the machine representation of data more similar to the state of affairs, to significantly increase the expressive capabilities of conceptual modeling of loosely structured data. The difference between the traditional and Web-languages of the specification of ontologies lies in the expressive possibilities of describing the domain and some of the possibilities of the inference engine for these languages. Typical language primitives additionally include constructs for aggregation, multiple class hierarchies, inference rules, and axioms; various forms of modularization for recording ontologies and relationships between them; the possibility of meta description of ontologies. There are many semantic data description tools, many of which are considered expressive enough for semantic data modeling tasks.

The following processes are important in the life cycle of ontology creation: project management, development itself, and development support. Project management procedures include planning, control and quality assurance. Planning determines what tasks need to be completed, how they are organized, how much time and what resources are needed to complete them. Monitoring ensures that scheduled tasks are completed and exactly as intended. Quality assurance is needed to ensure that the components and the product as a whole are at the specified level. Development includes specification, conceptualization, formalization, and implementation. First, a glossary of terms is built, which includes all terms (concepts and their instances, attributes, actions) that are important for the subject area, and their natural language descriptions. When a glossary of terms reaches a significant amount, concept classification trees are built. This is how the main taxonomies of the domain are identified, and each taxonomy creates ontology. The next step is to build binary relationship diagrams. Diagrams can serve as a source material for the integration of different ontologies. Then a dictionary of concepts is built, containing all the concepts of the domain, instances of such concepts, attributes of the instances of concepts, relations, the source of which is the concept, as well as optionally synonyms and acronyms of the concept.

A table of binary relations is constructed for each relation, the initial concept of which is contained in the classification tree. For each relationship, its name, names of the source concept and target concept, inverse relationship and characteristics are recorded. It also builds an instance attribute table for each instance from the concept dictionary. The main characteristics are the attribute name, value type unit of measure, precision, range, default value, attributes, formula or rule for displaying an attribute.

A class attribute table for each class is created from a vocabulary of concepts with similar characteristics and a logical axiom table that defines concepts in terms of true logical expressions. The definition of each axiom includes its name, natural language description, the concept to which the axiom refers, the attributes used in the axiom, a logical expression that formally describes the axiom.

A table of constants is built, where for each constant its name, natural language description, value type, value itself, unit of measurement, attributes that can be displayed using this constant, as well as a formula table for each formula included in the instance attribute table are indicated ... Each table, in addition to the formula, must specify its name, the attribute displayed using this formula, natural language description, accuracy, restrictions under which it is possible to use the formula.

Attribute classification trees are created that graphically show the corresponding attributes and constants used to display the value of the root attribute and the formulas used to do so. Trees are used to verify that the attributes represented in the formula have descriptions and that none of the attributes are missing. An instance table is built for each entry into the concept dictionary. The name of the instance, its attributes and their values are specified.

Domain ontologies are used in the construction of search engines, knowledge representation systems, knowledge engineering, and in solving problems of semantic integration of information resources. Ontology is understood as a formal specification of conceptualization that takes place in a certain context of the subject area. The main relation taken into account when constructing ontology is a generic relation between concepts. This is a hyponym-hyperonym relationship on the basis of which a taxonomy of concepts is formed. The representation of a set of concepts of the subject area and their relations is realized in ontological systems based on the model of the semantic network of frames.

Network nodes represent individual concepts of the domain, arcs represent relationships between concepts. A separate concept in this model is represented by a frame, the slots of which contain the attributes of the concept. Derived child concepts inherit the attributes of the base parent concepts. At the stage of defining ontology concepts, their attributes are usually given the name and type of the attribute. These attributes receive specific values when they are created based on the concepts of the ontology of instances (objects). The operations of creating instances of concepts are supported by most ontological systems. Moreover, the instances often correspond to the concepts of the lower levels of the ontological hierarchy.

Ontology represents a hierarchy of concepts that characterize the objective world, the objects of which correspond mainly to the concepts of the lower levels of the ontology, and its intermediate and upper levels are, as a rule, abstractions of varying degrees of generalization. Existing systems built on the basis of ontologies are designed to work with the ontology of software agents that process certain information requests. One of the promising directions in the development of ontological systems is the construction of systems that use ontological systematization as a tool for classifying objects in the domain with which users work, and as a means for organizing semantically oriented user access to these objects.

Potential areas of productive application of this approach include the work of personal computer users with files and documents. Traditional file access is based on the user's selection of folders and files in a hierarchical file system. In this case, the access tool is a program that implements the functions of a file manager. As the number of files grows and the structure of the file system becomes more complex, finding the desired document and file becomes more and more difficult for users. The solution to the problem can be the organization of access through semantically oriented interfaces, implemented on the basis of domain ontologies.

A document can be found and selected based on its own semantic features, regardless of its physical location on any disk or in any folder. When implementing these systems, it is required to build ontology of the subject area and provide objects of the subject area, files and documents with semantic annotations, on the basis of which access to the objects will be carried out. Annotated resources are included in the ontological system as objects of ontology instances. On the basis of such a system, navigation through the collection of resources available to users can be carried out by moving through the levels of a hierarchical menu, the items of which correspond to the concepts of the subject area of different levels of generalization. The selection of objects available to the user can be based on the processing of queries that specify templates and restrictions for the attributes of the resources of interest to the user. As a result, an ontological information system can combine the functions of a navigation system and a search system.

When creating a modern integrated automated production, the development of an automated information system comes to the fore as the basis for most of the tasks that arise at different stages of design, creation and operation of products. The properties of production systems coincide with the properties of complex systems: uniqueness, weak structuredness, composite character, heterogeneity of subsystems and elements that make up the system, etc., therefore, an information system can be based on knowledge and, in addition to the data itself, should include knowledge management tools, modeling and assessment of situations, inference and assessment of decision making. The model of a knowledge-based system is based on a domain ontology, the task of which is to extract and concentrate knowledge and its detailed formalization using a conceptual system.

Information in the system should be presented at different levels of abstraction and with varying degrees of detail. For complex systems, which include production systems, there are several models for calculating their parameters, depending on the purpose of the study. First, as a rule, an aggregated calculation is performed to determine the structural parameters or a general scheme is outlined to determine the dynamics of the system. Then, within the framework of the decisions made, a more accurate calculation is performed. This process of detailing can be repeated several times depending on the problem to be solved, and at each stage the search for the most rational solution is carried out. The solution found at one stage, when returned to a higher level, may not satisfy the developer. In this case, additional conditions are developed for the problem to be solved at a lower level.

The scheme for developing the parameters of a complex system using several models of the system at different levels of detail with feedback allows for movement both inward and upward, depending on the degree of detail of the system. It becomes realistically feasible only on the basis of a unified knowledge base. The upper levels are characterized by management tasks. Organizational tasks are characteristic of the middle levels. For the lower levels, design tasks are relevant. All these tasks are interconnected, and the division of production tasks into separate types is conditional.

Another important requirement for the subject ontology under consideration is the creation of a basis for the analysis and synthesis of a production system that are interconnected. So, in the process of technological preparation of production, the technologist must go through a number of stages in describing the actions that must be performed in order for the finished product to meet the high requirements of modern quality standards. It is necessary to build a chain of workshops, sections through which the part passes during the manufacturing process, indicating the types of work. The choice of material, assortment, from which the part will be made is important; calculation of workpiece parameters, dimensions, weight, consumption rates; preliminary assignment of auxiliary materials required during processing with indication of consumption rates. And also the design of single, group, typical technical processes.

It is required to calculate the time norms for transitions, additional techniques, operations for the technological process required for processing a part, depending on the equipment, tooling, auxiliary materials, calculated modes and other parameters that may affect the final result selected in the technological process. Relevant is the receipt of various summary sheets on the composition of products, a list of products, a list of technological processes, in which it is required to display any necessary technological information.

The ontology of the area under consideration should have a hierarchical structure. Conceptual terminology should include only terms that denote categories in relation to domain terms. Any concept denoted by the term of subject ontology, when generalized, always falls under one or another category of metaontology. The scope of a concept denoted by the term subject ontology is included in the scope of one or more concepts of metaontology. The number of conceptual terms should be sufficient to describe the subject area, but should not exceed the number necessary to avoid duplication. This can complicate the system and create situations that are not resolvable from a logical point of view during interpretation and program processing. Metaontology should be logically consistent and be the backbone of the entire ontology. Its structure determines the structure of the subject ontology. On its basis, an algorithm for checking the integrity of the system is built. Conceptual terminology should be expanded without drastically changing the structure and content of the software.

The structure of ontology is determined by the structure of a conceptual ontology. Each term of a subject ontology denoting a particular concept is necessarily associated with terms of conceptual terminology denoting categorical concepts. The subject ontology includes conceptual terms, the structure of which is formed by the theoretical concepts of the subject area. It is presented in terms of conceptual terminology. When adding new elements to the conceptual terminology, the existing structure of the subject terminology should not be disturbed. Only add-ons are possible.

An important component of subject ontology is the set of relationships between concepts. The hierarchical structure of ontology can formally be represented in the form of a directed graph, in which the vertices are the terms and concepts of the subject area, as well as the connections between them. These are associative and logical connections that reflect the relationship between objects of the subject ontology. Among them: system – element, genus – species, object, property.

When implementing ontology, a knowledge base is created in the form of an entity and relations between them and a complex of programs designed for knowledge processing. These are interpretation functions defined on the entities and relationships of the ontology. The knowledge processing system can represent a set of modules created by different programmers in accordance with the tasks assigned to them by specialists working in the subject area. The knowledge base processing subsystem is based on the knowledge base and the capabilities that can be implemented in it. They depend on the structure and completeness of the base. The knowledge base is being created taking into account its future use. It is the core of the system. It determines its capabilities. The knowledge processing subsystem should be based on the principles of formal logic. The construction of ontology is based on theoretical knowledge, which, from a logical point of view, is a system of interrelated concepts and statements in the subject area under consideration. They are linked in accordance with the concepts. The logical concepts are the main ones. The forms in which knowledge is recorded, such as "concept", "statement", "reasoning", "inference", are already contained in some formalized form in the knowledge base. They can be obtained algorithmically based on this base.

The domain ontology can serve as a basis for connecting to it various models designed to optimize various parameters of production systems when solving organizational problems, management and design problems. The same objects of the subject ontology can be considered from different points of view due to their inclusion in different conceptual constructions. This property of the information system allows you to establish links between different subject areas, which is important for complex systems.

5 REFERENCES

1. Baker, L.R. (2000). Persons and Bodies: A Constitution View. Cambridge, UK: Cambridge University Press.

2. Bakhtin, M. M. (1981). The Dialogic Imagination: Four Essays by M.M.. Translated by Caryl Emerson & Michael Holquist, University of Texas Press.

3. Biggart, John; Gloveli, Georgii; Yassour, Avraham(eds.). (1998). Bogdanov and His Work: a guide to the published and unpublished works of Alexander A. Bogdanov (Malinovsky) 1873–1928. Aldershot: Ashgate.

4. Bodrova, Elena, Carrie Germeroth, and Deborah J. Leong. (2013). Play and Self-Regulation: Lessons from Vygotsky. // American Journal of Play 6.1.

5. Briscoe, G. (2010). Complex adaptive digital EcoSystems // Proceedings of the International Conference on Management of Emergent Digital EcoSystems MEDES ’10. New York, NY, USA: ACM. pp. 39–46.

6. Briscoe, G., Wilde P. (2009). De. Digital ecosystems: self-organisation of evolving agent populations // Proceedings of the International Conference on Management of Emergent Digital EcoSystems MEDES ’09. New York, NY, USA: ACM. pp. 7:44–7:48.

7. Cole, M. (2003). Culture and cognitive science. Outlines. // Critical Social Studies, 5(3), 3–15.

8. Chiari, G., &Nuzzo, M. L. (1996). Psychological constructivisms: A metatheoretical differentiation // Journal of Constructivist Psychology – № 9, - P. 163–184

8. Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. Behavioral and Brain Sciences, 36(3), 181–204.

9. Daniels, Harry, ed. (1996). An Introduction to Vygotsky. London: Routledge.

10. Dennett, D., Bennett, M, Hacker, P., Searle, J. (2007). Neuroscience and Philosophy: Brain, Mind, and Language.Columbia University Press.

11. Dolezel, L. (1998). Heterocosmica. Fiction and Possible Worlds. Bloomington; L.: The John Hopkins University Press. 16 13.

12. Dudley, P. (1996). Bogdanov'sTektology (1st Engl. transl.). Centre for Systems Studies, Univ. of Hull UK.

13. Duff, D. (2002). Intertextuality versus Genre Theory: Bakhtin, Kristeva and the Question of Genre // Paragraph Vol. 25, No. 1, pp. 54-73.

14. Eco, Umberto (1994). The Role of the Reader: Explorations in the Semiotics of Texts. Bloomington: Indiana UP.

15. Falikman, M. (2014). Cognition and its master: New challenges to cognitive science. In: A. Yasnitsky, M. Ferrari, R. van der Veer (Eds.), Cambridge Handbook of Cultural-Historical Psychology. Cambridge: Cambridge University Press. pp. 474–487.

16. Ficheman I.K., Deus Lopes R. (2008). Digital learning ecosystems: authoring, collaboration, immersion and mobility // Proceedings of the 7th international conference on Interaction design and children IDC '08. New York, NY, USA: ACM. C. 9–12.

17. Fittipaldi, E. (2012). Everyday Legal Ontology. A Linguistic and Psychological Investigation within the Framework of Leon Petrażycki's Theory of Law. Milano, LED.

18. Floridi, L. (2014). The philosophy of information: ten years later // Metaphilosophy / ed. by A.T. Marsoobian. – Oxford, UK– Vol. 41. № 3. – pp. 420-442.

19. Floridi, L. (2004). Open problems in the philosophy of information // Metaphilosophy / ed. by A.T. Marsoobian. – Oxford, UK – Vol. 35. – № 4. – pp. 554–582.

20. Fodor, J.A. (1990). A Theory of Content and Other Essays, MIT Press.

21. Fodor, J.A. (1998). Concepts: Where Cognitive Science Went Wrong, The 1996 John Locke Lectures, Oxford University Press.

22. Fodor, J.A. (2003). Hume Variations.Oxford University Press.

23. Fodor, J.A. (2008). LOT 2: The Language of Thought Revisited, Oxford University Press.

24. Fodor, J.A., Pylyshyn, Z. W. (2014). Minds without meanings: an essay on the contents of concepts. MIT Press.

25. Fodor, J.A. (1987). Psychosemantics: The Problem of Meaning in the Philosophy of Mind, MIT Press.

26. Fodor, J.A. (1979). Representations: Philosophical Essays on the Foundations of Cognitive Science, Harvard Press (UK) and MIT Press (US).

27. Fodor, J.A. (1994). The Elm and the Expert: Mentalese and Its Semantics, The 1993 Jean Nicod Lectures, MIT Press.

28. Fodor, J.A. (1975). The Language of Thought, Harvard University Press.

29. Fodor, J.A. (2000). The Mind Doesn't Work That Way: The Scope and Limits of Computational Psychology, MIT Press.

30. Fodor, J.A. (1983). The Modularity of Mind: An Essay on Faculty Psychology, MIT Press.

31. Frank, J. (1982). Epiphenomenal Qualia // The Philosophical Quarterly, 32 (127), pp. 127–136.

32. NeleBemong, Pieter Borghart, Michel De Dobbeleer, KristoffelDemoen, Koen De Temmerman& Bart Keunen (eds.) (2010). Bakhtin's Theory of the Literary Chronotope: Reflections, Applications, Perspectives - Gent, Academia Press, v + 213 pp.

33. Hintikka, J. (1975). Impossible Possible Worlds Vindicated, in: Game-Theoretical Semantics // Journal of Philosophical Logic. Vol. 4. P. 475-484.

34. Hung, David, and MaishRamlalNichani. (2002). Bringing Communities of Practice into Schools: Implications for Instructional Technologies from Vygotskian Perspectives. // International Journal of Instructional Media 29.2.

35. Jaramillo, James A. (1996). Vygotsky's Sociocultural Theory and Contributions to the Development of Constructivist Curricula. // Education 117.1.

36. John Searle (1995). The Construction of Social Reality.– New York: Free Press. 256p.

37. Kinmont, D (1893). Vitalism and creativity : Bergson, Driesch, Maritain and the visual arts (1900-1914). Common denominators in arts and science. – Aberdeen. 285p.

38. Kitayama, S., Huff S. (2015). Cultural neuroscience: Connecting culture, brain, and genes. Emerging Trends in the Social and Behavioral Sciences. New York, NY: John Wiley, 2. pp.1–16

39. Kripke, Saul (1959). A completeness theorem in modal logic // Journal of Symbolic Logic. № 24. P. 3-14.

40. Lewis, D. (1973). Counterfactuals. Harvard University Press, Cambridge, Mass.

41. Loiko, A.I. (2020). Electronic Texbuok for the educational Discipline « Philosophy» of the compulsory Module «Philosophy». Minsk: BNTU. 228p.

42. Loiko, A.I. (2018). Eurasian: geopolitical risks and dialogue platforms. – Saarbrucken: LAP.

43. Loiko, A.I. (2019). Industry 4.0 anduncertaintiesinsocialdynamics / Глобальные риски цифровой эпохи и образы будущего: Материалы IV Международной научной конференции. Гуманитарные Губкинские чтения. – М.: Издательский центр РГУ нефти и газа (НИУ) имени И.М. Губкина, 2019. Ч.3. pp. 101-104.

44. Loiko, A.I. (2020) Interdisciplinary structure analysis systems in the field of artificial intelligence technologies / Системныйанализиприкладная-информатика № 1 pp. 40-44

45. Loiko A.I. (2020) Interdisciplinary projections of the social and cultural theory of L. Vygotski / A.I. Loiko // Современныетенденциикросс-культурныхкоммуникаций. – Краснодар: Изд. КубГТУ. pp. 318-324.

46. Loiko, A.I. (2021) New Format of Dialogue Platforms based on Translateral Thinking / ВестникУдмуртскогоуниверситета. Социология. Политология. Международныеотношения – Т.5. – Выпуск 3 – pp.374-380.

47. Loiko, A.I. (2012).Philosophyand science methodology. – Minsk: BNTU.

48. Loyko, A.I. Informationtechnologiesintheparadigmofcognitivesciences / VII Международная научно-техническая интернет-конференция "Информационные технологии в образовании, науке и производстве", 16-17 ноября 2019 года, Минск, Беларусь [Электронный ресурс] / Белорусский национальный технический университет ; сост. Е. В. Кондратёнок. – Минск: БНТУ, 2019.

49. Luria, A.R. (1976) Cognitive development: Its cultural and social foundations. Cambridge, MA: Harvard Univ. Press.

50. Mace, W.M., James, J. (1977). Gibson's strategy for perceiving: Ask not what's inside your head, but what your head's inside of. In: R.E. Shaw, J. Bransford (Eds.), Perceiving, acting, and knowing. Hillsdale, NJ: Erlbaum.

51. Malafouris, L. (2013). How things shape the mind: A theory of material engagement. Cambridge, MA: MIT Press.

52. Maturana, H., Varela F. (1987). The tree of knowledge. A new look at the biological basis of human understanding. Boston: Shambhala /New Science Library.

53. Metzinger, T. (2003). Being No One: The Self-Model Theory of Subjectivity. Cambridge, MA: MIT Press.

54. Millikan, R. G. (1986) Language, Thought, and Other Biological Categories: New Foundations for Realism. Cambridge, MA: MIT Press

55. Millikan, R. G. (2009) Biosemantics. In B. McLaughlin (ed.) The Oxford Handbook in the Philosophy of Mind. Oxford: Oxford University Press.

56. Millikan, R. G. (2005) Language: A Biological Model. Oxford: Clarendon Press, pp. 25-53

57. Millikan, R. G. (2008) A Difference of Some Consequence between Conventions and Rules, pp.87-100.

58. Nagel, T. (1974). What is it like to be a bat? // The Philosophical Review, 1974, 83 (4), pp. 435–450.

59. Nowaes, C.D. (2020). The Dialogical Roots of Deduction: Historical, Cognitive and Philosophical Perspectives on Reasoning. Cambridge University Press.

60. Oyserman, D. (2014). Culture as Situated Cognition. Emerging Trends in the Social and Behavioral Sciences. In: R. Scott, S. Kosslyn (Eds.), Emerging Trends in the Social and Behavioral Sciences. New York, NY: John Wiley. pp. 1–20.

61. Oyserman, D., Lee S.W.S. (2008). A situated cognition perspective on culture: Effects of priming cultural syndromes on cognition and motivation. In: R. Sorrentino, S. Yamaguchi (Eds.), Handbook of Motivation and Cognition across Cultures. San Diego, CA: Academic Press. pp. 237–265.

62. Partee, B.H. (2010). Possible Worlds in Humanities, Arts and Sciences // Proceeding of Nobel Symposium. S. Allén, Berlin, NY (de Gruyter). P. 93–123.

63. Piaget, J., Inhelder B. (1958). The growth of logical thinking from childhood to adolescence: An essay on the construction of formal operational structures (A. Parsons &Milgram, Trans.). N.Y.: Basic Books.

64. Putnam, H.W. (1985). Epistemology, Methodology, and Philosophy of Science: Essays in Honour of Carl G. Hempel. edited with Wilhelm K. Essler and Wolfgang Stegmüller. Dordrecht: D. Reidel.

65. Putnam, H.W. (2002). Ethics Without Ontology. Cambridge, Massachusetts: Harvard University Press.

66. Putnam, H.W. (1975). Mathematics, Matter and Method.Philosophical Papers, vol. 1. Cambridge: Cambridge University Press.

67. Putnam, H.W. (1978). Meaning and the Moral Sciences. London: Routledge and Kegan Paul.

68. Putnam, H.W. (1983). Methodology, Epistemology, and Philosophy of Science: Essays in Honour of Wolfgang Stegmüller. edited with Wilhelm K. Essler and Carl G. Hempel. Dordrecht: D. Reidel.

69. Putnam, H.W. (1975). Mind, Language and Reality.Philosophical Papers, vol. 2. Cambridge: Cambridge University Press.

70. Putnam, H.W. (2016). Naturalism, Realism, and Normativity, edited by Mario De Caro, Cam, Mass: Harvard University Press.

71. Putnam, H.W. (2012). Philosophy in an Age of Science, edited by Mario De Caro and David Macarthur. Cambridge, Massachusetts: Harvard University Press.

72. Putnam, H.W. (1971). Philosophy of Logic. New York: Harper & Row.

73. Putnam, H.W. (1983). Philosophy of Mathematics: Selected Readings. Edited with Paul Benacerraf. Englewood Cliffs, N.J.: Prentice-Hall, 1964. 2nd ed., Cambridge: Cambridge University Press.

74. Putnam, H.W. (1993). Pursuits of Reason: Essays in Honor of Stanley Cavell. edited with Ted Cohen and Paul Guyer. Lubbock: Texas Tech University Press.

75. Putnam, H.W. (1990). Realism with a Human Face.edited by J. F. Conant. Cambridge, Massachusetts: Harvard University Press.

76. Putnam, H.W. (1983). Realism and Reason.Philosophical Papers, vol. 3. Cambridge: Cambridge University Press.

77. Putnam, H.W. (1981). Reason, Truth, and History. Cambridge: Cambridge University Press.

78. Putnam, H.W. (1992). Renewing Philosophy. Cambridge, Massachusetts: Harvard University Press.

79. Putnam, H.W. (1988). Representation and Reality. Cambridge, Massachusetts: MIT Press.

80. Putnam, H.W. (2002). The Collapse of the Fact/Value Dichotomy and Other Essays. Cambridge, Massachusetts: Harvard University Press.

81. Putnam, H.W. (1967). The Innateness Hypothesis and Explanatory Models in Linguistics / Synthese, Vol. 17, No.1, pp.12–22.

82. Putnam, H.W. (1987). The Many Faces of Realism. La Salle, Ill.: Open Court.

83. Putnam, H.W. (1999). The Threefold Cord: Mind, Body, and World. New York: Columbia University Press.

84. Putnam, H.W. (1994). Words and Life. edited by J. F. Conant. Cambridge, Massachusetts: Harvard University Press.

85. Raskin, J. D. (2006). Constructivist theories. In J. C. Thomas & D. L. Segal (Eds.), Comprehensive handbook of personality and psychopathology. Vol. 1: Personality and everyday functioning (pp. 212–229). New York, NY: John Wiley.

86. Richerson, P., Boyd R. (2005). Not by genes alone: How culture transforms human evolution. Chicago, IL: University of Chicago.

87. Rota, Gian-Carlo (1989). "The Lost Cafe". In Cooper, Necia Grant; Eckhardt, Roger; Shera, Nancy (eds.). From Cardinals To Chaos: Reflections On The Life And Legacy Of StanisławUlam. Cambridge: Cambridge University Press. pp.23–32.

88. Ryan, M.-L. (1991). Possible worlds and accessibility relations: A semantic typology of fiction // Poetics today. № 12 (3). P. 553-576.

89. Shannon, C. (1948). A Mathematical Theory of Communication" / Bell System Technical Journal, Vol. 27, pp. 379–423, 623–656.

90. Schneider, G. Michael; Gersting, Judith; Brinkman, Bo (2015). Invitation to Computer Science. Boston: Cengage Learning.

91. Stalnaker, R. C. (1986). Possible Worlds and Situations // Journal of Philosophical Logic. № 15. P. 109-123.

92. Thirumurthy, V. (2002). Learning through Culture. (International/Intercultural). //Childhood Education 79.2.

93. Ulam, Stanisław (1983). Adventures of a Mathematician. New York: Charles Scribner's Sons.

94. Ussher, B., and Chris, G. (2002). Vygotsky, Physical Education and Social Interaction. Journal of Physical Education New Zealand 35.1.

95. Van der Veer, R., &Valsiner, J. (1991).Understanding Vygotsky: A quest for synthesis. Cambridge, MA: Blackwell.

96. Van Heijenoort, Jean (1967).From Frege to Gödel: a Source Book in Mathematical Logic, 1879–1931. Cambridge, Massachusetts: Harvard University Press.

97. von Neumann, John (1947). Heywood, Robert B. (ed.). The Works of the Mind: The Mathematician. Chicago: University of Chicago Press.

98.Vygotsky, L. (1962). Thought and language. Cambridge, MA: MIT Press.

99. Vygotsky, Lev S. (1978). Mind in Society: The Development of Higher Psychological Processes. Editors: Michael Cole, Vera John-Steiner, Sylvia Scribner, Ellen Souberman. –Harvard University Press, 159 p.

100. Vygotsky, Lev S. (1987). The Collected Works of L.S. Vygotsky. Vol. 1. “Problem of General Psychology”. trans. Norman Minick. New York: Plenum.

101. Weinstein, M. (2011). Arguing towards truth: The case of the periodic table / Argumentation, 25(2), pp.185-197.

102. Weinstein, M. (2013). Logic, truth and inquiry. London: College Publications

103. Weinstein, M. (2015). Cognitive science and the model of emerging truth. In Garssen, B.; Godden, D.; Mitchell, G.; Snoeck Henkemans, A. (eds). Proceedings of the8th International ISSA Conference, ISSA.

104. Wiener, N. (1948).Cybernetics: Or Control and Communication in the Animal and the Machine. Paris, (Hermann &Cie) &Camb. Mass. (MIT Press).

TABLE OF CONTENTS