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Issue Article

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ON MODERN PRINCIPLES, METHODS AND MEANS OF ENGINEERING ACTIVITIES

***Abstract**: In the article, the authors analyze the transition to a two-level version of education (bachelor's and master's degrees) in curricula focused on preparing masters in technical areas, a group of relatively new disciplines has appeared, which, first of all, should include the methodology of scientific creativity, protection of intellectual property, fundamentals of scientific research, technical aesthetics, philosophy and methodology of science. With such an organization of training, one can count on the emergence of graduates of higher educational institutions who master the basics of engineering and are capable of independent innovative activities.*

This article is the first to attempt to combine the material necessary to prepare the above courses into a single complex called "Fundamentals of Engineering."

***Key words**: functional theory of art, sociological relevance, axiological function, moral criteria, intersubjectivity, essentialistic knowledge of an engineer, subordination of nature to human needs.*

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Introduction

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The general principles of the main principles of engineering ethics are the support and development by engineers of the purity, honor and dignity of the engineering profession. To do this, engineers must:

Use your knowledge, skills and abilities to increase human well-being.

Serve the public, employers and customers fairly and impartially.

Respect the competence and prestige of the engineering profession.

Uphold the disciplinary standards of professional and technical communities.

Basic canons of engineering ethics

Engineers, in the performance of their professional duties, must place the safety, health and welfare of the public above all else.

Engineers must carry out work only within the scope of their competence.

Engineers must respond objectively to public inquiries.

Engineers in their professional field act as loyal representatives or trustees for each employer or customer and must avoid conflict.

Engineers should build their professional reputation on integrity and should not compete unfairly with others.

Engineers must support their own professional development and provide opportunities for professional development to engineers under their supervision.

Typical scenarios of conflict situations Situation “Paradox”.

The formula of any invention is drawn up in such a way that it considers exclusively the positive aspect. However, each invention, in its internal essence, is based on the resolution (removal) of a technical or social contradiction in its dialectical interpretation and development (this thesis is developed in more detail in the “Theory of Solution of Inventive Problems”). Therefore, in every innovation, negative consequences are inevitably present and then always appear. This provision especially concerns environmental problems.

Such situations are observed in all typical technical innovations: an increase in engine power leads to increased environmental pollution; an increase in flight speed leads to the appearance of ozone holes; An increase in the carrying capacity of vehicles leads to the destruction of roads and soil, etc.

What should an engineer do? Where are the boundaries of ethical and unethical, moral and immoral technical solutions? Situation "Good and Evil". We are talking about military inventions. The engineer understands that the invention is aimed at destroying industrial facilities, natural resources, technical means, and enemy manpower. The engineer, as a performer and manager of work, is professionally prepared for this type of activity. However, he lives in the real world and understands that devoting his life to the direct or indirect destruction of other lives is clearly evil.

What should a future engineer do during his training? During the period of designing military equipment? During the period of organizing work and managing other people?

Situation “Spiritless Automation” The issue of new technologies that make it possible to automate production is being discussed. Products put into production give birth to a world devoid of soul, a world that promotes the development of inertia, impersonality, and lack of spirituality. Panel and block construction of houses gave rise to dull neighborhoods and “gray” residents. Furniture made from particle boards consists of identical walls and tables with sharp, right angles, which respectively affect the human psyche: prickly, sharp angles appear in the behavior of the growing and already grown-up generation.

What should an engineer do? Should we cancel the automation of production processes? How to build both cheaply and beautifully? How can we make sure that things produced in continuous production bring joy to people? Situation "Internal conflict". The company has a large order, for example, for the production of an automatic line. However, individual units and components are not sufficiently developed and require improvement. The alternative is this: either a long but reliable way to debug individual units, or a relatively quick production of the entire line at once, for which the customer is already paying a lot of money, which has a beneficial effect on the financial situation of the engineer himself.

What to do? Argue with management, whose prestige depends on the timing of the order? Give information to the customer without informing the management of your company? Silence? The situation “Innovation is routine.” A typical problem when designing new technology. The device is designed the old fashioned way. Where electronics can be used, mechanics or hydraulics are used. The engineer understands that he needs to take a risk and give the new design a try to break into the market. But management is afraid of failures, inoperability and unreliability and therefore is “pursuing” an outdated, but already proven option.

What should an engineer do? Resign yourself? Conduct research yourself? Looking for sponsors? “Instant result” situation. The age-old debate about quality, quantity and cost. There are two options for completing any order, namely:

the first is to design and make things that are truly strong, reliable and durable.

the second is to imitate strength, reliability and durability through the use of externally similar materials and design solutions (color, shape, weight, speed, etc.).

At the same time, the main attention is paid not to the product itself, but to advertising and packaging. Many companies from the so-called developing countries took this path: the “yellow assembly” version of personal computers, toys from China, etc. What should an engineer working in a company do according to the second option? Don't think about the consequences? Struggle to improve quality? Quit your job?

Situation "Domestic priority" A Russian company offers an organization (possibly state-owned) its own invention for use in the production of products. The invention promises high efficiency and low implementation costs. But the organization is going to negotiate the purchase of similar products in one of the Western countries, for which its representatives are going to travel to this country in the near future. The engineer, who must evaluate the proposal as an expert, is reminded of the priority of developing relations with this country (political aspect) and of the interest of managers in the trip (personal aspect). How should an engineer behave if the effectiveness of a domestic invention is obvious to him? Situation "Service invention".

An engineer works on an invention during office hours, using office equipment. When he is close to completing the work, he leaves the company and sells the product as his own invention. Perhaps the engineer received a low salary and, moreover, irregularly. How to evaluate an engineer's behavior from an ethical point of view? Situation "Choice". The problem of fairness and reliability in engineering. An engineer works for a government organization that prepares reports on the environmental impacts of projects currently planned by the government. The engineer reports the results of his work to management, after which the manager asks him to change some of the conclusions presented in the report and/or remove some data from it. What should an engineer do? Situation "Personal Interest".

The engineer is expected to make an unbiased decision in the best interests of the client, but the engineer has his own interests (related to investment, family relationships, etc.) that may influence the decision. For example, an engineer is expected to help a company decide which product to purchase for the company's needs, and the engineer is the owner (or partner) of a company that offers those products. Should an engineer remove himself from a situation in which he has a conflict of interest? Should the engineer tell the client that self-interest makes him biased? Situation "Security".

The engineer is concerned about the safety of the project. Events can develop as follows. The engineer reports his concerns to his boss, but the boss is reluctant to take any action and advises him to remain calm. The engineer must decide whether to "sound the siren", i.e. contact the authorities, the press, etc. At the same time, the employer can treat the engineer very well. How to combine a loyal attitude towards the employer with protecting the interests of society? When should an engineer "sound the siren"? "Risk" situation (an aggravated version of the "safety" situation).

An engineer must make difficult decisions regarding the degree of risk associated with the equipment he is designing. How to decide on the acceptable level of risk?

A few words about the semiotic (linguistic) aspect of engineer training. The main operational means of engineering thinking is the ability to express one's thoughts using symbolic means and understand the meaning of regulatory texts, the form of which can take different forms: diagrams, drawings, specifications, etc. That is why it is necessary to use a large amount of illustrative material, which allows a methodical, step-by-step introduction to the subject of training, who has already learned the language of "technical graphics" from special courses (where, in addition to drawings and diagrams, various formulas can also be included, expressing graphic dependencies), to social and philosophical categories, revealed in our research using the language of the constructive-conceptual apparatus of the systems approach. For this reason, we considered it necessary to provide in the appendix a dictionary of concepts, which should form the basis of an engineer's thesaurus and reveal to the learner the main categories of an engineer's humanistic thinking.

As we part with the reader, let us draw his attention once again to the fact that in addition to knowledge acquired in a rational way, an engineer, relying on a system of moral values, in real life uses will, emotions, intuition, faith and other irrational components of human activity. Therefore, the strategy of higher technical education should be associated with the growth of the student's self-awareness, with training that performs the function of humanizing the individual.

The authors hope that the presented materials will help Russian engineers develop creative abilities, develop a sense of confidence in their knowledge and realize life goals through education and engineering.

In modern higher and postgraduate education of Russian engineers, a number of problems have arisen that urgently require immediate solutions. First of all, these include: the problem of very specific ways to humanize technical education and the problem of educating systems thinking. The humanization of education is by no means an expansion of the curricula of higher technical educational institutions by including individual humanities disciplines. First of all, this is:

1) "humanization" of educational material based on the principle: science is not just subject information, but a developing system of knowledge and activities for its production;

2) systematization of the material in such a way that teachers themselves come to understand their subject courses as part of a single developing system of knowledge.

The first direction involves the formation of cognitive activity in students, the second direction is the path of systemic compaction of information. The purpose of this article is to help both students and teachers in practice use specific forms of the above-mentioned areas of humanization when mastering technical knowledge. This goal required a synthesis of ideas from such fields of knowledge as philosophy, sociology, systems analysis and technical sciences. Discovering the relationships between scientific and technical creativity and innovation activities associated with intellectual innovations required turning to the theory of knowledge, i.e., in essence, to the laws of dialectics. At the same time, the process of creativity is always associated with insight (illumination), which determines a certain unconscious penetration into the deep essence of phenomena, therefore there is a need to address the issue of the synthesis of the rational and irrational in creative and innovative processes. The relevance of the topic of the proposed material is confirmed by the trends in the development of these problems in all industrially advanced countries. The preparation of the article also necessitated the need to outline ways to solve fundamental problems associated with the restructuring of higher technical education.

The first priority should be given to the task of humanizing education, which is becoming increasingly urgent due to the accelerating growth of scientific and technical information and the filling of educational programs with a huge amount of "ready-made knowledge" intended only for rote memorization. Also significant is the task of defining and introducing into the educational process the methodology of scientific and technical creativity, which largely determines the success of a specialist's innovative activity.

In the early nineties of this century in Russia there was a demand from society for specialists capable not of routinely following established social and technical canons, but of active creative innovative activity, of adapting their professional qualities to the operating conditions of new technology and market relations developing in Russia. The relevance of the task, in addition, is dictated by the need to eliminate and prevent in the future the current significant lack of demand by society for specialists receiving higher technical education according to outdated social, scientific and technical principles, which has led and still leads to obvious and hidden unemployment, to the loss of only work in their specialty, but also the meaning of life for an entire social stratum - engineers and scientific and technical workers in Russia.

This particular situation is clearly reflected in the system of higher technical education, where it became especially aggravated during the period of so-called perestroika and then the denationalization of enterprises. Today it has become obvious that even a "good engineer", filled with precise technical knowledge acquired at a university, is just a good performer of a given algorithm and, least of all, a creator. Life requires that an engineer be both a qualified expert in modern production and a creator of new scientific and technical projects, such as the Russian engineers I.P. Bardin, A.N. Tupolev, V.G. Shukhov and others. To solve this problem, there is only one way - to form a creative engineer, or an innovative engineer, already at a university, for which it is necessary to mobilize all the means that reveal the factors and driving forces of scientific and technical creativity. They are discussed in the monograph as very specific ways of forming a new type of engineer. These factors include psychological, philosophical, economic, sociological; in the monograph they are considered comprehensively and systematically. The leading one, in our opinion, is the factor of humanization of education. Social and philosophical problems of innovative, scientific, technical and engineering activities have now emerged as a relatively independent field of epistemology. Knowledge about scientific and technological progress, scientific and technological revolution, scientific and technical creativity, obtained only within the framework of historical, sociological, philosophical, psychological, pedagogical, economic and technical sciences, cannot fully reveal the inner essence of socio-technical innovations in scientific and technical areas of activity of modern society. Therefore, there is a need not only to improve, but also to develop a general concept for the further development of the system for training specialists with higher technical education and the methodology for its management. The creation of a new paradigm for the educational process becomes not only a pedagogical, technological or environmental problem, but also a socio-economic task, the successful solution of which determines the success of the development of the entire society. An analysis of the literature devoted to engineering activity indicates significant interest among the world community in issues related to the formation of an innovative engineer. There are many works that explore various aspects of engineering and innovation activities. These include, first of all, the works of V.V. Alekhina, L.V. Yatsenko et al. Philosophical understanding of scientific and technical activities related to ethical, aesthetic and social problems is presented in the works of G.Ya. Bush, V.F. Gorbachevsky, B.I. Kudrina and others. Psychological problems, including the psychology of scientific and technical creativity and engineering activities, are widely covered in the works of M.G. Yaroshevsky and his employees, in particular Ya.A. Ponomareva. Still, modern researchers consider the organization of technical education in universities to be a key issue.Scientists such as A.G. are working in this direction. Bondarenko, V.F. Shepetko and others. There are very serious reasons for highlighting this issue as a priority. Currently, the process of teaching technical specialties is a complex social phenomenon, determined by many different factors. Today, this process is becoming the object of attention not only of teachers, but also of philosophers, sociologists, psychologists, historians, economists and even politicians who understand the direct dependence of the economic situation of the state on the choice of the right course for social management of the process of training scientific and engineering personnel. Philosophical issues of training engineers are analyzed in the works of A.S. Kokoreva, M.L. Shubas and others. Social aspects of training engineers in technical universities of Russia are considered in the works of V.D. Golikova, V.G. Nesterova and others. In the field of psychology, the research of S.M. is of interest. Vasileisky, T.V. Kudryavtsev and others. The specifics of the historical approach to engineering activities are reflected in the works of O.V. Kozlovskaya and V.I. Martinkus. The economic problems of the activities of engineers are covered in sufficient detail in the works of E.A. Guseva, A.S. Pavlova and others. Recognizing the need to change the content and structure of the educational process based on the introduction of new humanitarian disciplines and special courses, the authors of works devoted to the process of education in higher educational institutions, at the same time, as a rule, end their works with the conclusion that significant work is needed on general retraining of higher education subject teachers in terms of involving history and especially sociology to form the creative potential of a specialist. The authors of works devoted to the learning process in higher education institutions, at the same time, as a rule, end their works with the conclusion that significant work is needed on the general retraining of higher education subject teachers in terms of involving history and especially sociology to form the creative potential of a specialist. 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However, despite the correct conclusions about the need to humanize technical education, such works are difficult to use in practice due to the lack of specific recommendations and methods in them. This is understandable, since such research is usually carried out by specialists with basic humanitarian training, who are unfamiliar with the features of designing and managing modern technology and the corresponding training courses. If highly qualified technical specialists take on such a task, then they give specific recommendations and techniques, brought to the possibility of their real use. However, there is another extreme here. In the overwhelming majority of cases, these recommendations are highly specialized and largely technocratic in nature. It is extremely difficult, and sometimes impossible, to identify the focus on humanizing engineering thinking.

An attempt to break out of this circle of uncertainty can be considered the development of a relatively young scientific direction in the history of philosophy - “Philosophy of Technology”. The founders of this direction and their followers in the hierarchy of priority tasks for training specialists identified as the main tasks the development of the creative potential of the individual and the development of a mechanism for the formation of this development in the conditions of higher education. It should also be noted that until now the process of both theoretical and practical understanding of such categories as engineering activity, engineering thinking, scientific and technical creativity has developed in such a way that the psychological and epistemological aspects have received the greatest development, and holistic, systemic, philosophical and sociological aspects, in essence, have been studied very little and, as a rule, have the nature of general recommendations that are difficult to actually implement in the sociotechnical activities of an engineer. Therefore, it is natural that the public consciousness is dominated by the idea of scientific, technical and engineering activity as a special spiritual activity, as if divorced from creativity in general and especially from art. In this regard, the task of revealing engineering activity arises with the help of a specific historical study of socio-technical processes. Such an analysis makes it possible to understand the inextricable connection between the method of production and scientific and technical creativity, scientific and technical creativity and culture, the connection between engineering and innovation activities with art, with the moral values of a creative person. Analysis of approaches to solving this problem led to the need to highlight the following social contradictions as the main ones for the system of higher technical education, namely:

social-production contradiction that has arisen in the education system at the level of “higher technical educational institution - society” and consists in the fact that, despite extensive and deep professional training, a significant part of college graduates in the conditions of the new system of socio-economic relations are incapable of independent creative, innovative activities;

a social and personal contradiction that has arisen in the education system at the level of “student (engineer) - higher technical educational institution” and consists in the fact that many college graduates, having a significant stock of not only technical, but also natural science and humanitarian knowledge, do not know how use them to solve not only social, but also technical problems.

Social phenomena associated with these contradictions exert powerful pressure on the "student - technical university - society" system. "From above" this pressure manifests itself in the form of dissatisfaction with the education system expressed by society; "from below" - in the form of dissatisfaction expressed by students of technical universities.

The result of the development and aggravation of these contradictions is a sharp drop in the social order for the "production" of specialists with higher technical education, since individual enterprises and industries, and ultimately the entire society, do not need such a specialist. This can be confirmed by the small competition in technical universities for engineering specialties and the associated numerous simplifications when admitting applicants to engineering specialties. The consequence is a decline not only in the prestige, but also in the quality of training of engineers.

Thus, the main problem that this work is aimed at solving is to find ways to eliminate the current discrepancy between the process of forming engineering personnel and the needs of further development of society. Obviously, ways to solve this problem are related to the system of training engineers in the country's universities.

The working hypotheses of the study are based on the study of relevant works on the sociology of management, sociology of culture, sociology of education and science, as well as socio-philosophical research on issues of natural science and technology, in particular, on the history and theory of scientific and technical creativity. Based on a synthesis of many published works and their own research, the authors put forward the following points:

a properly organized education system in technical universities can become a means of managing the social stratum, including engineers and scientific and technical workers in Russia;

humanization of technical education, studying not only ready-made knowledge, but specific ways of producing knowledge, i.e. historical experience of scientific and technical creativity, is currently becoming the leading factor determining the quality of training of graduates of technical universities or retraining of engineering and scientific personnel.

The authors' conviction that the conclusions and recommendations of the study are justified and effective also led to the realization of the difficulty of their practical implementation, since they are associated with a radical restructuring of textbooks and the educational process, the implementation of which will require considerable time and new cadres of innovative teachers. But there are not so many of them and they also have a certain inertia. Let us emphasize once again that the main thing in the near future is to solve the problem of humanizing education, because without "humanizing" the educational process with the mere transfer of ready-made knowledge, a higher technical school will forever remain a system for training not the creators of new technology, but only living memory devices.

In these studies, the formulation of the problem defined by the famous sociologist V.A. is taken as fundamental. Yadov as "an expression of the need for knowledge of social contradiction." Before proceeding to the formulation of the problem, at least basic information about the object of research should be given. According to classical works in sociology, a social process, an area of social reality, and a social attitude can be chosen as an object of study. In our case, the object of study is a social process—the process of forming engineering personnel. The social contradiction in this object is the discrepancy between the acquired knowledge, and ultimately the skills and abilities of graduates of technical universities, and the needs of society. The subject of the study is the formation of engineering personnel through the education system. The problematic situation in this case is characterized by a discrepancy between the functioning of a social object (the process of forming engineering personnel) and the needs of the further development of society. Therefore, the problem is of a research nature and is associated with the need to study a certain area of social life (engineers and students of technical universities as a certain community, professional layer - stratum). The purpose of the study acts as a possible construction of a model of the final result (problem solution), expressed in the development of theoretical and practical means for resolving social contradictions through the subject of research itself. To achieve the goal, a methodology for humanizing the formation of engineering personnel through the education system must be developed. The development of this methodology is the main task, the solution of which will eliminate the social contradiction. To solve the main problem means to develop the existing paradigm of education (consisting in the transfer of knowledge about the world and its laws) to the introduction into practice of the educational process of the methodology of creative transformation of the world around us. Let us repeat once again that the process of humanization in technical universities currently occurs only through the humanization of education, i.e. through the introduction of various humanitarian disciplines into training, which should contribute to raising the general cultural level of students. We are talking about changing the technology of education itself, about humanization through natural science and technical disciplines. Therefore, the working hypothesis of this study is formulated as follows: the process of humanization of technical education has now become the leading factor determining the quality of training of a graduate of a technical university or retraining of engineering and scientific personnel. Let us also note that the formulations of the hypothesis and the problem are based, firstly, on the specifics of the stratum itself - engineers and, secondly, on the peculiarities of the formation of this social stratum with the help of education, which we consider as a means of managing a social group of the population - the engineering corps of Russia.

Main part

Science is a form of spiritual activity of people aimed at producing knowledge about nature, society and artificial systems. The main goal of science is to comprehend the truth and discover objective laws based on a generalization of facts in their interrelation. Understanding the laws makes it possible to predict development trends in the world around us and contribute to its transformation. At the same time, science is a creative activity to obtain new knowledge and the results of this activity. The main components of scientific activity are, namely:

the process of acquiring new knowledge;

combining the acquired knowledge into a holistic system;

infrastructure for organizing scientific activities.

At the end of the 19th and beginning of the 20th centuries, a qualitative change occurred in the development of science. Science becomes not only the productive force of society, but also acquires decisive importance in the life of society. That is why science as a special form of activity becomes the subject of research in philosophy and the history of science and technology. A new direction of research is emerging - science studies - the science of science. Currently, science is a form of activity of communities of scientists and is aimed at obtaining and using in practice new knowledge about various natural and artificial systems, their properties and relationships. Knowledge can be recognized as scientific if it meets certain criteria: objectivity, reproducibility, objectivity, empirical and theoretical validity, logical evidence. Scientific activity differs from other types of human activity in the desire for objective truth and maximum evidence of the results obtained. Science as an activity can be represented by three aspects: as knowledge itself, as a social institution (professional associations of scientists) and as an area of human spiritual activity.

Knowledge is an objective reality given in the consciousness of a person who, in his activities, reproduces the natural connections of the real world. Cognition is the process of acquiring and developing knowledge; such an interaction between an object and a subject, the result of which is the acquisition of new knowledge. The term “knowledge” can be given different meanings, namely:

ability, ability, skills to do something;

educational information;

cognitive (gnoseological) form of a person’s relationship to reality.

A person experiences the world around him in two main ways. The first is material and technical - the production of vital means (labor). The second way of knowledge is spiritual activity. In the process of scientific knowledge, there is no rejection of other forms of knowledge. Each form of social consciousness corresponds to its own specific forms of knowledge (philosophy, politics, religion, etc.) Scientific knowledge is the process of obtaining objective knowledge aimed at studying real laws. Scientific knowledge is always associated with the description, explanation and prediction of the processes being studied. Many forms outside of scientific knowledge are older than knowledge, historically being its predecessors: astrology and astronomy, alchemy and chemistry. There are several forms outside scientific knowledge: para scientific, false scientific, quasi scientific, anti scientific.

Science, being a part (subsystem) of culture, has a significant impact on the development of society and itself experiences the opposite effect depending on the needs of society. This process of mutual influence is associated with the historical formation of various types of science: ancient, medieval, non-classical, etc. In each cultural-historical type of science and in each field of science, its own specific set of ideals and norms of scientific research is realized, concretizing the values of science that distinguish it from others types of activities. It is for this reason that qualitatively different areas of science arose: natural sciences, social sciences and humanities, technical and technological sciences, logical and mathematical disciplines, etc.

Scientific knowledge is obtained and justified using scientific methods and means, the most important of which include: abstraction, analysis, synthesis, conclusion, proof, idealization, observation, experiment, classification. Each area of scientific knowledge develops its own methods and means, as well as a special language characteristic of a given scientific direction. The main types of scientific knowledge include theories, disciplines, areas of research (special, problematic, interdisciplinary), fields of science (mathematical, historical, physical, etc.), types of sciences (natural sciences, humanities, engineering, etc.). The scientific community is united into relevant social institutions that organize the acquisition and dissemination of knowledge. Forms of institutionalization can be laboratories, institutes, academies, state or public scientific institutions, firms, etc.

Obtaining true and useful information about various objects of our world is the main goal of both ordinary and scientific knowledge. Scientific knowledge serves as a continuation (development) of ordinary knowledge (common sense). At the same time, the goal of scientific knowledge is to achieve not just knowledge, but scientific knowledge and scientific truth. The following methods and means used in scientific activities can be distinguished, namely:

Reflection and control of human consciousness regarding the means, methods and conditions for obtaining knowledge.

Using the methods of logic as a science of evidence-based thinking.

Development of methods for obtaining reliable empirical information using systematic observations and experiment.

Application of statistical analysis to process the obtained empirical data.

The use of devices and instruments for the objectification of sensory information and quantitative registration of processes.

Development of various models for the study of natural and artificial objects.

Unlike ordinary knowledge, in science the criteria for verifying any statements, provisions, and conclusions for both theoretical and experimental research are specially fixed.

The scientific method is usually called a set of means used in science to obtain, substantiate and apply scientific knowledge. The combination of these means is diverse and specific for different types of sciences and for qualitatively different levels of the same science (for example, for the theoretical and empirical levels). There is practically no single procedure for obtaining and substantiating knowledge, a universal method, for all fields of science and levels of scientific knowledge. In the natural sciences, the main means are systematic observations, experiments, and modeling. In the mathematical sciences, the main methods are the cognitive construction of abstract structures, the use of the axiomatic method, and deduction.

Unlike science, art is a special form of social consciousness associated with the birth of artistic images that enrich humanity with emotions, feelings, and experiences. Art expresses the personal meanings of an individual, a group, a generation. Art is a form of reflection of reality that allows for a personal and subjective image of the world based on artistic images. Art acts as a source of mental and spiritual enrichment of the individual based on empathy for the characters and situations of works of art.

Science is focused on the search for general patterns, while art pays attention to the individual, the individual. The values and ideals of art are historically changeable, unlike most axioms and laws of science. Art reveals a national, ethnic type of worldview. Art is addressed, first of all, to the sensory-associative and emotional, and science is addressed to the rational-rational ways of thinking. For science, the goal-setting regulator is the search for patterns, in art - the search for an aesthetic ideal.

Science as an integral formation includes a number of special sciences, which are divided into a large number of scientific disciplines. Modern classification of sciences is carried out on various grounds. According to the subject and method of cognition, they distinguish the sciences of nature - natural science, the sciences of society - the humanities and social sciences, the sciences of cognition and thinking itself.

- logic, epistemology, etc., sciences about artificial systems - technical sciences. Each group of sciences includes various scientific disciplines. For example, the natural sciences include mechanics, physics, chemistry, biology, etc., each of which is divided into its own scientific disciplines. In addition, all sciences are usually divided into two types: fundamental and applied. Fundamental sciences are focused on elucidating the basic laws and principles operating in the real world, applied sciences are focused on the direct application of the results of scientific knowledge to solve specific industrial and socially practical problems.

The main functions of science include the production of scientific and theoretical knowledge, the functions of observation, description, explanation of the behavior of an object, ideological and cultural functions, technological function, and the function of productive force. Modern researchers also note such functions of science as social regulation of social processes and projective-constructive functions associated with the creation of new technologies. The process of scientific knowledge is always associated with the interaction of subject and object and necessarily includes four components: subject, object, method, language. The subject of science is a researcher, scientific team, etc. The object of science (subject, subject area) is what the researcher studies. Each science develops a system of methods and techniques characteristic of it, determined by the peculiarities of this subject area. Similar to the method, the language of this science is developed, not only natural (special terminology), but also artificial (symbols, equations, formulas, etc.).

The structure of scientific knowledge can be presented as a unity of two levels: empirical and theoretical. These levels are closely related to each other and in the process of the evolution of science mutually transform into each other. At the empirical level, there is mainly a collection of factual material about the behavior of the object. Techniques such as description, comparison, measurement, observation, experiment, analysis, induction are used. Almost any scientific research begins with the collection, systematization and synthesis of facts. A fact becomes a scientific fact if knowledge about an event is reliably proven through observations and experiments. In scientific knowledge, facts form the empirical basis for putting forward hypotheses and are the basis for confirming or refuting theories. Empirical knowledge can be represented in the form of the following hierarchical structure: single observations, scientific facts, empirical laws, phenomenological theories. The indicated levels of empirical knowledge represent hypothetical, probabilistic knowledge.

Epistemology is a theory of scientific knowledge, one of the components of philosophy; studies the laws and possibilities of knowledge, explores the stages, forms, methods and means of the process of knowledge, conditions and criteria for the truth of scientific knowledge. Epistemology is part of a more general branch of scientific knowledge - science studies, which also studies issues of organizing and planning scientific research, the sociology of science, the logic of science, etc.

In epistemology, the following main patterns of development of science are distinguished:

The development of science is conditioned by the needs of practice. This is one of the main sources of scientific development.

Relative independence of science development. The solution of practical problems can be carried out only when science reaches a certain level of development, a certain stage of knowledge of reality.

Continuity in the development of scientific theories, concepts, methods and means of scientific knowledge.

The ambiguity of the process of development of science is the alternation of periods of evolutionary and revolutionary development. Evolutionary development is associated with the process of gradual accumulation of facts and experimental data within the framework of existing theories. A revolution in science is associated with a revision of fundamental provisions, laws, and principles as a result of the discovery of new phenomena that do not fit into the framework of existing theories.

Interaction and interdependence of branches of science, manifested, in particular, in the fact that the subject of one science can be studied using the techniques and methods of another.

Freedom of criticism and open expression of different opinions. As a result, one-sided views are overcome.

The theoretical structure of scientific knowledge has the following levels:

Axioms, general theoretical laws.

Particular theoretical laws describing the structure, properties and behavior of idealized objects.

Particular statements about specific states, properties and relationships of objects in time and space.

Theory is the most complex and developed form of scientific knowledge, providing a holistic reflection of natural and significant connections in a certain area of reality. A theory is a holistic, developing system of true knowledge that has a complex structure. In modern science, the following elements of the theory are distinguished:

Initial foundations - basic concepts, principles, axioms, laws, equations.

Idealized objects are abstract models of essential properties and connections of the systems being studied.

The logic of a theory is a set of rules and methods of proof.

Philosophical foundations and value factors.

A set of laws and statements derived as consequences from a given theory in accordance with specific principles.

The main functions of the theory are:

The integral function is the integration of reliable knowledge into an integral system.

The explanatory function is the identification of causal dependencies and connections of the phenomenon being studied, essential characteristics, laws of origin and development.

Methodological function - on the basis of any theory, methods, methods, and techniques of research activity are formulated.

Predictive function - based on theoretical concepts, predictions are made about the existence of unknown facts, properties, and connections.

The practical function is a guide to the translation of theoretical principles into reality.

The variety of forms of idealization and types of idealized objects corresponds to the variety of types of theories. The following types of theories are distinguished: descriptive, mathematical, deductive and inductive, fundamental and applied, formal and substantive, open and closed, explanatory and descriptive, physical, chemical, sociological, psychological, etc.

Mathematical theories are characterized by the highest degree of abstraction. The dominant role in the construction of mathematical theories is played by axiomatic and hypothetico-deductive methods, as well as the process of formalization.

Theories of empirical sciences (physics, chemistry, biology, sociology, history, etc.) are divided into two classes: phenomenological and non-phenomenological.

Phenomenological, or empirical, sciences are associated with the description of properties and processes observed experimentally (sociological, psychological, pedagogical, etc.). Such theories, as a rule, do not use complex abstract models. Phenomenological theories are focused, first of all, on the primary generalization and ordering of existing facts. They are mainly qualitative in nature and are usually formulated using natural language using special terminology of the relevant field of science. Phenomenological theories arise at the beginning of the development of science, in the process of accumulation, systematization and generalization of factual material. With the development of scientific knowledge, phenomenological theories are replaced by non-phenomenological, or explanatory, theories. They explain the connections between phenomena and properties of an object, reveal the mechanism of the phenomena and processes being studied, moving on to the formulation of laws of behavior of the system. Therefore, this type of knowledge can be classified not as empirical, but as theoretical, since it involves actions with abstract, ideal objects.

Based on the accuracy of forecasts, two classes of theories can be distinguished: theories with reliable forecasts (theories of classical physics, chemistry, mechanics) and theories with probabilistic forecasts, or stochastic theories (theories of social sciences and humanities).

Below are the main features characteristic of any type of theory:

A theory is not individual reliable scientific propositions, but their totality, an integral developing system.

A description of a set of facts only becomes a theory when it reveals the causes and patterns of phenomena on the basis of which scientific facts arose.

Any theory must necessarily have justification and proof of its own provisions.

The theory should strive to explain the widest possible range of phenomena and to continuously deepen knowledge about them.

The theory must reflect the fundamental patterns associated with the behavior of the object being studied.

The structure of a theory is determined by the systemic organization of theoretical constructs (idealized objects).

Theory is not only ready-made knowledge, but also the process of obtaining it with a corresponding analysis of its occurrence and development. The theories of modern science are created not only by inductive generalization of experience, but also by means of idealized objects that are used as hypothetical models. In this case, the idealized object becomes not only a theoretical model, but is also capable of setting a specific research program.

Scientific laws can be defined as connections or relationships between phenomena and processes. In this case, these connections or relationships must meet the following criteria, namely:

objectivity, i.e. be able to express the real relationships of objects participating in the objective activities of people;

materiality, i.e. be inherent in all processes of a given class of objects under any conditions;

necessity, i.e. always be implemented in appropriate conditions;

immanence, i.e. reflect the deep connections operating within a given system;

stability and repeatability, or reproducibility, i.e. sameness of action under similar conditions.

Understanding laws is a complex and contradictory process of reflecting reality. Laws begin with assumptions, hypotheses. Experimental material allows us to clarify, correct, and introduce new hypotheses, bringing the general concept to the form of a law. Based on the obtained laws, not only the explanation of phenomena of this class is carried out, but also the prediction of new phenomena and processes. According to the forms of movement and transformation of matter, one can distinguish mechanical, physical, chemical, biological, social laws; by areas of activity - laws of nature, society, thinking; according to the degree of universality - universal or dialectical, general or special, particular or specific; according to the mechanism of determination - dynamic and statistical, causal and non-causal; in terms of fundamentality - empirical and theoretical.

Science as an integral system has its own foundations and has ideals and norms of research. These characteristics are inherent in science in all its guises - both as a form of activity, and as a body of knowledge, and as a social institution. The foundations of science include the conceptual apparatus, principles, ideals, and standards of scientific research. Science can be considered accomplished when it is possible to establish the underlying scientific picture of the world. In addition to the natural, social and technical sciences, a distinction is made between theoretical and experimental, fundamental and applied science. Currently, science is developing taking into account the specialization of knowledge, as well as at the intersections of interdisciplinary fields. Modern scientists believe that the ideals and norms of science are of a specific historical nature and play the role of regulatory principles - they set goals and determine the process of research activity. The relationship and interconnection of ideals and norms can be formulated in the following positions, namely:

norms indicate typical, average rules; ideal - to the highest standard form of development of an object;

standards must be implemented everywhere; ideals are guidelines;

norms define the boundaries of space for achieving goals; ideals - an extremely perfect space in which goals and values coincide;

norms are subject to change; ideals are relatively stable.

Ideals and norms determine the formulation and formulation of the problem of scientific research. The problem must contain a contradiction, indicating the existing limit of knowledge and new facts, to explain which research is necessary. The relationship between sociocultural values and cognitive ideals and norms has a significant impact on the formulation and course of scientific research.

Science, of course, is largely determined by social practice and its needs. But at the same time, science also has relative independence and an internal logic of its own development. The general patterns of the development of science include: continuity, unity of quantitative and qualitative changes, differentiation and integration, interaction, mathematization and computerization, theorization and dialectization, acceleration of development, axiologization and ecologization. The principle of axiologization of science requires taking into account the value components of the cognitive process. The greening of scientific knowledge is the process of penetration of environmental laws into the natural, technical, social and human sciences. The objective basis of continuity in science is the progressive development of objects and phenomena caused by their inherent contradictions. Each higher stage of development of science arises on the basis of the previous one, retaining everything valuable that was accumulated earlier. New theories do not completely deny the old ones, since previous theories, with a certain degree of approximation, reflect the objective laws of reality in their subject area. The process of succession can be expressed using the terms “tradition” and “innovation”. A typical example of innovation is discoveries, new concepts. Traditions in science are knowledge accumulated by previous generations of scientists and preserved in scientific schools and individual scientific disciplines.

Quantitative changes in science are the gradual accumulation of new facts, observations, and experimental data within the framework of existing scientific concepts, leading to the expansion and refinement of concepts, principles, and theories. Qualitative changes lead to so-called scientific revolutions, the reason for which is the inability to explain new scientific facts using known theories and laws. The development of sciences is characterized by the dialectical interaction of two processes - differentiation (new scientific disciplines) and integration (the unification of sciences, as a rule, into disciplines located at their junction). Differentiation is a consequence of the increase and complexity of knowledge, which always leads to specialization and division of labor. Integration arises when it is necessary to solve problems that are too difficult for individual scientific disciplines (cybernetics, synergetics, etc.). The interaction of sciences is the enrichment of a scientific discipline with research methods and techniques of other sciences. Therefore, the most rapid growth of scientific knowledge and discoveries occurs in the process of interpenetration of sciences. Mathematics plays a special role in the development of various sciences. The essence of the mathematization process lies in the application of quantitative concepts and formal methods of mathematics to the content of special sciences. One of the main directions of mathematization is mathematical modeling, the essence of which is to replace an object with a mathematical model. Here, computerization comes first as a technology for effective solutions using logical and computational algorithms.

Modern science is characterized by processes of increasing complexity of knowledge. Theoretical models (abstract, symbolic, logical-mathematical) are becoming increasingly important. Dialectization is also an essential pattern that connects scientific knowledge with the idea of development, the introduction of the category of time into most sciences. The accelerated development of science (exponential law of development) is manifested in an increase in the number of scientific works and publications, an increase in the number of scientists, an increase in costs for science and income from the implementation of its developments. Scientific knowledge, as well as other types of knowledge of reality, is necessary to regulate human activity. The structural characteristics of the activity can be presented in the form of a diagram.

Any activity is regulated by certain values in accordance with given goals. The goal of an activity can be defined as an ideal image of a product, and the result of an activity as a materialized goal, or a finished product. The ultimate goal of science is to foresee the process of transforming objects of activity (object) into corresponding products. The main task of science is to identify the laws in accordance with which objects change and develop. Natural and technical sciences study the processes of transformation of nature. Social sciences study the change of social objects. The orientation of science towards the study of objects that can be included in activity, and their study as subject to objective laws of functioning and development, is the main feature of scientific knowledge. Science is aimed at a substantive and objective study of reality. However, science cannot replace all forms of knowledge of the world, of all culture. Everything that science cannot cover is connected with art, religion, and philosophy. The goal of science is also to anticipate changes in objects, which is also a feature of scientific activity. It is advisable to classify the features of scientific knowledge, in contrast to everyday knowledge, taking into account the above characteristics of activity. The conditions for conducting almost any scientific research are associated with a number of requirements, the fulfillment of which largely ensures the success of the cognition process itself. These requirements include:

a special language of science that clearly captures concepts and definitions;

special equipment necessary to study objects of activity;

consistency and validity of scientific knowledge;

the presence of a research methodology as the main means of organizing scientific research;

perception of truth as the highest value when conducting research and generating new knowledge.

Based on what has been said, we can formulate the main features of scientific knowledge, namely, an orientation toward the study of the laws of transformation of objects and the objectivity and objectivity of scientific knowledge that realizes this orientation;

the emergence of science beyond the subject structures of production and everyday experience and the study of objects regardless of today's capabilities.

Scientific methods are developed on the basis of theoretical knowledge. The effectiveness of methods depends on the content, fundamentality and degree of development of theories. At the same time, the methods themselves are used for further development of theoretical knowledge. Thus, theories and methods are not separated from each other, they are interconnected and in the process of activity, theories are transformed into methods, and methods enrich and develop theories. And yet theory and method are not identical concepts. The main differences between theory and method are as follows:

theory is the result of previous activity, and method is the beginning of subsequent activity;

the main functions of the theory are explanation and prediction, the main functions of the method are regulation and orientation of activity;

the theory is based on a system of ideal images reflecting the patterns of object behavior; a method is a system of rules and regulations that act as a tool for further cognition;

the theory is developed to solve a problem related to the object being studied, the method is aimed at identifying methods and mechanisms for studying the object.

Theories and laws are not methods for studying an object. To fulfill their methodological function, they must be transformed from an explanatory form into regulative principles of methods.

Methods cannot be viewed as a frozen set of regulations and rules. The method as a method of research should not remain unchanged, but should change along with the subject of activity in accordance with its specifics. The reliability and truth of the method must be determined by the content of the subject. Understanding this situation is especially relevant at the present time with active and rapid changes in the subjects of research. A method is not a simple set of techniques and rules developed independently of material reality and practice. The method is also not a way of a priori solving problems. The origins of the method must be sought in real, material reality. In modern literature, it is customary to distinguish three main aspects of the method, namely:

a) objective-substantive - the conditioning of the method by the subject of knowledge with the help of theory;

b) operational - the dependence of the method on the subject of cognition, on his abilities and level of competence;

c) praxeological - the degree of effectiveness, constructiveness, and reliability of the method.

There are several bases for classifying scientific methods. Depending on the role and place in the process of scientific knowledge, formal and substantive, empirical and theoretical, fundamental and applied methods are distinguished. In addition, methods are divided into qualitative and quantitative, deterministic and probabilistic, direct and indirect cognition. It is customary to distinguish the following main groups of methods:

Philosophical methods. These include: analytical, intuitive, phenomenological, hermeneutic, etc. With the help of philosophical methods, general regulations of research and their general strategy are set. A significant role in modern scientific knowledge is played by the dialectical-materialist methodology, as well as the principle of a materialist understanding of history. The essence of this principle, expressed in the brief and very simplified formula "Social being determines social consciousness," comes down to the following provisions:

the basis of the life of society is the social existence of people (material production, economics);

social consciousness is derivative (mediated) by social existence;

social consciousness has its own laws of development and has a reverse impact on the development of social existence;

the development of society is correlated with the development of socio-economic formations;

the history of society is the result of the activities of people in various forms (individuals, organizations, classes, etc.).

General scientific approaches and methods play the role of an "intermediate methodology" between philosophy and the theoretical and methodological provisions of the special sciences. The following can be cited as examples of general scientific concepts: information, model, structure, function, system, element, probability, etc. The characteristic features of general scientific concepts are, firstly, the combination in their content of the properties and concepts of philosophical categories and special sciences, and, secondly, the possibility of formalization using mathematical theories. On the basis of general scientific concepts and concepts, methods and principles of cognition are formulated, ensuring the connection of philosophy with special scientific knowledge. An example is such a general scientific discipline as synergetics - the theory of self-organization and development of open systems of any nature: natural, social, cognitive. The main concepts in synergetics are: order, chaos, nonlinearity, bifurcations, etc. At the same time, these concepts are closely related to philosophical categories: being, development, time, chance, etc.

Particularly scientific methods are a set of methods, principles of knowledge, research techniques used in sciences that consider various forms of movement of matter (mechanics, physics, chemistry, biology, sociology).

Disciplinary methods are a system of techniques used in scientific disciplines included in a certain branch of science. Each fundamental science is a complex of disciplines that have their own subject and their own research methods.

Interdisciplinary research methods are a set of methods that arose as a result of a combination of different levels of methodology, borrowed or developed on the basis of several scientific disciplines. Widely used in the implementation of complex scientific programs.

In any science there are elements of universal significance (laws, concepts, principles). Therefore, in every science there is philosophy, since any particular is only one of the forms of manifestation of the universal. The impact of philosophical principles on the process of scientific research can be better understood if we consider the role of the basic functions of philosophy in scientific knowledge. Below is a brief description of them.

The integrative function of philosophy is a systematic generalization and synthesis of various forms of knowledge, practice, and culture, leading to the acquisition of new, universal knowledge.

The critical function of philosophy, focused on all spheres of human activity. Critical analysis is a method of activity, the main task of which is to holistically assess phenomena, identify contradictions, strengths and weaknesses.

The ontological function of philosophy is the development of a general picture of the world with the help of universal objective characteristics; representation of material reality in the unity of various forms of movement and fundamental laws. Understanding the general vision of the world in the past and present gives philosophy the opportunity to perform a predictive function, constructing options for the world in the future.

The epistemological function of philosophy is the development of guidelines about the essence of the cognitive process, its forms, foundations, conditions of reliability, etc. In contrast to the special sciences, philosophy, as a direct subject of study, specifically deals with the laws, forms and principles of knowledge in general.

Methodological function of philosophy. By studying the general laws of existence and knowledge, philosophy develops the most general methods of research. These methods are implemented in the form of general norms and requirements that the subject of knowledge can implement in his specific research.

Axiological function is the creation of ideological and semantic guidelines; development of moral and aesthetic criteria with the help of which universal human values are formulated.

The selective, or selective, function of philosophy has a significant impact on scientific knowledge in the process of constructing fundamental theories. If there are options for solving a scientific problem, and a situation of choice arises, then the researcher implements only those that are consistent with his worldview, i.e. with the philosophical and methodological orientations of the scientist.

The predictive function of philosophy is the development of ideas and concepts for future evolutions of knowledge. Examples of the successful implementation of this function include the ideas of ancient atomism and the dialectical method.

An additional or auxiliary function of philosophy is associated with the use of philosophical and methodological principles in their unity as criteria of truth. For example, a violation of the principles of dialectics (objectivity, specificity, historicism, etc.) will inevitably lead to distortion of the results of a specific scientific study.

Philosophy has predictive capabilities in relation to natural scientific research, developing in advance the categorical structures necessary for it. The generation of new categorical models of the world in the system of philosophical knowledge is carried out through the constant development of philosophical categories. There are two main sources that ensure this development:

Reflection on various phenomena of culture (material and spiritual) and identification of real changes that occur in the categories of culture during the historical development of society.

Establishing meaningful and logical connections between philosophical categories, their interaction as elements of a developing system, when a change in one element leads to a change in another.

Philosophical knowledge acts as a special self-awareness of a culture, which actively influences its development. By generating the theoretical core of a new worldview, philosophy thereby introduces new ideas about the desirable way of life that it offers to humanity. By justifying these ideas as values, it functions as an ideology. At the same time, its constant focus on developing new categorical meanings, posing and solving problems, many of which at this stage of social development are justified primarily by the immanent theoretical development of philosophy, brings it closer to the methods of scientific thinking.

One of the first concepts of philosophy in the cultural space of mankind is considered to be the metaphysical, or transcendental, concept. The main provisions of this concept are:

philosophy develops the most general laws about man and the process of cognition;

philosophy is the most objective among the entire body of knowledge;

philosophical knowledge is of a universal nature, in contrast to particular sciences;

philosophical knowledge is based on human self-knowledge, the source of special sciences is empirical experience;

philosophy determines true knowledge, while private sciences are limited to experience and the inductive nature of inferences.

The transcendental concept helped the development of special sciences and played a positive role in the development of rational thinking in relation to scientific research. With the help of philosophy, abstract, theoretical thinking was formed with the transition to ideas and hypotheses about the structure and evolution of the world. The use of the above principles by philosophy until the 19th century was associated with the following points, namely:

relatively small amount of scientific knowledge;

the significant role of religion in the spiritual life of society;

the insignificant role of special sciences in the general culture of society.

Starting from the second half of the 19th century, scientific knowledge began to play an increasingly important role in industrial production, in the formation of productive forces, and in the organization of the education system. The reorganization of science itself begins, its transformation into an integral system of knowledge. A new reality is emerging - classical science, realizing itself as independent of both philosophy and religion. As a result of this complex and dynamic process, a positivist concept is formulated in philosophy and science. Scientists argue that the criterion for the truth of theoretical knowledge should be the degree of its correspondence to the results of experiments. Subsequently, an anti-interactionist concept arose, combining the right of self-sufficiency of philosophy and science, the absence of direct relationships between them. Proponents of this concept proceed from the idea of dividing culture into natural science and humanitarian culture. At the same time, philosophy is classified as a humanitarian direction along with art, religion, and morality. The essence of the dialectical concept is to affirm the connections between philosophy and science, as well as the dialectically contradictory unity between them. The subject of philosophy is the universal. At the same time, philosophy strives to comprehend the universal in a rational-logical, but not empirical way. The subject of private science is the individual, concrete, and empirically comprehended. Here lies the dialectical contradiction between philosophy and the particular sciences: they deny and complement each other within the framework of the whole - knowledge of the world. Philosophical knowledge cannot satisfy the criteria of rationality to the same extent as concrete scientific knowledge. Universalism and value-worldview orientation make philosophy more speculative and reflective and at the same time less rigorous and demonstrative than knowledge in private, concrete sciences. The process of scientific knowledge is creative and socially conditioned. The discovery of laws and theories is always associated with the formulation and substantiation of hypotheses. The philosophical foundations of science presuppose a certain foundation, consisting of epistemological, ontological, methodological, axiological formations, with the help of which specific scientific models are built. The philosophical foundations of science, which are a means of connecting philosophical and private knowledge, are distinguished as follows:

ontological foundations - general views about the picture of the world, general laws;

epistemological foundations - provisions on the nature of scientific knowledge;

methodological foundations - provisions on methods of obtaining knowledge, methods of proof;

axiological foundations - statements about the practical and theoretical significance of science in the cultural system, ethical aspects of science.

The influence of philosophy on the theoretical and empirical levels of knowledge in science is manifested in different ways. Empirical knowledge is determined by observational or experimental data, theoretical knowledge is determined by connection with philosophy. This connection is especially pronounced during periods of scientific revolutions. During these periods of time, a change in the scientific picture of the world occurs, often accompanied by a change in the ideals and norms of scientific research.

In addition to the philosophical foundations of science, the most important link between philosophical and private scientific knowledge is the philosophical problems of science. The following examples can be given as a statement of philosophical problems of science:

what is the nature of mathematical knowledge?

what is probability?

What is the specificity of humanitarian knowledge?

Classification of scientific problems is difficult due to the variety of philosophical problems. General approaches to this type of classification can be:

differences in the content of the philosophical part of the problem (ontological, epistemological, etc.);

differences in the scientific part of the problem (philosophical problems of physics, chemistry, sociology, etc.);

goals and direction of research (from philosophy to science or from science to philosophy).

The most important element of the connection between philosophy and science is the philosophy of science itself, which carries out reflection on science. The subject of this reflection is the philosophical interpretation of the structure, development and content of science as a whole and its individual disciplines. Three levels of philosophy of science can be distinguished, namely:

general philosophy of science;

philosophy of areas (types) of scientific knowledge: natural sciences, humanities, mathematics;

philosophy of individual scientific disciplines: mechanics, astronomy, psychology, etc.

The most important problems considered by the philosophy of science are:

mechanism of relationship between philosophy and science;

criteria for scientific knowledge;

structure of science;

methods of scientific knowledge;

patterns of development of science.

The main sections of the philosophy of science include: ontology and epistemology of science, logic and methodology of science, axiology and sociology of science. What is common and different between philosophy and science is determined by the complex historical process of the evolution of the relationship between philosophy as a meta-science and specific subject knowledge that makes up the content of a particular scientific discipline or scientific direction. Specific (special) sciences are focused on the process of cognition of certain aspects of an object or phenomenon and do not reach the level of general laws. In other words, each science has its own subject of research in relation to the object (natural, technical, economic, social, humanitarian aspects).

Therefore, the first difference between philosophy and a separate science is due to the fact that the main goal of subject science is the desire to know the truth within the framework of a given subject; philosophy strives to identify universal provisions that reach the level of metaphysical laws.

The second difference between science and philosophy is related to the methodology of searching for true knowledge. Subject science, as a rule, seeks answers to the following questions: where, why and how did the object arise? Philosophy is based, first of all, on a value-based approach to the analysis of the objects being studied and, in turn, asks the questions: for what purpose and for what purpose did the object arise? Considering the above, it can be argued that philosophy is focused on creating a holistic picture of the world; science in its traditional understanding is removed from value systems, which are, in fact, the only foundation for objective knowledge of reality. This difference serves as a source of mutual enrichment of science and philosophy, promotes their interpenetration, and helps to use universal philosophical concepts in subject scientific knowledge. Philosophy gets the opportunity to use not only theoretical, but also experimental scientific data. In this process it becomes a science using traditional scientific criteria. The main criteria of scientific character include the following:

objectivity. The principle of objectivity involves abstraction from the interests of the individual; objects and relationships between them must be known without the introduction of subjective knowledge;

evidence. The principle of evidence presupposes the need for rational justification of any scientific position;

systematicity. The principle of systematicity presupposes the ordering of knowledge based on theoretical concepts and specific theories;

verifiability. The principle of testability (verifiability) presupposes the possibility of proving scientific propositions using logic, observation, and experiment.

The most important criterion is objectivity. Scientific knowledge, of course, strives for the most objective description of the object being studied. However, it should be noted that even within the framework of one specific science, this criterion may have different interpretations. The confirmation of this thesis is especially evident in applied sciences (various theories of the origin of the Earth, theories of gluing, etc.). Philosophy, in order to satisfy the principle of objectivity, must inevitably impart a high degree of universality to any of its statements. The complexity and inconsistency of this situation does not allow philosophers to talk about the full use of the principle, but at the same time makes it possible to use it for the development and critical assessment of philosophical thought. Both science and philosophy are associated with a theoretical and rational way of comprehending existence. Both science and philosophy are based on a system of proof of the propositions put forward. One of the main criteria for scientific knowledge is testability (verification). It should be noted that in philosophy there is no and there can hardly be an unambiguous interpretation of this criterion.

All noted criteria of scientificity also apply to the content of philosophical knowledge, especially to ontology (philosophy of nature), epistemology (epistemology) and methodology of scientific knowledge, which can be found in virtually all philosophical systems that have the corresponding problems (Table 1).

Table 1. Philosophy and science: general and different

General or different	Philosophy	The science

Various	Universal provisions. A holistic picture of the world. Value approach. Combination rational and irrational	Subject knowledge. Models of individual object properties. Study specific object. Only rational knowledge. Experimental research
General and interdependent	Use of scientific knowledge. Use and analysis of the principle of objectivity. Use of theoretical scientific knowledge	Using philosophical models of the world. The principle of objectivity at the level of limited subject knowledge. Theoretical knowledge

The methodology of science is an integral part of epistemology. On the one hand, methodology is considered as the doctrine of methods of cognition in general. On the other hand, methodology acts as a set of methods in any specific area of scientific knowledge. The following criteria can be accepted as criteria for the scientific nature of knowledge: truth, intersubjectivity, systematicity. The truth of knowledge is understood as its correspondence to the cognizable object. Truth can be characteristic not only of scientific, but also of ordinary, everyday knowledge. In epistemology, truth means the correspondence of knowledge to reality and the reliability of its content. Knowledge is understood as a form of expression, recognition of truth. The form of recognition of truth can be of a very diverse nature: opinion, faith, ordinary knowledge, scientific knowledge. For scientific knowledge, it is obligatory to have grounds with the help of which the truth is asserted (proofs of the theorem, logical conclusions, experimental results). The principle of sufficient reason (the law of sufficient reason) is basic for any scientific direction: every thought must be justified by thoughts whose truth has been proven. Inte subjectivity expresses the property of the universality of scientific knowledge. The truths of scientific knowledge must be universal, in contrast to the truth of faith or the truth of ordinary knowledge, which can be individual in nature. The criterion of intersubjectivity is supplemented by the requirement of reproducibility, invariance of scientific knowledge: any researcher must obtain the same results under the same conditions of studying the same object. Systematicity in relation to scientific knowledge is characterized by a strict inductive-deductive structure, reasoning built on the basis of available experimental data. Each of the above criteria is necessary, but not sufficient for the statement that existing knowledge is truly scientific. Only the simultaneous implementation of all criteria determines the reliability of scientific knowledge. In the structure of scientific knowledge, one can identify features characteristic of each scientific field:

each branch of science refers to a specific set of objects of knowledge;

the subject of this industry is the relationships, interactions and transformations inherent in a certain set of objects;

the subject of the industry identifies a range of problems that are important for these specialists (problems); at the same time, there are key problems that are identical for all stages of development of this branch of science;

each branch of science has adopted its own research methods, focused on the corresponding criteria of truth, the subject and object of knowledge;

there is special (for this industry) theoretical and empirical knowledge obtained as a result of observations;

there is a language specific to a given branch of science, which includes concepts and terms that are most suitable for formulating tasks in a given area of professional activity.

Scientific knowledge can be classified on various grounds:

by groups of subject areas: mathematical, natural, humanitarian, technical;

by the way of reflecting the essence of knowledge: descriptive (phenomentalist) and explanatory (essentialist). Examples of phenomenalistic knowledge are sections of biology, psychology, pedagogy, etc. Essentialist knowledge is based on quantitative analysis (almost all sections of technical knowledge, some sections of sociology, etc.);

according to its functional purpose, scientific knowledge can be divided into fundamental and applied;

according to forms of thinking - empirical and theoretical. Empirical knowledge is established facts of science and generalizations of empirical patterns and laws formulated on their basis. Empirical research is aimed at the object and is based on experimental data.

Theoretical knowledge is the laws common to a given science, which make it possible not only to explain scientific facts, but also to predict the behavior of the objects being studied.

At the empirical stage of the development of science, the main means of forming scientific knowledge are empirical research and their logical generalization in the form of empirical patterns, laws, principles, classifications. The next stage is associated with modeling the behavior of the object and the transition to the formation of integral theoretical systems. At the same time, theoretical models for explaining reality arise.

The forms of organization of scientific knowledge are:

scientific facts (events, results recorded in a certain way);

provisions (a clearly formulated thought, a scientific statement);

concepts (thought reflecting general and specific features, properties of an object);

category (a concept that reflects the most general properties of objects. For example, the philosophical categories “space”, “time”, etc.);

principle (can be considered in two ways: firstly, as a central concept, representing the extension of any provision to all processes in a given subject area, secondly, as a standard for any activity);

law (an essential, consistently recurring relationship between phenomena);

theory (the highest form of organization of scientific knowledge, giving a holistic idea of the essential connections in the object being studied);

metatheory (a theory that analyzes the methods and methods of constructing scientific theories in a certain branch of scientific knowledge);

paradigm (concepts or theories underlying the formulation of problems and accepted as models for solving scientific research problems);

problem (knowledge or understanding of something that is not currently known to science, but is necessary for the development of science or practice);

hypothesis (assumed knowledge). If the truth of the hypothesis is proven, a new theory, law, principle arises; if not confirmed, the hypothesis is considered incorrect.

In science, three basic principles of knowledge are accepted: determinism, correspondence and complementarity.

The general scientific principle of determinism is based on the form of causality of any event: one phenomenon or process under certain conditions gives rise to another phenomenon or process. In modern science, probability theory and mathematical statistics are widely used not only in the natural sciences and technical areas of research, but also in the humanities.

The principle of correspondence is associated, first of all, with the understanding that with the advent of new, more general theories, theories whose validity has been experimentally established for certain phenomena should not be excluded as false, but retain their significance as a special case of a more general new theory. In addition, the principle of correspondence also means the continuity of theories, i.e. the need to correlate new theoretical constructs with those already developed in science.

The principle of complementarity is aimed at taking into account the subjective activity of the researcher. The interaction of the object of research with the subject (researcher), including with the help of devices and instruments, leads to different manifestations of the properties of the object depending on the type of interaction with the cognizing subject (various techniques and instrumentation). Therefore, it is legitimate to talk about different scientific descriptions of an object, the use of different theories describing the same object. Table 2 shows the differences in the characteristics of classical and modern science, taking into account the application of the above principles.

Table 2. Comparative characteristics of classical and modern science

Signs of aging	Periods of scientific development	
	Classical	Modern
An object	The process is isolated without taking into account the conditions for its study	Accounting for observational or experimental conditions
Method of cognition	Fixation of directly obvious correspondence between knowledge and reality	Use of mutually exclusive concepts in research (the principle of complementarity)
Empirical data	Knowledge is a direct generalization of experience. Empirical methodology	Constructing conceptual diagrams aimed at to understand experimental data
True	Knowledge adequate to reality	Multivariate vision of one object (system)
Scientificity	The presence of uncertainty is insufficient validity of knowledge	Absolute accuracy is unattainable

Methods of cognition are defined as ways of constructing and justifying systems of scientific knowledge, as well as a set of techniques for obtaining new scientific knowledge. The general philosophical method of cognition is dialectics - the logic of creative thinking, reflecting the dialectics of reality. The basis of dialectics as a method of scientific knowledge is the ascent from the abstract to the concrete. In dialectics, problems acquire a historical character; the study of the development of knowledge is the basis of knowledge. Dialectics focuses knowledge on revealing contradictions and finding ways to resolve them. The main content of the methods of scientific knowledge consists of scientific theories tested by practice. At the same time, special importance is attached to the analysis of the knowledge system, since any scientific knowledge system has a certain independence in relation to a specific subject area. Analysis of a scientific knowledge system plays a significant role in empirical and theoretical research tasks: when choosing a basic theory, formulating hypotheses, justifying the use of one or another mathematical apparatus, when simplifying a knowledge system for teaching, for coordination with other knowledge systems, etc.

Methodological approaches to research are used as methods of scientific knowledge. The approach can be considered as an initial principle, a basic position (systemic, functional, personal, activity-based, anthropological and other approaches). At the same time, the methodological approach acts as a direction for studying the subject of research (qualitative, quantitative, logical, historical, etc. approaches). In this case, the categories of dialectics are used: content and form, quality and quantity, historical and logical, etc.

Theoretical research methods include: theoretical analysis and synthesis, abstraction and concretization, analogy, modeling. Empirical research methods include: analysis of literary sources, observation, testing, experiment, methods of expert assessments, etc. With a certain degree of convention, the levels of significance of research can be divided into:

general industry;
disciplinary;
generally problematic;
particularly problematic.

Any means of cognition are constructed, developed and justified for specific cognitive purposes. The means of cognition differ in the following groups: material, mathematical, logical, linguistic. Material means of cognition include instruments and instruments for scientific research. In the history of science, the emergence of material means is associated with the formation of empirical research methods - observation, measurement, experiment. These funds are directly aimed at the objects being studied; they play a major role in the empirical testing of hypotheses and other results of scientific research, and in the discovery of new facts. The use of material means of cognition has a significant impact on the formation of the conceptual apparatus of science, on the methods of description and idealization of the objects being studied.

In mathematics, the science of quantitative relations and spatial forms abstracted from specific content, specific means of abstracting form from content have been developed and rules have been formulated for considering form as an independent object in the form of numbers, which makes it possible to identify connections between objects from which form is abstracted. Under the influence of mathematical means of cognition, the theoretical apparatus of descriptive sciences changes significantly. Mathematical tools make it possible to systematize empirical data, identify and formulate quantitative patterns. Mathematical tools are also used as special forms of idealization and analogy - mathematical modeling.

The use of logical means of cognition in the process of constructing reasoning and evidence allows the researcher to separate controlled arguments from those that are intuitively or not critically accepted, false from true. In almost any scientific research, a scientist must use logical means to answer the following questions:

What logical requirements should descriptions of empirically observed characteristics satisfy?

How to logically analyze the initial systems of scientific knowledge, how to harmonize one knowledge system with another?

How to build a scientific theory that allows you to give scientific explanations or predictions?

Linguistic means of cognition are associated with the rules for constructing concepts. In any scientific research it is necessary to clarify the introduced concepts, use or introduce new ones. The rules for using language, with the help of which the researcher constructs his reasoning and evidence, formulates hypotheses and draws conclusions, are the basic point of cognitive actions. In most studies, a significant role is played by the correlation of a given subject language, which describes a specific area of research, with the specific languages of related sciences, as well as a comparison of the conceptual apparatus with the corresponding concepts in foreign languages.

The term “technology” (techne) originated in Ancient Greece and denoted skill, skill, art in any field of human activity aimed at something that nature is not capable of producing. Currently, the concept of “technology” has the following interpretations:

a set of technical devices - from the simplest tools to the most complex technical systems;

a set of different types of activities to create technical devices. These types of activities primarily include: scientific and technical research, design, manufacturing, maintenance during operation.

A characteristic feature of modern technical sciences is the targeted application of scientific knowledge in technical practice; technology is becoming more and more knowledge-intensive. The main purpose of technology is to relieve a person from performing physically difficult or routine work in order to provide him with more time for creative activities and make his daily life easier. Various technical devices can significantly increase labor efficiency and productivity, make more efficient use of natural resources, and also reduce the likelihood of human error when performing any complex operations. The main tasks of technology include:

creation of material and cultural values;

production, transformation and transmission of various types of energy;

collection, processing and transmission of information;

creation and use of various means of transportation.

Equipment is classified by area of application, for example: industrial equipment, transport, household appliances, computer technology, etc. Equipment can also be divided into production (for example, machines, tools, measuring instruments, etc.) and non-production (household appliances, passenger vehicles, leisure equipment). Military equipment is also a separate class, which includes all technical devices and machines designed to maintain defense capability and conduct combat operations on land, sea, air and space. The basis of technical progress is an increase in the basic indicators of all types of equipment. This process is called modernization. The main technical indicators include:

productivity - the amount of products (information, etc.) manufactured, processed, transported per unit of time;

reliability - the ability of a technical device to perform its functions without failures at the appropriate level of quality or meet the specified requirements for a given period of time;

profitability - the amount of material resources, time, energy spent on producing a unit of product, moving a unit of cargo, etc.

In recent years, much attention has been paid to such indicators as environmental friendliness, ergonomics, and aesthetics of technical devices. Currently, improvement in many industrial areas is carried out exclusively in these areas. Moreover, if the improvement in ease of use and appearance of devices occurs in accordance with consumer requests, then environmental parameters are regulated by law. Until the end of the 18th century, the development of technology occurred mainly on the basis of experience (empirically). Currently, the development of technology is directly related to new scientific knowledge and research, and is a consequence of fundamental scientific discoveries. An indispensable condition for creating devices such as a nuclear reactor or a computer is a deep understanding of the processes underlying their operation. On the other hand, scientific research is impossible without modern technology of the highest level. Over the past centuries, technology has had a decisive impact on the socio-economic structure of human society. It was machine production that caused the transition from feudal society to capitalism, and the development of household and consumer technology that created modern Western civilization. The specificity of technical sciences can be understood by studying technical sciences in the unity of their methodological and social aspects. This unity reveals itself through the peculiarities of the structure, functioning and development of technical sciences. The social aspect in the content of technical sciences is expressed in the social conditionality of their tasks and the social nature of the objects of research. Technical knowledge is knowledge about artificial objects, i.e. about objects created by people to achieve their own goals.

The target orientation of technical objects determines their structure, properties and functioning features. Since technical knowledge must explain and justify the characteristics of the objects under study, technical sciences should naturally include a description of social functions in the content of technical knowledge. The content of technical knowledge is determined by the level of development of social practice more than the content of natural sciences. Therefore, the change in content in technical sciences occurs more intensively than in natural sciences.

Another feature of technical knowledge is that it is aimed at the design of both technical and social systems. Technical sciences should be considered as a special form of knowledge that arises on the border of design and research and integrates elements of both. This approach should be fundamental when considering the content, history and logic of the development of technical knowledge.

The social characteristics of technical sciences influence their methodological content. In particular, the nature of research in the technical sciences differs from research in the natural sciences, and the technical sciences themselves should not be built as a semblance of the natural sciences. The epistemological function in the technical sciences is connected with their producing function, with the maintenance of the design and operation of technical objects. The activity of obtaining and applying knowledge in technical sciences is inseparable from technical knowledge itself. Consequently, technical sciences can be considered as a complex social organism (sociotechnical systems), including both scientific and technical activities and scientific and technical knowledge. Scientific and technical knowledge does not arise as an end in itself. It is simultaneously a means of transforming the subject environment and production activities. In this sense, technology, like science, is a means of regulating social processes. The main feature of science is scientific knowledge. Technical knowledge, first of all, reflects the socio-technical features of objects. In addition, technical knowledge determines the structural and functional characteristics of objects.

Identification of the features of science is achieved by revealing the specifics of the product it creates—scientific knowledge. Unlike science, technology has its own special specificity of activity. Therefore, it is necessary to consider the characteristics of technical knowledge and methodological features of technical sciences.

The object of technical sciences is, first of all, technology itself, understood as material objects and complexes of objects. In addition, engineering sciences study technological processes and materials. These structural elements are the objects of specific areas of technical knowledge. Each of these groups is a complex of objects that differ from each other in functional and structural characteristics. In patent practice, these groups are usually called "devices," "methods," and "substances." In cognitive activity they can be considered independently of each other, but in practical activity they are always connected with each other in a certain way, forming an integral, object-based structure of practice. Moreover, these objects have a dual nature. Technical objects are a synthesis of natural and artificial. The artificiality of technical objects is expressed in the fact that they are products of creative human activity, adapted to the goals of the activity and perform certain, predetermined functions. To achieve his goals, a person transforms the natural environment, creates the necessary norms and properties of objects corresponding to certain functions. The boundaries of the artificial are largely determined by the capabilities of the natural, i.e. properties of natural substances.

Based on the duality of a technical object, two types of its characteristics can be distinguished: firstly, any technical object can be considered as a special case of the manifestation of the laws of nature established by the natural sciences; secondly, a technical object has specific characteristics inherent in it as a means of purposeful activity. These characteristics reflect the capabilities of its functioning and can be called technical in contrast to natural properties. Therefore, knowledge of only the natural sciences is not enough to fully understand technical objects; knowledge of the social nature of technical objects is also necessary, since the nature of people's activities, their goals and means are determined by the level of social development of society.

Technical characteristics can be considered in a purely technical or technological sense: efficiency, power, speed, etc. Such characteristics express the social nature of technical objects indirectly through the level of development of subject practice and technology. However, since a technical object is necessarily included in the social environment, it has not only technical, but also a number of other characteristics: economic, ergonomic, aesthetic, environmental, psychophysiological. They can be designated as sociotechnical.

The technical characteristics of an object act as a manifestation of its mechanical, physical, chemical and other properties obtained from the natural with the aim of creating an artificial one. Technical sciences are called upon to study this process of transformation; Scientific and technical knowledge must combine engineering and practical experience and natural science research.

The idea of natural and technical characteristics does not exhaust the subject of technical sciences. The traditional task of technical sciences should be considered to be the explanation of the connections between the functioning features and structure of an object. This is where the theoretical basis of scientific and technical knowledge arises. For simple tools, the connection between structure (structure, design) and functions is quite simple to detect. The action of simple tools (knife, drill, etc.) depends, first of all, on the shape and properties of the material. As technical objects develop and become more complex, the above connections develop and become more complex, leading to the need to introduce a structural and functional analysis of the artificial environment. Natural science discovers, studies and explains what can be used for practical activities; Engineering sciences study and explain exactly how this scientific knowledge can be used in the actual production process. In this sense, technical knowledge follows natural scientific knowledge.

The production orientation of technical sciences, their focus on design and construction determine the features of research activities in this area:

Technical knowledge should ensure that a group of sociotechnical indicators is taken into account and show ways and means to achieve them.

Technical sciences, on the one hand, generalize scientific knowledge in various fields of activity, on the other hand, they are forced to make them extremely specific in order to perform particular, special tasks of a particular industry.

Almost any technical task requires optimization of a number of parameters that determine the successful functioning of a technical object.

Orientation to practice requires accurate, reliable knowledge and appropriate quantitative calculations of any project. At the same time, these calculations must be simple enough to provide reliable and fast solutions.

The philosophy of technology examines the phenomenon of technology as a whole, not only its internal development (history of technology), but also the place of technology in social development. Technology has (unlike technology and technical sciences) its own object and subject of research. The object of the philosophy of technology is not only technology itself, but also technical activity and technical knowledge, considered as part of the general culture of mankind. The subject of philosophy of technology is the development of social technical consciousness, considered as a process of reflection in relation to the object of philosophy of technology. The main task of the philosophy of technology is to analyze the technical perception of the world or study the technical relationship of man to the surrounding reality. Despite the close connection between science and technology, and, accordingly, the philosophy of science and philosophy of technology, their connections and relationships with each other have undergone significant changes in the historical process of human development. The initial period of development is characterized by syncretism of knowledge and the inseparability of science and technology. The technique was traditional, local and religious or cultic. Ancient science was close to philosophy in its desire to achieve a comprehensive understanding of occurring phenomena. It is necessary to recognize the fact of the Renaissance (Renaissance) in science, technical experiment begins to be used, the foundations of theoretical knowledge emerge, based on practice, new professions appear in society: scientist and engineer. The need for training professional personnel becomes obvious. In the 20th century, fundamental transformations took place, associated primarily with environmental, technological and humanistic problems that arose in both scientific and technical activities. Philosophy of science develops means of methodological analysis; philosophy of technology helps the development of technical sciences. As complex systems are developed and implemented, the role of philosophy of technology increases, since the systems approach requires a new level of design and research methodology. New social institutions are emerging associated with the massive introduction of scientific research into engineering practice. Scientific and technical knowledge become system-forming factors that determine the level and nature of not only scientific and technical, but also social progress. The philosophy of technology is focused on the problems of the essence and meaning of technology. Technology has always been aimed at improving and strengthening human senses, as well as maximizing the intellectual potential of people. In the modern world, what comes to the fore is not so much the production of things (technical activity), but rather the methods and methods of production (technological aspect). Therefore, it would probably be more accurate to use the term “philosophy of technology” or “philosophy of practical activity”, however, taking into account the historical tradition, we will use the concept “philosophy of technology”, without forgetting the internal reconstruction of this concept that has occurred over the last century. Considering the above and understanding technology as an activity, we can talk about self-reflection, namely, assessing the history of technology, development prospects (forecasting), and analysis of consequences. It is this approach that underlies the philosophy of technology and requires taking into account technological, natural science, social, economic and environmental criteria to develop optimal strategies for the development of society on a scientific and technical basis. In the history of mankind, two approaches to the development of the surrounding world have operated and continue to operate.

The first path is based on an attempt to adapt man to nature, create harmony with the environment, maintain balance between society and nature, and organically combine the natural and artificial worlds. In this case, of necessity, an objective need arises for a harmonious combination in the process of activity of the fundamental categories of science, technology, art and religion.

The second way is based on the subordination of nature to human needs. Nature is seen as a workshop for transforming the world, possessing a certain resource. In this case, humanity assumes the role of an earthly god, whose raison d'être is to satisfy its own needs through the maximum use of natural resources. As a result, technology becomes the dominant factor in the development of man himself, which inevitably leads to the loss of spirituality.

The philosophy of technology identifies several general levels of technological development of technology: special technologies, general technologies, technical sciences, systems engineering.

The first level is associated with craft, artisanal technologies. These include various kinds of prescription reference books and textbooks specialized in narrow areas (schools, including crafts).

The second level brings technical knowledge to the generalization of various fields of technology, to an attempt to reach the level of systematization of knowledge about various crafts.

The third level is the level of theoretical knowledge. Technology becomes scientific, scientific technical disciplines with an appropriate educational and methodological base emerge.

The fourth level can be seen as an attempt at an integrated, systematic approach. At the same time, integrated design of complex systems with simultaneous development of a control system is assumed.

In the works of domestic and foreign scientists, a number of approaches to the analysis of the process of interpenetration of science and technology are visible: a linear model, an autonomous model, an evolutionary model, a functional model, a scientific and technical model.

The linear model is characterized by a straightforward, simplified view of the relationship between science and technology. Science is associated only with the production of knowledge, technology - with its application; science and technology act as various social institutions with their own goals and objectives. The autonomous model also views science and technology as independent of each other, but still having a certain degree of coordination; scientific knowledge is considered as theoretical, technical knowledge as empirical. The evolutionary model assumes three areas of activity: scientific, technical, production. Each of these areas has its own innovative processes that determine the path of evolution. The functional model connects scientific research with the development of devices and instruments and with an attempt to create a theoretical basis for their functioning, which is a new scientific direction focused on future achievements not only in scientific but also in technical activities. The scientific and technical model assumes scientific achievements as the main source of development, which are the basis for the development of new technologies. Technical knowledge is directly related to natural science. However, it cannot be considered only as applied; technical knowledge has its own specifics. Engineering activities must use both knowledge about natural and artificial systems. That is why an engineer needs knowledge in the field of natural and technical sciences. The combination of knowledge about the natural (natural science) and artificial world in engineering activities makes it possible to create real technical systems. A technician performing practical tasks can do without scientific knowledge; It is impossible to carry out engineering tasks without a scientific basis. Technical knowledge connects the functional and structural description of objects. At the empirical level of knowledge development, such a connection often appears as a simple description of the functions and structure corresponding to a given object. For a theoretical level, such a description is not enough. It is necessary to analyze the processes occurring in a technical object. Scientific and technical knowledge of an object must be associated with three concepts: structure, function, technology (method, technique, method, process). According to these concepts, three groups of indicators can be distinguished, with the help of which the relationships between these concepts are clarified (Figure 1).

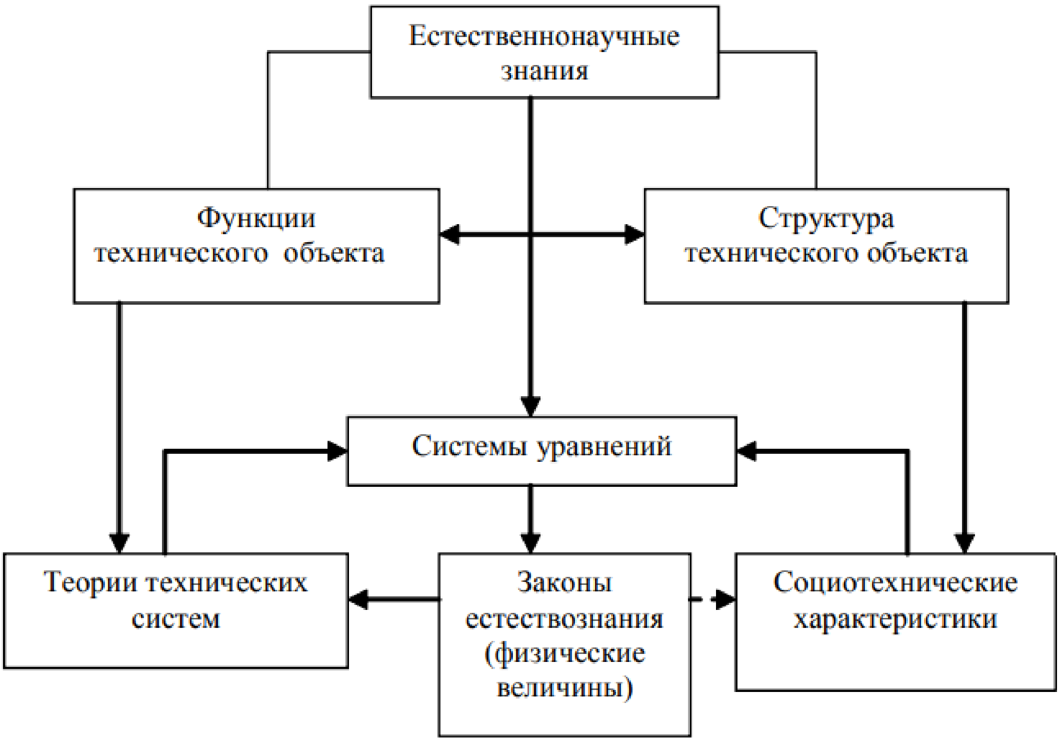

Figure 1. Description of a technical object as a sociotechnical system

The first group of indicators relates to natural scientific knowledge. In this case, a set of natural characteristics can be identified: E1, E2, ..., En. Then the mathematical description of the ideal process model will be represented by equations connecting these indicators. These equations characterize the process (technology), but not the structure of the object. The features of a technical object as a means of activity are not revealed using a natural scientific description.

The second group of indicators reflects functional and technical knowledge about the object. The implementation of functions is carried out both by influencing other objects and by influencing the object itself. Such actions are assessed using specific quantities that have a certain dimension and physical meaning (speed, power, accuracy, etc.). A common feature that unites a set of quantities taken from natural science or technology and distinguishes them as an integral set of parameters is that they are given as characteristics of the functioning of a technical object focused on expedient activity.

Technical objects are also associated with the social environment in which their implementation takes place. In the process of engineering design, it is necessary to take into account economic, aesthetic, psychological, and environmental factors. Therefore, a functionally technical description is actually sociotechnical. Not all sociotechnical indicators are directly related to the structural characteristics of an object. A direct connection can only be seen in technical and technological indicators; indicators of another type are related to the structure indirectly. For example, when constructing roads, it is necessary to take into account the multivariate assessment of a given object. In addition to the “direct” characteristics - width, strength, etc. - any road significantly changes not only purely economic, but also social and environmental characteristics in a given region.

It is important that the complex of social characteristics be objectively taken into account at the design stage of the facility. In practice, it is convenient to divide the entire set of indicators into two parts: technical and technological and socio-economic. Then the functioning of a technical object can be represented by equations connecting sociotechnical characteristics: CT1, CT2 ... CTn.

The third group of indicators, included in the technical theory, is associated with the structure of the object and is a reflection of its design characteristics: K1, K2, ... Kn. In theory, the object should receive the image of an ideal model with precise quantitative characteristics determined using structural and functional analysis. A group of equations connecting natural scientific and structural quantities can be represented by the equation:

VS(E, K) = 0, where s = 1 ... m.

The next stage in obtaining theoretical knowledge about a technical object is to establish relationships between natural scientific knowledge and the functions of the object. It is necessary to develop a system of equations that would include both physical and technical quantities:

Wf (T, E) = 0, where f = 1 ... n.

It is possible to achieve taking into account the relationships between physical quantities adopted to describe natural science processes by including technical indicators in the corresponding equations. The possibility of such inclusion is due to the fact that technical indicators have a physical meaning and in this respect are similar to the values accepted when describing natural scientific processes. It may be that a physical quantity and a technical indicator directly coincide with each other. And yet, technical indicators (characteristics, parameters) are not a direct result arising from the laws of nature known in natural science. The connection between them and the laws of physics (chemistry, biology) arises during the analysis (often mutual “intersection”) of a number of laws of natural science. As a result, equations appear that include quantities of type E and T. The resulting equations express the relationship between natural scientific quantities and technical indicators and reveal the physical nature of the latter. An example is the use of Hooke's law to assess deformation phenomena that arise during a number of technological operations during printing production.

And yet, obtaining a system of equations connecting the quantities E and T cannot be considered as a simple continuation of natural science research. In natural science, the main goal is to establish the laws of behavior of natural systems. In a technical object, it is necessary to identify the physical nature of the functioning of an artificial system. Therefore, we can consider that the connections between E and T act as fundamental dependencies that have the nature of fundamental laws for a given technical object. As a result, two groups of equations are obtained, with the help of which one can obtain another group connecting technical characteristics with the parameters of the structure of the object:

Up = (T, K) = 0, where p = 1 ... q.

Thus, when describing a technical object, three groups of characteristics and three types of connections between them arise. At the same time, various variants of the mathematical description are possible, including one when the characteristics of all three groups are present in one system of equations.

A scientific and technical description of an object can be presented as a mathematical transformation of the form of recording physical equations, as a result of which the technical characteristics and properties of an artificial system will be included in the equations. The main goal of such transformations is to provide a theoretical explanation of the functioning of a technical object that has a certain structural structure. Then it becomes possible to identify all of the specified groups of characteristics when describing a technical object, to show their relationships, as well as the dependence of artificially created functions (properties) into a single system of knowledge. Such a synthesis is especially evident in such scientific areas as technical aesthetics, ergonomics, and engineering psychology. The focus of these sciences is a person with his socio-psychological characteristics in the conditions of production activity. The main task that is solved is the study of the properties of technical objects in order to create optimal conditions for the subject's production activities.

If we consider science simultaneously from logical and epistemological positions, we can distinguish the following interrelated processes: the development of a knowledge system and the development of methods of cognition. The system of scientific knowledge in itself is not a goal, but plays the role of a means of solving problems and tasks. In science, such systems are created to identify the achieved level of knowledge and to apply the acquired knowledge. It is the use of scientific knowledge that leads to the creation of methods. However, knowledge of objective laws does not yet mean obtaining new technologies (methods, techniques) that can be put into practice.

Forecasting the development of technical sciences is necessarily associated with two reciprocal processes: research and normalization.

The research process allows, based on the existing knowledge base, to determine the logic of the development of science and technology and to understand the patterns inherent in this process. In the future, the use of these patterns provides new opportunities for innovative ways of developing science and technology.

The regulatory process is aimed at finding optimal ways to achieve specific goals. Such goals are always formulated as a certain level of development, taking into account relevant social and economic factors. The forecast, in this case, comes down to the formulation and substantiation of hypotheses for the further development of systems. At the same time, the needs of society are always taken into account, which makes this process a tool for managing scientific and technological progress.

The use of these procedures makes it possible to combine the process of cognition with the process of creation or transformation, which is fundamentally important for technical sciences.

The nature of the development of science is determined by two factors: material, determined by the needs of technological development, and theoretical, related to the logic of scientific knowledge. Material factors are determined by the means that society has or wants to have at the present time. Technical sciences, creating ideal models and mathematical apparatus for calculating elements of objects, provide means for the design study of real technical objects, for the design and production of equipment. However, technical sciences cannot solve such problems on their own. It is necessary to involve knowledge of natural sciences and humanities. Technical sciences, relying on the knowledge of fundamental sciences and ideal models of processes built in the natural sciences, create ideal models of devices that have certain technical functions. Subsequently, with the help of these functions, social needs are realized. Technical knowledge plays a special role in the interaction of fundamental and human sciences. With their help, iku is used to ultimately create sociotechnical systems (Figure 2).

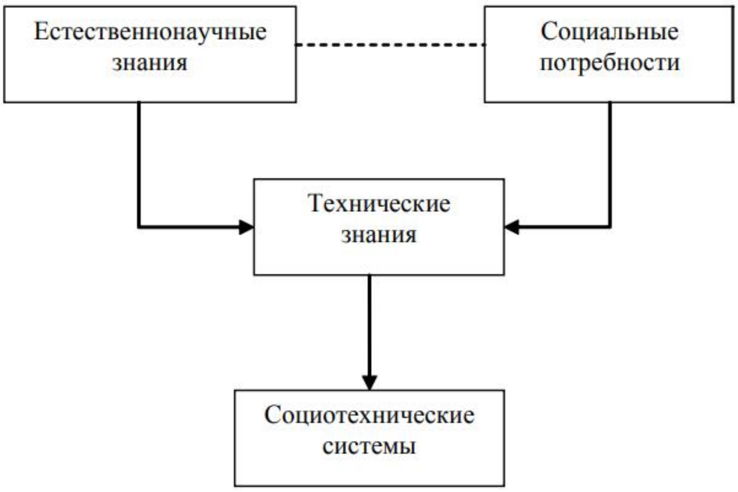

Figure 2. The place of technical sciences in the knowledge system

An example is the intensive development of technical sciences in the field of materials science. Over the past decades, the following trends have emerged: expanding the range of natural materials used, increasing consumption of artificial materials, improving the properties of the materials used, and creating materials with specified properties. The most innovative direction should be considered the creation of materials with predetermined properties. For the successful implementation of this direction, it is necessary to unite scientists of various specialties from the field of natural and technical sciences (chemists, physicists, materials scientists, etc.) and conduct comprehensive research in materials science.

Throughout history, there have been two trends in science: differentiation and integration of knowledge. Before the scientific and technological revolution, differentiation was leading, which led and is leading to the emergence of a large number of scientific disciplines and, unfortunately, the isolation of sciences from each other. In modern conditions, in our opinion, the process of integration of scientific knowledge should become the leading one. The driving force behind this process is the urgent need for a comprehensive study of complex processes. Their study is possible only with the joint and concerted efforts of various sciences; it requires the creation of complex sciences and the development of universal research methods. Nowadays it is more correct to talk about leading problems rather than leading industries.

Awareness of this situation can be seen in specific examples of strengthening the role of methodology. Such areas as a systems approach and synergetics have emerged and are being actively introduced into all areas of activity; The teaching system in secondary and higher schools is changing (the natural science textbook combines physics, chemistry, and biology). The ideal of such a process is the creation of a unified knowledge system. However, the desire for universal knowledge does not mean the unification of natural science and technical knowledge. There is a deep process of strengthening the fundamental component of technical knowledge. The fact is that discoveries in the field of scientific knowledge do not mean the possibility of directly implementing the results of such research in real production conditions. For such an implementation, no less fundamental research is required in the field of technical knowledge, which will make it possible to find options for the practical application of the laws of nature in technology; create, in essence, new laws of behavior of artificial systems.

If at the initial stages of the development of technology it was enough to know the laws of mechanics in order to learn how to apply them to technical objects with the help of applied research, now such application is possible, as a rule, after fundamental research in the field of technical sciences and then only applied research in relation to specific systems.

In the course of the scientific and technological revolution, science is increasingly turning into a productive force. At the same time, technical sciences are the basis for the connection between science and production. One of the core features of the development of technical sciences is the transition to the analysis of technical objects as systems, which inevitably leads to the need to restructure the thinking of engineers involved in the processes of research and design of technical objects. The systems approach is characterized by a comprehensive development of functional representations. At the same time, the system looks like a set of functional elements and functional connections that provide the necessary properties of the system. This approach was most fully reflected in practical activities in functional-cost analysis, the use of which in the last quarter of the 20th century became widespread not only in industry, but also in the management system, in economics and even in the humanities. The universality of functional analysis is due to the fact that during its implementation the object is presented as a functionally integral organism with all the diversity of processes occurring in it. At the same time, the description of objects based on physical representations does not lose its significance and becomes fundamental in the transition from functional to structural analysis. The inclusion of technical knowledge in the circle of system concepts changes the characteristics of technical sciences. The role of the abstract theoretical level of technical knowledge is increasing, especially when describing processes. A simple description of objects does not satisfy modern engineering; combining structural elements no longer provides high efficiency in solving technical problems. The project should be based on an understanding of the functional diagram of the object. Then processes (technologies) are selected, on the basis of which the necessary functions can be performed, after which structural diagrams are developed. Therefore, the apparatus of theoretical description of processes must be well developed even before the actual design stage as a means of transition from function to process and structure. If previously the main attention in the theoretical training of an engineer was expressed in mastering natural science and mathematical knowledge, now it is necessary to pay more and more attention to methodological training, teaching methods of engineering thinking, which has already been confirmed in the training of systems engineers.

The differentiation of knowledge is due to the emergence of many new objects in the form of devices and technologies, for which descriptions can be created according to standards known in engineering. Integration acts as the development of universal design methods, the unification of various technical disciplines to solve a technical problem. Along this path, complex sciences may emerge. The contrast and separation of technical and human knowledge about various aspects of objects should be replaced by a universal synthesizing approach, in which various forms of knowledge mutually enrich each other in the creation and management of systems.

As natural science increasingly adapted to the tasks of fundamental science, the need arose for the emergence of a “bridge” with the help of which it would be possible to search for new forms of implementation of the processes being studied. Such a search had to be transformed into a special type of activity that would provide a connection between the achievements of natural science and practice. Guided by the achievements of fundamental sciences, such activities are aimed at finding various options for implementing newly discovered patterns and phenomena. It is precisely this that becomes the basis of engineering sciences, combining theoretical knowledge about the "natural" and "artificial". As a result, applied research serves both the engineering and natural sciences. For natural sciences, applied research is an additional experimental field in which existing theories are tested and new phenomena and theoretical means of describing and explaining them are searched for. At the same time, they expand engineering capabilities and also provide the theoretical apparatus necessary for constructing technical theories.

Technical knowledge has always been associated with the sciences of society and man. Therefore, it is quite natural that technology, directly or indirectly, contains features determined by the social and biological needs and characteristics of a person. The stricter the requirements imposed by the social environment on the designed objects, the more technical knowledge is based on humanitarian knowledge. In any case, the design of technical means is simultaneously focused on solving social problems, and therefore modern engineering science cannot do without taking into account humanitarian knowledge. Social systems are a special kind of artificial systems, since they, like technical systems, are the result of purposeful action (social design), the purpose of which is determined by the corresponding main function of the future system (unions, parties, etc.). The commonality of methodological techniques for constructing and studying "artificial" social and technical systems seems interesting and useful for technical knowledge. Examples of the above are: the use in management of functional cost analysis, in sociology and psychology - methods of scientific and technical creativity that came to these areas of scientific knowledge from invention and "pure" technology.

Conclusion

Specialists interested in a deeper study of the above-mentioned issues can be recommended to familiarize themselves with the works of V.G. Afanasyeva, Ts.Ts. Chayropova and others. As for the history of engineering, which is organically included in the history of science and technology, it has been analyzed quite deeply in the works of the staff of the Institute of the History of Natural Science and Technology of the Russian Academy of Sciences, in particular in the journal "Questions of the History of Natural Science and Technology".

There are quite a few different definitions and various interpretations of the concept of "technology". Their content varies depending on the specifics of the activity that they define and the field of knowledge in relation to which the definition is given. One of the most common and most general approaches can be given in the following interpretation, namely:.

A technique is a set of techniques aimed at achieving a goal. Or in another version: technology is a set of techniques aimed at combating the forces of nature and interchange of matter. A more modern version of the definition is as follows: technology is a set of skills, abilities, techniques and knowledge that allow humanity to use the reserves of raw materials and energy available in nature. The following definition is quite capacious and quite accurate: technology is an activity aimed at satisfying human needs, which leads to changes in the material world.

Variants of definitions used, as a rule, in real production conditions include the following: technology is all the material conditions necessary for the production process to take place. Or: technology is the means of labor developing in the system of social production. There are also options for socio-economic approaches to defining the concept under consideration. Technology is a set of means that, based on a given situation, allows the most satisfactory way to achieve the intended goal; technology is a set of actions of a knowledgeable person aimed at dominating nature; technique is a skill whose methods are external to the goal.

As can be seen from the analysis of the above definitions, the concept of "technique" is based on categories such as art, skill (techne) or master of skill (technicos).

The circumstances are such that you have to choose between a traditional and a new solution that promises increased efficiency and reduced costs. The choice, however, should be based only on preliminary testing. The young engineer's boss unexpectedly informs a group of colleagues that the recommendations must be substantiated within two days. At an engineering school, a young employee had the opportunity to research a new device, but now, in production conditions, there is no time for thorough research. Nevertheless, the device is promising. The engineering team agrees with the boss and recommends an old, proven device. The boss instructs a young employee on how to write a report praising an old device and recommending its use. The report should not contain a word about a new alternative. What should an engineer do?

Summarizing the above, it should be noted that against the backdrop of an increase in the number of publications devoted to certain aspects of engineering work, the scarcity of studies in which it would be considered as a spiritual and practical activity becomes noticeable. The creativity of an engineer has not yet been studied deeply enough in the sociological and philosophical literature. Scientific, technical and engineering activities as a cumulative source of technological innovation in a number of important aspects are outside the field of research. Therefore, the need arose not so much to optimize the processes of scientific and technical creativity and scientific and technical activity, but to develop a general concept for the further development of a system for training specialists with higher technical education and a methodology for managing this system. The creation of a new paradigm for the educational process has become not only a pedagogical, technological or environmental problem, but also becomes a philosophical and socio-economic problem, on the successful solution of which scientific and technological progress throughout the country depends. It should be noted that until now the process of both theoretical and practical understanding of the categories "engineering activity", "engineering thinking", "scientific and technical creativity" has developed in such a way that its psychological, logical and epistemological aspects have received the greatest development, and generally - sociological, essentially, have been studied very little and, as a rule, are in the nature of general recommendations that are difficult to actually implement in the sociotechnical activities of an engineer. Therefore, it is natural that the public consciousness is dominated by the idea of scientific, technical and engineering activity as a special kind of spiritual activity, as if divorced from creativity in general and especially from art. Without accepting the limitations of such views, the author came to the conclusion that engineering activity should be considered as a dialectical unity of change in the object and subject of activity, as a constant divergent-convergent process of scientific and technical activity, including its subject, spiritual and organizational components. Engineering activity can be understood and revealed only through a specific historical study of socio-technical and socio-economic processes. Such an analysis makes it possible to understand the inextricable connection between the method of production and scientific and technological progress, scientific and technological progress and culture, the connection between engineering activity and art, with the moral values of a creative person. Modern highly industrialized and largely technocratic society is in dire need of such theoretical works that carry the potential of practicality and make it possible to harmonize the processes of scientific and technical activity with the help of technological innovations.

It should also be noted that there has been a sharply increased public need to unite representatives of different scientific disciplines in solving technical problems. This is confirmed by the material incentives Japanese and American firms provide for scientists and engineers to obtain second and third degrees, including the study of foreign languages and non-technical sciences. The real embodiment of this trend is the synector teams in manufacturing performance analysis consulting firms. An example indicating the negative impact of differentiation of sciences is the division of engineering departments of a higher educational institution into departments for equipment and technology in the same branch of production. Such a separation, formally convenient for organizing the educational process and for compiling a range of specialties, led to a deep and long-term mutual alienation of the style of engineering thinking of process engineers and mechanical engineers, as a result of which many unsuccessful and ineffective decisions arose in the design and manufacture of technical objects.

To give universal recommendations for changing the entire system of higher technical education is an unrealistic task. This work is only an attempt to fill the "blank spots" that have arisen between the socio-philosophical and subject-technical areas of training in the education system, with the help of concrete sociological and concrete methodological research.

Solving the problems posed in the work is complicated by the fact that during times of crisis many social contradictions appear that are inherent in the existing social system. Therefore, this study does not claim to solve all problems associated with scientific, technical and engineering activities. Considering the multifaceted nature of engineering activity in the light of the onset of a new period in the education system, conditioned by the need to develop students' systems and computer styles of thinking, the author puts forward the following thesis as a basic one: the process of development of natural intelligence should not be identified with the development of increasingly universal artificial intelligence systems, including including computerization. The authors also disagree with the statements that engineering activity will become art only when, on the basis of fully automated and computerized labor, the techniques and methods of scientific and technical technology are combined with artistic creativity. The emergence of value-based approaches to human activity is a long-standing humanistic tradition. Mythology is actually considered the beginning of humanitarian culture. Religion divided the world into material and immaterial (mystical, otherworldly, supernatural), which led to an awareness of the importance of the spiritual in this world, which can also be attributed to humanistic cultural studies. Philosophy develops a rationalistic picture of existence, based on the human mind and scientific achievements. The humanistic orientation of philosophical concepts is expressed in value systems developed by philosophy. As shown in this work, art, including technical art (techne), originating in the springs of myth-making, religious teachings, and philosophy, ultimately led humanity to the development of rationalism, which degenerated in the 20th century into technicism and technocracy.

There has been a shift in the value system towards greater satisfaction of human material needs. In the history of its development, humanity has moved further and further away from truly humanistic ideals, moving away from the social-humanistic direction of progress towards scientific and technological progress. Frightened by the results of such a movement, which led to an ecological and moral catastrophe, the world community, at least its leading part, is trying to change the course of human development towards humanization. This process is most important for the education system. In the education system itself - to humanize the process of technical education.

Using various sociocultural approaches (social, philosophical, systemic, structural-functional, general systems theory), we tried to formulate a technology paradigm for the formation of engineering thinking associated with the destruction of ideologies of utilitarian-pragmatic goals. We also tried to contribute to the work of streamlining the mass of recommendations, conglomerative in form and eclectic in content, by introducing a sociotechnical approach to solving technical problems using NTT and innovative technologies. In contrast to the descriptive (descriptive) method of constructing humanistic concepts adopted in socio-philosophical works, the study proposes a constructive definition of the methodology for moving the system of higher technical education along the path of humanization. To reveal this approach, the present study raised issues of dialectics, ethics and aesthetics as necessary. Over the past decades, society's requirements for specialists have significantly transformed. In addition to being highly qualified in their field, workers in science, technology, and management must be capable of creative activity and self-improvement. Engineering activity began to have a planetary character, technogenesis became commensurate with natural scales, covering the entire territory of the earth. The humanization of scientific and technological progress to mitigate technocratic blows should be directed primarily towards the humanization of the process of education of engineers. Nowadays, the disciplinary, narrowly subject paradigm of education continues to operate, fostering "chauvinism of special disciplines." Those who call for a shift in the training of engineers to a paradigm shift, to the introduction of a problem-based method, and the like, are right, in fact. The difficulty of such a transition lies in the fact that there are no simple and quick solutions leading to successful results in education. It is obvious that the transition period requires not only time, but also special techniques. During this period, an understanding should come of how to move from technical knowledge, how to move from technocratic thinking to sociotechnical knowledge, to humanistic thinking.

First of all, the purpose of education must be changed; it is not knowledge itself that is important, but the development of personality with the help of knowledge. Such goal setting requires solving the problem of teaching students creativity and self-improvement. It is not enough to call for internalist activities focused on self-education. Tools for this activity need to be developed. If this is successful, then both the student and the graduate engineer will be able to take advantage of the content and scope of knowledge that is already available in existing educational programs, using this knowledge to humanize technical activities. The stated position is the main goal of this work. It is to achieve this goal that it is shown how, with the help of a sociotechnical approach, using the diversity of such concepts as "consumer properties" and "result quality", one can arrive at a full-fledged creative educational process.

Therefore, in this article, significant attention is paid to the consideration of the transcendental in engineering activities, i.e. such categories as faith, intuition, imagination, fantasy, creativity, "working" for the humanization of engineering thinking. The introduction of such conventional concepts as "efficiency coefficient" is associated with the need for an instrumental and constructive description of innovative processes in engineering activities. The ability to operate with these concepts will enable the engineer not only to adapt to innovation, but also to actively participate in the creative process and master the art of solving real life problems. The tools that the NTT methodology has in its arsenal will help the engineer make the transition from a system of conceptual knowledge to a system of instrumental knowledge, and move on to real creativity.

The search for effective criteria for optimizing engineering activities is a fundamental point to which considerable attention is paid in the study. The anthropological aspect of performance results can be realized with a sufficiently in-depth analysis of the concept of "result quality". This will help in teaching to move from explanatory and illustrative methods to problem-search methods.

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ASPECT OF DEMOGRAPHIC SECURITY AND QUALITY OF LIFE OF THE INDIGENOUS SMALL POPULATION OF THE NORTH (SIPN)

Abstract*: the article discusses the problems of population savings, which are especially relevant for the northern regions of Russia, where population reproduction is accompanied by certain risks associated with the specifics of the Arctic zone. The main threats to demographic security in the indigenous indigenous peoples include the persistence of a negative migration balance, a reduction in natural growth and the total fertility rate. In addition, the preservation of demographic security is affected by problems in the field of mortality: the presence of high losses of the working-age population as a result of premature mortality from external causes of death; persistence in excess of male mortality; reflected in the low level of life expectancy. As a result, demographic threats are expressed in the absence of significant demographic growth.*

Problematic issues in the field of population mortality represent the main threats to the demographic security of indigenous peoples. In the Arctic region, there is a high proportion of deaths among people of working age, with a significant excess mortality among men. Mortality from external causes of death, which ranks second in the structure of causes of death, has a significant influence on the formation of the overall mortality rate of the population. These causes of death can constitute a significant reserve for reducing mortality in general, which determines their priority position among measures to reduce mortality in the population as a whole. The study analyzed problems and developed solutions to reduce infant mortality among indigenous peoples in the Yamalo-Nenets Autonomous Okrug. For this purpose, policies regarding the health of indigenous peoples of the North were reviewed, including measures aimed at reducing child mortality. As conclusions, recommendations were formulated aimed at increasing the efficiency of the health care system and social support for indigenous peoples.

Key words: *population conservation, reproduction, demographic security, threats, fertility, external causes of death, migration outflow, indigenous minorities, mortality processes, excess mortality of men, infant mortality, health care, indigenous peoples of the North.*

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Introduction

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Saving of the population seems to be one of the general directions of modern policy of the Russian Federation. Demographic tasks are identified among the priority tasks in the latest Decree of the President of the Russian Federation V.V. Putin: ensuring sustainable natural population growth; increasing life expectancy to 80 years by 2035. It is emphasized that the implementation of breakthrough scientific, technological and socio-economic development and an increase in the country's population depend on their solution. This task is especially relevant for the Arctic regions of Russia, where population reproduction is accompanied by certain risks caused by the natural, climatic and socio-economic specifics of the Arctic zone.

In the Arctic regions, the main threats to demographic security include the lack of significant population growth, which is due to changes in the ratio of sources of population formation. The migration outflow of the population is not compensated by natural growth; the negative migration balance until 2023 exceeded natural growth. Although in recent years there has been some improvement in the migration situation, nevertheless, in the indigenous minorities the migration balance coefficient remains almost 2 times higher than in the Far Eastern Federal District. Modern trends in natural growth have again returned to their previous vector of decline. Although for 2000–2023 the natural increase rate increased 1.9 times, but the results for 2022 showed a reduction in the natural increase rate by 17%. The total fertility rate, which had previously been increasing, has acquired negative dynamics since 2018 (2018 – 2.09, 2019 – 1.93). Only in the rural population this indicator exceeds the level of simple reproduction (2.59 – 2021). The ratio in the distribution of births by birth order changes. Although the share of children third or more in birth order in 2018 increased slightly compared to 2017 (from 30% to 31.7%), the absolute numbers of those born decreased slightly (2015 – 4899 children, 2016 – already 4866 children). In the area of population mortality, there are much more serious problems that make it possible to position them as the main threats to the demographic security of the region. This is a high proportion of deaths in working age, excess mortality among men, high population losses as a result of external causes of death. The latter acts as one of the significant points in the characteristics of mortality in the region. The excess mortality of men, which is generally characteristic of mortality processes, in the case of external causes of death manifests itself even more clearly. As a result of problems in mortality, life expectancy reached 70 years only by 2015. The excess mortality of men also determines their lag in life expectancy.

Changes in the processes of fertility, mortality and migration directly affect the age structure of the population; The population is aging. The share of the elderly population has more than doubled compared to 1990: from 6.7% to 16.4% in 2017. The aging of the population occurs simultaneously with a reduction in the proportion of children, which is typical for almost all regions of Russia.

In a certain sense, the risks of demographic security include the presence of significant territorial differentiation in the reproduction of the population of the republic, which necessitates the development of special measures to save the population separately for groups of territories or population groups. This applies primarily to the northern and Arctic municipal regions of Yakutia.

The modern world is constantly faced with the need to improve people's lives, improve the quality of the social environment and the availability of social services, and meet the social needs of the population. Increasing the level of social development is considered not only as an important condition for the economic success of the state, but also as the basis for the development of territorial systems, including in the sphere of the formation of their human capital - the basis for any changes in society. At the same time, the ability of states to meet the growing needs of the population is limited, and governments often lack the necessary resources to ensure maximum access to social services for the population. The need to solve these problems is reflected in the list of priority goals in the field of sustainable development established in the most important document of global international cooperation of the United Nations "Transforming our world: the 2035 Agenda for Sustainable Development." — Sustainable Development Goals (SDG-2035). The key way to achieve global goals in the field of sustainable development is partnership with the participation of many stakeholders from all sectors of society - public, private, non-profit. It is expected that throughout the world in the near future there will be increased participation of the private and non-profit sectors in previously traditionally public spheres, and it is this that will play an important role in the social development of countries, facilitating access to technology, finance and knowledge, pooling and mobilizing resources and expertise for implementation of initiatives in the social sphere.

A new social policy, focused on cooperation between its various participants and the development of effective partnerships between the state, business and civil society, should build on the existing experience of partnerships in the field of social development of regional and local communities. Various types of partnerships serve as tools that expand the capabilities of states to implement social policy. In some countries, the institution of public-private partnership is more developed; in other countries, priority is given to a less institutionalized and more flexible process of social integration. Global businesses are increasingly demonstrating their commitment to corporate social responsibility, delivering valuable social benefits to local communities and economic benefits to society as a whole. These are the trends that are typical today for both the global and Russian Arctic, where economic growth is directly related to the development of natural resources, the need to consolidate the population and develop the social sphere. Currently, in countries with Arctic territories (Canada, USA, Denmark, Sweden, Norway, Finland, Iceland and Russia), the issue of increasing the effectiveness of social policy is among the highest priorities. The problems of social development that many countries face today are significantly aggravated in the Arctic by the lack of infrastructure and personnel in the social sphere, and the extremely low availability of social services for a significant part of the population. This makes it impossible to ensure not only an increase in the level, but also the preservation of the existing availability and quality of social services for residents of many Arctic regions.

The economic development of the Arctic, which undoubtedly requires the consolidation of the population in this territory, is impossible without a developed social sphere. In conditions where the state is unable to cover and take into account all the specifics and features of processes in the social sphere at the level of local communities, the Arctic social partnership is one of the most effective policy instruments in this area.

Social partnerships have acquired particular relevance in today's critical conditions caused by the COVID-19 coronavirus pandemic, which require urgent high-quality social transformations and the inclusion in such activities of a wide range of participants from all sectors of society. This practice is already widespread, as evidenced by the many initiatives implemented to date by governments, local communities, corporations and companies, non-profit organizations and volunteer movements. We leave a detailed consideration of such an experience, given its scale and unprecedented nature, outside the scope of this work, but our study makes an attempt to begin to comprehend it. The scientific and analytical report presented to the attention of readers reflects the results of a study of social partnership and directions of its development in the Arctic, as well as specific examples of social partnership implemented in the social sphere of the Arctic territories of Russia and foreign countries. In this article we show how, despite the unevenness and variability in the use of certain instruments of partnership between the state, the private sector and society in the social sphere, largely due to existing inter-country differences, social partnerships in the Arctic have made it possible to enrich the opportunities, quality and coverage of services social sphere. Analyzing striking examples of multi-stakeholder social partnerships in Norway, Canada, Greenland, Russia and other Arctic countries, we talk about how social partnerships in the Arctic can effectively contribute to solving social problems, increasing internal potential and self-development of socio-economic territorial systems and local communities of the Arctic, ensuring their sustainable development. We hope that our article also provides potential sources of inspiration for disseminating the principles of cooperation and initiating projects in the social sphere of the Russian Arctic based on social partnership.

Main part

The savings of the population in the northern regions largely depends on the mortality rate of the population, which is associated with losses of demographic potential along with migration outflow. The specific age structure of the population of the Republic of Sakha (Yakutia) ensures a relatively low overall mortality rate. However, there is a high proportion of deaths in working age, and for men this figure increased during 2000–2021. 2 or more times higher than the same figure for women.

The male population has the greatest problems in preserving demographic potential. Excessive male mortality as a serious problem of demographic security has been observed for a long period of time, and in working age it is much higher than the index for the population as a whole. The indices in excess of male mortality from external causes of death are very high (Table 1).

Table 1. Male excess mortality index in the Republic of Sakha (Yakutia) for 2000-2021.

	2001	2010	2016	2020	2021	*2016/2021*
From all reasons	1.66	1.75	1.69	1.55	1.48	*0.89*
From external causes of death	4.51	4.77	4.08	4.57	4.47	*0.99*
From all types of transport injuries	3.38	3.72	3.80	3.67	2.96	*0.88*
From suicide	5.54	6.04	4.25	4.63	6.26	*1.13*
From murders	5.36	5.95	5.25	10.46	4.45	*0.83*

The most serious threat to the mortality rate of the region's population is high mortality due to external causes, which until 2021 were in 2nd place in the structure of causes of death. In 2020, they accounted for 16.2% of the total number of deaths (compared to 24.6% in 2000). In men, this class of causes of death retained its second position in the structure of causes of death. The external mortality rate is especially characteristic for the northern and Arctic regions of the republic.

During 2000–2021 the mortality rate from external causes of death decreased from 164.4 to 135.4 (for both sexes). Decrease in the absolute number of deaths from external causes in 2000–2021. is accompanied by positive dynamics in reducing the share of these causes of death in the total number of deaths (Table 2).

Table 2. Dynamics of deaths from external causes for 2000-2021, people.

	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Deaths, total, people.	7470	9325	9696	9402	8992	8918	8351	8239	8165	8053
Died from external causes, people.	1836	2341	2186	1872	1740	1637	1533	1482	1392	1302
Share in the total number of deaths, %	24.58	25.10	22.55	19.91	19.35	18.36	18.36	17.99	17.05	16.21

The predominant causes of external mortality are suicides and murders. In total, in 2021 they accounted for 37.1% of the total number of deaths from external causes (47% in 2020). An increase in the mortality rate was typical for suicides (1.4 times). For other reasons, a decrease was noted: from murders (1.2 times), from accidental alcohol poisoning (1.5 times). The most favorable dynamics are for deaths due to road accidents (by 38.9% in 2000–2021). A specific characteristic of mortality from external causes is the high proportion of deaths of working age. The predominant causes of external mortality are suicides and murders. In total, in 2021 they accounted for 37.1% of the total number of deaths from external causes (47% in 2020). Solving problems in the field of protecting health and increasing the efficiency of the health care system for indigenous peoples of the North is justified by the general direction of state policy and is one of the most important conditions for the socio-economic development of the region. In the Yamalo-Nenets Autonomous Okrug, a state policy is being pursued, which includes various measures in relation to the indigenous peoples of the North, aimed at improving the quality and standards of life of the indigenous peoples of the North, creating favorable conditions for a long, safe, healthy and prosperous life.

Despite the success of the ongoing activities, there are problems in the healthcare sector regarding the difficulty of providing medical care in remote and hard-to-reach areas, especially in cases of pregnancy and childbirth, as well as diseases of infants under one year old. Infant mortality deserves special attention, since its level largely characterizes not only the general health of newborns, but also affects the life expectancy rate.

In recent years, there has been a downward trend in infant mortality rates overall in the Yamalo-Nenets Autonomous Okrug, but at the same time they remain quite high in rural areas. In 2020, the infant mortality rate in places of traditional residence and traditional economic activities of indigenous peoples was 14.75 ‰. In 2021, the largest number of deaths were registered in the Yamal (6 infants) and Tazovsky regions, the main cause of which is acute pneumonia. The reduction in indicators was achieved through measures aimed at improving medical care for pregnant women and children, among which can be identified, namely:

− advanced training of obstetricians and gynecologists (including through remote webinars);

− providing the population with means of communication in order to ensure life safety and preserve health;

− the work of the Commission to analyze the causes of maternal, perinatal, infant and child mortality (supervised by the Governor of the Autonomous Okrug);

− developed methodological recommendations and memos for parents (concerning the most dangerous conditions in children, the most common symptoms and syndromes of diseases in which first aid is important in preventing the development of complications);

− the work of sanitary assistants (allows first aid to be brought closer directly to the tundra camp);

− organization of re-evacuation (this solution allows patients to be delivered to their place of permanent stay after discharge from hospitals).

These and other activities are reflected in documents such as: “Strategy for the development of healthcare of the Yamalo-Nenets Autonomous Okrug for the period until 2035”, “Information on the results of the activities of the Department for the Affairs of Indigenous Minorities of the North of the Yamalo-Nenets Autonomous Okrug in 2021”, “ Resolution of the Governor of the Yamalo-Nenets Autonomous Okrug dated December 28, 2021 No. 132-PG “On approval of the People's Program of Indigenous Minorities of the North in the Yamalo-Nenets Autonomous Okrug.” Despite the in-depth study of this problem, several areas can be identified that will improve the efficiency of providing assistance to pregnant women and children, namely:

1. The introduction of a satellite tracking system for the movements of families of tundra dwellers (will allow rescue services to track the location of nomads in the event of an emergency, which is especially important if a pregnant woman refuses prenatal hospitalization).
2. Providing hospitals with all-terrain vehicles (allows to increase the availability of medical care).
3. Maintaining information databases for complete records of pregnant women and children who may need medical care and who live in hard-to-reach areas (this measure will make it possible to have information about families in which there is a possibility of infant death).
4. The introduction of remote telecommunication technologies for the provision of medical care (allows you to identify and diagnose diseases without leaving your place of permanent residence, and increases the possibility of contacting when the first symptoms of diseases appear).

The main problem is related to the accessibility of care and these measures are aimed specifically at increasing the efficiency of providing medical care and introducing specialized and high-tech assistance to the indigenous peoples of the North of the Yamalo-Nenets Autonomous Okrug, paying special attention to improving medical care for the nomadic population, families of reindeer herders who have children under one year of age or pregnant women.

Conclusion

Thus, the main threats to demographic security in the republic include a negative migration balance, a reduction in the birth rate, the presence of high losses of the working-age population, the persistence of excess male mortality and a low level of life expectancy, which ultimately affects the lack of significant demographic growth.

Thus, problems in the field of mortality pose one of the main threats to the demographic security of the northern region. Among measures to reduce mortality, priority should be given to measures to reduce external mortality, mortality of the working-age population and excess mortality of men. In measures to reduce external mortality, paramount importance should be given not so much to medical prevention, but mainly to social prevention measures, which will be more effective in reducing the scale of mortality from external causes. In this short scientific and analytical report, we brought to the attention of readers a number of vivid stories from the life of the modern Arctic, telling about examples of social partnership leading to improving the lives of the people inhabiting this territory. These examples showed that social partnerships can be initiated by local communities, non-profit organizations, companies and business structures, regional authorities and national governments, and international structures. And, as experience shows, the main impetus for the formation of effective and flexible forms of social partnership are objective economic and social prerequisites. In fact, it is always a response to a need. Regardless of the level at which a particular project is conceived and implemented, aimed at solving social problems through social partnership, each of them includes, first of all, measures aimed at the development and qualitative transformation of a specific territorial community.

Our examples once again reminded us of how specific the economy and social sphere of the Arctic are due to the extremeness and complexity of the natural, climatic and other conditions of this macroregion. Social networks and partnerships in the social sphere become even more important in Arctic communities. Here, when there is a need for rapid and, most importantly, high-quality transformations in the social sphere, there comes an awareness of the decisive role of partnerships between large and small companies, the state and society, and the pooling of all resources to overcome social problems.

The study showed that initiatives implemented through social partnerships at local and regional levels in the Arctic can be extremely diverse. This is the development and implementation of innovative technologies in healthcare, education, social services, increasing hospital capacity, expanding medical and social care services, creating urban spaces favorable for life, social investments of business in the development of regions and municipalities, initiatives in the field of culture and sports. This is confirmed by the inspiring stories presented in the report of high corporate social responsibility of companies operating in Yamal, Greenland and the Murmansk region, the activities of a company seeking to obtain a high level of social license - approval of the local community - in the Finnish municipality of Kittilä, or the story of the project "Work and Entrepreneurship" in the Norwegian municipality of Alta, aimed at developing an entrepreneurial culture in the municipality. Social partnerships in the Arctic can also work at the level of individual industries or population groups. This is confirmed by examples of projects implemented under public-private partnership conditions for the creation of a new Wood Center campus of the University of Alaska in Fairbanks, the construction of the Stanton Hospital in Yellowknife, Canada and kindergartens in the Yamalo-Nenets Autonomous Okrug, or social integration in the "Path to Independence" project in Anchorage, where more than twenty participants from the public and private sectors came together to begin to solve one of the most difficult social problems - the problem of homelessness. Emerging in response to the need to solve social problems that differ in their properties or locality, social partnerships are also implemented at the global level. Evidence of this is the Arctic Human Health Initiative we reviewed, which affects all Arctic states. The practices of implementing social partnerships presented in the report show that the state's partnership with business structures and the activation of the potential of the local community are indeed an incentive for the self-development of socio-economic territorial systems, including such complex ones as the Arctic, directly influencing the main resource of self-development of the territory - human potential. The presented review of specific examples of social partnership in Arctic local communities of foreign countries and Russia indicates the high effectiveness of such activities for all its participants, without exception. Despite the fact that the models of social partnership are different and depend on the traditions of a particular country, the principles of the political structure, the economic and social situation, the development of civil society, they all have common goals - the development of social resources of Arctic local communities, the growth of the economy of the Arctic territories and ultimately sustainable development of the Arctic. In critical situations such as economic crises or global epidemics,not only does the need for social partnership increase many times over, but the scope of its application also expands significantly. In the article we only touched upon this topic a little, but based on the existing examples we can confidently say that the coming years, when the actions of all participants in the triad "government - business - society" will be focused on solving and mitigating the consequences of the COVID-19 coronavirus pandemic (and , quite likely, the global economic crisis caused by it) will be transformative for the discovery and implementation of new opportunities for social partnership. An analysis of the practices of social partnership in the Arctic allows us to conclude that to date a number of unique solutions have been formed here, elements of which can be adapted and replicated in practice.

Arctic practices for achieving social goals, based on cooperative strategies, provide excellent opportunities for activating local communities and searching for innovative ideas for solving social problems. It is precisely such practices, implemented by Arctic communities, that will help shape the future development of the Arctic, making it, as the title of this report suggests, truly social.

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Issue Article

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PECULIARITIES OF CO-MANAGEMENT OF INDIGENOUS INDIGENOUS PEOPLES' ECONOMICS IN THE ARCTIC TERRITORIES

Abstract*: in the article, the authors analyze the cooperation of indigenous peoples of the North, the study of whose way of life becomes a separate object of scientific research. The purpose of this article is to study the development of scientific approaches to the study of the traditional economy of indigenous peoples of the North in the Arctic zone of the Russian Federation. The main research method was a comparative analysis of publications from the beginning of the 20th century to the present period of both domestic and international scientists studying the traditional types of economy of the indigenous peoples of the Russian Arctic. The analysis of publications was carried out in all available branches of scientific knowledge, not limited to a strictly economic focus, since the economy of the traditional economy of the indigenous peoples of the Arctic is inextricably linked with technology, technical and organizational equipment of farming and other areas. As a result of the study, high research activity on the topic under study was revealed, especially since the increased attention of government authorities to the development of the Arctic territories. However, it was determined that there is no comprehensive approach to studying the economic development of the economies of indigenous peoples living in the Russian Arctic.*

Intensive industrial development, carried out today in the Arctic territories of the Russian Federation and other northern countries, in addition to positive economic and social transformations, entails climate change, environmental problems, as well as the destruction of the way of life and economic management of the indigenous peoples of the North, who are interested not only in ensuring and guaranteeing their rights on the part of the state, but also in making management decisions on the use and protection of territories of traditional residence and management together with government bodies and resource users.

Key words: *traditional farming; indigenous peoples; Russian Arctic; sustainable development; comparative analysis, indigenous peoples of the North, the Arctic, territories of traditional residence, co-government of the state and indigenous peoples, legal mechanisms of co-government.*

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Introduction

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The Russian Arctic is characterized by such specific features as the presence of extreme natural and climatic conditions, poor social infrastructure, and vast territory, which make it difficult to achieve a high quality of life for the population in the Arctic region. At the same time, this determines the relative "conservation" of the traditional way of life, which forms the basis of the economic model of the traditional types of management of indigenous peoples in the Russian Arctic. Globalization processes, climate change and socio-economic policy vectors have an irreversible impact on changes in the traditional way of life of indigenous peoples. Natural-climatic, economic and environmental factors, industrial development of the territory and the provision of traditional food products become decisive in increasing the threat to the conservation of the indigenous population of the Arctic region of the Russian Federation. This increases the relevance of an in-depth study of the economics of the traditional economy of indigenous peoples of the North in the Arctic territories of the country.

Mostly ethno-economic research is focused on the study of traditional households in the Asian Arctic of Russia, where the indigenous population (Nenets, Khanty, Mansi, Evenks, Chukchi, Eskimos, etc.) makes up about 14% of the population of the Russian Asian Arctic sector. On the contrary, studies of traditional households in the European part of the Arctic zone of Russia, the number of indigenous people in which constitutes 0.6% of the population of the macroregion, are rare and mainly affect the ethnocultural aspects of environmental management of the indigenous population. Unlike the Asian sector of the Russian Arctic, where departmental statistical monitoring is carried out on the number and composition of traditional households, employment and economic activity, etc., in the European sector of the Russian Arctic zone there is no such accounting. The source of official statistical information on the indigenous population is only the data of the 2010 All-Russian Census. And finally, in contrast to the Asian Arctic of Russia, where a coordinated policy in relation to traditional households is being quite successfully implemented (Strategy for the long-term socio-economic development of the Tazovsky district of the Yamalo-Nenets Autonomous Okrug, the law of the Chukotka Autonomous Okrug "On state regulation and state support for the development of reindeer husbandry in the Chukotka Autonomous Okrug", tripartite interaction of councils of representatives of the nomadic indigenous population with regional government bodies, local governments and enterprises of the fuel and energy complex of the Yamalo-Nenets Autonomous Okrug, etc.), in the European sector of the Arctic zone of Russia, a policy of this kind is focused only on issues of preserving cultural and natural heritage.

In the process of evolutionary development, local economic systems changed under the influence of socio-historical and natural factors. Important actors in transformation processes - ethnic migrants, who brought their economic culture to the new territory, used in their traditional economic practices the same resource base as representatives of the indigenous ethnic group, without taking into account the formal and informal institutions that had developed here. Such expansion in some cases led to a violation of the traditions of environmental management of the indigenous population and, as a consequence, to economic losses. The Arctic territory is no exception. An Arctic-type economy cannot develop without taking into account the "small economies" of the indigenous and indigenous population. In the context of historical and economic retrospection of traditional "endemic" economic practices, it is necessary to identify the adaptation mechanisms of small economies to socio-economic and political transformations, which will overcome the narrowness and fragmentation of modern historical and economic studies of traditional households in the Arctic zone of the Russian Federation, based on the analysis of a limited statistical database of modern data, and the current imperfection of institutional regulation of the life of traditional households.

The majority of indigenous peoples of the North live in hard-to-reach places with a harsh climate and limited opportunities for personal consumption of natural resources. The traditional economy and environmental management of northern peoples, being the basis of their livelihoods, a significant factor in preserving their original way of life, culture, and national psychology, is the most important historically established component of northern ecosystems, demonstrating environmentally balanced ways of developing the environment. Northern indigenous peoples are the bearers of unique historically acquired knowledge about the Arctic landscapes, traditional values and culture.

At the same time, northern regions around the world are rich in various mineral resources, and states are interested in their active exploitation. Active development of mineral resources of the northern Arctic territories remains one of the priorities of Russia's economic policy in the new century, the basis of its powerful energy potential. However, the Arctic is not only a storehouse of resources, but also, first of all, the home and territory of life, economic and cultural well-being of indigenous peoples and those who historically lived with them in harsh climatic conditions. The Arctic is the territory of life of people, cultures and peoples who have managed to develop their own management system, a system of values appropriate to this harsh region. Intensive industrial development, carried out today in the Arctic territories, entails climate change, environmental transformation, destruction of the way of life and economic management of the indigenous peoples of the North. Modern practice shows that these peoples are interested not only in providing compensation, compensation for material losses, guarantees of special environmental rights by the state, but also in making management decisions on the use and protection of territories of traditional residence and management together with government authorities.

That is why in recent years, in many northern countries, a form of interaction between the state and indigenous peoples has been developing, such as co-management of territories of traditional residence and economic activity. Co-governance is a partnership between two or more parties, one of which is usually the government. The International Union for Conservation of Nature defines co-management as a partnership in which government agencies, local communities and resource users, non-governmental organizations and other interested parties appropriately share authority and responsibility for the management of a specific area or set of resources. Borrini-Feyerabend and other authors define co-governance as “a pluralistic approach to natural resource management, involving a diversity of partners in a diversity of roles, and, in most cases, an approach to the ultimate goals of dialogue about the environment, the sustainable use of natural resources and the equitable sharing of benefits and responsibilities.” related to resources." S. N. Kharyuchi, in particular, identifies this type of co-management for indigenous peoples as environmental co-management (or co-management in the field of protection and rational use of natural resources), and defines it as joint management decision-making in the field of protecting the ancestral habitat and traditional image life in places of their traditional settlement and environmental management.

Regulation of co-management relations in international law and national law of the Nordic countries. Several international instruments pay particular attention to the relationship between the state of the natural environment and sustainable development and the cultural, social, economic and physical well-being of indigenous peoples. Thus, Agenda 21 requires States to promote, recognize and strengthen the role of indigenous peoples and local communities. For example, states are encouraged to recognize the importance of values, traditional knowledge of indigenous peoples in the use of natural resources; involve indigenous peoples in the process of implementing strategies in the field of rational use and conservation of natural resources, sustainable development strategies.

The UN Declaration on the Rights of Indigenous Peoples of 2007 also plays a significant role in the process of regulating the life of indigenous peoples, which defines important guarantees for the implementation of the rights of indigenous peoples to manage their territories of residence and economic activity. The rights of indigenous peoples to participate in the use, rational development and conservation of natural resources are also recognized in the International Labor Organization (ILO) Convention No. 169 “Indigenous and Tribal Peoples in Independent Countries” of 1989 on the sustainable development of indigenous peoples of the North // World of Indigenous Peoples “Living Arctic”. 2009. No. 22. P. 87-90.

The Convention specifically secures the rights of indigenous peoples to natural resources, emphasizing the special importance of the connection of these peoples with natural resources. In addition, the provisions of Convention No. 169 require the participation of indigenous peoples in the management of natural resources located in a certain territory, and above all in land management. States that have signed and ratified these international instruments must promote the fullest realization of the social, economic and cultural rights of indigenous peoples, including consulting and cooperating with indigenous peoples through their representative institutions to obtain their free, prior and informed consent before, take legislative or administrative measures that may affect their interests, as well as discuss with indigenous peoples projects implemented in their territories, especially in connection with the development, use or exploitation of natural resources.

The Russian Federation has not yet signed the UN Declaration on the Rights of Indigenous Peoples and has not ratified Convention No. 169. According to Russian researchers, a significant part of the provisions of the said Declaration, as well as Convention No. 169, corresponds to the norms of Russian legislation and is primarily consistent with the provisions of the Constitution RF. At the same time, some provisions of these international documents do not fully correlate with Russian legislation. Since in some cases there is no possibility of eliminating such contradictions or there are significant obstacles in eliminating them, which may lead to violations of the rights of citizens in Russia, their recognition and ratification must be carried out with some reservations. Indigenous peoples constitute a special group of the population, whose traditional way of life is based on a deep relationship with their original habitat, without which it is impossible to preserve their identity. In particular, L.V. Andrichenko emphasizes that the issues of legislative delimitation of powers between different levels of government in the field of protecting the ancestral habitat and traditional way of life of indigenous peoples are currently acquiring particular importance.

Main part

The study of the development of the economy of the traditional economy of the indigenous peoples of the Russian Arctic has become the subject of scientific research by scientists since the 1920-1930s; during various types of special research on the territory of the Soviet Arctic, the 1940-60s are mainly characterized by ethnographic descriptions of the economy and material indigenous cultures: from the first schemes of V.G. Bogoras before the doctrine of economic and cultural types, which from its first steps actively used materials on the peoples of Siberia. Thanks to this tradition, a general typology of forms of economy of the Arctic aborigines and the first experiments in mapping them appeared. In the 1970s–1980s. among Soviet publications, historical descriptions of the traditional economy of the northern peoples, as well as their rational knowledge, environmental management norms, and ideological ideas prevailed (Alekseenko E.A.; Vasiliev V.I., etc.). Ethno-ecological explanations have grown in popularity in archaeological reconstructions. As part of the justification for the need for a strategy for a more rational, balanced development of the northern territories, taking into account the interests of the indigenous population of the Arctic, an inevitable step was to take into account the recognition of the historical, economic and moral value of indigenous forms of environmental management (Krupni). The current state of research on traditional households in the Russian Arctic includes legislative aspects of traditional environmental management and the rights of the indigenous population. The scientific research of Kuropatnik M.S. is devoted to the trends in the ethnosocial and legal development of traditional households in the Arctic. The problems of managing the socio-economic systems of traditional households of the indigenous small population of the Arctic are studied in the works of Bogdanova E.N., Gorbunov S.N. and others. At the beginning of the 20th century, issues of the ethno-economics of traditional households in the Russian Arctic also began to be actively studied, which is presented in the works of Kolesnikova Yu.S., Gladun E.F. etc. The main idea of the work of these researchers is to study the specifics of the economic activities of the indigenous population of the Arctic.

The current priority direction for the development of the Arctic zone of Russia is its sustainable, balanced socio-economic development based on the systemic interaction of state authorities and local governments, the business community and local communities by increasing the efficiency of the economic activities of traditional households. It is the effective use of the economy of traditional households that is a reserve for achieving sustainable, balanced development of the Arctic region, especially in terms of ensuring food security for large settlements in the region and preserving unique Arctic industries. Thus, the historical aspect of the study allows us to identify the adaptation mechanism of small economies to socio-economic and political transformations in the second half of the 19th century. - the beginning of the 20th century, which are effective for solving modern problems of non-competitiveness and unprofitability of small traditional industries in the North and the revival of national villages as bases for the functioning and potential development of traditional crafts and industries in order to include the ethno-economy of traditional households in the regional economy. Microeconomic analysis, carried out using an explicit analytical apparatus to contextual historical information containing information about the preservation of institutions, their changes and the influence of previous institutions on subsequent ones, allows us to affirm the formation of multidimensional knowledge among the indigenous population, which has become a necessary factor in the development of new non-traditional types of their economic activities. This had a cumulative impact on the interaction of individuals within individual transactions, in which the issue of motivation for following certain rules of behavior, understanding the impact, preservation and change of non-technical characteristics (primarily cultural characteristics) required the study of the micro-mechanisms behind their emergence, stability and dynamics on level of interacting individuals in historical retrospect. In general, in modern studies of traditional households in the Arctic zone of Russia, many unresolved issues remain; there is no holistic concept of sustainable development of traditional households; the role of traditional management in the country's Arctic economy is not defined. Currently, issues of the development of national and regional innovation systems as a whole are reflected in the works of N.V. Beketov, researchers of the Kola Science Center of the Russian Academy of Sciences, and others. However, the issues of conceptual justification for the formation of innovative subsystems in relation to the traditional forms of economy of the indigenous peoples of the Arctic regions, as a necessary condition for the development of the regional economy and a factor in improving the quality of life and savings of the population, are given insufficient attention in modern scientific works. Thus, in the collective work of researchers from the Ural Economic School, issues of innovative development and development of Arctic territories were considered; Considerable attention is paid to the social aspect, in particular, the features of the formation and reproduction of the population of the Arctic territories are highlighted and an assessment of the socio-demographic potential of indigenous ethnic groups is given. Alekseev V.V. and Raevsky S.V. studied both theoretical and practical issues of improving management of the economic development of the northern region, taking into account the interests of indigenous peoples. However, the work focuses, first of all, on the use of the natural resource potential of the region; the development of traditional forms of economy of indigenous peoples is beyond the scope of the study. Levkina A.O. and Gladun E.F. an attempt was made to consider the prospects for sustainable innovative development of local Arctic economies, based on the widespread use of collaborative technologies as a new paradigm for the balanced development of the Russian Arctic territory; For a more complete understanding of the possibilities of ensuring and preserving the traditional economy of the indigenous peoples of the North, the historical evolution of the legal status and administrative status of the northern aboriginal population is considered. Separate studies are devoted to the implementation of innovations in reindeer husbandry on the territory of the Republic of Sakha (Yakutia), where researchers propose innovative technologies for the development of reindeer husbandry in conditions of a multi-structure form of ownership in different climatic and economic zones of Yakutia; practical and theoretical justifications for waste-free technology and industrial processing of reindeer herding products in the extreme conditions of the Far North are given. The question of the need to introduce innovations in reindeer husbandry of the Yamal-Nenets Autonomous Okrug is acutely raised in the works of the project manager and implementers E.N. Bogdanova and A.A. Lobanova. Another promising vector for the innovative development of traditional forms of farming is the development of its promising directions based on the discovery of new opportunities for the use of plant and animal raw materials of the Arctic through the study of their chemical composition and the subsequent development of functional biomedical and biopharmaceutical innovative functional products. Plants growing in the Arctic have adaptive mechanisms that allow them to overcome the negative effects of low temperatures. Biomedical research is being conducted to study the chemical composition and functional properties of Arctic biological resources. In particular, a lot of research in this direction was carried out by the project group of the Scientific Research Center for Arctic Studies of the Yamalo-Nenets Autonomous Okrug. Currently, one of the promising areas of research into traditional forms of economy of indigenous peoples has also become the study of the impact of climate change on the development of Arctic territories and the adaptation of socio-ecological-economic systems to the ongoing processes. Thus, teams of scientists from the St. Petersburg Scientific Research Institute of Forestry, the Main Geophysical Observatory named after. A.I. Voeykov, the All-Russian Research Institute of Agricultural Meteorology, have developed a technology for probabilistic forecasting of regional climate in Russia based on scenario forecasts of changes in climate impacts on economic sectors. In 2020, the Climate Center of Roshydromet summarized the results of research and development in the field of scientific and methodological substantiation of sectoral and regional adaptation strategies to current and expected climate changes in the Russian Federation. This climatological model is of high scientific value, but it is not adapted for analyzing the scenario impact of climate on the economy of the traditional economy of the indigenous peoples of the Arctic region. Scientists from the Institute of National Economic Forecasting of the Russian Academy of Sciences presented work on studying the impact of global climate change on the health of the population of the Russian Arctic. Representatives of the Kola Science Center of the Russian Academy of Sciences carried out a comprehensive assessment of the consequences of modern climate dynamics and anthropogenic impact on biota, the environment and nature management in the Murmansk region, taking into account changes in the life of the Sami. It is worth noting that research is underway on the impact of climatic conditions on the traditional economy of indigenous peoples in certain Arctic municipalities, for example, in the Taimyr Dolgano-Nenets municipal district and the Evenki municipal district of the Krasnoyarsk Territory, in the Yamalo-Nenets Autonomous Okrug. Based on sociological and anthropological research, this issue was studied by A.N. Davydov. and Mikhailova G.V. using an analysis of the perception of the Nenets on the island of Vaygach, the indigenous inhabitants of the Republic of Sakha (Yakutia), as well as O. Anisimov, A. Ivanova and others using the example of the Yamalo-Nenets Autonomous Okrug. A number of scientists have analyzed environmental problems in the Yamalo-Nenets Autonomous Okrug resulting from climate change, which has led to the need to change the migration routes of reindeer herds, melting ice and changing water areas. The thickness of the ice cover in the winter of 2013-2014 and the anthrax outbreak in the summer of 2016 provoked discussion about the "crisis" of Nenets reindeer husbandry, which manifested itself in excessive herd growth and overgrazing. In contrast to the need declared by biologists to significantly reduce the population of Yamal reindeer in order to increase the "ecological safety" of A.V. Golovnev presents an alternative approach, focused on the traditional Nenets rule "the land remains after us."Similar studies are being carried out by foreign scientists who assess the impact of climate change on the traditional economy, culture, well-being and health of the indigenous peoples of Europe, including in Finland, Sweden and Norway. Scientists also predict the risks, consequences and opportunities of global warming for various sectors of the national economy. So, Vasilyev V.V. and others, the expected socio-economic consequences and risks for business activities from predicted climate changes in the Arctic region are summarized. Porfiryev B.N., Makarov I.A. and others in their works assess the consequences of climate change in the Russian Arctic, mainly in the infrastructure aspect (energy, transport, production). Chugunkova A.V. and others indicate that changes in climatic parameters can be accompanied by both favorable and unfavorable effects for the sectors of the economy that are most susceptible to them - forestry and agriculture. Yakovleva E.N. and others propose an opposite methodological approach to assessing natural and climate risks, namely, assessing the impact of the negative anthropogenic and technogenic impact of the national economy on climate change. Morgunov B.A. and others in their works assess in aggregate transboundary risks, the consequences of climate change and economic activity on the water resources of the Arctic. Volkov S.G., Vlasova T.K. in their work they point out the impact of climate change on the ecological sustainability of pastures, the adaptive capabilities of pastoral communities and the viability of local socio-economic systems both in the Arctic and in the highlands of Tibet (China). Based on field research by S.I. Fedorov. The issues of agricultural activity, in particular, horse breeding, cattle breeding, hunting and crop production of the Yakuts in the conditions of climate change and cold "shortage" are considered. Kovalevsky D.V. and others, the need to adapt the Russian economy and society as a whole to the expected consequences of climate change in the Arctic in order to reduce the vulnerability of the population and economic facilities to them is substantiated. Thus, the task of the Arctic states carrying out intensive industrial development is to form a balanced, reasonable approach to maintaining a balance between the accelerated development of the industrial potential of the northern territories and the creation of opportunities for human development. An increasing number of states are changing their national constitutions and legislation in order to recognize and ensure the rights of indigenous peoples to occupy, own and manage territories of traditional environmental management. In the United States, for example, the participation of indigenous peoples in natural resource management is becoming mandatory. Rules on co-management in the field of use and protection of subsoil, forests, and territorial planning appear in environmental, natural resource, urban planning and other areas of legislation. The practice of so-called good neighbor agreements between indigenous tribes and natural resource companies is actively developing. Among the new US regulations governing shared management are the Native American and Alaska Traditional Lands and Resources Acts, the Freedom of Information Act, and the Emergency Planning and Notification Act. In Canada, legislation on co-government is also developing, new examples of judicial practice are appearing, in addition, other forms and methods of regulating national relations are being used: political methods of resolving relations with the indigenous population (federal-provincial conferences, constitutional conferences), bilateral and multilateral negotiations, including representatives indigenous peoples, as a result of which various agreements are signed. In light of the above, the example of Norway is also interesting. There, the participation of indigenous peoples in the use of natural resources has been ensured at the legislative level and in judicial practice over the past 40 years, and in the 1980-1990s. There were changes in the Constitution and legislation, according to which the indigenous people of Norway - the Sami - received additional environmental rights. Features of co-government of the state and indigenous peoples in the Russian Federation. Unfortunately, the existing legislative framework for regulating and protecting the rights of indigenous peoples in the Russian Federation has not yet been fully formed. It does not fully comply with international standards and norms, the regulation of individual relations remains fragmented, powers are unreasonably delimited between government bodies of the Russian Federation and its constituent entities, and there are a significant number of outdated norms. Until now, in the Russian Federation, the principle of state protectionism for residents of the northern territories has been clearly visible, which was enshrined in federal legislation in 1996. Despite the fact that many regulations of that period have lost force, government authorities continue to apply a policy of guardianship and control over indigenous peoples. As R. Sulyandziga, director of the Center for Assistance to Indigenous Peoples of the North, notes, "the federal government today needs political will, it is necessary to initiate the process of agreements and negotiations, creating a legal basis for the promotion and implementation of the model of joint decision-making, thereby maintaining its influence and control over vast territories, geopolitically significant and with great resource potential. This will stimulate the self-development of the indigenous peoples themselves, their socio-economic activities, and develop joint resource management. Co-management of resources should be a new component of public policy. In the joint management regime, issues of quotas for hunting and fishing, environmental protection, forestry and subsoil use are resolved." In the Fundamentals of State Policy of the Russian Federation in the Arctic for the period up to 2020 and beyond, one of the strategic priorities is the need to improve the quality of life of indigenous peoples and the social conditions of their economic activities, ensure rational use of natural resources, and preserve the cultural heritage of indigenous peoples. With the adoption of the Concept of Sustainable Development of Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation, the state assumed obligations to preserve indigenous peoples, ensure their livelihoods and sustainable development. On the one hand, the legislation of the Russian Federation contains some norms that grant indigenous peoples of the North the right to participate in the co-government of the territories of their residence, including the Arctic. Thus, the Constitution of the Russian Federation, without highlighting the right of indigenous peoples to co-government, guarantees the right of citizens to participate in the management of state affairs, both directly and through their representatives, and to exercise local self-government. Federal Law of April 30, 1999 No. 82-FZ "On guarantees of the rights of indigenous peoples of the Russian Federation", specifying these provisions, enshrines the right of indigenous peoples to participate through their authorized representatives in the preparation and adoption by state authorities and local governments of decisions on protection issues ancestral habitat, traditional way of life, farming and crafts.

Firstly, there is no guaranteed representation of indigenous peoples in legislative bodies and representative bodies of local self-government. In 2004, the authority of the constituent entities of the Russian Federation to establish quotas for the representation of these peoples in their legislative bodies and representative bodies of local self-government was revoked; secondly, there is no provision for the organization of local self-government, due to the compact residence of indigenous peoples on the territory of the municipality. Undoubtedly, choosing the optimal model for organizing local self-government of indigenous peoples is quite difficult. This is due to various factors. Due to objective reasons (way of life, traditions, specifics of the territory), for example, the indigenous population of the north of the Yamalo-Nenets Autonomous Okrug mainly leads a mobile nomadic lifestyle and is located far from populated areas. As a result, the system of state authorities and local self-government is currently structured in such a way that the majority of the indigenous population living on the territory of the municipality, for objective reasons, does not have a real opportunity to interact with the authorities and participate in the management of the territory; thirdly, in 2024, the norm allowing the communities of indigenous peoples of the North, Siberia and the Far East to be given separate powers of local government was abolished. Previously, the Federal Law "On Guarantees of the Rights of Indigenous Minorities of the Russian Federation" established a system of representation of indigenous minorities through the establishment of quotas in the legislative bodies of state power of the constituent entities of the Federation and local governments. The absence of quotas for the representation of indigenous peoples in the legislative and executive bodies of state power of the constituent entities of the Russian Federation and representative bodies of local self-government largely reduces the level of guarantees for ensuring the rights of small peoples; finally, fourthly, government bodies directly aimed at solving the problems of the northern peoples have been eliminated at the federal level. Thus, the State Committee for the North of Russia ceased to exist in 2022. Since 2022, there has been a permanent body - the Committee of the Federation Council for the Affairs of the North and Small Peoples. The Committee's jurisdiction included issues of legislative support: state policy in the regions of the Far North and equivalent areas; social and economic development of the Northern regions; the foundations of life support and development of indigenous peoples of the North, support of tribal communities, traditional environmental management, crafts; state support for the development of the economy and livelihoods of the population of the northern regions, the use of natural resources in the Far North, etc. Subsequently, by Decree of the Government of the Russian Federation of January 26, 2015 No. 40, the Regulations on the Ministry of Regional Development of the Russian Federation were approved. The Ministry was a federal executive body carrying out the functions of developing state policy and legal regulation in the field of socio-economic development of constituent entities of the Russian Federation and municipalities, including regions of the Far North and the Arctic. However, in 2018 the Ministry was abolished. Thus, at present, issues related to the development and implementation of state national policy and legal regulation in the field of protecting the rights of national minorities and indigenous peoples of the Russian Federation, the implementation of the ethnocultural needs of citizens belonging to various ethnic communities, as well as ensuring the effective use by subjects of of the Russian Federation and municipalities, state support funds provided for the ethnocultural development of the peoples of the Russian Federation are within the competence of the Ministry of Culture of the Russian Federation, the problems of indigenous peoples in the State Duma are included in the range of issues of the Committee on Nationalities Affairs, and in the Federation Council - the Committee on Federal Structure, Regional politics, local government and Northern affairs. Nevertheless, an analysis of regional legislation shows that in a number of constituent entities of the Russian Federation, opportunities have been created for the participation of indigenous peoples in the co-government of their territories. Thus, in the Duma of the Khanty-Mansiysk Autonomous Okrug - Ugra, for more than 15 years, the Assembly of Representatives of Indigenous Minorities of the North has been functioning with a special status, three members of which are directly elected to this body in a single multi-mandate electoral district (Articles 27, 49 of the Charter of the Khanty-Mansiysk Autonomous Okrug district - Ugra dated April 26, 1995 No. 4-oz, Article 17 of the Law of the Khanty-Mansiysk Autonomous Okrug - Ugra dated November 19, 2001 No. 76-oz “On the Duma of the Khanty-Mansiysk Autonomous Okrug - Ugra”). In the Sakhalin region, an institute has been established for a representative of the peoples of the North at the regional Duma, who is elected at the congress of these peoples and carries out its activities in the legislative body on a permanent professional basis. The Charter of the Chukotka Autonomous Okrug dated November 28, 1997 No. 26-O stipulates: “Bills that directly affect the rights and interests of indigenous peoples of the North are adopted by the Duma of the Autonomous Okrug with the participation in their consideration of the Chukotka regional public organization “Association of Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation.” Such consideration is mandatory when preparing draft laws on issues related to determining the legal status of ancestral lands, reserve territories, national communities, national villages, national rural settlements; with the legal regulation of traditional crafts and management and other issues affecting the traditional way of life and management of indigenous peoples, guarantees of their social and other rights.” In a number of regions, special committees and commissions are being created, in charge of the affairs of the northern peoples, as part of the legislative body: the Republic of Sakha (Yakutia), Krasnoyarsk and Kamchatka Territories, Nenets and Chukotka Autonomous Okrugs; in the system of executive authorities: Kamchatka and Krasnoyarsk territories, Nenets and Yamalo-Nenets autonomous districts; as well as structures of representatives of indigenous peoples of the North under the executive authorities (for example, the council of elders in the Kamchatka Territory and the Nenets Autonomous Okrug, the council of representatives of these peoples in the Krasnoyarsk and Khabarovsk Territories, the Murmansk Region, the Yamalo-Nenets Autonomous Okrug). Significant results in the development of co-government are achieved when regional government bodies strive to connect local self-government with the needs of the northern peoples. Thus, the Constitution of the Republic of Sakha (Yakutia) dated April 4, 1992 states that in places of compact residence of these peoples, local self-government is carried out taking into account national-ethnic characteristics in the manner prescribed by law (Part 2 of Article 99). For example, establishing and changing the boundaries of the territories of municipalities is carried out by the law of the Republic of Sakha (Yakutia), taking into account historical and other local traditions, socio-economic characteristics of the relevant territories, the location of transport communications, the presence of engineering infrastructure and other geographical, urban planning features (clause 2 of article 5 of the Law Republic of Sakha (Yakutia) dated November 30, 2018 171-3 No. 349-III “On local self-government in the Republic of Sakha (Yakutia).” Public organizations, including international ones, also make a great contribution to the development of co-government. cite the international project “Environmental co-management of resource-extracting companies, authorities and indigenous peoples of the North.” This project, supported by the Global Environment Facility and the UN Environment Program “Russian Federation: support for the national action program for the protection of the Arctic marine environment,” was implemented in three Arctic regions. regions of Russia - the Yamalo-Nenets and Nenets Autonomous Okrugs and the Republic of Sakha (Yakutia), selected as model ones. During the implementation of the project in these regions, an analysis of co-management practices was carried out and recommendations for its improvement were developed. The experience of interaction between organizations of indigenous peoples, authorities, public environmental organizations, subsoil user companies and the local population was also studied. Another example of the involvement of indigenous peoples of the North in co-management is the Yamal LNG project, implemented by the largest Russian independent gas producer, NOVATEK. The project involves the construction of a plant for the production of liquefied natural gas (LNG) and transport infrastructure, the creation of a seaport in the Yamal region (the northeastern part of the Yamal Peninsula, the western shore of the Ob Bay), as well as an ice-class tanker fleet. The project documentation was finalized with the participation of representatives of indigenous peoples. In particular, the company organized meetings of representatives of indigenous communities of the North, who pointed out the need to study and identify sacred places and take into account the interests of private sector reindeer herders regarding kaslany routes (reindeer translocation) that run through the Yamal LNG license area. The district's government authorities also consider it necessary to create a supervisory board with the participation of representatives of the indigenous population and protect the rights of indigenous peoples to co-govern their ancestral territories. So, an analysis of regional legislation and practice allows us to assert that the constituent entities of the Russian Federation do not ignore the issues of involving indigenous peoples and their associations in the management of state affairs. However, the capabilities they have in this regard are not used to the fullest, selectively, and without proper consistency. Consequently, co-management is carried out fragmentarily, not on an ongoing basis. Despite the fact that international law and the federal legislation of the Russian Federation contain good prerequisites for the implementation of the rights of indigenous peoples to exercise co-government together with government authorities, currently in Russia there are no tools and mechanisms for the development of this model of relationships.

Conclusion

All of the above indicates high research activity on assessing the impact of climate change on the ecological state of Arctic ecosystems, economic activity and the health of the indigenous population living in the regions of the Russian Arctic. However, it should be noted that the conceptual methodological approaches used in modern science to the study of innovative development of regions, the impact of industrial development and climate change on socio-economic development and various ecosystems are based on the fact that risk identification is carried out within each branch of knowledge separately due to the specialization of scientific research. teams to study specific groups of factors. Accordingly, the possibility of implementing an integrated approach is initially excluded, and risk factors that lie in the field of another branch of knowledge are excluded from the models. Moreover, it should be emphasized that the issue of adaptation of the indigenous population has been insufficiently studied, taking into account the specific features of the Arctic territories. In this regard, we propose a number of measures to facilitate the establishment and development of co-government of indigenous peoples of the North in the Arctic territories of Russia.

1. The Russian Federation should ratify the Convention on Indigenous and Tribal Peoples in Independent Countries and endorse the UN Declaration on the Rights of Indigenous Peoples. Ratification and adherence to the recommendations specified in these international documents will give indigenous peoples more rights and opportunities to manage the territories of their residence and economic activity, since in this case Russia will have to include in its legislation norms on the special rights of indigenous peoples to lands and natural resources, rules on co-management together with government bodies.

2. The model of co-government of indigenous peoples should be properly consolidated in the Concept of sustainable development of indigenous peoples of the North, Siberia and the Far East. It is this document that is aimed at uniting the efforts of state authorities and local governments with civil society institutions, including associations of small peoples of the North, to resolve issues of sustainable development of these peoples. However, the Concept does not provide for any directions for expanding the participation of indigenous peoples in managing the affairs of the state and society. The concept of "co-government" and the main forms of its implementation can also be included in regional legislation on indigenous peoples.

3. It is important to overcome the fragmentation of legal regulation of social relations with the participation of indigenous peoples. The main provisions of the federal laws "On guarantees of the rights of indigenous peoples of the Russian Federation", "On territories of traditional natural resource management", "On the general principles of organizing communities of indigenous peoples of the North, Siberia and the Far East of the Russian Federation" must be linked with sectoral regulatory legal acts of environmental and natural resources bloc, in particular with the Land and Forestry Codes of the Russian Federation, federal laws "On Environmental Protection", "On Environmental Expertise", etc.

4. It is necessary to increase the legislative and administrative capabilities of state authorities of the constituent entities of the Russian Federation and local governments to involve indigenous peoples in the management of northern territories. It is the constituent entities of the Russian Federation that can create conditions that allow indigenous peoples to effectively be included in the decision-making process that affects their rights and interests. As a priority measure in federal legislation, it is necessary to consolidate the authority of state authorities of the constituent entities of the Russian Federation to establish quotas for the representation of indigenous peoples in legislative bodies and municipal representative bodies, as well as provisions on the possibility of organizing local self-government taking into account the way of life of these peoples and, if necessary, empower communities of northern peoples with separate powers of local governments.

5. The legislation of the constituent entities of the Russian Federation may also include special norms that establish mechanisms for taking into account the opinions of the indigenous population when providing land for use for activities other than traditional management. General rules on taking into account public opinion when providing land are contained in the Land Code of the Russian Federation,

but in practice, indigenous peoples often do not have a legally regulated opportunity to express their own opinion.

6. It should be a regular practice of government bodies of the constituent entities of the Russian Federation to hold consultations and negotiations between companies that use natural resources and authorized organizations of indigenous peoples of the North on issues that directly affect the rights and interests of these peoples, which also involves the establishment of an order and development of procedures for these consultations.

The adoption of these measures will contribute to the development of co-government of the indigenous peoples of the North and the state, which is especially important at present for the intensively developing Arctic territories.

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EMPOWERING HR: HOW MICRO AND SMALL ENTERPRISE FINANCING TRANSFORMS SIAK DISTRICT'S WETLAND AREAS

Abstract*: The research aims to assess the human resource development of Micro and Small Enterprises (MSEs) in the wetland area of Siak Regency. The study uses a qualitative method with 50 samples spread across four sub-districts. The results reveal a relatively good level of education, but many MSE workers lack work experience. There are weaknesses in product development, innovation, market understanding, and information technology use. The lack of optimal training and monitoring of HR development complicates the situation. MSEs consider financing crucial for business development but face obstacles in access and high interest rates. There is a lack of special financial products for HR development and minimal role of financial institutions in providing information and consultation. To address these issues, eight HR development strategies are proposed, including partnerships with educational institutions, regional governments, and Village-Owned Enterprises (BUMDes), special financing programs, regional superior local products, diversification, product innovation, and CSR partnerships.*

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Introduction

The dualism of rural and urban development has long been a problem in Indonesia. Rural areas tend to be marginalized in economic development, making rural areas tend to be left behind and become areas familiar with poverty. This can be seen from the poverty rate in rural areas in Riau Province in September 2022, which was 7.07 % higher than the poverty rate in urban areas, namely 6.49% (BPS Riau, 2022).

The underdevelopment of rural areas is related to urban bias in rural development. The decline in rural development is caused by rural areas always losing out to the political, social and economic forces of urban areas. Where development capital is used more intensively and focuses on urban development. This causes rural areas to become underdeveloped and highly dependent on urban development multipliers (Pasaribu, 2012). The lagging behind in rural development becomes more obvious in wetlands areas, especially peatlands, as areas that tend to be marginalized from infrastructure development and an economy that tends to be monotonous on small farms (Najiyati, 2005). Dominant control of capital and land by large companies and city residents has exacerbated poverty in rural peatland areas.

To catch up with rural development, especially in wetland areas, improving the people's economy is the main way to improve community welfare (Pasaribu, 2012). The existence of micro, small and medium enterprises as a form of people's economy is an effort to catch up with rural development and reduce poverty levels in rural areas (Pasaribu, 2012).

Micro and Small Enterprises (UMK) are one of the economic sectors that have an important role in economic development in Indonesia, namely creating jobs, increasing people's income, and improving the welfare of society as a whole. Data from the Ministry of Cooperatives and MSMEs since 2017, the contribution of MSMEs to Indonesia's GDP is above 60% until 2021.

Siak Regency is a wetland area and has the potential to develop local regional potential. The number of MSEs in Siak Regency was recorded as continuing to grow in the 2015-2018 period. In 2015 and 2016 the number of MSEs in Siak Regency amounted to 2,606 units, then experienced an increase of 15.8% to 3,018 MSE units in 2017. In 2018 the number of MSEs again increased by 3.25 % to 3,116. In 2019 the number of MSEs increased to 3,214. Meanwhile, in 2020 the number of MSEs experienced a very drastic increase to 13,597 MSEs. This increase shows that MSEs are a source of economic strength for the community in Siak Regency, especially during the crisis due to this pandemic (Siak Regency Cooperative and MSME Service, 2022).

MSMEs as a national and regional economic force have absorbed 199.57 million workers in Indonesia (Lakip Kemenkopukm, 2021), but are still experiencing various obstacles in their development. The development of MSEs is still hampered by traditional business management, inadequate quality of human resources, production scale and techniques, low innovation capabilities and limited access to financial institutions, especially banking (Sarwido, 2014).

The development of MSMEs in Indonesia, especially in rural areas, is still hampered by at least two factors. First, internal factors, namely weak capital, financing (credit), production, production, marketing and human resources. Second, external factors, namely support for guidance, policy and development of MSMEs (Irnawati, 2013).

The government has made various efforts to increase MSE financing, such as the People's Business Credit (KUR) program and Micro, Small and Medium Enterprises (MSME) financing through national banks. Figure 3 shows data on MSME credit towards total banking credit.

Based on data from the Ministry of Cooperatives and SMEs of the Republic of Indonesia, from 2014-2021, MSME Credit to Total Banking Credit has increased every year. In 2021, MSME Credit to Total Banking Credit will increase by 21.02 % .

In the Wetland area of Siak Regency, MSEs play an important role in driving the wheels of the local economy. However, the big challenge faced by MSEs in this region is limited access to financing. This is an obstacle in the development of MSEs, including in the development of human resources. MSE financing in the Wetland area of Siak Regency can take the form of loans, capital assistance and access to markets. This financing can help MSEs to improve the quality of human resources and competitiveness, so that they can more effectively utilize the economic potential that exists in this region.

Several previous studies have discussed the contribution of MSE financing to MSE human resource development. According to other research conducted by Sulaiman and Wardhani (2017) shows that MSME financing has a significant impact on the development of SME human resources. This research also shows that financing provided by microfinance institutions can improve the quality of SME human resources and make a positive contribution to local economic growth. Other research conducted by Kusnadi, Hidayat, and Sari (2019) also shows that SME financing can help SMEs to develop human resource capacity, improving product quality, and expanding access to markets. The same thing was also done by Alfi et al. (2020), shows that MSE financing can help MSE owners to improve skills and knowledge through increasing access to technology that can increase productivity and quality of their products. Strengthened by research conducted by Nuryanah et al. (2020) found that MSE financing can also help MSE owners to improve their skills and knowledge through training and guidance.

Based on the description above, we can see that the problem of financing and credit for MSEs is still a major problem nationally and regionally. Improving financing problems in MSEs is important because it has been proven to encourage improvements in the quality of MSEs' human resources. Increasing the quality of human resources will further encourage increased business productivity, improved product quality and increased business competitiveness. For this reason, the research objectives are (1) to determine the condition of human resources and human resource development for MSEs in the wetland area of Siak Regency; (2) To find out how MSEs perceive financing and the role of financial institutions in developing human resources for MSEs in the wetland area of Siak Regency; (3) To find out the strategy for developing MSE human resources in the wetland area of Siak Regency.

METHODS, DATA, AND ANALYSIS

This research uses qualitative methods supported by primary data obtained from interviews with informants. The method used in determining informants uses the purposive sampling method using certain criteria. According to Bungin (2011), purposive sampling is determining the group of participants who will become informants according to selected criteria that are relevant to the research problem. The criteria used in determining informants are Micro and Small Business (UMK) actors in accordance with the criteria of the Republic of Indonesia Government Regulation Number 7 of 2021 concerning Facilitation, Protection and Empowerment of Cooperatives and Micro, Small and Medium Enterprises, according to business capital criteria:

1) Micro Businesses have business capital up to a maximum of IDR 1,000,000,000.00 (one billion rupiah) excluding land and buildings where the business is located;

2) Small businesses have business capital of more than IDR 1,000,000,000.00 (one billion rupiah) up to a maximum of IDR 5,000,000,000.00 (five billion rupiah) excluding land and buildings where the business is located;

3) Medium Enterprises have business capital of more than IDR 5,000,000,000.00 (five billion rupiah) up to a maximum of IDR 10,000,000,000.00 (ten billion rupiah) excluding land and buildings where the business is located.

Meanwhile, according to the criteria, annual sales results are:

1) Micro Businesses have annual sales of up to a maximum of IDR 2,000,000,000.00 (two billion rupiah);

2) Small Businesses have annual sales of more than IDR 2,000,000,000.00 (two billion rupiah) up to a maximum of IDR 15,000,000,000.00 (fifteen billion rupiah);

3) Medium Enterprises have annual sales of more than IDR 15,000,000,000.00 (fifteen billion rupiah) up to a maximum of IDR 50,000,000,000.00 (fifty billion rupiah).

The number of informants in the research was 50 people spread across four sub-districts within the wetland area of Siak Regency, namely Sungai Apit District, Sabak Auh District, Bunga Raya District and Dayun District.

To develop a strategy for developing human resources for MSEs in the wetland area of Siak Regency, SWOT analysis was used, namely comparing internal factors consisting of strengths and weaknesses with external factors consisting of opportunities and threats (Rangkuti, 2013).

Wheelen (2003) states that SWOT analysis is a situation analysis in the strategy formulation process. In this analysis, strategic factors will be identified by combining IFE (Internal Factor Evaluation) with EFE (External Factor Evaluation) into the SWOT (Strengths, Opportunities, Weakness, and Threats) matrix. The results of the SWOT matrix analysis are useful for planning strategies for developing human resources for MSEs in the wetland area of Siak Regency.

According to Rangkuti (2013) in SWOT analysis, IFE (Internal Factor Evaluation) matrix analysis is a strategy formulation tool for summarizing and evaluating the main strengths and weaknesses in the variable area under study and also provides a basis for identifying and evaluating the relationship between the variables that are the object. With the IFE Matrix, it is possible to determine the potential of MSE human resources in the wetland area of Siak Regency in dealing with their internal environment and to understand the factors that are important in developing human resources.

RESULTS AND DISCUSSION

Human Resources (HR) development strategy in the wetland area of Siak Regency as an important ecosystem and has a crucial role in maintaining environmental balance and supporting various forms of Small and Medium Enterprises (UKM) activities. Human resource development in the Wetland area of Siak Regency is very important to maintain and preserve the ecosystem of existing business units. The HR (Human Resources) development model for micro and small businesses is an approach specifically designed to help micro and small business owners develop the skills, knowledge and abilities of their employees. Human resource development is very important for micro and small businesses because quality human resources can be a key factor in the success and growth of the business.

To develop a strategy for developing human resources for MSEs, it is first necessary to identify the internal conditions of MSEs in the wetland area of Siak Regency. Identification of internal strategic factors for MSEs is formulated in the Internal Factors Evaluation (IFE) Table. The results of identifying internal strategic factors obtained 3 strength factors and 4 weakness factors. These strength and weakness factors are then given weights and ratings. The results of weighting and rating can be seen in the following table:

Table 1. Internal Factors Evaluation (IFE) of MSEs in the Wetland Area of Siak Regency

No	Key Internal Factors	Weight	Ratings	Weighted Score
A	Strengths			
1	UMK human resources have a fairly good level of education	0.16	4	0.64
2	The production aspect is quite efficient	0.15	3	0.45
3	Has local regional potential	0.14	3	0.42
	Total Strengths Value	0.45		1.51
B	Weaknesses			
4	Weak conditions of business management and financial management of MSEs	0.14	2	0.28
5	Weak MSE marketing strategy	0.14	2	0.28
6	The development of local regional potential is still weak	0.14	2	0.28
7	Accessibility to financial institutions is still quite difficult	0.13	2	0.26
	Total Value of Weaknesses	0.55		1.10
	Total IFE Value	100		2.61

Source: Processed Data (2023)

Based on Table 1, it can be seen that the total score for internal strategy factors is 2.61. The IFE table above also shows that the main strengths of MSEs in the wetland area of Siak Regency include (1) MSE human resources have a fairly good level of education; (2) The production aspect is quite efficient; and (3) Has local regional potential. The weak factors that hinder the development of MSEs in the wetland area of Siak Regency include (1) Weak conditions of business management and financial management of MSEs; (2) Weak MSE marketing strategy; (3) The development of local regional potential is still weak; and (4) Accessibility to financial institutions is still quite difficult.

The identification of external strategic factors for MSEs is formulated in the External Factors Evaluation (EFE) Table. The results of identifying external strategic factors obtained 3 opportunity factors and 3 threat factors. These opportunity and threat factors are then given weights and ratings. The results of weighting and rating can be seen in the following table:

Table 2. External Factors Evaluation (EFE) of MSEs in the Wetland Area of Siak Regency

No	Key External Factors	Weight	Ratings	Weighted Score
A	Opportunities			
1	Political and legal conditions support the development of MSEs	0.17	4	0.68
2	There are still wide market opportunities open	0.18	4	0.72
3	Technological development	0.17	3	0.51
	Total Value of Opportunities	0.52	11.00	1.91
B	Threats			
4	Bigger competitors	0.17	3	0.51
5	Financing administration is quite complicated	0.16	4	0.64
6	There are no special financing products for MSE HR development	0.15	3	0.45
	Total Threats Value	0.48	10.00	1.60
	Total EFE Value	1.00		3.51

Source: Processed Data (2023)

Based on Table 2, it can be seen that the total score for external strategy factors is 3.51. The EFE table above also shows that the main opportunities for MSEs in the wetland area of Siak Regency include (1) Political and legal conditions supporting the development of MSEs; (2) Wide market opportunities are still open; and (3) Technological developments. The threat factors that can hinder MSEs from maximizing existing opportunities include (1) Larger competitors; (2) Financing administration is quite complicated; and (3) There is no special financing product for developing MSE human resources.

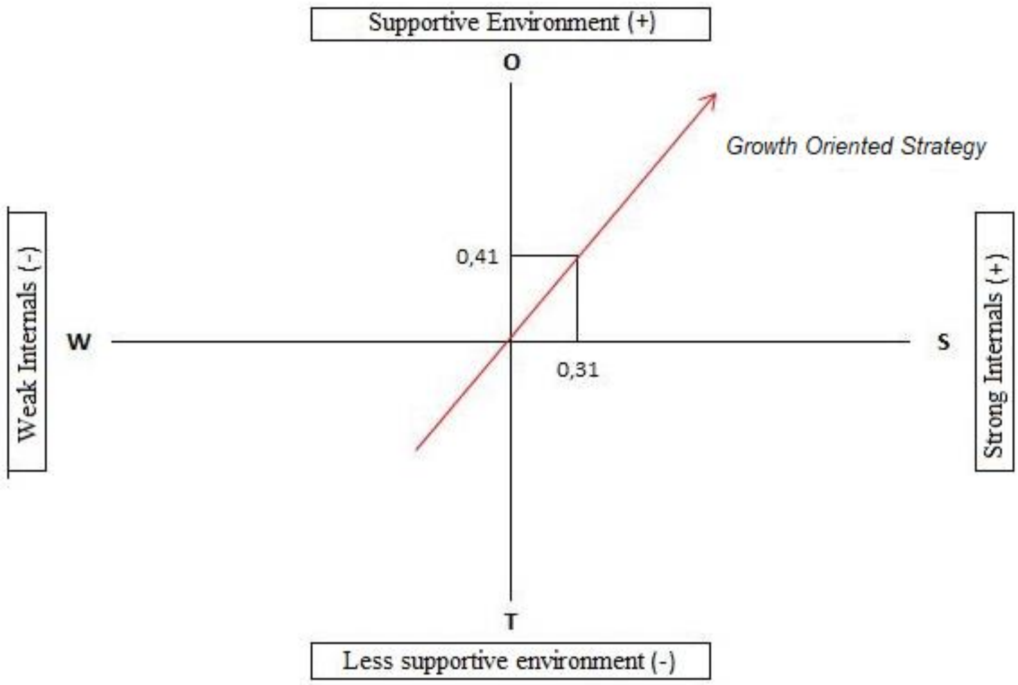
Based on the weighting and grouping of internal factors and external factors for the condition of MSEs in the wetland area of Siak Regency, the position of MSEs in the space matrix can be determined. In general, the potential for MSEs in the wetland area of Siak Regency has internal strengths, but is faced with external threats which make the business development process still not optimal. To obtain the space matrix, calculations are carried out on the coordinate points in the space matrix, namely:

Table 3. Space Matrix Coordinate Points

No	Internal Factors	Total Score
1	(+) Strengths	1.51
2	(-) Weaknesses	1.10
	Total IFE Score	0.41
No	External Factors	Total Score
1	(+) Opportunities	1.91
2	(-) Threats	1.60
	EFE Total Score	0.31

Source: Processed Data (2023)

Calculating the coordinate points in the space matrix is by adding up the score values resulting from the IFE and EFE analysis. So we found a strategy space matrix for developing MSE human resources in the wetland area of Siak Regency, namely:



Source: Processed Data (2023)

Figure 1. MSE HR Development Space Matrix

The results of the MSE HR development space matrix in the wetland area of Siak Regency are in quadrant position one. This is a very profitable situation, the position of MSEs provides opportunities and internal strengths in developing human resources, so that with the strengths they have, the usefulness of existing opportunities becomes an advantage for MSEs in carrying out human resource development. The strategy that must be implemented in this condition is the development of MSE human resources in an inclusive, collaborative and aggressive manner (growth oriented strategy).

From the space matrix model for developing human resources for MSEs in the wetland area of Siak Regency, a strategy for developing human resources for MSEs in the wetland area of Siak Regency was prepared. The strategy for developing MSE human resources in the wetland area of Siak Regency consists of 4 strategies, namely Strength and Opportunity (SO), Weakness and Opportunity (WO), Strength and Threat (ST) and Weakness and Threat (WT).

The SO (Strength and Opportunity) strategy is used to capture and exploit the opportunities possessed by MSEs in the wetland area of Siak Regency by maximizing their internal strengths. The following are SO strategies in HR development, namely:

1. Partnership Strategy with Educational Institutions in Carrying out Human Resource Development and Product Innovation

The Human Resource Development program in the wetland area of Siak Regency aims to improve the performance of small and medium enterprises (MSEs) through partnerships with educational institutions. The program involves training, research, facility and infrastructure development, and product development. Training activities include seminars, workshops, and other training programs to support MSEs in various aspects of human resource management, agricultural product management skills training, and leadership management. Research activities focus on improving production facilities and infrastructure, aiming to increase efficiency, productivity, quality, and sustainability. Product development research activities focus on creating regional specialty products, attractive packaging, certification assistance, and clinical trials. Research shows that partnership programs have a positive impact on business performance and can create product innovation for MSEs based on regional commodities. Overall, these partnerships contribute to the growth and competitiveness of MSEs in the wetland area of Siak Regency.

2. Partnership Strategy with Regional Government in Promoting MSE Products

The Human Resource Development (HRD) program in the wetland area of Siak Regency aims to improve the performance of Micro, Small and Medium Enterprises (MSEs) through partnerships with educational institutions. These partnerships involve long-term relationships, multi-level cooperation, and mutual trust to achieve business goals. HRD activities include seminars, workshops, and other training activities that support the development of human resources for MSEs, such as agricultural product management skills training and leadership management.

Research activities focus on improving production facilities and infrastructure in the wetland area of Siak Regency, aiming to increase efficiency, productivity, quality, and sustainability of production. This includes creating appropriate production equipment for MSEs that can support their productivity. Product development research activities are also conducted to improve the ability of MSEs to compete in the business world.

The partnership program has a positive impact on business performance, as research shows that HRD with partnership training programs significantly impacts business performance. Collaboration between business actors and the government is essential for enhancing the community's economy, starting from small to medium businesses. Promotions of MSE products are carried out through product exhibitions, government websites, regional government banners, and billboards, supported by the government's commitment to using local products made by MSEs.

The local government's commitment to using local products is the biggest contribution made by the government in supporting MSEs. Research shows that government collaboration with MSEs in marketing activities has a positive effect on consumers, with aesthetics, uniqueness, and taste. Online media and banners have been found to be effective in promoting products produced by MSEs, with better visual attention attracting the location/product of the MSEs.

In conclusion, the HRD program in the wetland area of Siak Regency has a significant impact on the growth and competitiveness of MSEs.

The WO (Weakness and Opportunity) strategy is used to improve or fix the weaknesses of MSEs in the wetland area of Siak Regency in order to maximize existing opportunities. The following are WO's strategies in HR development, namely:

1. HR Development Strategy in the Context of Strengthening Digital-Based Businesses

The Siak Regency government is implementing a strategy to strengthen digital-based businesses through HR development activities. These include training in business management, financial management, and marketing management. The Siak Sustainable Business Inkusi (Siak Sustainable Business Inkusi) is a business mentoring program for selected MSMEs with innovative ideas that positively impact social and environmental aspects. The program aims to increase economic growth and support the Green Siak vision and the target of 1000 MSMEs/year.

Financial management training is also being provided to help MSEs make wiser financial decisions and reduce risks. The Siak Regency government also offers digital marketing programs, such as using social media as a business center and other platforms for MSEs to promote their products. Research shows that training in small businesses positively impacts organizational performance, productivity, and employee satisfaction. Additionally, financial management training and assistance have helped

MSEs organize their finances better and promote their products more effectively.

2. HR Development Strategy that focuses on the Development of Regional Superior Local Products

Siak Regency, particularly in the Wetland area, is focusing on developing superior regional products through local community efforts. These products, mainly from rice, corn, cassava, shallots, and chilies, are being developed through empowerment programs by the regional government, Civil Society Organizations, and NGOs. Other products include food and textile businesses. Human resource development, including brand creation, packaging training, and branding, is being done to enhance the local economy. Research shows that product branding significantly impacts business efforts and improves MSEs' performance and competitiveness.

The ST (Strength and Threat) strategy is used to reduce or minimize threats to MSEs in the wetland area of Siak Regency by utilizing internal strengths. The following is ST's strategy in developing MSE human resources, namely:

1. Financing Program from the Government Specifically for MSEs in Collaboration with Financial Institutions

The government in Siak Regency is implementing a financing program to support the growth of Micro, Small, and Medium Enterprises (MSEs) through credit interest subsidies and collateral. This program aims to provide lower interest rates for MSEs, enabling them to develop, invest, and create jobs. The government also encourages MSEs through collateral guarantees and People's Business Credit distribution. Additionally, the government collaborates with cooperatives and MSMEs in the form of Corporate Social Responsibility (CSR) to improve the economy. The government also provides direct assistance to MSEs, such as business capital and production equipment grants, to support their growth and contribute to community welfare.

2. HR Development Strategy that Focuses on Product Diversification and Innovation Development

HR development focuses on product diversification and innovation for multinational enterprises (MSEs). This involves education, training, mentoring, market research, and product development. The Siak Regency Government, in collaboration with PT. Riau Andalan Pulp and Paper, PT. Research shows that product diversification increases competitive advantage for businesses, especially in developed areas with less funding constraints. Expanding HR development programs in the wetland area of Siak Regency is necessary for optimizing local economic potential.

3. Partnership Strategy with Village-Owned Enterprises (BUMDes)

Village-Owned Enterprises (BUMDes) play a crucial role in improving the economy of small and medium businesses (MSEs) in Siak Regency. These businesses access capital, facilities, and infrastructure through various programs, such as traditional financial loans, government programs, and unproductive assets. The presence of BUMDes helps MSEs deal with financial problems, such as the Covid-19 pandemic, and provides an opportunity to revive their businesses. BUMDes also provides production facilities and infrastructure for MSEs, including agricultural product production and sales facilities for local products. The partnership program also involves product distribution activities, allowing MSEs to create jobs, support local community development, and sell their products to markets outside the region. Research shows that the synergy between BUMDes and MSEs provides good business space for the community's economy.

The WT (Weakness and Threat) strategy is used to improve existing weaknesses in MSEs in the wetland area of Siak Regency to minimize the threats they have. The following is WT's strategy in developing MSE human resources, namely:

1. Partnership Strategy with Village-Owned Enterprises (BUMDes)

Village-Owned Enterprises (BUMDes) play a crucial role in improving the economy of small and medium businesses (MSEs) in Siak Regency. These businesses access capital, facilities, and infrastructure through various programs, such as traditional financial loans, government programs, and unproductive assets. The presence of BUMDes helps MSEs deal with financial problems, such as the Covid-19 pandemic, and provides an opportunity to revive their businesses. BUMDes also provides production facilities and infrastructure for MSEs, including agricultural product production and sales facilities for local products. The partnership program also involves product distribution activities, allowing MSEs to create jobs, support local community development, and sell their products to markets outside the region. Research shows that the synergy between BUMDes and MSEs provides good business space for the community's economy.

2. Partnership Strategy with Corporate CSR

The Corporate Social Responsibility (CSR) program is a form of cooperation between the government and companies, aimed at increasing the scale of Small and Medium Enterprises (MSEs). This program includes equipment assistance, low interest financing, interest-free loans, and training for MSEs. Companies like PT Ivomas Tunggal and Pertamina Hulu Energi provide equipment assistance, while low interest financing programs and loans without capital help MSEs meet their financial needs. Human resource training activities are also part of CSR programs, aiming to improve performance for business actors. The implementation of CSR programs involves identifying MSEs' needs, program plans, facilities, evaluation, and mentoring. Research has shown the success of CSR programs in developing MSE businesses, providing loans, and increasing HR competency. However, proper government regulation is needed to ensure the implementation of CSR programs aligns with MSEs' needs and solves their problems.

CONCLUSION

1) The educational level of MSE human resources is relatively good, but most of them lack work experience. Apart from that, most MSE human resources are still weak in product development and innovation, lack understanding of market conditions, business opportunities and the application of information technology in the marketing process is still not optimal. This condition is exacerbated by the lack of optimal training and weak monitoring and evaluation processes for human resource development.

2) MSEs' perception of the role of financing is quite good in business development and improving production facilities and infrastructure. However, the ease of access to financing from financial institutions is still considered difficult in the administration process, apart from that the interest rates offered are relatively high. Apart from that, the role of financial institutions in developing human resources in MSEs is still weak due to the absence of special financial products for human resource development and the lack of role of financial institutions in providing information and consultation related to human resource development.

3) There are 8 HR development strategies, namely (a) Partnership strategy with educational institutions in carrying out HR development and product innovation; (b) Partnership strategy with local governments in promoting MSE products; (c) HR development strategy in the context of strengthening digital-based businesses; (d) a human resources development strategy that focuses on developing regional superior local products; (e) financing programs from the government specifically for MSEs in collaboration with financial institutions; (f) HR development strategy that focuses on developing product diversification and innovation; (g) partnership strategy with Village-Owned Enterprises (BUMDes); and (h) Partnership strategy with company CSR.

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Issue Article

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SOCIETY IN THE SYSTEM OF SOCIAL ORDER

Abstract*: The article examines the concept of traditional society. According to the author, traditional society is characterized by what could be termed as gerontocracy: the older, the wiser; the more ancient, the more perfect; the deeper, the truer. Traditional societies and institutions, reorganizing themselves, effectively adapt to changing conditions, and traditional values in some cases can even provide sources of legitimization to achieve new goals.*

Key words*: Tradition, society, values, civilization, order, social order, mechanism, environment.*
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Introduction

Tradition is a unique way of making decisions. There's no need to agonize over weighing all the pros and cons. Simply agreeing, accepting, and embracing what historical experience offers, what has been achieved and discovered within its boundaries is sufficient. All that's left is to overlay the past onto the present and perhaps clarify some details. Tradition is somewhat like a social instinct, a historically inherited ability to carry out actions (practical and not so practical) on automatic impulse: it is a revered and respected mechanism, typically religiously sanctioned.

Tradition leaves its mark on everything it touches, imprinting its influence on people, turning them into socially stereotypical figures, hindering their development as unique individuals. It affects freedom, distorting it beyond recognition with collective responsibility in the form of mutual guarantee. It impacts society by impeding its progress, maintaining a continuous status quo with only authorized innovations.

Main part.

Tradition establishes a status-centered way of life. This means that it is not the individual who determines status, but rather, status determines the individual. The functions or roles performed by people are dependent on such ascriptive factors like age, gender, and belonging to a specific community (ancestral, familial, clan-based, territorial, etc.). Efforts aimed at changing this situation typically do not succeed, and more often than not, they are not even attempted. People take the established social order for granted. The social status predestination of individuals virtually eliminates all self-determination.

Tradition, traditionalism provides a certain comfort of existence. However, without the “spice”, without those sharp sensations that only the contrast of change can bring. Yet, it is solid, reliable and, most importantly, long-lasting. Even though[1] not endless. The expansion of knowledge, the rise of general culture, the accumulation, albeit slow, of industrial experience, population growth, climate changes - in short, the complexity of human life activities gradually undermines traditionalist bastions of existence. They grow weary of responding to the challenges of time, becoming historically inadequate. The disappearance of many ancient peoples, once

[1] Rouce A.P. Ethnic Identity: Strategies of Deversity. Bloomington, 1982, p. 137.

flourishing states and civilizations, is the most convincing confirmation of this.

In some cases, authors, essentially recognizing the legitimacy of new perspectives on the issue of tradition, preferred to maintain the old meaning for the term "tradition" (as something rigid and conservative); while using different terms to describe the transitional states of society. For instance, American ethnologist A. Royce suggests the concept of "historical style," which is based on common characteristics and values, implying flexibility and variability. This may seem paradoxical, but such an approach, where the meaning of the term "tradition" narrowed down to purely individual (more psychological rather than sociocultural) manifestations, led to the complete disappearance of the opposition "tradition vs. modernization." Both social forms of the past and modern social forms could be interpreted as external manifestations of a flexible, adaptable "historical style."[1]

Other researchers preferred to maintain the "tradition," but in essence, it was close to what Royce called the "historical style." Edward Shilz's concept, where "following tradition essentially involves implementing various variations on a theme perceived from previous generations... Tradition is not self-reproducing or self-generating. Only living, perceiving, and desiring human beings can perceive and modify it. Tradition evolves because its bearers strive to create something better, more suitable."[2]

The most adequate theory from the perspective of historical ethnology is the doctrine of tradition by S. Eisenstadt. However, it should be noted that this theory is not typical of English-speaking traditology. Anthropology, on the other hand, hardly uses the concept of "tradition," or more precisely, only uses it in a narrow sense close to the concept of ritual. As for sociology, there is still quite a frequent occurrence of an evolutionary understanding of tradition: "By tradition... we shall mean," writes Shtompka, "the set of objects and ideas whose origins trace back to the past but can be found in the present, i.e., everything that has not been destroyed, discarded, or broken. In this case, tradition is equivalent to heritage - that which has actually been preserved from the past... Any tradition, regardless of its content, can either inhibit creativity or innovation by offering ready-made solutions to contemporary problems."[3] This definition of tradition is typical in modern Western sociology. However, there are also a few distinct positions. For instance, in defining the specificity of traditional society, R. Guénon writes: "In traditional civilizations, everything is based on intellectual intuition. In other words, the most essential aspect in such civilizations is a purely metaphysical doctrine, and everything else stems from it either as a direct consequence or as a secondary application to one particular level of reality. This is true not only in terms of social institutions but also in terms of sciences, i.e., the forms of knowledge that belong to the realm of the relative and that in traditional civilizations are considered as continuations or reflections of knowledge of the absolute and fundamental."

Conclusion.

Thus, tradition, while perceived as dynamic and variable, loses its own structure, its own essence. This perspective is not acceptable for historical ethnology. Alongside the teaching on tradition, which is almost uninteresting to us, Shilz proposes the concept of the "central zone of culture," which we will discuss shortly and which will become one of the most important concepts of ethnopsychology. It is important to note that true hierarchy is maintained everywhere and in everything. Everything relative, on the other hand, is not considered non-existent (that would be downright absurd) and is taken into account only as necessary. However, it is put in its proper place, viewed as something strictly secondary and subordinate. Within this realm of the relative, there exist different degrees of reality, determined by how far removed a thing is from the sphere of Higher Principles.[4]

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Issue Article

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THE INVESTIGATION OF Na^+, K^+ SALTS OF AMIDES, OBTAINED BY INTERACTION OF MONO- AND DIETANOLAMINE WITH ETHYLENEDIAMINTETRAACETIC ACID AS CORROSION INHIBITOR IN H_2S CONDITION

Abstract: *Amides of ethylendiaminetetraacetic acid synthesized by interaction it with monoethanolamine (MEA) and diethanolamine (DEA) in various mol ratio (1:1-3). Obtained amides were investigated and confirmed by IR, and 10% solutions of their Na^+, K^+ salts prepared for establishing their anticorrosion activity.*

10% solutions of synthesized salts were prepared for study as corrosion inhibitors in H_2S condition on the steel plate. It was determined that Na^+, K^+ salts of amides obtained by interaction of EDTA with MEA in 1:2 mol ratio and Na^+, K^+ salts of amides obtained by interaction of EDTA with DEA in 1:1 molar ratio shows the best anticorrosion activity at concentation 200 mg/l and protection effect was 97% and 97,6%.

Key words: *ethylendiaminetetraacetic acid, monoethanolamine, diethanolamine, H_2S corrosion, protection effect.*

Language: *English*

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Introduction

In modern time, the problem of corrosion of equipment of oil industry in our republic is still actual. The main goal of researchers is to solve problems bonded with corrosion. The reason of corrosion of equipment as a resupt of expluatation is H_2S and carbon dioxide corrosion. The adsorbtion of hydrogen increases in the metal surface under H_2S and metal exposes corrosion, that results metal destroy[1]. So, the corrosion effects are global problems [2]. H_2S-corrosion activates and increases under oxygen, CO_2 action on metal surface. By the synergetical effect of factors shown above, the iron atoms ionizes that results to cross-destruction of metal equipment [3].

Presence of H_2S in oil and undeground water is the reason of corrosion intensification in equipmemt that used in oil industry. Problems released to H_2S corrosion is actualized, corrosion control increases and quantity of corrosion inhibitors increases day by day. Before 1980 about 5 thousands inhibitors were known. Today researchers study not only way of synthesis the new inhibitors but also the propeties known ones and ways to evaluate their inhibitor properties. The relation between structure of compound and it's inhibitor properties also is area of interest of scientists. The investigation of structor-inhibitor properties of compounds forms the condition of obtaining new effective compounds. [4-7].

Group of researchers by the tutoring of academician V.M.Abbasov carried out the wided range of experiments initiated preparation of corrosion inhibitors Kaspi-2, Kaspi-4 and Araz-1. Inhibitors Kaspi-2 and Kaspi-4 that characterized with high provided by H_2S corrosion inhibitory activity were tested in Kazakhstan Tengiz field and has shown best results in comparative studies.

Academician V.M.Abbasov and colleagues prepared inhibitor VFİKS-82 that tested and applyed in various objects in the period of USSR [8-11]. Same authors prepared and applyed inhibitor Azeri [12].

N.İ.Mursalov [13-16] and collegues synthesized complexes of imidazole derivatives, obtained on the base of triethanolamin and technical oil acids, with formic and acetic acids in 1:1 and 1:2 mol ratio and investigated their anticorrosion activity of Ct3 brended steel in the water-kerocine two-phased condition with dissolved hidogen-sulfide. It was determined that studied complexes are 90% effective in H_2S condition from minimal concentration 10 mg/l.

For decreasing corrosion in inner part of gas pipes E.F.Sultanov [17] synthesized and studied effectivity of multifunctional bacterial inhibitor Neftqaz-2016 NİM consist naften and oil acid in the appropriate ratio and poliaminenand copper salts. It was established that by use the inhibitor in corrosion proseses in gas pipes the effectivity against H_2S corrosion is 98.4% applying reagnet in concentration 100 mg/l.

As shown above, the applying of inhibitores for corrosion protection of equipment is the most simple and effective and is suitable economically [18-23].

So, the problem of preparation of inhibitors thar are effective against H_2S corrosion is still actual problem for oil industry [24-27].

İn our scietific laboratory we carry out the studies in this direction. Amides of ethylendiaminetetraacetic acid obtained by interaction it with monoethanolamine (MEA) and diethanolamine (DEA) in various mol proportions (1:1-3) [25] and 10% solutions of their Na^+ and K^+ salts and prepared solutions for establishing their H_2S-corrosion actiivity [29].

Synthesized Na^+, K salts of amides of EDTA with MEA in various mol ratio is effective against H_2S corrossion in concentration 50, 100, 150, 200 mg/l for 6 hours. Study results presented in table 1.

Table 1. Results of study of Na^+, K^+ salts of amides, obtained by interaction of monoetanolamine with ethylenediamintetraacetic acid as corrosion inhibitor in H_2S condition

Compound	Concentaration C, mg/l	Corrosion rate P, g/m^2hour		Protection effect, Z%	Delay constant, γ
		With inhibitor	Without inhibitor		
1	2	3	4	5	6
Synthesis Na salt of EDTA with MEA in 1:1 mol ratio	50 100 150	0,126 0,126 0,126	0,031 0,020 0,012	75 84,1 90,4	4,06 6,3 10,5

	200	0,126	0,004	96,8	31,5
Synthesis K salt of EDTA with MEA in 1:1 mol ratio	50 100 150 200	0,634 0,634 0,634 0,634	0,240 0,190 0,110 0,08	62,1 70,03 82,6 87,38	2,64 3,33 5,76 7,92
Synthesis Na salt of EDTA with MEA in 1:2 mol ratio	50 100 150 200	0,793 0,793 0,793 0,793	0,317 0,205 0,075 0,023	60 74,1 90,5 97,0	2,5 3,86 10,5 34,4
Synthesis K salt of EDTA with MEA in 1:2 mol ratio	50 100 150 200	0,793 0,793 0,793 0,793	0,425 0,316 0,204 0,112	46,4 60,15 74,2 85,8	1,86 2,5 3,8 7,0
Synthesis Na salt of EDTA with MEA in 1:3 mol ratio	50 100 150 200	0,476 0,476 0,476 0,476	0,275 0,124 0,056 0,024	42,2 73,9 88,2 94,9	1,73 3,83 8,5 19,8
Synthesis K salt of EDTA with MEA in 1:3 mol ratio	50 100 150 200	0,952 0,952 0,952 0,952	0,476 0,374 0,225 0,126	50 60,7 76,3 86,7	2,0 2,54 4,23 7,55

Initially syntesized in 1:1 mol ratio Na^+, K^+ salts of amides of EDTA are studied as protective agent against H_2S-corrosion and established that 10% solutions of synthesized compounds in concentration 50 mg/l shows 75% protection effect, but increasing the concentration up to 100, 150, 200 mg/l increases protective effect to 84,1; 90,4; 96,8%. 10% solution of 1:1 mol ratio syntesized K^+ salt of amide of EDTA shows protective effect in concentration 50 mg/l about 62,1% 1and in concentration 100, 150, 200 mg/l is effective about 70,03; 82,6 və 87,38%

10% solutions of Na^+, K^+ salts of amides synthesized in 1:2 mol ratio were studied against metal plates H_2S corrosion in various concentration. It was established, that Na^+ salt in concentration 50 mg/l shows 60% effect, in concentration 100, 150, 200 mg/l shows effect 70,1; 90,5 and 97% approximately. 10% solution of K^+ salt in concentration 50 mg/l shows 46,4%, anticorrosion effect and in concentration 100, 150, 200 mg/l shows 60,15; 74,2; 85,8% effect approximately.

10% solutions of Na^+, K^+ salts of amides synthesized in 1:3 mol ratio were studied against metal plates H_2S corrosion in various concentration. It was established, that Na^+ salt in concentration 50 mg/l shows 42,2% effect, in concentration 100, 150, 200 mg/l shows effect, 73,9; 88,2; 94,9% approximately. 10% solution of K^+ salt in concentration 50 mg/l shows 50% anticorrosion effect and in concentration 100, 150, 200 mg/l shows 60,7; 76,3; 86,7% anticorrosion effect approximately.

As can be seen from the table, the best result was shown by the 10% solution of Na^+ salt of amide synthesized in 1:2 mol ratio at a concentration of 200 mg/l.

İn this case the protection effect is 97%, delay constant is 34,4.

By the same way, 10% solutions of Na^+, K^+ salts of amides obtained by interaction of EDTA with DEA in various mol ratio were synthesized and their effectivity against H_2S corrosion of metal plates was investigated. The results of study is presented in table 2.

Table 2. Results of study of Na^+, K^+ salts of amides, obtained by interaction of dietanolamine with ethylenediamintetraacetic acid as corrosion inhibitor in H_2S condition

Compound	Concentaration C, mg/l	Corrosion rate P, g/m²hour		Protection effect, Z%	Delay constant, γ
		With inhibitor	Without inhibitor		
Synthesis Na salt of EDTA with DEA in 1:1 mol ratio	50 100 150 200	0,952 0,952 0,952 0,952	0,396 0,125 0,078 0,022	58,4 86,8 91,8 97,6	2,4 7,6 12,2 43,2

Synthesis K salt of EDTA with DEA in 1:1 mol ratio	50 100 150 200	0,534 0,534 0,534 0,534	0,204 0,206 0,146 0,056	44,9 61,4 72,6 89,5	1,8 2,5 3,6 9,5
Synthesis Na salt of EDTA with DEA in 1:2 mol ratio	50 100 150 200	0,793 0,793 0,793 0,793	0,317 0,223 0,096 0,023	60 71,8 87,9 97,09	2,5 3,5 8,26 34,4
Synthesis K salt of EDTA with DEA in 1:2 mol ratio	50 100 150 200	0,793 0,793 0,793 0,793	0,474 0,316 0,187 0,079	40,2 60,15 76,4 90,0	1,67 2,5 4,2 10,03
Synthesis Na salt of EDTA with DEA in 1:3 mol ratio	50 100 150 200	0,952 0,952 0,952 0,952	0,396 0,258 0,143 0,057	58,40 67,4 84,9 94,0	2,4 3,68 6,65 16,7
Synthesis K salt of EDTA with DEA in 1:3 mol ratio	50 100 150 200	0,725 0,725 0,725 0,725	0,376 0,212 0,126 0,078	48,1 70,7 82,6 89,2	1,9 3,4 5,7 9,2

10% solutions of Na^+, K^+ salts of amides synthesized in 1:1 mol ratio were studied against H_2S corrosion of metal plates in various concentration. It was established, that Na^+ salt in concentration 50 mg/l shows 58.4% effect, in concentration 100, 150, 200 mg/l shows effect 86,8%; 91,87%; 97,6% approximately. 10% solution of K^+ salt in concentration 50 mg/l shows 44,9%, anticorrosion effect and in concentration 100, 150, 200 mg/l shows 61,4; 72.6; 89,5% effect approximately.

10% solutions of Na^+, K^+ salts of amides synthesized in 1:2 mol ratio were studied against H_2S corrosion of metal plates in various concentration. It was established, that Na^+ salt in cincentration 50 mg/l shows 60% effect, in concentration 100, 150, 200 mg/l shows effect 71,8; 87,9; 97,9% approximately. 10% solution of K^+ salt in concentration 50 mg/l shows 40,2%, anticorrosion effect and in concentration 100, 150, 200 mg/l shows 60,15; 76,4; 90,0%% effect approximately.

10% solutions of Na^+, K^+ salts of amides synthesized in 1:3 mol ratio were studied ahainst metal plates H_2S corrosion in various concentration. It was established, that Na^+ salt in concentration 50 mg/l shows 58,4% effect, in concentration 100, 150, 200 mg/l shows effect, 67,4; 84,9; 94% approximately. 10% solution of K^+ salt in concentration 50 mg/l shows 48.1% anticorrosion effect and in concentration 100, 150, 200 mg/l shows 70,7; 82,6; 89,2% anticorrosion effect approximately.

As can be seen from the table, the best result was shown by the 10% solution of Na^+ salt of amide synthesized in 1:1 mol ratio at a concentration of 200 mg/l.

İn this case the protection effect is 97,6%, delay constant is 43,2.

Conclusion

10% solutions of Na^+, K^+ salts of amied obtained by interaction EDTA with MEA and DEA in various mol ratio were prepared and their H_2S corrosion of metal plates inhibitor effectivity was studied. It was established that 10% solutions of Na^+ salts of amides in concentration 200 mg/l shows 95-97% effectiveness against H_2S corrosion, but 10% solutions of K^+ salts is 85-90% protective.

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FREQUENCY ANALYSIS OF GROUND PRESSURE AT A DEPTH OF UP TO 20 KILOMETERS DURING SEISMIC IMPACT

***Abstract**: A computer calculation of the seismic impact with different frequency of tremors in the ground was performed in the article. Analysis of the results revealed that at low frequencies of tremors, the greatest pressure is observed in the first seconds of impact at a depth of up to one and a half kilometers. At high frequencies of tremors, a decrease in ground pressure is observed, but with attenuating cycles over the entire studied time range.*
***Key words**: ground pressure, frequency, seismic impact, depth.*
***Language**: English*

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Introduction

Seismic impact, which is the movement of ground under the action of ground tremors of varying intensity, can be unregulated (earthquake caused by natural movement of the earth's crust) or regulated (man-made explosions). Current research in this area has been presented in the works [1-10]. Seismic waves can cause damage to buildings depending on the intensity of the tremors. The magnitude of the frequency of tremors from the source affects the intensity of vibrations of the layers of the earth's crust. Therefore, in this study, an experiment was conducted to determine the effect of the frequency of tremors from the seismic source on the magnitude of ground pressure.

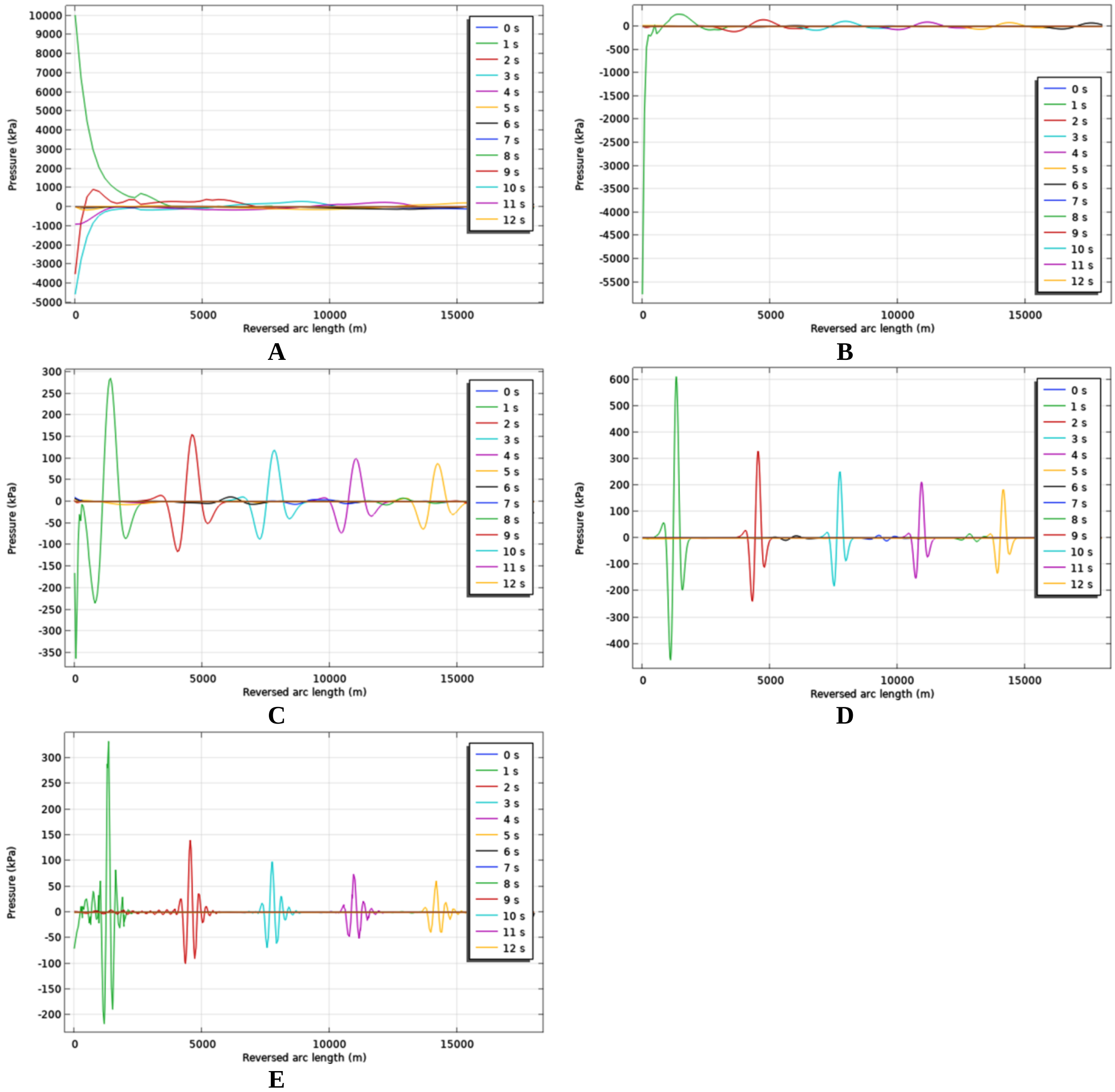

Figure 1. Dependences of changes in ground pressure during seismic impact with the frequency of tremors: A – 0.2 Hz, B – 1.0 Hz, C – 2.0 Hz, D – 5.0 Hz, E – 10.0 Hz.

Materials and methods

To determine the ground pressure with a density of 2200 kg/m^3, a fragment of the earth's crust with a depth of 20 kilometers was taken under seismic impact. Seismic tremors with a frequency from 0.2 to 10.0 Hz were generated on the Earth's surface. The following mechanical properties were assigned to the ground: bulk modulus – 12.516 GPa, shear modulus –

7.5092 GPa, Poisson's ratio – 0.25001. The velocities of passage of pressure and shear waves in the ground under the action of tremors were assumed to be 3.2 km/s and 1.8475 km/s, respectively. The time shift of the tremors was set to 0.6 s.

Results and discussion

The results of the computer simulation were processed and presented graphically in the Fig. 1.

The graphs show the dependence of pressure changes on the accepted depth of the ground during seismic impact in the form of tremors of different frequencies. The calculated magnitudes of pressure in the ground were measured in the transverse direction of wave propagation from the source deep into the ground.

It is noted that at low frequencies (0.2-1.0 Hz), in the first seconds of seismic impact, the ground is subjected to significant pressure, which causes stretching and compression of the layers. At the same time, a decrease in pressure is already observed at a shallow depth of the ground (up to about two kilometers from the source of tremors). In the future, the pressure magnitude gradually decreases to a minimum magnitude at a depth of over 13 kilometers. The frequency of tremors of 1.0 Hz is characterized by the occurrence of pressure, which leads to compression of the ground with the formation of pressure changes in the amplitude form. At higher tremor frequencies (2.0-10.0 Hz), the pressure varies cyclically in the range from -200 to 600 kPa. Over time, the amplitude of the pressure change decreases with increasing depth of the ground. The minimum pressure magnitudes were determined during seismic impact with tremor frequencies of 2.0 and 10.0 Hz.

Conclusion

Thus, the low frequency of tremors is accompanied by significant pressure in the ground at a shallow depth in the first seconds of seismic impact, followed by a decrease in pressure to almost zero at a depth of more than 13 kilometers. At a frequency of 10.0 Hz, the pressure in the ground varies in a small range, but the cycle of compressive and tensile pressures repeats over the entire time range with a response at a depth of up to 20 kilometers. Thus, it can be concluded that low frequencies of tremors can lead to significant deformations of layers of ground and aboveground buildings located in the zone of seismic impact.

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THE EFFECT OF THE VELOCITY/PRESSURE OF THE FLUID FLOW ON THE EROSION RATE OF THE INNER WALL OF A PIPE WITH HYDRAULIC RESISTANCE

Abstract: *The analysis of the formation of erosion on the inner wall of a pipe with a 90-degree bend under conditions of fluid flow in it with different initial velocities was performed in the article. It is determined that the mechanism of erosion manifests itself at a water flow velocity between 5 and 10 m/s and with an increase in the flow velocity, the erosion rate also increases.*
Key words: *erosion, pressure, fluid, flow velocity, pipe, local hydraulic resistance.*
Language: *English*

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Introduction

The fluid flow in pipes causes erosion, which is a process of mechanical washing out of the inner wall material. The fluid flow velocity and local hydraulic resistances in the pipes are the main factors affecting the erosion rate of the inner walls [1-8]. The effect of the erosion phenomenon is enhanced if solid particles are present in the fluid flow [9-10].

Local hydraulic resistance, such as an elbow, is performed to change the direction of fluid flow in the pipe. High pressure occurs at the bending point due to a change in the flow velocity of the fluid. At the same time, greater pressure will act on the inner wall of the pipe from the side of the outer bend radius, which contributes to the occurrence of an erosion process of greater intensity. Determining the effect of the initial velocity of the fluid flow in the pipe elbows on the erosion rate of the inner wall will reveal the critical velocities of fluid movement in pipelines.

Materials and methods

The process of fluid flow (water) in the elbow of a metal pipe with a diameter of 20 mm was simulated. The inlet and outlet pipes were accepted in lengths of 50 and 150 mm, respectively. The largest and smallest bending radii of the pipe were assumed to be 50 and 10 mm, respectively. The hardness of the metal pipe is selected to be approximately 2 GPa. The fluid with a temperature of 293.15 K flowed into the inlet pipe at an initial velocity of 0.1, 0.5, 1.0, 2.5, 5.0, 10.0, 15.0 and 20.0 m/s in series. The k – ω model was used to evaluate the characteristics of the fluid flow in the pipe, and the Finnie erosion model was used to estimate the erosion rate.

Results and discussion

The calculation results are presented in the Table 1. The maximum calculated values of the fluid pressure and the erosion rate of the inner wall in the radial bend of the pipe were taken. Two cases were considered: on the outer bend radius and the inner bend radius of the pipe.

With an increase in the inlet velocity of the fluid flow at the site of the radial bend of the pipe, the pressure of the moving fluid also increases. Positive pressure occurs at the outer bend radius, and negative pressure occurs at the inner bend radius. With an increase in the inlet velocity of the fluid flow, the ratio of positive and negative pressures decreases. It is noted that when the flow velocity of fluid in the pipe is up to 5 m/s, the process of erosion of the inner wall is not observed. However, at a fluid flow velocity of over 10 m/s, erosion was detected at the outer bend radius of the pipe. The erosion rate increases up to the set value of the fluid flow velocity of 20 m/s. There is no erosion of the inner wall at the inner bend radius of the pipe.

Table 1. Calculated values of the erosion rate in the pipe depending on the pressure of moving fluid.

Parameter	At the outer bend radius	On the inner bend radius
	v = 0.1 m/s	
Pressure, Pa	3489.99×10^{-3}	-537.18×10^{-3}
Erosion rate, kg/(m²×s)	0	0
	v = 0.5 m/s	
Pressure, Pa	72.56	-27.9
Erosion rate, kg/(m²×s)	0	0
	v = 1.0 m/s	
Pressure, Pa	273.31	-128.99
Erosion rate, kg/(m²×s)	0	0
	v = 2.5 m/s	
Pressure, Pa	1.6×10^{3}	-0.92×10^{3}
Erosion rate, kg/(m²×s)	0	0
	v = 5.0 m/s	
Pressure, Pa	6.3×10^{3}	-3.95×10^{3}
Erosion rate, kg/(m²×s)	0	0
	v = 10.0 m/s	
Pressure, Pa	2.36×10^{4}	-1.67×10^{4}
Erosion rate, kg/(m²×s)	3.58×10^{-9}	0
	v = 15.0 m/s	
Pressure, Pa	5.2×10^{4}	-3.86×10^{4}

Erosion rate, kg/(m²×s)	2.53×10^{-8}	0
v = 20.0 m/s		
Pressure, Pa	9.13×10^{4}	-7.01×10^{4}
Erosion rate, kg/(m²×s)	7.5×10^{-8}	0

Conclusion

Local hydraulic resistances in the pipes create high pressure and a change in the velocity and direction of the fluid flow, which leads to the formation of a cavitation process. With an increase in the inlet velocity of the fluid flow to 5 m/s, the process of erosion of the wall of the elbow of the metal pipe is not observed. At an inlet flow velocity of more than 5 m/s, erosion manifests itself on the inner wall of the pipe elbow from the side of the outer bend radius.

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ABOUT PROFESSIONAL AND PERSONAL DEVELOPMENT OF CADETS THROUGH A FOREIGN LANGUAGE

Abstract: *The article reveals the role of a foreign language in the professional and personal development of cadets of a higher military educational institution, highlights the features of the discipline, proposes a functional scheme for including foreign language training of cadets of a military university in the education system of a military specialist, points out the modern tasks of foreign language training in a military university, and emphasizes the value guidelines of the national culture.*

Key words: *Professional and personal development, system of higher military education, foreign language education, military university, future officer, professional activity.*
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О ПРОФЕССИОНАЛЬНО-ЛИЧНОСТНОМ РАЗВИТИИ КУРСАНТОВ ПОСРЕДСТВОМ ИНОСТРАННОГО ЯЗЫКА

Аннотация: *В статье раскрывается роль иностранного языка в профессионально-личностном развитии курсантов высшего военного образовательного учреждения, выделяются особенности дисциплины, предлагается функциональная схема включения иноязычной подготовки курсантов военного вуза в систему образования военного специалиста, указываются на современные задачи иноязычной подготовки в военном вузе, подчеркиваются ценностные ориентиры национальной культуры.*

Ключевые слова: *Профессионально-личностное развитие, система высшего военного образования, иноязычное образование, военный вуз, будущий офицер, профессиональная деятельность.*

Введение

К особенностям дисциплины «Иностранный язык» исследователи [1,2] относят *беспредельность* и *неоднородность*. *Беспредельность* определяет уровень, на котором обучающийся должен владеть иностранным языком, каким должно быть предметное содержание для достижения этого уровня, то есть тематику и сферу общения. Беспредельность предмета подразумевает изучение или знакомство с культурой народа, правилами речевого и неречевого поведения, то есть выход за рамки изучения отдельных аспектов языка (лексика, грамматика, фонетика, орфография, синтаксис, стилистика).

Неоднородность в изучении иностранного языка заключается в объеме знаний, которыми должен владеть обучаюшийся, чтобы говорить на изучаемом языке. Для этих целей необходимо знать все аспекты языка (фонетику, лексику, грамматику), знать правила употребления единиц языка, знать связующие слова, чтобы построить связное высказывание (система языка); хорошо владеть речевым материалом – от речевых образцов до формул речевого этикета (система речи); иметь языковые способности (уметь слушать и слышать, дифференцировать языковой материал, прогнозировать языковой материал, догадываться о его значении, уметь его обобщать и систематизировать).

И.А. Зимняя выделяет еще одну характерную черту в овладении иностранным языком – *плотность общения* [1]. Плотность общения на родном языке велика, поскольку на нем говорят родители, близкие родственники, друзья, педагоги, СМИ, Интернет. Сферы и тематика общения на родном языке весьма разнообразны и обширны. При изучении иностранного языка плотность общения ограничивается несколькими часами в зависимости от количества занятий иностранным языком в неделю. Следует отметить, что и на занятиях могут существовать ограничения, а именно: 1) использование иностранного языка преподавателем (говорит он только на иностранном языке или злоупотребляет родным языком); 2) сколько обучающихся в группе и сколько времени они говорят на изучаемом языке в рамках занятия; 3) какие упражнения на занятии использует преподаватель (языковые, условно-речевые, речевые); 4) есть ли у обучающихся возможность участвовать в практическом иноязычном общении или они только читают, переводят и пересказывают тексты.

Различия в изучении родного и иностранного языка состоит также в том, что они выполняют разные функции. И.А. Зимняя пишет, что «родной язык, выступая в единстве функций общения и обобщения, сначала является основным средством «присвоения» ребенком общественного опыта, а уже потом и вместе с выполнением этой функции – средством выражения, формирования и формулирования его собственной мысли» [1,с.29]. Применительно к обучению иностранному языку школьников И.А. Зимняя высказывает положение, в полной мере относящееся к курсантам военного вуза, о том, что иностранный язык в образовательной организации не может служить средством познания, как родной язык; основная функция изучаемого языка – это функция общения. Уже в процессе школьного обучения в ходе изучения языка обучающиеся знакомятся с понятиями, свойственными только носителям языка (например, прямой и обратный порядок слов, артикль, согласование времен, управление глаголов, конверсия), знакомятся с явлениями культуры страны изучаемого языка. В процессе изучения иностранного языка в вузе культурные особенности языка становятся для студентов более осмысленными, а иноязычная коммуникация приобретает как личностное, так и профессиональное значение.

Отдельно выделим еще одну специфическую особенность иностранного языка как учебного предмета. Это сформировавшееся к нему субъективное отношение как к очень трудному предмету, часто не поддающемуся успешному усвоению в условиях обучения. Не секрет, что иностранный язык требует ежедневной и систематической работы, которая должна быть мотивирована, то есть обучающийся должен осознавать, ради чего он изучает иностранный язык, иметь четко поставленную конкретную цель изучения (к примеру, понимать содержание и смысл песен любимого певца, общаться с англоговорящими сверстниками онлайн, самостоятельно прочитать инструкцию к технике и т.д.). Цель всегда должна быть понятна и конкретна для обучающегося.

В системе профессиональной подготовки военного специалиста иноязычная подготовка является ее подсистемой, функционально включенной в систему потребностно-целевых ориентиров образования военного специалиста, в которой мы выделяем три качественных уровня: общественно-государственный уровень - среда институционально организованного образования офицерского корпуса, обусловливающая потребность в иноязычной подготовке как подсистеме в системе его образования; военно-профессиональный уровень – сфера деятельности выпускника военного вуза (военно-профессиональная среда), обусловливающая задачи иноязычной подготовки в военном вузе; личностный уровень – личность курсанта военного вуза как субъекта иноязычной подготовки (Рис.1). Это логически обусловливает выявление ориентиров, определяющих функциональное включение иноязычной подготовки в систему профессионального образования военного специалиста, ориентацию на профессионально-личностное развитие курсантов в процессе данной подготовки: что находит отражение в развитии стандартах, а также объективно – в практике работы военного специалиста;

военно-профессиональная сфера деятельности выпускника задает профессиональную ориентацию задачам общий ориентир задается общественно-государственной потребностью в институциональной системе подготовки военных кадров (общественно-государственный уровень), сети организаций военного образования; иноязычной подготовки в вузе (военно-профессиональный уровень), что находит отражение в Государственных образовательных образовательных стандартах, а также объективно – в практике работы военного специалиста;

личность военного специалиста как субъекта иноязычной подготовки задает ориентацию на культурную и профессиональную самоидентификацию, самореализацию и саморазвитие в процессе данной подготовки (личностный уровень).

Современная система профессионального образования помогает развивать множество личностных качеств, например, готовность к диалогу и общению, навык работы в коллективе, умение продуктивно общаться с людьми из разных культур, способность воспринимать особенности разных менталитетов и, в конце концов, дружелюбие и толерантность. Все эти качества прививаются общей концепцией современной системы профессионального образования, а иноязычная подготовка является неотъемлемой ее частью.

Особенности культурно-национального компонента современного общества подчеркивают требование к изучению иностранных языков как одной из системных ценностей национальной культуры, что способствует формированию ценностного отношения как к своей, так и иной культуре. По этой причине крайне важно в наше время признать необходимость нового подхода к осуществлению иноязычной подготовки в вузе, что является важнейшей ценностью каждой национальной культуры.

Общественно-государственный уровень – среда институционально организованного образования офицерского корпуса, обусловливающая потребность в иноязычной подготовке как подсистеме в системе его образования

Функции:

- развитие института иноязычной подготовки в высшем военном образовании как социокультурного и профессионального феномена;
- развитие института высшего военного образования в целом, как элемента социальной практики (в плане целей, системы, функций);
- регулирование процессов развития военной культуры в обществе, формирование образа офицера.

Военно-профессиональный уровень – сфера деятельности выпускника военного вуза (военно- профессиональная среда), обусловливающая задачи иноязычной подготовки в военном вузе

Функции:

- развитие института иноязычной подготовки как профессионально значимого элемента профподготовки офицера в вузе;
- выявление и развитие ресурсов для профессионально-личностного развития;
- формирование требований к офицеру в области профессиональной иноязычной коммуникации.

Личностный уровень – личность курсанта военного вуза как субъекта иноязычной подготовки

Функции:

- культурной и профессиональной самоидентификации;
- культурной и профессиональной самореализации;
- удовлетворение потребности в профессиональной и межличностной коммуникации;
- профессионально-личностного саморазвития.

Рис. 1. Функциональная схема включения иноязычной подготовки курсантов военного вуза в систему образования военного специалиста

Реализации этого подхода должны сопутствовать:

- развитие самосознания;
- самоопределение в национальном и жизненном планах;
- познание обучающимися культурных ценностей;
- адаптация личности обучающегося к актуальной социокультурной (в том числе профессиональной) среде;
- формирование положительной позиции к национальным традициям и фольклору;
- обучение и развитие навыков межкультурного общения.

А.Т.Нурманов утверждает, что «важную роль в формировании межкультурной компетенции играет терпимое, уважительное отношение к другой культуре и ее особенностям. На основе особенностей функционирования русского языка в современном Узбекистане можно видоизменить понятие «межкультурная компетенция», уточнив ее содержание и название: «межнациональная компетенция». Межнациональная компетенция должна обозначать не столько знание о специфических фактах другой культуры (особые реалии народного быта, значимые факты истории, значимые личности), сколько владение «чужими» нормами коммуникативного поведения и спокойно-уважительное отношение к ним и тем ценностям и стереотипам, которые за ними стоят» [3,c.38].

Важно отметить, что процесс гуманизации всей системы образования и смена ее ценностных ориентаций находятся в активной фазе. Он фокусируется на развитии личности, которое включает в себя обеспечение ее социально-экономических и культурных, в том числе – профессиональных, взаимоотношений с окружающими. Для того, чтобы научиться понимать иностранный язык, недостаточно выучить нужные слова. Одной из главных задач является освоение культурной картины мира, изучение менталитета и традиций, что является достаточно сложным в процессе обучения. Тем не менее, знания о чужой культуре не только дают обучающимся возможность общаться с людьми-носителями языка, но и помогают им осознать, что кроме их родной культуры существуют и другие, с отличными понятиями о жизни, о мире и традициях. Такое целостное представление о культуре способствует становление целостной личности как субъекта культуры, а также – развитию системного и критического мышления.

Перспективы развития общества и профессиональной сферы деятельности военного специалиста требуют от выпускника вуза привнести новые личностные и профессиональные навыки. Чрезвычайно важно развивать способность критически и системно мыслить, коммуникативную и лингвистическую компетенции, навыки самоанализа и способность действовать самостоятельно в различных ситуациях. Все эти качества развиваются с помощью коммуникации в процессе иноязычной подготовки, направленной на приобретение способности ориентироваться в среде изучаемого языка и адекватно реагировать на ситуации, возникающие в процессе общения.

Иноязычная коммуникация способствует развитию у курсантов «чувства языка», что благоприятно для выпускников, поскольку ведет к овладению культурой речевого общения. Чувство языка исследователи связывают с формированием языковой личности. По Виноградову, формирование языковой личности состоит в «привитии особой перцептивной способности», заключающейся в «постижении иной ментальности, стратегии и тактики жизни, а значит, иного способа осмысления информации, затрагивающего любые стороны жизни» [4, с. 217].

Новый импульс этому процессу призвана задать модернизация иноязычной подготовки. Согласно приведенным выше положениям, иноязычная подготовка в военном вузе ориентирована на следующие задачи:

- реализация профессионально-коммуникативной ориентации обучения, направленной на включение выпускников в профессиональную сферу;
- приобретение знаний, навыков и умений иноязычной коммуникации, которые важны как в профессиональных, так и жизненных коммуникативных ситуациях;
- разноплановое развитие у курсантов интеллектуальных и творческих способностей;
- формирование у курсантов ценностного отношения к своей стране, ее культурным традициям, к военной профессии;
- обеспечение практики применения знаний и умений, полученных в вузе, в различных ситуациях обучения и реальной жизни.

Особенность дисциплины «Иностранный язык» в школе и вузе заключается в многозначных функциях иностранного языка в жизни человек. Выступая как средство общения в реализации личных и профессиональных возможностей, иностранный язык способствует получению «мирового духовного опыта», приобщению к мировой культуре, что, безусловно, влияет на развитие личности и создает возможности для духовного роста человека [5,6].

Профессионально-личностно развивающий потенциал иноязычной подготовки курсантов кроется в ее межкультурно-коммуникативной сущности. Отличительной чертой межкультурной коммуникации является то, что основным посредником при «встрече» культур служит человек, выступающий в качестве основного носителя информации. Межкультурная коммуникация обусловливает взаимопроникновение культурно-коммуникативных смыслов, достижение взаимопонимания с учетом и сохранением национальной картины мира коммуницирующих субъектов, но одновременно и их взаимообогащением в социокультурном и духовном планах.

Отличительной характеристикой иноязычной коммуникации в контексте профессионально-личностного развития курсантов является ее педагогический характер, так как она представляет собой многозначную иноязычную коммуникативную деятельность обучающегося – социальную (личностную) и профессионально ориентированную.

В понятийном поле межкультурной коммуникации закономерно возникает понятие диалога. Данное понятие многозначно. В иноязычной подготовке диалог рассматривается и как вид речи, и как функциональная разновидность языка, и как дидактический материал для овладения речевыми конструкциями применительно к тем или иным ситуациям. Личностные качества человека раскрываются в общении, в диалоге с другими людьми. По утверждению М.М.Бахтина, человек раскрывается в человеке только в общении, только во взаимодействии с людьми. «Быть – значит общаться диалогически», – отмечал он, подчеркивая тем самым природу человеческого события [7, с. 270]. Он глубоко ошибочным считал трактовку диалога только в рамках полемики, спора, пародии, что обычно допускается в литературном жанре, называя указанные формы «наиболее очевидными», «грубыми» формами диалогизации. Он раскрывает понятие диалога предельно широко – как «доверие к чужому слову, благоговейное приятие (авторитетное слово), ученичество, поиски и вынуждение глубинного смысла, согласие, его бесконечные градации и оттенки (но не логические ограничения и не чисто предметные оговорки), наслаивания смысла на смысл, голоса на голос, усиление путем слияния (но не отождествления), сочетание многих голосов (коридор голосов), дополняющее понимание, выход за предел понимаемого и т.п. Эти особые отношения нельзя свести ни к чисто логическим, ни к чисто предметным. Здесь встречаются целостные позиции, целостные личности» [8, с.300].

Услышать «другого», встать на его точку зрения, сравнить «свое» и «чужое» – необходимое условие диалога, практическая действенность которого позволила М.М.Бахтину рассматривать данное явление культуры не как предпосылку к действию, а как само действие. Данный аспект проблемы диалога как социокультурного механизма профессионально-личностного развития в процессе иноязычной подготовки ориентирован на обеспечение взаимодействия субъектов и воспроизводство социокультурных норм, что позволяет сохранить базовые культурные ценности и, вместе с тем, обогащать культуру выработкой новых ценностей.

Следовательно, «приобщение будущих специалистов к мировым ценностям, формирование и развитие у них умения взаимодействовать в мировом пространстве с представителями разных культур» [9, с.221] является одной из важных задач современного высшего военного образования.

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Issue Article

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COGNITIVE MODEL OF PEDAGOGIC EXPERTISE

***Abstract**: A cognitive model of a teacher's pedagogical skills has been developed. Sense and numeric variables have been introduced. Numerical coefficients that measure the magnitude of the strength of relationships between variables have been introduced. The numerical values of deviations from 0 to the right/left of the variability of z_{ik} z-variables, multiplied by the "weights" c_{kj}, were found (modeled). The sum of the products $z_{ik}c_{kj}$, k=1,..., 9, forms a new y-variable; for j=1,..., 9, the y-variables form an uncorrelated set of y-variables.The meanings of these y-variables, which are extracted hidden knowledge about the factors of the pedagogical skill of a teacher teaching students within the framework of the original 9 z-events, were found. The model added (cognized) another 9 z-events to them. Newer y-events are quantitatively and meaningfully substantiated. The manifestations of events are realized, their formulaic, phraseological, visualized on graphs descriptions of curve behavior are justified and correspond to the expected. A system of 9 semantic equations with 18 semantic variables has been developed: meaning(y_1),..., meaning(y_9), meaning(z_1),..., meaning(z_9). Nine semantic solutions-knowledge (new extracted knowledge), cognize the meanings, pairwise connections, and strengths of manifestations of 13 semantic variables. Visualization of the mutual dynamics of curves (variability values of z-, y-variables from matrices Z_{m9},Y_{m9}) of knowledge about "weights" (from C_{99}) and z-, y-variabilities in a model with 9 z-variables, 9 y-variables showed the dynamics of the model values of unmeasured indicators of manifestations of teacher skill. The variables introduced into the model are endowed with mathematical and statistical properties, and the parameters are constant. They are modeled in the Optimization Problem and depend on the number of variables and on the values of 3 indicators. Both uncorrelated (y-) and correlated (z-) variability are multiplied by their "weights" - the strength of the factor manifestation. Interesting knowledge was gained after visualization. The most informative is the found event y_4. Meaning (y_4) = "presentation of new educational material (with force c^2_{44}=1.0000)^2), carried out by the teacher with the attention of the student (with force c^2_{14} =0.3548^2)." 3 more events are informative: meaning (y_3)= "repetition of already studied material (with strength c^2_{33} = 0.6000^2), carried out by the teacher with a decrease in the strength of manifestation of 3 factors: a) information about learning goals (with strength (-0.7165)^2), b) presentation of new educational material (with force c^2_{43} = (-0.1248)^2)"; meaning (y_2) = "attracting the student's attention (with strength c_{212} =0.3502^2), explaining learning goals (with strength c^2_{22} = (0.3502)^2) and repeating already studied material (with strength c^2_{32} = 1.0000)^2)"; meaning (y_1) = "the teacher's efforts to attract the attention of students, shown (with force c^2_{11} = (+0.5000)^2) reduce the amount of information for learning purposes (with force c^2_{21} = (-0.1735)^2)". The presented structure of situations in which the model has learned unknown hidden knowledge can be applied to subjects (professor, student) if the initial data is changed - z-situations for the teacher are replaced with z-situations inherent in universities.*

***Key words**: multisense equation with known and unknown semantic variables, Cognitive Model of teacher pedagogical skill.*
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КОГНИТИВНАЯ МОДЕЛЬ ПЕДАГОГИЧЕСКОГО МАСТЕРСТВА

Аннотация*: Разработана Когнитивная модель педагогического мастерства учителя. Введены смысловые, числовые переменные. Введены числовые коэффициенты-измерители величин сил взаимосвязей между переменными. Найдены (смоделированы) числовые значения отклонений от 0 вправо\влево изменчивости z_{ik} z-переменных, умноженных на «веса» c_{kj}. Сумма произведений $z_{ik}c_{kj}$, k=1,…, 9, образует новую y-переменную, при j=1,…, 9 y-переменные образуют некоррелированное множество y-переменных. Найдены смыслы этих y-переменных, являющихся извлеченными скрытыми знаниями об факторах педагогического мастерства учителя, обучающего учеников рамках исходных 9 z-события К ним модель добавила (познала) еще 9 z-событий. Новее y-события количественно и по смыслам обоснованы. Проявления событий реализованы, обоснованы их формульное, фразеологическое, визуализированное на графиках описания поведений кривых соответствует ожидаемому. Разработана система из 9 смысловых уравнений с 18 семантическими переменными: смысл(y_1),…, смысл(y_9), смысл(z_1),…,смысл(z_9). Девять семантические решения–знания (новые извлеченные знания), познают смыслы, парные связи, силы проявлений 13 семантических переменных. Визуализация взаимных динамик кривых (значений изменчивостей z-, y-переменных из матриц Z_{m9},Y_{m9}) знаний о «весах» (из C_{99}) и z-, y-изменчивостях в модели с 9 z-переменными, 9 y-переменными показала динамики модельных значений неизмеряемых показателей проявлений мастерства учителя. Введенные в модель переменные наделены математическими и статистическими свойствами, а параметры постоянны. Они смоделированы в Оптимизационной Задаче и зависят от количеств переменных и от значений 3-х индикаторов. Как некоррелированные (y-), так коррелированные (z-) изменчивости умножаются на свои «веса» - силы проявления фактора. Получены интересные знания после визуализации. Самым информативным является найденное событие y_4. Смысл(y_4)=«представление нового учебного материала (с силой c^2_{44}=1,0000)^2), проводится учителем с привлечением внимания ученика (с силой c^2_{14}=0.3548^2)». Информативны еще 3 события: смысл(y_3)=«повторение уже изученного материала (с силой c^2_{33}=0,6000^2), проведенное учителем с уменьшением сил проявления 3-х факторов: а)сведений целях обучения (с силой (-0,7165)^2), б)представления нового учебного материала (с силой c^2_{43}=(-0.1248)^2)»; смысл(y_2)=«привлечение внимания ученика (с силой c^2_{12}=0,3502^2), разъяснение целей обучения (с силой c^2_{22}=(0.3502)^2) и повторение уже изученного материала (с силой c^2_{32}=1.0000)^2) »; смысл(y_1=«усилия учителя по привлечению внимания учеников, проявленные (с силой c^2_{11}=(+0,5000)^2) уменьшают объем информации в целях обучения (с силой c^2_{21}=(-0,1735)^2)».*

Изложенную структуру ситуаций, в которых модель познала неизвестные скрытые знания, можно применить для субъектов (профессор, студент), если измененить исходные данные –z-ситуации для учителя заменить на z-ситуации, присущие университетам.

Ключевые слова*: многосмысловое уравнение с известными и неизвестными семантическими переменными, Когнитивная модель педагогического мастерства учителя.*

Введение

Интеллектуальное движение вошло в историю под названием «когнитивная революция». Бум интереса к когнитивизму пришёлся на середину прошлого века, первые исследования в этой области начались за многие десятилетия до того. Рассмотрим словесную модель преподавания Роберта Ганье. «Преподавание, по Ганье, - это ряд внешних по отношению к ученику событий, призванных стать подспорьем для внутренних событий обучения. Внутренние события — это стоящие за обучением физиологические процессы обучающегося, такие как регистрация поступающей информации органами чувств и, например, её сохранение в долгосрочной памяти»[1] Ганье считал, что цель преподавания — облегчить внутренние процессы обучения. Ученик должен перейти из одного состояния ума в другое. Преподаватель же помогает ему пройти этот путь, который Ганье представляет как последовательность из девяти событий. Здесь ниже опишем Когнитивную модель педагогического мастерства учителя, исходными данными для нее служат девяти событий Роберта Ганье.

Исходные данные

Исходной информацией для модели являются смыслы 9 z-факторов, выражающих компетенции индивидов-обучаемых, z-факторы способствуют внедрению аналитических способностей и управляются смыслами 9 y-факторов. Смыслы y-факторов неизвестны.

1. смысл(z_1)=«привлечение внимания

[1] https://skillbox.ru/media/education/9-sobytiy-prepodavaniya/?utm_source=media&utm_medium=link&utm_campaign=all_all_media_links_links_articles_all_all_skillbox

(признак учителя);

2. смысл(z_2)=«информирование учеников о целях обучения (признак учителя);

3. смысл(z_3)=«повторение уже изученного материала (проявление признак ученика);

4. смысл(z_4)=«представление нового учебного материала (признак учителя);

5. смысл(z_5)=«поддержка обучения (признак учителя);

6. смысл(z_6)=«подталкивание к демонстрации приобретённых навыков (признак учителя);

7. смысл(z_7)=«предоставление обратной связи (признак учителя);

8. смысл(z_8)=«оценка результатов (проявление признак ученика);

9. смысл(z_9)=«улучшение усвоения знания и его перенос на практику».

Введены 3 индикатора $corr(z_3,y_1)=c_{31}=0{,}5$; $corr(z_3,y_2)=c_{32}=1$; $corr(z_8,y_3)=c_{83}=0{,}6$ присутствия знаний, соответствующие смыслам y-переменных y_1, y_2,y_3.

Задача: разработать систему из 9 смысловых уравнений с 18=9+9 семантическими переменными смысл(y_1),…, смысл(y_9), смысл(z_1), …,смысл(z_9), удовлетворяющих матричному смысловому равенству вида смысл(Z_{m9})= смысл($Y_{m9}C^T{}_{99}$), где смысл(Z_{m9})=смысл(z_1)⊕…⊕ смысл(z_9), смысл($Y_{m9}\mathbf{C}^T{}_{\mathbf{99}}$)=смысл($Y_{m9}\mathbf{c}^T{}_{\mathbf{1}}$)⊕…⊕ смысл($Y_{m9}\mathbf{c}^T{}_{\mathbf{9}}$). Элементы матрицы $C^T{}_{99}$ равны 9 элементам первых 9 строк $\mathbf{c}^T{}_{\mathbf{1}}$**, …,** $\mathbf{c}^T{}_{\mathbf{9}}$ матрицы индикаторов C_{99}, а ее i-ая строка $\mathbf{c}^T{}_{\mathbf{j}}$ имеет компоненты, равные компонентам матрицы индикаторов C_{99}: $c^T{}_j=(c_{j1},c_{j2},\dots,c_{j9})$, i=1,…,9. Этому матричному смысловому равенству соответствует математическое матричное равенство для числовых переменных вида: $Z_{m9}=Y_{m9}C^T{}_{99}$.

Применяемая система многосмысловых уравнений

Многосмысловое уравнение [1-2] конструируется из многомерной математической модели [3], где уже введены числовые параметры, переменные, функции связи, соответствующие реальным свойствам реальных многомерных объектов разных типов. Тип объектов, их свойств отражается в смыслах свойств объектов [2-8]. Суммы смыслов свойств (z-переменных) объекта могут образовать новый смысл y-переменной (взамен старому смыслу) или нет. В многомерной математической модели (она является вторичной, первична матричная смысловая модель) переменные делятся на 2 вида: известные имена-смыслы z-переменных: смысл(z_1),…,смысл(z_9) и y_t известные имена-смыслы y-переменных смысл(y_1),…,смысл(y_9). Количество 9 переменных равно количеству дисперсий $disp(y_1)=\lambda_1$, $disp(y_2)=\lambda_2,\dots,disp(y_9)=\lambda_9$. В соответствии с значениями λ_1, $\lambda_2,\dots,\lambda_9$, взятыми из пары смоделированных матриц (C_{99},Λ_{99}) проставляются числовые параметры $c_{11},\dots$, c_{99} в нижеприведенные 9 уравнений системы многосмысловых уравнений. Не проводим удаления слагаемых с «весами» c_{ij}, если даже их величины не удовлетворяют критерию быть индикатором скрытых знаний [11,14], поэтому количество слагаемых в уравнениях с неизвестными новыми смыслами смысл(y_1), смысл(y_2),…,смысл(y_4) не сокращаются. Более «короткие» суммы смыслов приведены для облегчения осмысливания читателем статьи. Для конструирования 6 фраз для 4 новых смыслов (новых семантических y-переменных) новый_смысл(y_1), новый_смысл(y_2), новый_смысл(y_3), новый_смысл(y_4), существенно дополняющих исходные смыслы смысл(y_1), смысл(y_2), смысл (y_3), смысл(y_4) применялись методы смыслового преобразования исходных семантических переменных в новые семантические переменные. Это – трудозатратная особенность когнитивного моделирования.

Требуемые фразы, отражающие смыслы неизвестных 9 новых смыслов y-переменных, можно сконструировать, если смоделировать:

а) пару матриц собственной структуры (Λ_{99},C_{99}), где C_{99} – матрица псевдособственных векторов [9], $C_{99}C^T{}_{99}=I_{99}$, $C^T{}_{99}C_{99}=\neq I_{99}$, $\Lambda_{99}=diag(\lambda_1,\dots\lambda_9)$, $tr(\Lambda_{99})= \lambda_1+\dots+\lambda_9=9$, условие упорядоченности $\lambda_1\geq\dots\geq\lambda_9\geq0$ не требуется;

б) матрицы значений некоррелированных изменчивостей Y_{m4}, коррелированных изменчивостей (отклонений от 0) Z_{m9}, соответствуют своим системам многосмысловых уравнений с известными и неизвестными семантическими (смысловыми) переменными.

Иное название [9-12] элементов матрицы C_{99} введено в статьях [1-9], оно отражает смысл «весов», моделируемых в нашей модели, наш метод моделирования отличается от методов из [2-9].

Новые моделируемые 2 матрицы в нашей модели должны обладать свойствами: ортогональная (не ортонормированная) матрица C_{99} собственных векторов $\mathbf{c_j}=(c_{1j},c_{2j}\dots c_{9j})^T$, расположенных по столбцам матрицы $C_{99}=[c_1|c_2|\dots|c_9]$ согласована со своим спектром Λ_{99} неиспользуемой нами ковариационной матрицы $W_{99}=(1/m)Z^T{}_{m9}Z_{m9}$, $\Lambda_{99}=diag(\lambda_1,\dots\lambda_9)$ В решаемой ниже Оптимизационной Задаче: (I_{99},I_{99})=>(C_{99}, Λ_{99}) (другие методы смотрите в [9-15]) целевая функция отличается от ранее применявшейся функции: $\lambda_1+\dots+\lambda_9=9$, теперь это равенство является функцией ограничений при изменяемых значениях 9*9+9 элементов 2-х матриц C_{99}, Λ_{99}, $C^T{}_{99}C_{99}\neq I_{99}$, $C_{99}C^T{}_{99}=I_{99}$. Моделируемые ниже случайные матрицы U_{m9} и Y_{m9} такие, что подчиняются соотношениям Обратной Модели Анализа Главных Компонент [16-17]:

$(1/m)U^T{}_{m9}U_{m9}=I_{99}$, $Y_{m9}=U_{m9}\Lambda^{1/2}{}_{99}$, $Z_{m9}=Y_{m9}C^т{}_{99}$, в матрице Y_{m9} элементы j–го столбца $y_{1j},y_{2j},…,y_{mj}$ (j-ая y-переменная, j=1,…,9) имеют среднее арифметическое, равное нулю: $(1/m)(y_{1j}+y_{2j}+…+y_{mj})=0$ и дисперсию равную λ_j: $(1/m)(y^2{}_{1j}+y^2{}_{2j}+…+y^2{}_{mj})=\lambda_j$, сумма дисперсий равна 9: $\lambda_1+…+\lambda_9=9$. Матрицы $Y_{m9}=U_{m9}\Lambda^{1/2}{}_{99}$, $Z_{m9}=Y_{m9}C^т{}_{99}$ в таком порядке моделируются иинтерпретируются как многомерные выборки [17]. В нашей модели мы моделируем нестандартизованные $(C^т{}_{99}C_{99}\neq I_{99})$ коррелированные z-переменные являются многомерными данными, объединенных в матрицу Z_{m9}, в которой элементы j–го столбца $z_{1j},z_{2j},…,z_{mj}$ (j-ая переменная, j=1,…,9) имеют среднее арифметическое равное нулю: $(1/m)(z_{1j}+z_{2j}+…+z_{mj})=0$, и дисперсию не равную 1: $(1/m)({}^{z2}{}_{1j}+z^2{}_{2j}+…+z^2{}_{mj})\neq1$, сумма дисперсий не равна 9. Элементы матрицы C_{99} интерпретируются как индикаторы знаний [10-12]. Матрица Y_{m9}, в которой элементы j–го столбца y_{1j}, $y_{2j},…,y_{mj}$ (j-ая y-переменная, j=1,…,9) имеют среднее арифметическое равное нулю: $(1/m)(\ y_{1j}+y_{2j}+\ …\ +y_{mj})=0$, и дисперсию равную λ_j: $(1/m)(y^2{}_{1j},\ +y^2{}_{2j}+…+y^2{}_{mj})=\lambda_j$, сумма дисперсий равна 9: $\lambda_1+…+\lambda_9=9$. Матрица Y_{m9}, интерпретируется как многомерная выборка. Нестандартизованные коррелированные z-переменные - данные, объединенные в матрицу Z_{m9}, в которой элементы j–го столбца $z_{1j},z_{2j},…,z_{mj}$ (j-ая z-переменная, j=1,…,9) имеют среднее арифметическое равное нулю: $(1/m)(z_{1j}+z_{2j}+…+z_{mj})=0$ и дисперсию, не равную 1: $(1/m)(z^2{}_{1j}+\ z^2{}_{2j}+…+z^2{}_{mj})\neq1$, сумма дисперсий не равна 9. Матрица Z_{m9} интерпретируется как многомерная нестандартизованная выборка.

Применяемая система многосмысловых уравнений состоит из 4-х смысловых уравнений с 18=9+9 семантическими переменными смысл(y_1), смысл(y_2), смысл(y_3), смысл(y_9), удовлетворяющих матричному смысловому равенству вида смысл(Z_{m9})=смысл($Y_{m9}C^T{}_{99}$), где смысл(Z_{m9})=смысл(z_1)⊕…⊕смысл(z_9), смысл($Y_{m9}\mathbf{C}^T{}_{\mathbf{99}}$)=смысл($Y_{m9}\mathbf{c}^T{}_{\mathbf{1}}$)⊕смысл($Y_{m4}\mathbf{c}^T{}_{\mathbf{2}}$)⊕ …⊕ смысл($Y_{m94}{}^T{}_{\mathbf{9}}$).

Когнитивная модель педагогического мастерства

Информационными компонентами когнитивной модели «компетенций, внедряющие аналитические способности» являются:

1. Модельная пара матриц (C_{99},Λ_{99}): матрица собственных чисел Λ_{99}, матрица псевдособственных векторов C_{99} таких, что выполняются условия: $C_{99}C^т=I_{99}$, $C^т{}_{99}C_{99}=\neq I_{99}$, $\Lambda_{99}=diag(\lambda_1,…\lambda_9)$, $tr(\Lambda_{99})=\lambda_1+…+\lambda_9=9$, Λ_{99}=diag(2.000, 2.000, 2.000, 3.000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000).

2. Матрицы C_{99} и Λ_{99} моделируются при решении Оптимизационной задачи. Вид таблицы-программы Оптимизационной задачи: (I_{99},I_{99})=>($C_{99}\Lambda_{99}$) приведен в Таблице 2.

3. Известные смысловые переменные смысл(z_1),…, смысл(z_9) в модели используются для нахождения новых смыслов для модельных y-переменных y_1,y_2,y_3,y_4, которые управляют соответствующими числовыми 9 z-переменными (z_1,z_2,…,z_9).

4. девять смысловых уравнений:

смысл(y_1)==смысл(z_1)*0,5000+смысл(z_2)*(-0,1735) ;

смысл(y_2)=смысл(z_1)*0,3502+смысл(z_2)*1,0093+ смысл(z_3)*1,0000;

смысл(y_3)=смысл(z_1)*0,3517+смысл(z_2)*(-0,7165)+смысл(z_3)*0,6000)+смысл(z_4)*(-0,1248);

смысл(y_4)=смысл(z_1)*0,3548)+смысл(z_4)*1,00;

смысл(y_5)=смысл(z1)*0,3548)+смысл(z_4)*(-0,1259)+ смысл(z_5)*1,0000;

смысл(y_6)=смысл(z_2)*(-0,1124)+смысл(z_3)*(-0,0720)+смысл(z_4)*(-0,0063)+смысл(z_6)* 1,000;

смысл(y_7)=смысл(z_1)*0,3548)+смысл(z_7)*1,00;

смысл(y_8)=смысл(z_8)*1,0000);

смысл(y_9)=смысл(z_1)*0,3548)+смысл(z_9)*1,0000.

Системе из 9 смысловых равенств соответствует система из 9 числовых алгебраических равенств:

$y_1= z_1*0,5000+z_2*(-0,1735)$;

$y_2=z_1*0,3502+ z_2*1,0093+ z_3*1,0000$;

$y_3=z_1*0,3517+z_2*(-0,7165)+z_3*0,6000*+z_4*(-0,1248)$;

$y_4=z_1*0,3548+z_4*1,0000$;

$y_5=z_1*0,3548+z_4*(-0,1259)+ z_5*1,0000$;

$y_6=z_2*(-0,1124)+z_3*(-0,0720)+z_4*(-0,0063)+z_6*1,000$;

$y_7=z_1*0,3548+ z_7*1,0000$;

$y_8=z_8*1,0000$;

$y_9=z_1*0,3548+ z_9*1,0000$.

5. Ненулевые (4 штуки) дисперсии λ_1=2.0000, λ_2=2.0000, λ_3=2.0000, λ_4=3.0000, λ_5=0.0014, λ_6=-0.0004, λ_7=-0.0004, λ_8=-0.0004, λ_9=-0.0004. Пять дисперсий с учетом погрешностей вычислений равны 0 из модельного спектра Λ_{88}=diag(2.0000, 2.0000, 2.0000, 3.0000, 0.0014, -0.0004, -0.0004, -0.0004, -0.0004) равны значениям алгебраических формул y–изменчивостей y_{i2},y_{i1},y_{i3},y_{i4}, i=1,…, 24, имеют разные значения. Других значений не удалось получить при решении Оптимизационной Задачи с 3 индикаторами (управляющие параметры, соответствующие смыслам y-переменных y_1,…,y_4 присутствия знаний.

6. Из вычисленных в рамках модели 9*9=81 индикаторов в смысловой модели используются все (в том числе 3 назначенных экспетом) индикаторов наличия модельных знаний, как показано на Рисунках 1-9, адекватных ожидаемым знаниям.

7. Каждая из четырех смысловых формул из пункта 3 когнитивно сконструирована из смыслов 9 неизмеряемых и зависимых друг от друга z-показателей. Девять y–изменчивости попарно (y_{1i},y_j), $i\neq j$, не коррелируют друг с другом: $(y_1,y_2)=corr(y_2,y_3)=corr(y_1,y_3)=\ldots=corr(y_8,y_9)=0$, так как $\lambda_{12}=\lambda_{23}=\ldots=\lambda_{89}=0$. Эти равенства – формальное выражение исходной словесной гипотезы модели: y–переменные по смыслам не влияют друг на друга.

8. Коррелированные смыслы 9 z-показателей являются входными данными модели, они сформулированы в пункте «Исходные данные» статьи.

9. Состав исходных индикаторов (3 штуки, Таблица 2) $corr(z_3,y_1)=c_{31}=0,5$; $corr(z_3,y_2)=c_{32}=1$; $corr(z_8,y_3)=c_{83}=0,6$ отражает минимальные очевидные знания, по значениям согласуются с модельными 81-3=78 смоделированных индикаторов, формально найденных при решении Оптимизационной Задачи. В индикаторе $corr(z_3,y_1)=c_{31}=0,5$ отражена тождественность реакции смысла(z_3)=«повторение учеником уже изученного материала» ученика на проявление смысл(y_1) учителя:

В индикаторе $corr(z_3,y_2)=c_{32}=1$ отражена тождественность силы реакции (=1.000) ученика силе проявление (=1.000) учителя: смысл(z_3)=«повторение учеником уже изученного материала» равна величине проявления смысла(y_2) показателя y_2 учителя, где смысл(y_2) выражает смысл y–показатель мастерства учителя.

В 3-м индикаторе $corr(z_8,y_3)=c_{83}=0,6$ отражена тождественность силы реакции (=0.5) ученика силе проявление (=0.5) усилиям учителя: смысл(z_8)=«оценка результатов ученика» равна величине проявления смысла(y_3) показателя y_3 учителя, где смысл(y_3) выражает смысл y–показателя мастерства учителя. Как следствие от 3-х индикаторов (наименьшая априорная информация для модели, исключающая подсказку для познающей модели) сконструированы ниже конкретные фразы смыслов 9 y–показателей мастерства учителя.

10. Модельные матрицы Y_{m4}, Z_{m8} (Таблицах 5 и 6) (полученные путем вычисления по алгоритму и путем компьютерного моделирования случайных матриц $V^0{}_{m8}$, U_{m8} удовлетворяют равенствам алгебраической системы уравнений, соответствуют найденным выше 4 многосмысловым уравнениям.

Таблица 1. Модельная матрица C_{99} псевдособственных векторов с 3 исходными индикаторами Λ_{88}=diag(2.000, 2.000, 2.000, 3.000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000)

	c1	c 2	c 3	c 4	c 5	c 6	c 7	c 8	c 9
z1	0,5000	0,3502	0,3517	0,3548	0,3548	0,0000	0,3548	0,0000	0,3548
z2	-0,1735	1,0093	-0,7165	0,0000	0,0000	-0,1124	0,0000	0,0000	0,0000
z3	0,0000	1,0000	0,6000	0,0000	0,0000	-0,0720	0,0000	0,0000	0,0000
z4	0,0000	0,0000	-0,1248	1,0000	-0,1259	-0,0063	0,0000	0,0000	0,0000
z5	0,0000	0,0000	0,0000	0,0000	1,0000	0,0000	0,0000	0,0000	0,0000
z6	0,0000	0,0000	0,0000	0,0000	-0,0008	1,0000	0,0000	0,0000	0,0000
z7	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000	0,0000	0,0000
z8	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000	0,0000
z9	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000
| c|	0,2801	2,1414	1,0126	1,1259	1,1418	1,0179	1,1259	1,0000	1,1259

Оптимизационная Задача

Для моделирования матрицы C_{99} индикаторов наличия скрытых знаний сформируем для пары матриц (C_{99}, Λ_{99}) 2 диагональные единичные матрицы (I_{99},I_{99}). Они являются начальными значениями (C_{99},Λ_{99}). Процедура GRD2 после последовательных приближений преобразует матрицы (I_{99},I_{99}) в матрицы (C_{99},Λ_{99}). Для процедуры GRD2, необходимы функции ограничений, помогающие процедуре GRD2 уменьшить работу при поиске решения (матрицы C_{99},Λ_{99}). Решается Оптимизационная Задача: $(I_{99},I_{99})\Rightarrow(C_{99},\Lambda_{99})$ целевая функция имеет вид $\lambda_1+\ldots+\lambda_9=9$. Есть опасение, что процедура GRD2 откажется искать решение (C_{99},Λ_{99}). Используем ограничения:

$\lambda_1+\ldots+\lambda_8$ =9 при изменяемых значениях 9*9+9 элементов 2-х матриц C_{99}, Λ_{99}. Ограничения на элементы матриц: $C^TC\neq I_{99}$, $C_{99}C^T_{99}=I_{99}$, $\Lambda_{99}=diag(\lambda_1,\ldots\lambda_9)$, $tr(\Lambda_{99})=\lambda_1+\ldots+\lambda_9=9$, без ограничений на монотонность: $\lambda_1\geq\ldots\geq\lambda_n\geq 0$.

Мы проведем моделирование матрицы псевдособственных векторов $C_{99}:(I_{99},I_{99})\Rightarrow(C_{99},\Lambda_{99})$, $C^T_{99}C_{99}\neq I_{99}$, $C_{99}C^T_{99}=I_{99}$ и моделирование для нее диагональной матрицы Λ_{99}. Особенность матрицы псевдособственных векторов C_{99} состоит в том, что и позволяют моделировать коррелированные z-переменные с дисперсиями, большими 1. Такая z-переменная более изменчива, чем y-переменная y_4, это соответствует свойствам показателей из текста сказки. Сильно изменчивые z-переменные (z_2, z_3, z_3, z_5, z_6) через формулы передают заметные ненулевые дисперсии y-переменным y_1, y_2, y_3. Значения z-переменных (z_1, z_2, z_3, z_4, $z_5,\ldots$, z_9) являются многомерными данными, объединенных в матрицу Z_{m9}, в которой элементы j–го столбца $z_{1j},z_{2j},\ldots,z_{mj}$ (j-ая переменная, j=1,…,9) имеют среднее арифметическое равное нулю: $(1/m)(z_{1j}+z_{2j}+\ldots+z_{mj})=0$, и дисперсию не равную 1: $(1/m)(z^2_{1j}+z^2_{2j}+\ldots+z^2_{mj})\neq 1$, сумма дисперсий не равна 9.

Конструирование смыслов 9 y-факторов с 3 исходными индикаторами присутствия скрытых знаний

Элементами конструирования каждого смысла (из 9 y-факторов) является подмножество смыслов, выбранное из множества 9 z-факторов:

1. смысл(z_1)=«привлечение внимания (признак учителя)
2. смысл(z_2)=«информирование учеников о целях обучения (признак учителя)
3. смысл(z_3)=«повторение уже изученного материала **(проявление признак ученика)**
4. смысл(z_4)=«представление нового учебного материала (признак учителя)
5. смысл(z_5)=«поддержка обучения (признак учителя)
6. смысл(z_6)=«подталкивание к демонстрации приобретённых навыков (признак учителя)
7. смысл(z_7)=«предоставление обратной связи (признак учителя)
8. смысл(z_8)=«оценка результатов (**проявление признак ученика**)
9. смысл(z_9)=«улучшение усвоения знания и его перенос на практику».

Дисперсии 9 y-факторов: λ_1=2.0000, λ_2=2.0000, λ_3=2.0000, λ_4=3.0000, λ_5=0.0014, λ_6=0.000, λ_7=0.000, λ_8=0.000, λ_9=0.000. Дисперсии 9 z -факторов: 1.3704, 3.1244, 2.7200, 3.0312, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000.

Для системы смысловых уравнений с ненулевыми параметрами («весами») при смысловых переменных найдем фразы смыслов смысл(y_1), смысл(y_2), смысл(y_3), смысл(y_4), смысл(y_5), смысл(y_6), смысл(y_7), смысл(y_8), смысл(y_9), каждая из которых равна своей сумме смыслов из множества {смысл(z_1),…,смысл(z_9)}.

смысл(y_1)=смысл(z_1)*0,5000+смысл(z_2)*(-0,1735);

смысл(y_2)=смысл(z_1)*0,3502+смысл(z_2)* 1,0093+ смысл(z_3)*1,0000;

смысл(y_3)=смысл(z_1)*0,3517+смысл(z_2)*-0,7165)*+смысл(z_3)*0,6000+смысл(z_4)*(-0,1248);

смысл(y_4)=смысл(z_1)*0,3548+смысл(z_4)* 1,0000;

смысл(y_5)=смысл(z_1)*0,3548+смысл(z_4)*(-0,1259)+ смысл(z_5)*1,0000;

смысл(y_6)=смысл(z_2)*(-0,1124)+смысл(z_3)*(-0,0720)+смысл(z_4)*(-0,0063)+смысл(z_6)*1,000.

смысл(y_7)=смысл(z_1)*0,3548+смысл(z_7)* 1,0000;

смысл(y_8)=смысл(z_8)*1,0000;

смысл(y_9)=смысл(z_1)*0,3548+смысл(z_9)* 1,0000.

Будем конструировать фразы смыслов для смысл–переменных, начиная с y–переменной с нулевой дисперсией, в порядке возрастания величины дисперсии. Пять y–переменных имеют нулевые дисперсии, они являются постоянно действующими факторами мастерства учителя (Таблица 5). Четыре y–переменных имеют ненулевые доминирующие дисперсии, соответствующие y–переменные являются случайными (результатами неслучайных усилий учителя) событиями. Содержат извлеченные скрытые знания, представляющие собой особо ценные знания из видов извлеченных знаний.

Рассмотрим смысловое уравнение смысл(y_9)=смысл(z_1)*0,3548+смысл(z_9)*1,0000. Начнем с фразы, присущей смыслу z–переменной z_9 с наибольшим «весом» c_{99}=1.0000. Фраза «привлечение внимания (признак учителя) с силой $(0,3548)^2$ дает многократное «улучшение усвоения знаний и их перенос на практику» у **ученика** с силой $c^2_{99}=1,000^2$. Так как $c^2_{19}+c^2_{99}=1$, то сила усилий учителя при «событии z_1» в 3 раза вырастут по силе у ученика при наступлении «события z_9». Здесь мы сконструировали новый смысл(y_9)=«усилия учителя при привлечении внимания (проявленные с силой $(0,3548)^2$) проявляется с силой $c^2_{99}=1,000^2$ у **ученика** в виде «улучшения усвоения знаний и его перенос на практику». Это – 1-ая порция постоянных знаний, извлеченных нашей когнитивной моделью. Так как $c^2_{19}+c^2_{99}=1$, то усилия учителя при событии z_1 в 3 раза вырастут у ученика при наступлении события z_9». Такова могучая сила умения учителя (лектора) привлекать внимание к добыче знаний.

Следующее смысловое уравнение смысл(y_8)=смысл(z_8)*1,0000) имеет смысл смысл(y_8)=«оценка результатов **учителем**».

Смысл z–события перефразируется в смсл y-события. Соответствующая ей переменная y8 имеет дисперсию λ_8=0.000, что выражает акт: переменная y_8- независимый фактор, характеризующий педагогическиое мастерство учителя.

Рассмотрим 7-ю смысловую неизвестную переменную смысл(y_7)=смысл(z_1)*0,3548+ смысл(z_7)*1,0000. Смысл(y_7)=«привлечение учителем внимание ученика с силой $(0,3548)^2$ дает многократный эффект: ученик с силой $c^2_{77}=1,000^2$ проявляет «обратную связь». Рассмотрим сложное смысловое уравнение

смысл(y_6)=смысл(z_2)*(-0,1124)+смысл(z_3)*-0,0720)*+смысл(z_4)*(-0,0063)+смысл(z_6)*1,000. мы должны найти сумму 4-х смыслов: а) смысл(z_2)=«**информирование** учеников о целях обучения»; б) смысл(z_3)=«повторение уже изученного материала»; в) смысл(z_4)=«представление нового учебного материала»; г) смысл(z_6)=«подталкивание к демонстрации приобретённых навыков». Суммирование смыслов 4-х фраз дает смысл(y7)=«**подталкивание** учителем к демонстрации приобретённых навыков ученика (с силой $1,000)^2$), проводимое одновременно с уменьшением: а) сведений о целях обучения, б) повторения пройденного, в) представления нового учебного материала».

Смысл правой части смыслового уравнения смысл(y_6)=смысл(z_2)*(-0,1124)+смысл(z_3)*(-0,0720)+смысл(z_4)*(-0,0063)+смысл(z_6)*1,000 равен сумме смыслов 4-х z–переменных z_2,z_3,z_4,z_6, фраза которого содержит доминирующий смысл(z_6) события z_6. Смысл(y_6)=«усиливающееся **подталкивание** учеников к демонстрации приобретённых навыков проявляется у учителя с силой c^2_{66}=1,000».

Рассмотрим смысловое уравнение

смысл(y_5)=смысл(z_1)*0,3548+смысл(z_4)*(-0,1259)+смысл(z_5)*1,0000. новое извлеченное знание дает смысл(y_5)=«поддержка учителем обучения (с силой $c^2_{45}1,0000)^2$) и привлечение внимания ученика (с силой $c^2_{15}=0,3548^2$), проводимых с уменьшением (с силой $(-0,1259)^2$) объма представления нового учебного материала».

Рассмотрим смысловое уравнение смысл(y_4)=смысл(z_1)*0,3548+смысл(z_4)*1,0000.

смысл(y_4)=«представление нового учебного материала (с силой $c^2_{44}1,0000)^2$), проводится учителем с привлечением внимания ученика (с силой $c^2_{14}=0,3548^2$)».

Рассмотрим сложное смысловое уравнение смысл(y_3)=смысл(z_1)*0,3517+смысл(z_2)*-0,7165)*+смысл(z_3)*0,6000)*+смысл(z_4)*(-0,1248). Имеем: смысл(y_3)=«повторение уже изученного материала (с силой c^2_{33}=0,6000), проведенное учителем с уменьшением сил проявления 3-х факторов: а)сведений целях обучения (с силой $(-0,7165)^2$), б)представления нового учебного материала (с силой $c^2_{43}=(-0,1248)^2$)».

Рассмотрим смысловое уравнение

смысл(y_2)=смысл(z_1)*0,3502+смысл(z_2)* 1,0093+смысл(z_3)*1,0000. суммирование 3-х смыслов дает фразу, выражающую смысл y–переменной y_2. Смысл(y_2)=«привлечение внимания ученика (с силой $c^2_{12}=0,3502^2$), разъяснение целей обучения (с силой $c^2_{22}=(0,3502)^2$) и повторение уже изученного материала (с силой $c^2_{32}=1,0000)^2$) ».

Рассмотрим смысловое уравнение для неизвестной y–переменной y_1: смысл(y_1)=смысл(z_1)*0,5000+смысл(z_2)*(-0,1735). Фраза «усилия учителя по привлечению внимания учеников, проявленные (с силой $c^2_{11}=(+0,5000)^2$) уменьшают объем информации о целях обучения (с силой $c^2_{21}=(-0,1735)^2$)» суммирует смысл 2-х фраз. Это событие имеет долю, равную 2\9=22% информации, она должна проявляться не постоянно, а быть случайным событием, не случайно проводимом учителем – обладающим педагического мастерства.

Таблица 4. Извлеченные знания из 9 показателей (ситуаций) педагогического мастерства учителя

№	% дисперсии	Смыслы независимых y–факторов, зависящих от смыслов z-факторов педагогического мастерства	Динамика z-факторов	Выводы
9	0/9=0,00%	смысл(y_9)=«привлечение внимания (признак учителя) с силой $0,3548)^2$ дает многократное «улучшение усвоения знаний и их перенос на практику» у ученика с силой $c^2_{99}=1,000^2$	disp(z_1)= 1,3704; disp(z_9)= 0,0000;	Постоянно проявляемый y-фактор y_9
8	0/9=0,00%	смысл(y_8)= «оценка результатов учителем»	disp(z_8)= 0,0000;	Постоянно проявляемый y-

				фактор y_8
7	0/9=0,00%	смысл(y_7)=«привлечение учителем внимание ученика с силой c^2_{17}=0,3548)^2 дает многократный эффект: ученик с силой c^2_{77}=1,000^2 проявляет «обратную связь»	disp(z_1)= 1,3704; disp(z_7)= 0,0000;	Постоянно проявляемый y-фактор y_7
6	0/9=0,00%	Смысл(y_6)=«усиливающееся подталкивание учеников к демонстрации приобретённых навыков проявляется у учителя с силой c^2_{66}=1,000»	disp(z_2)=3,1244 disp(z_3)=2,7200 disp(z_4)=3,0312 disp(z_6)= 0,0000	Постоянно проявляемый y-фактор y_6
5	0.0014/9=%	смысл(y_5)=«поддержка учителем обучения (с силой c^2_{45}1,0000)^2) и привлечение внимания ученика (с силой c^2_{15}=0,3548^2), проводимых с уменьшением (с силой (-0,1259)^2) объма представления нового учебного материала	disp(z_1)= 1,3704; disp(z_4)= 3,0312; disp(z_5)=0.00000	Постоянно проявляемый y-фактор y_5
4	3.0000 =22,%	смысл(y_4)=«представление нового учебного материала (с силой c^2_{44}1,0000)^2), проводится учителем с привлечением внимания ученика (с силой c^2_{14}=0,3548^2)»	disp(z_1)= 1,3704; disp(z_4)= 3,0312;	случайное событие, не случайно проводимомое учителем
3	2.0000/9 =%	смысл(y_3)=«повторение уже изученного материала (с силой c^2_{33}=0,6000), проведенное учителем с уменьшением сил проявления 3-х факторов: а)сведений целях обучения (с силой (-0,7165)^2), б)представления нового учебного материала (с силой c^2_{43}=(-0,1248)^2)»	disp(z_1)=1,3704; disp(z_2)=3,1244 disp(z_3)=2,7200 disp(z_4)=3,0312	случайное событие, не случайно проводимомое учителем
2	2.0000/9 =%	Смысл(y_2)=«привлечение внимания ученика (с силой c^2_{12}=0,3502^2), разъяснение целей обучения (с силой c^2_{22}=(0,3502)^2) и повторение уже изученного материала (с силой c^2_{32}=1,0000)^2 »	disp(z_1)=1,3704; disp(z_2)=3,1244 disp(z_3)=2,7200	случайное событие, не случайно проводимомое учителем
1	2.0000/9 =%	Смысл(y_1=«усилия учителя по привлечению внимания учеников, проявленные (с силой $c^2$11=(+0,5000)^2) уменьшают объем информации целях обучения (с силой $c^2$21=(-0,1735)^2)»	disp(z_1)=1,3704; disp(z_2)=3,1244	Случайное собы тие, не случайно проводимомое учителем

Моделирование числоых матриц Y_{m9}. Z_{m9} y- и z–отклонений для системы из 9 многосмысловых уравнений по математической модели, где отдельно моделировались матрицы U_{m8} и Y_{m8} [17] такие, что $(1/m)U^T_{m9}U_{m9}=I_{99}, Y_{m9}=U_{m9}\Lambda^{1/2}_{99}$, затем моделировалась матрица $Z_{m9}=Y_{m9}C^{\#}_{99}$. Матрица значений z-переменных $z_1,z_2,z_3,\ldots,z_9$ $Z_{m9}=Y_{m9}C^T_{99}$, $C^T_{99}C_{99}\neq I_{99}$, $C_{99}C^T_{99}=I_{99}$. Легко вычисляется в ЭТ Excel. Матрицы Z_{m9} и Y_{m9} содержат модельные значения неизмеряемых изменчивостей (отклонений от 0), соответствующих неизмеряемым факторам.

Матрица $Y^{(t)}_{m9}$ t=1,…,∝, обеспечивает случайность будущих значений y- и z–отклонений из матриц ($Y^{(t)}_{m9}$, $Y^{(t)}_{m9}$, $Z^{(t)}_{m9}$). В матрице Y_{m9} элементы j–го столбца $y_{1j},y_{2j},\ldots,y_{mj}$ (j-ая y-переменная, j=1,…,9) имеют среднее арифметическое, равное нулю: $(1/m)(y_{1j}+y_{2j}+\ldots+y_{mj})=0$, дисперсию равную λ_j: $(1/m)(y^2_{1j}+y^2_{2j}+\ \ldots+y^2_{mj})=\lambda_j$, j=1,…,9, при этом сумма дисперсий равна 9: $\lambda_1+\ldots+\lambda_9=9$. Матрицы Z_{m9}, Y_{m4} приведены в Таблицах 5 и 6.

Таблица 2. Вид таблицы-программы Оптимизационной задачи: ($I_{99}I_{99}$)=>(C_{99} Λ_{99}) в модели с 9 z-переменными, 9 y-переменными

	c1	c2	c3	c 4	c 5	c 6	c 7	c 8	c 9	
z1	0.5000	0.3502	0.3517	0.3548	0.3548	0.0000	0.3548	0.0000	0.3548	1.0000
z2	-0.1735	1.0093	-0.7165	0.0000	0.0000	-0.1124	0.0000	0.0000	0.0000	1.0000
z3	0.0000	1.0000	0.6000	0.0000	0.0000	-0.0720	0.0000	0.0000	0.0000	1.0000
z4	0.0000	0.0000	-0.1248	1.0000	-0.1259	-0.0063	0.0000	0.0000	0.0000	1.0000
z5	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000
z6	0.0000	0.0000	0.0000	0.0000	-0.0008	1.0000	0.0000	0.0000	0.0000	1.0000
z7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000
z8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000
z9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
	0.2801	2.1414	1.0126	1.1259	1.1418	1.0179	1.1259	1.0000	1.1259	9.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
lam	2.0000	2.0000	2.0000	3.0000	0.0014	-0.0004	-0.0004	-0.0004	-0.0004	9.0000
c31=	0.5		1.00000							
c32=	1					0.01000	1.0000			
c83=	0.6									

Таблица 3. Матрица V^0_{m9} значений равномерно распределенных в интервале [-1;1] случайных чисел

1	-0.4646	-0.4208	-0.4467	0.1822	-0.2373	0.2769	0.1333	-0.3864	0.0935
2	-0.3656	0.1962	0.4569	0.1153	-0.0670	0.4778	-0.2932	-0.2191	0.3926
3	-0.3368	0.1917	0.3552	-0.1805	0.0618	-0.3893	-0.1463	0.3376	0.4593
4	-0.1570	0.1225	-0.4359	-0.1318	0.1613	0.2923	-0.2448	0.1988	-0.0867
5	0.0718	0.1469	0.0877	0.2431	-0.2131	-0.2979	0.1971	0.0891	0.5052
6	0.3425	0.3623	0.0308	0.2562	0.2417	0.2121	0.0968	-0.3223	-0.4161
7	0.0955	-0.1962	0.2034	0.1217	-0.0281	-0.4186	-0.3190	0.1167	0.3185
8	-0.1658	-0.4121	-0.1979	0.2644	0.1127	0.4469	0.4801	-0.4829	-0.0724
9	-0.0629	0.3148	0.3654	0.1067	0.1038	-0.4489	0.2807	0.1633	-0.1883
10	-0.1947	-0.4330	-0.2805	0.0032	0.0166	0.2306	-0.0520	0.1810	-0.3446
11	0.4076	0.1886	-0.2859	0.1268	0.1579	-0.2391	-0.1061	0.1125	0.5347
12	0.0309	-0.0434	0.1004	-0.3163	-0.3782	-0.0021	-0.2861	-0.3691	-0.0586
13	-0.4528	-0.0467	-0.2773	-0.4491	-0.0163	-0.1912	-0.4184	0.0720	-0.1856
14	-0.3211	-0.1485	-0.2774	0.3958	-0.1598	-0.4928	0.3564	-0.0848	0.1128
15	-0.1299	0.4351	0.3378	0.0235	-0.3824	-0.1569	0.4035	-0.1778	-0.1770

16	0.2713	-0.0147	0.0239	0.1041	0.3567	-0.0445	-0.1444	-0.3493	0.0889
17	-0.3582	-0.1107	-0.1700	0.1469	-0.1175	-0.3339	-0.3014	0.4656	-0.1219
18	0.3970	-0.0329	0.0916	-0.3602	0.3165	0.3707	-0.1796	0.3895	0.3278
19	0.1661	0.4212	-0.0267	0.2641	-0.3909	0.3327	-0.1653	-0.0184	-0.1227
20	0.4649	-0.1478	-0.3075	-0.3156	-0.0139	0.3994	0.2066	0.3931	-0.4102
21	0.1232	-0.4835	0.4271	0.1170	-0.0591	-0.0834	0.4382	-0.4040	-0.0930
22	0.3096	-0.4802	0.0736	-0.2280	0.0914	-0.2408	-0.3303	0.0186	-0.3512
23	0.4942	0.4336	0.0309	-0.1383	-0.0294	0.0637	-0.1092	0.4030	-0.2001
24	-0.1651	0.1574	0.1211	-0.3510	0.4725	0.2362	0.5034	-0.1267	-0.0047
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Таблица 4. Матрица U_{m9} u–изменчивостей

	0.0903	0.0857	0.0718	0.0555	0.0495	0.0964	0.0827	0.0812	0.0802
1	0.7436	-0.4153	-0.2281	0.8263	-0.0217	-0.9420	1.3706	-0.3625	2.0095
2	-1.6547	-0.3955	-0.5570	-1.0416	-0.0615	-3.0314	-0.4419	-0.7060	0.0668
3	-0.1563	-0.3558	1.3048	-0.8841	0.1821	-0.6532	0.4381	-1.3537	-1.6002
4	-0.0079	0.9596	0.6762	0.7367	-0.7079	-0.9728	0.9011	1.1771	-0.1553
5	0.6364	-1.2108	-0.0007	1.3483	0.4668	-0.0086	-0.4550	-1.4518	-0.6002
6	-0.8913	2.2394	-0.7031	0.3733	-0.6129	0.3233	-1.7712	0.7499	0.5589
7	-0.7062	-0.1436	-1.0029	-0.1365	1.3096	0.3533	0.5903	-0.9233	-1.0323
8	-0.4792	-0.0704	0.4864	0.5376	0.7314	-0.3152	-0.1884	0.1077	2.4988
9	-1.0271	0.6099	1.0620	-0.5395	-0.9092	1.4050	-0.9401	-0.9941	-0.6371
10	-1.4664	-0.5227	0.2768	-0.0200	-0.2805	0.4192	1.3697	0.9838	0.8270
11	1.3482	0.7469	-0.1792	2.2269	1.4599	-0.1647	-0.2353	-0.1971	-1.1453
12	2.3752	-0.2786	-1.8792	-1.5296	-0.3125	-0.4433	0.2286	0.0168	0.1127
13	1.4911	1.3194	0.3444	-1.2370	-1.0093	-0.2377	1.9748	0.3259	-0.4172
14	0.3818	0.2539	0.4842	1.5332	-0.2301	1.1642	0.7904	-1.6693	0.7257
15	1.0579	-0.7309	0.0497	-0.6717	-1.9640	0.4437	-1.3539	-1.1231	0.2335
16	-0.0022	2.2051	-0.7112	0.0298	1.4642	-0.1022	-0.6050	0.1078	0.0863
17	-1.7507	0.0042	0.1017	0.3932	-0.9960	0.6465	1.8197	-0.3866	-0.7503
18	-0.1891	-1.2273	0.8037	-0.1248	1.6843	-1.0178	-0.3612	1.4192	-1.1554
19	-0.4836	-0.5673	-1.7579	1.0217	-1.6755	-0.8972	-0.8257	0.3564	-0.1007
20	0.5270	-1.8989	0.5679	0.5168	-0.2665	1.0748	-0.1778	2.3089	0.1360
21	-0.4064	-1.1683	-0.4574	-1.3172	1.3044	1.2677	-0.8312	-0.7621	1.3785
22	-0.2544	0.3877	-1.2645	-1.5119	1.0771	1.6560	0.7778	0.8675	-0.2764
23	0.0427	-0.4414	-0.2731	0.4690	-0.8828	0.4983	-1.0187	1.1810	-1.3862
24	0.8717	0.7005	2.8566	-0.9989	0.2506	-0.4659	-1.0556	0.3276	0.6230
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Таблица 5. Матрица Y_{m4} y–изменчивостей

	y 1	y 2	y 3	y4
1	1.0516092	-0.5873	-0.3226	1.4312
2	-2.340099	-0.5593	-0.7877	-1.8041
3	-0.221042	-0.5032	1.8453	-1.5313
4	-0.011172	1.3571	0.9563	1.2760
5	0.9000055	-1.7123	-0.0010	2.3353
6	-1.260489	3.1670	-0.9943	0.6466
7	-0.998718	-0.2031	-1.4183	-0.2364
8	-0.677691	-0.0996	0.6879	0.9312
9	-1.452539	0.8625	1.5019	-0.9344
10	-2.073803	-0.7392	0.3915	-0.0346
11	1.9066427	1.0563	-0.2534	3.8571
12	3.3590401	-0.3940	-2.6576	-2.6493
13	2.1087338	1.8659	0.4871	-2.1425
14	0.5399467	0.3591	0.6848	2.6556
15	1.4960965	-1.0336	0.0703	-1.1634
16	-0.003111	3.1185	-1.0058	0.0516
17	-2.475864	0.0059	0.1438	0.6810
18	-0.267428	-1.7357	1.1366	-0.2162
19	-0.683914	-0.8023	-2.4860	1.7696
20	0.7452905	-2.6855	0.8031	0.8951
21	-0.574736	-1.6522	-0.6469	-2.2815
22	-0.359776	0.5483	-1.7883	-2.6187
23	0.0603869	-0.6242	-0.3862	0.8123
24	1.23277	0.9907	4.0398	-1.7301
	5.893E-06	0.0000	0.0000	0.0000
	1.9999915	2.0000	2.0000	3.0000

Таблица 6. Матрица Z_{m9} z–изменчивостей

	z 1	z 2	z 3	z 4	z 5	z 6	z 7	z 8	z 9
1	0.7145	-0.5441	-0.7809	1.4715	0.0000	0.0000	0.0000	0.0000	0.0000
2	-2.2831	0.4058	-1.0319	-1.7058	0.0000	0.0000	0.0000	0.0000	0.0000
3	-0.1811	-1.7916	0.6040	-1.7616	0.0000	0.0000	0.0000	0.0000	0.0000
4	1.2588	0.6865	**1.9308**	**1.1566**	**0.0000**	0.0000	0.0000	0.0000	0.0000
5	0.6787	-1.8837	**-1.7129**	**2.3355**	**0.0000**	0.0000	0.0000	0.0000	0.0000
6	0.3585	4.1276	**2.5704**	**0.7707**	**0.0000**	0.0000	0.0000	0.0000	0.0000
7	-1.1532	0.9845	**-1.0541**	**-0.0594**	**0.0000**	0.0000	0.0000	0.0000	0.0000
8	0.1986	-0.4758	0.3132	0.8453	0.0000	0.0000	0.0000	0.0000	0.0000
9	-0.2276	0.0465	1.7637	-1.1219	0.0000	0.0000	0.0000	0.0000	0.0000
10	-1.1704	-0.6668	**-0.5043**	**-0.0835**	**0.0000**	0.0000	**0.0000**	0.0000	**0.0000**

11	2.6028	0.9169	0.9042	3.8887	0.0000	0.0000	-0.0001	0.0000	0.0000
12	-0.3333	0.9238	-1.9886	-2.3177	0.0000	0.0000	0.0000	0.0000	0.0000
13	1.1188	1.1686	2.1581	-2.2034	0.0000	0.0000	0.0000	0.0000	0.0000
14	1.5789	-0.2219	0.7699	2.5701	0.0000	0.0000	0.0000	0.0000	0.0000
15	-0.0020	-1.3532	-0.9915	-1.1722	0.0000	0.0000	0.0000	0.0000	0.0000
16	0.7550	3.8687	2.5150	0.1771	0.0000	0.0000	0.0000	0.0000	0.0000
17	-0.9436	0.3324	0.0922	0.6631	0.0000	0.0000	0.0000	0.0000	0.0000
18	-0.4184	-2.5198	-1.0537	-0.3580	0.0000	0.0000	0.0000	0.0000	0.0000
19	-0.8693	1.0901	-2.2939	2.0799	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0324	-3.4152	-2.2036	0.7949	0.0000	0.0000	0.0000	0.0000	0.0000
21	-1.9030	-1.1044	-2.0403	-2.2007	0.0000	0.0000	0.0000	0.0000	0.0000
22	-1.5461	1.8971	-0.5247	-2.3955	0.0000	0.0000	0.0000	0.0000	0.0000
23	-0.0360	-0.3638	-0.8560	0.8605	0.0000	0.0000	0.0000	0.0000	0.0000
24	1.7702	-2.1084	3.4146	-2.2344	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	**0.0000**	**0.0000**	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000
	1.3704	**3.1244**	**2.7200**	**3.0312**	0.0000	0.0000	0.0000	0.0000	0.0000

Визуализация знаний о «весах» и z-, y-изменчивостях в модели с 9 z-переменными, 9 y-переменными

Точки на Рисунках 1-8 показывают взаимные динамики “скачки-падения» точек переменных из 9 числовых уравнений. Визуализация динамик факторов ситуаций отличается от визуализаций динамик факторов из других предметных областей [1-17]. Рисунки 1-8 визуализируют формулы, числовые параметры, приведенные в Таблице 4. Извлеченные знания из 9 показателей (ситуаций) педагогического мастерства учителя.

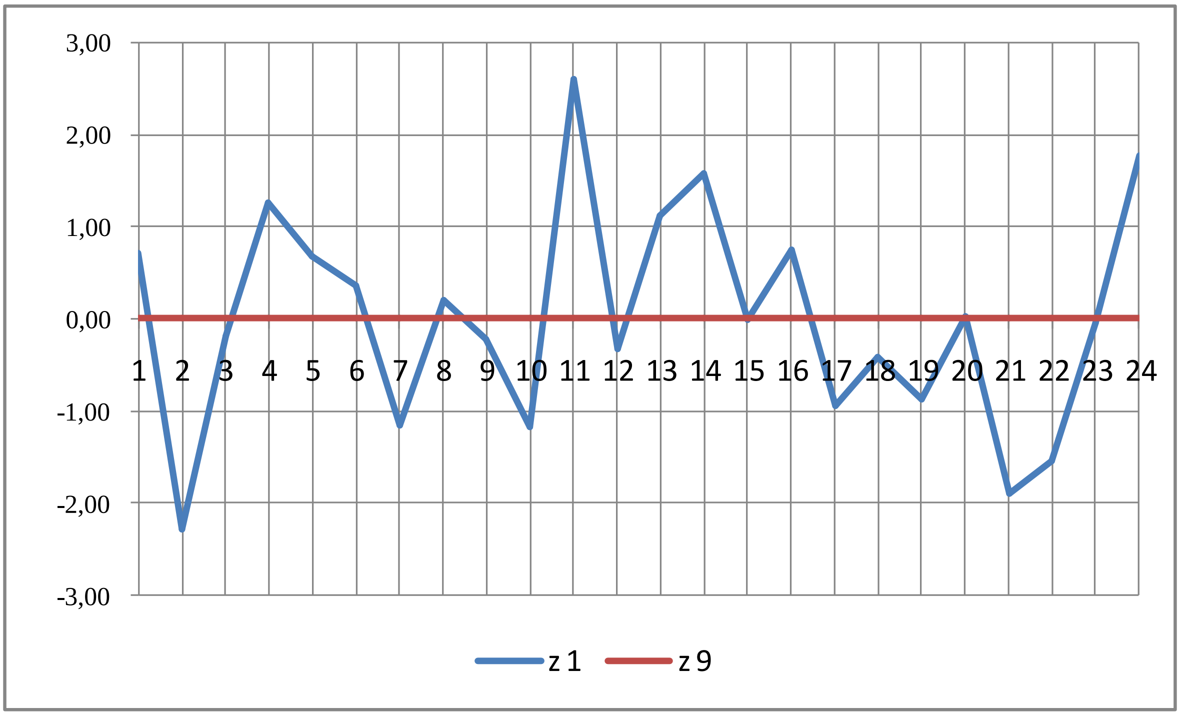

Рисунок 1. Взаимная динамика 2-х изменчивостей z_1, z_9, влияющих на постоянную динамику y-изменчивости фактора y_9 со смыслом «»

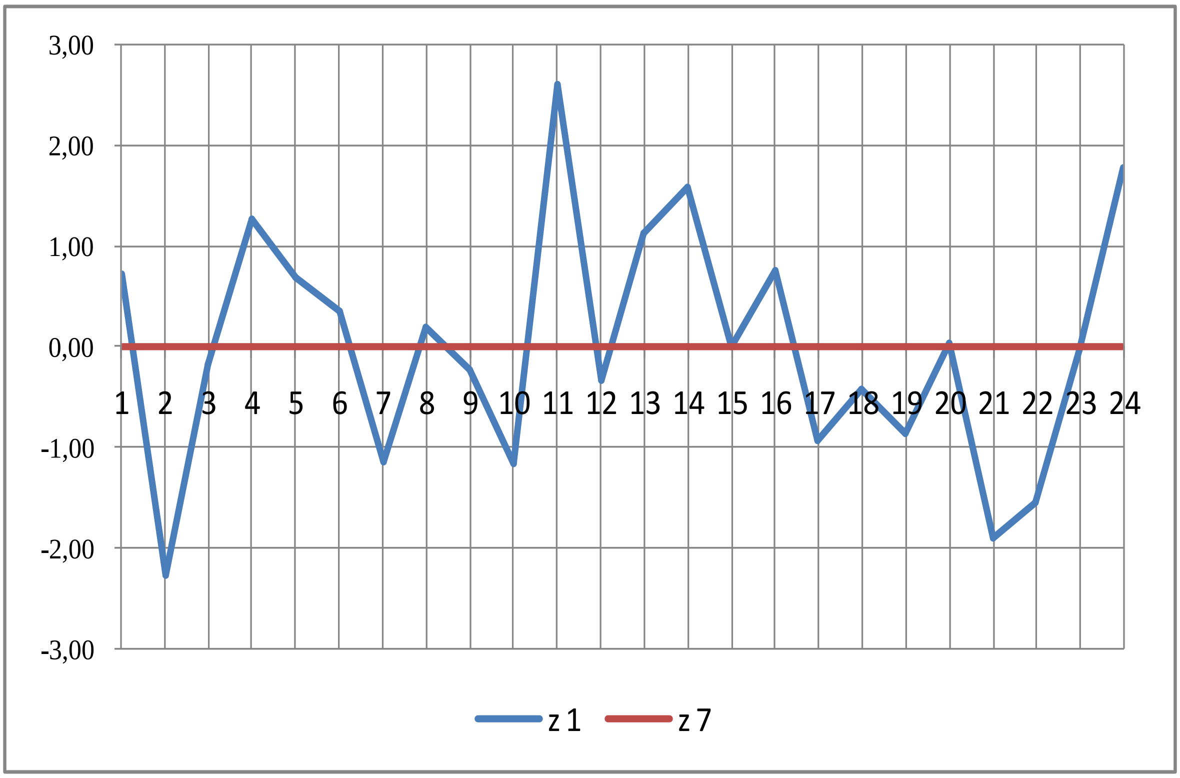

Рисунок 2. Взаимная динамика 2-х изменчивостей z_1, z_7, влияющих на постоянную динамику у-изменчивости фактора y_7 со смыслом «»

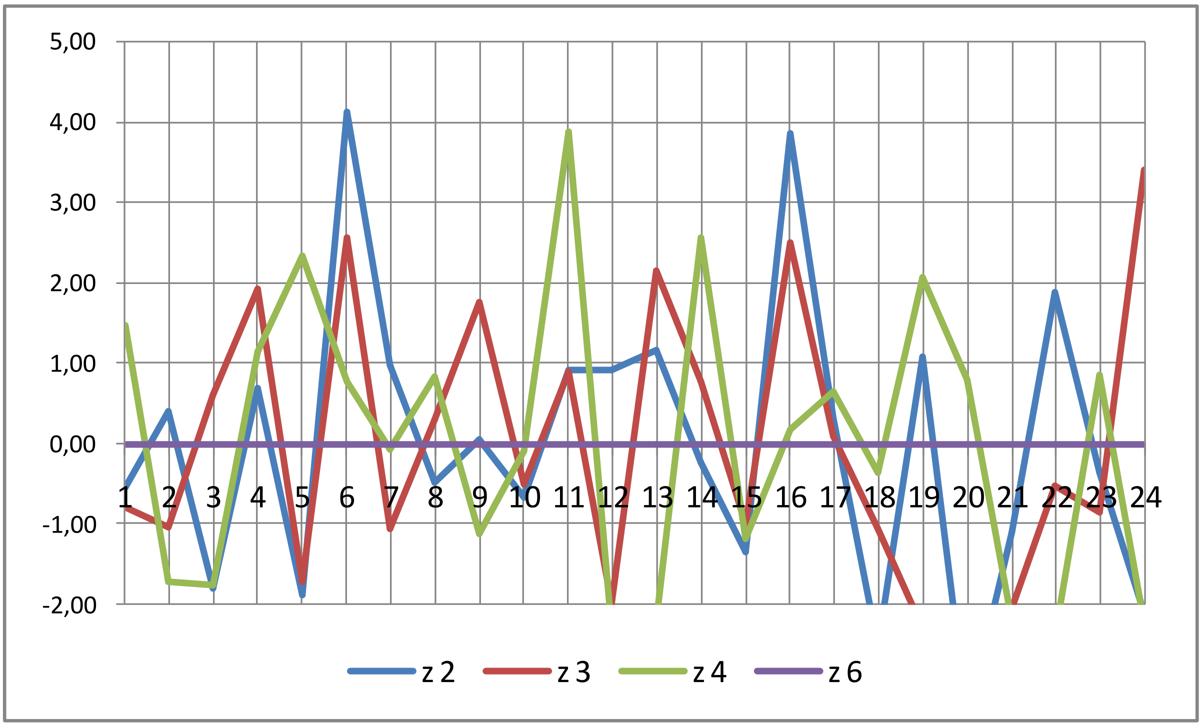

Рисунок 3. Динамика 4-х изменчивостей z_2, z_3, z_4, z_6 , влияющих на постоянную динамику у-изменчивости фактора y_6 со смыслом «»

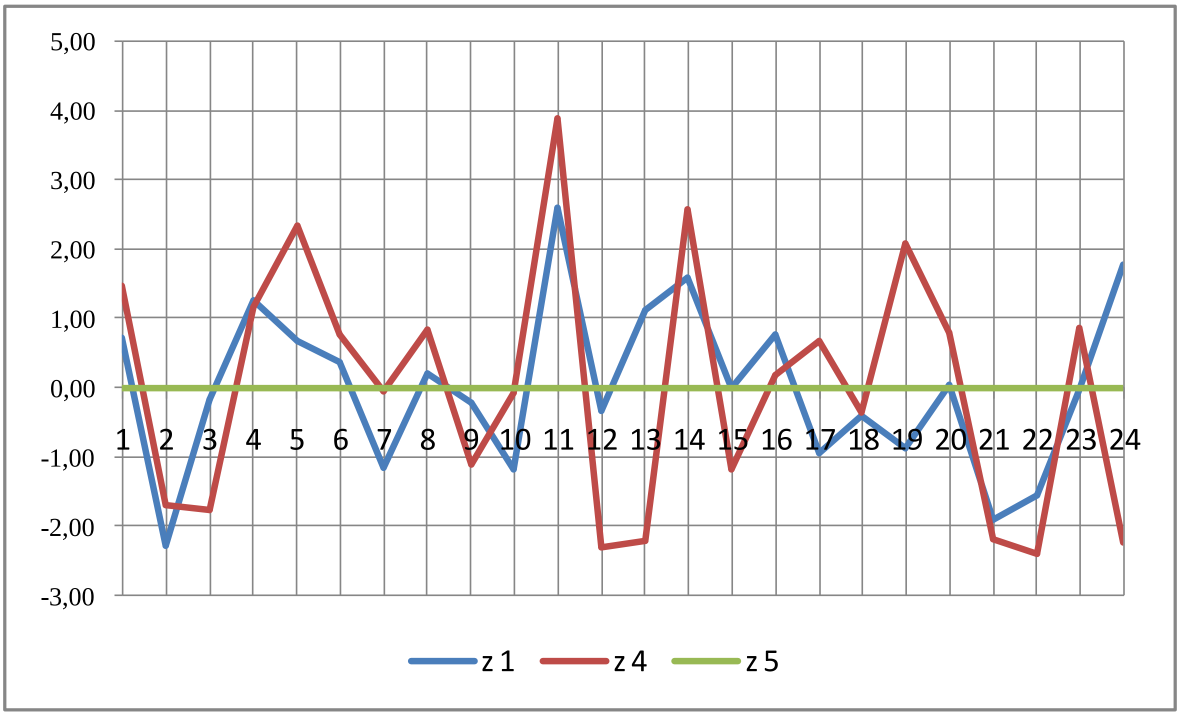

Рисунок 4. Взаимная динамика 3-х z -изменчивостей z_1, z_4, z_5, влияющих на на постоянную динамику y-изменчивости фактора y_5 со смыслом «»

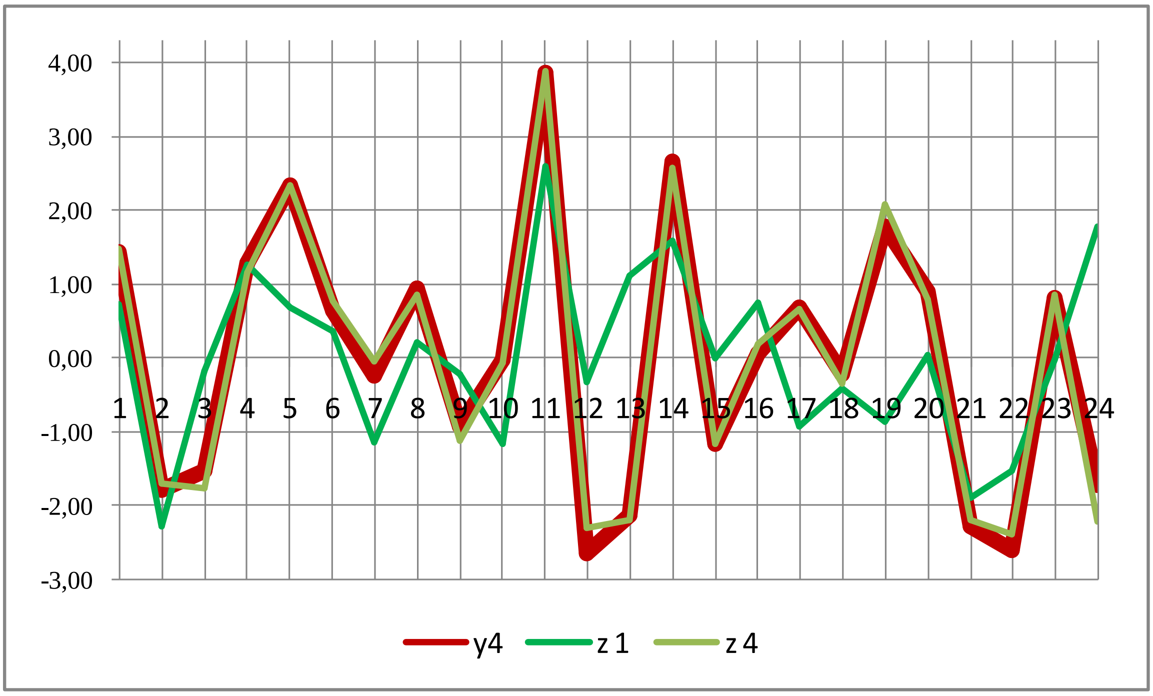

Рисунок 5. Совпадающая динамика 2-х изменчивостей , z_6, z_6 влияющих на случайную динамику y-изменчивости фактора y_4 со смыслом «»

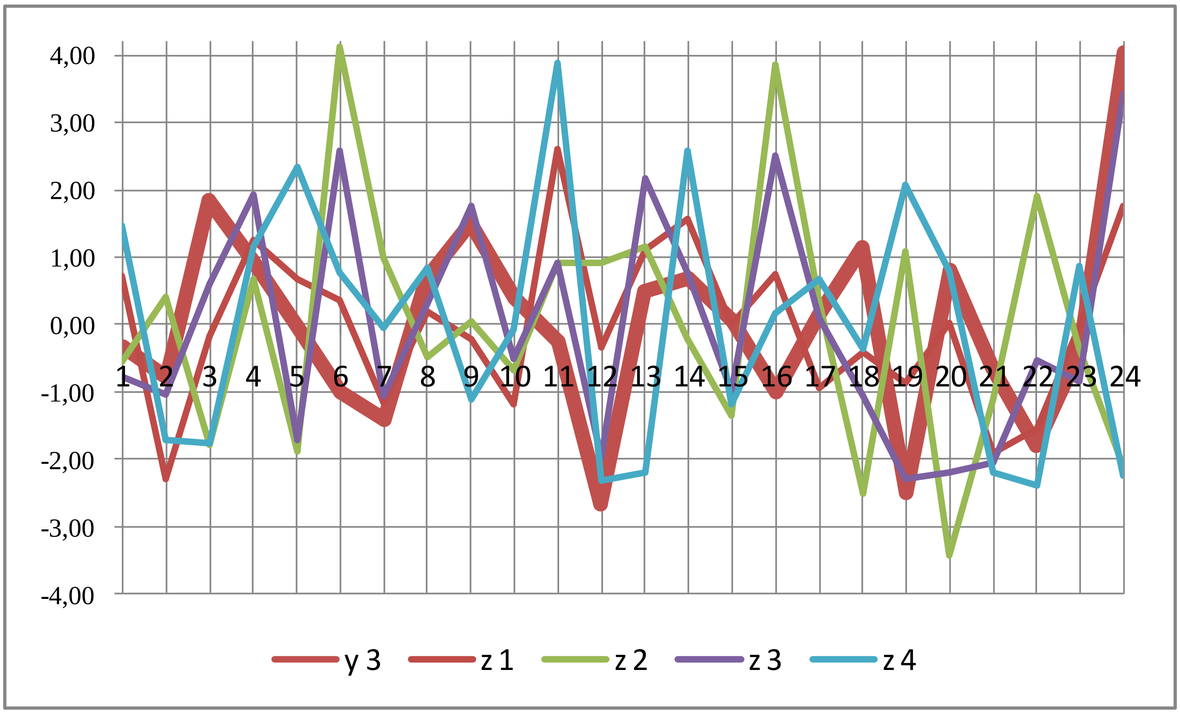

Рисунок 6. Взаимная динамика y-изменчивости фактора y_3 («состояние моря, зависящая от желаний старухи») и 3-х z-изменчивостей факторов z_1,z_2,z_3, z_4

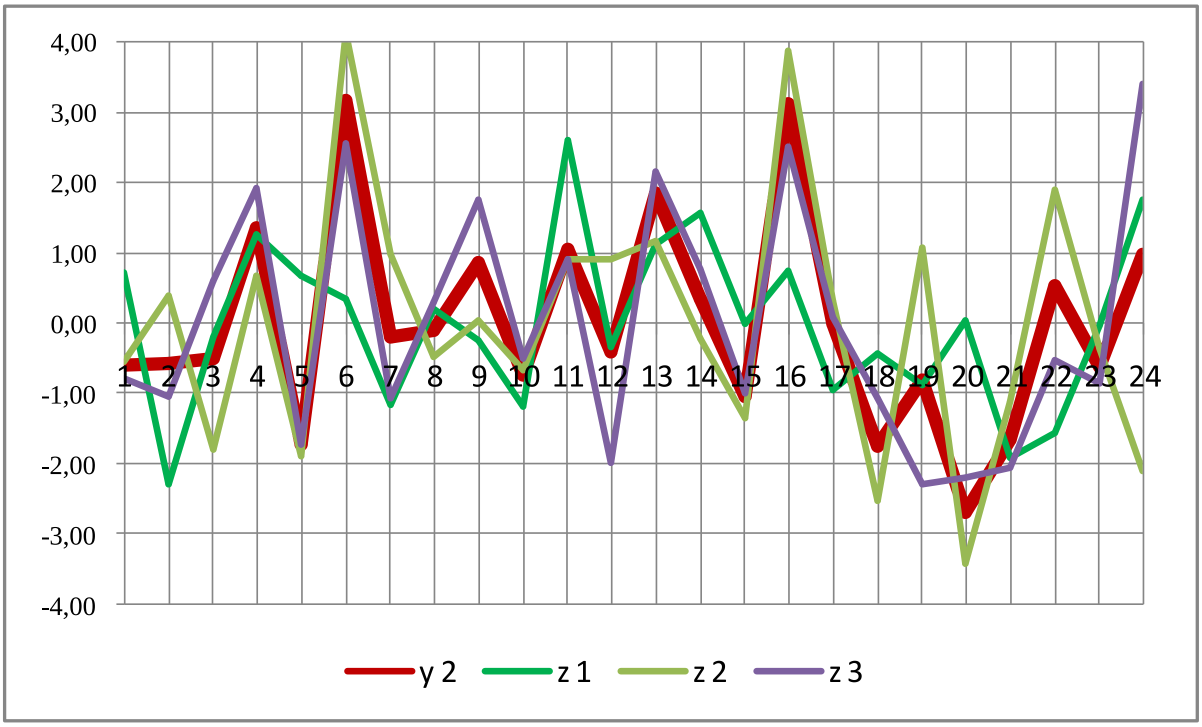

Рисунок 7. Взаимная динамика y-изменчивости фактора y_2 и 3-х z-изменчивостей факторов z_1, z_2,z_3, влияющих на случайную динамику z-изменчивости фактора y_2 со смыслом «»

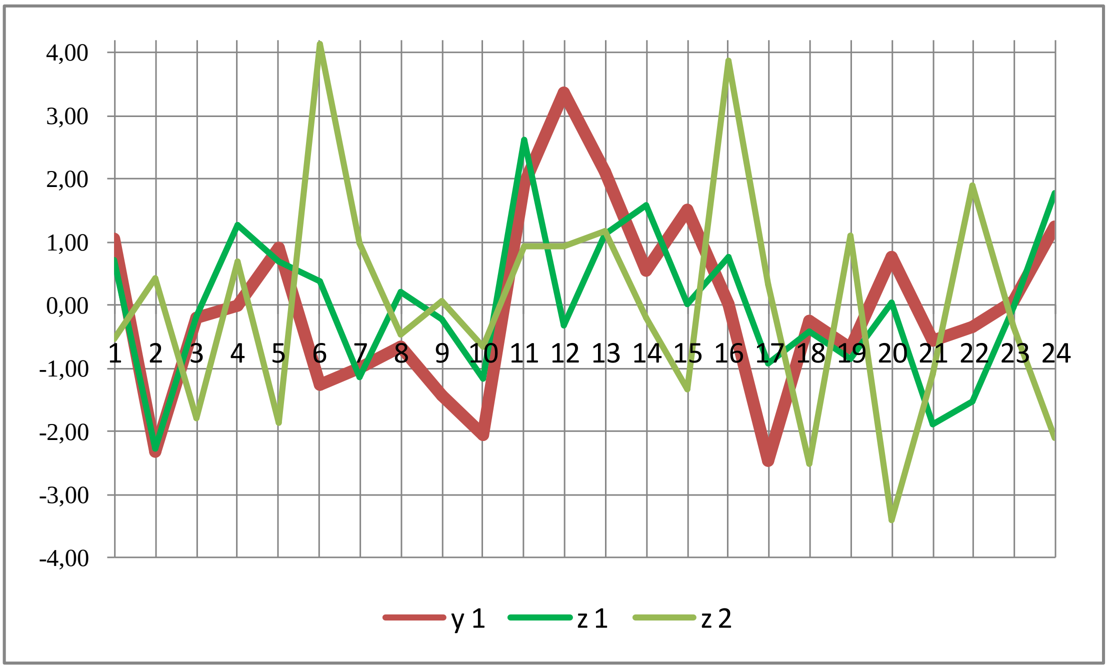

Рисунок 8. Взаимная динамика 2 изменчивостей z –факторов, влияющих на на случайную динамику изменчивости y-фактора y_1 с новым смыслом «о»

смысл(y_1)=смысл(z_1)*0,5000+смысл(z_2)*(-0,1735);

смысл(z_1)=«привлечение внимания (признак учителя)

2. смысл(z_2)=«информирование учеников о целях обучения (признак учителя)

Проводим конструирование суммарной фразы для неизвестной семантической переменной новый_смысл(y_1). Дисперсия переменной равна disp(λ_1)=2.0000, поэтому мы ожидаем в фразе смысла смысл(y_1) большего объема информации, сможем ли мы преобразовать ее в знания? В анализируемом уравнении присутствуют 2 смысла 2-х z–переменных: «привлечение внимания (признак учителя» (с силой c^2_{11}=0.5000^2, смысл(z_1)), «информирование учеников о целях обучения (признак учителя» (с силой c^2_{21}=(-0,1735)^2, смысл(z_2)). Объединение 2-х смыслов возможно выразить следующей фразой. Усилия учителя по привлечению внимания учеников, проявленные (с силой c^2_{11}=(+0,5000)^2) уменьшают объем информации о целях обучения (с силой c^2_{21}=(-0,1735)^2). Это новое событие, проявляемое через смысл y–переменной y_1, имеет долю =2\9=22% информации, она должна проявляться не постоянно, а быть случайным событием, не случайно проводимом учителем – обладающим педагогическим мастерством. смысл(y_1)=«Усилия учителя по привлечению внимания учеников, проявленные (с силой c^2_{11}=(+0,5000)^2) уменьшают объем информации о целях обучения (с силой c^2_{21}=(-0,1735)^2)». Эти отрицания присутствуют при других слагаемых в смыслах других y–переменных: смысл(z_2)*-0,7165), смысл(z_2)*(-0,1124). Фраза об уменьшают объем информации «о целях обучения» содержится в фразах смыслов y–переменных y_3, y_6, y_1. Она дополняет другие обоснованные факты. Смысловые уравнения вида смысл(y_1)==смысл(z_1)*0,5000+смысл(z_2)*(-0,1735), смысл(y_6)=смысл(z_2)*(-0,1124)+ смысл(z_3)*-0,0720)*+смысл(z_4)*(-0,0063)+ смысл(z_6)*1,0000,
смысл(y_3)=смысл(z_1)*0,3517+смысл(z_2)*(-0,7165)+ смысл(z_3)*0,6000+ смысл(z_4)*(-0,1248).

Предупреждает учителя о необходимости уменьшения объема информации о целях обучения. В других предметных областях [2-9] такого не было.

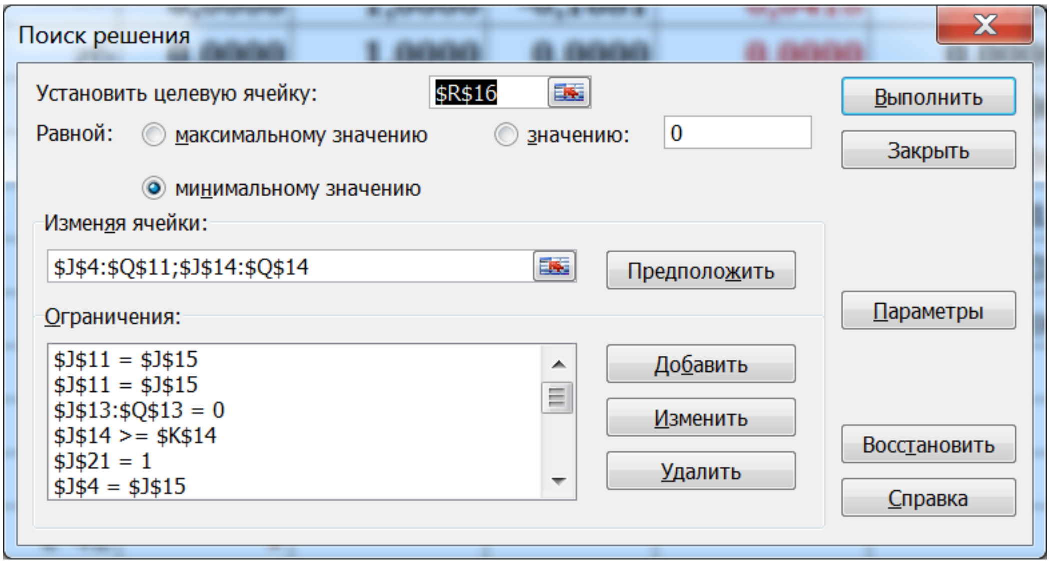

Рисунок 9. Окно надстройки «Поиск решения» с операторами таблицы-программы решения оптимизационной Задачи: $(I_{88},I_{88})=>(C_{88}, \Lambda_{88})$

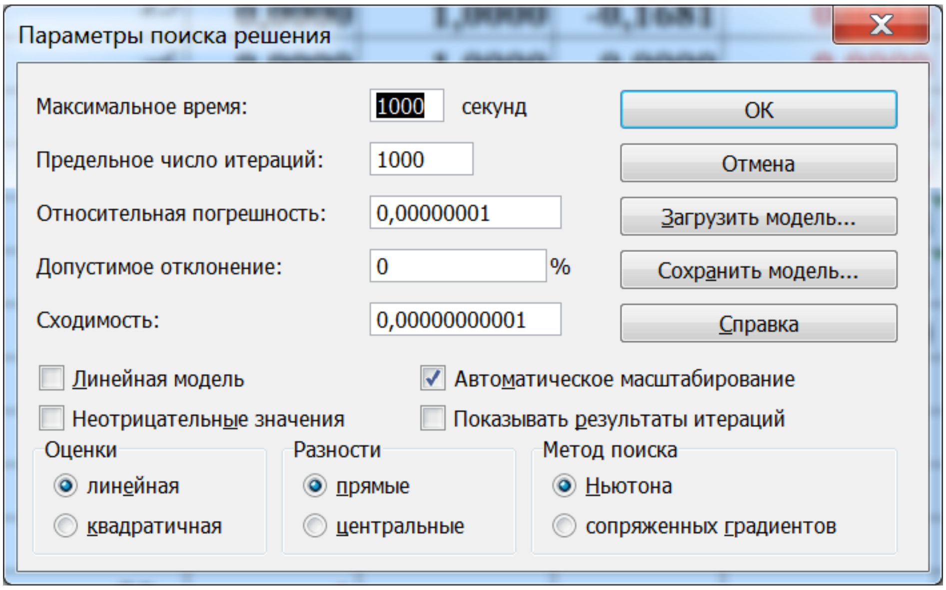

Рисунок 10. параметры поиска решения (C_{88}, Λ_{88}) в таблице-программе решения оптимизационной Задачи: $(I_{88},I_{88})=>(C_{88}, \Lambda_{88})$

Заключение

Выше разработана Когнитивная модель педагогического мастерства учителя. Введены смысловые, числовые переменные. Введены числовые коэффициенты-измерители величин сил взаимосвязей между переменными. Найдены (смоделированы) числовые значения отклонений от 0 вправо\влево изменчивости z_{ik} z-переменных, умноженных на «веса» c_{kj}. Сумма произведений $z_{ik}c_{kj}$, k=1,…, 9, образует новую y-переменную, при j=1,…, 9 y-переменные образуют некоррелированное множество y-переменных. Найдены смыслы этих y-переменных, являющихся извлеченными скрытыми знаниями об факторах педагогического мастерства учителя, обучающего учеников в рамках исходных 9 z-события. К ним модель добавила (познала) еще 9 z-событий. Новее y-события количественно и по смыслам обоснованы. Проявления событий реализованы, обоснованы их формульное, фразеологическое, визуализированное на графиках описания поведений кривых соответствует ожидаемому. Разработана система из 9 смысловых уравнений с 18 семантическими переменными: смысл(y_1),…, смысл(y_9), смысл(z_1),…,смысл(z_9), удовлетворяющих матричному смысловому равенству вида смысл(Z_{m9})=смысл($Y_{m9}C^T_{99}$), где смысл(Z_{m8})= смысл(z_1)⊕…⊕смысл(z_8), смысл($Y_{m4}\mathbf{C}^{\#}_{\mathbf{48}}$)= смысл($Y_{m9}\mathbf{c}^T_{\mathbf{1}}$)⊕смысл($Y_{m9}\mathbf{c}^T_{\mathbf{2}}$)⊕…⊕ смысл($Y_{m9}\mathbf{c}^T_{\mathbf{9}}$). Этому матричному смысловому равенству соответствует матричное равенство для числовых z-, y-переменных, смоделированных в виде матриц: $Z_{m9}=Y_{m9}C^T_{99}$. Девять семантические решения–знния (новые извлеченные знания), познают смыслы, парные связи, силы проявлений 13 семантических переменных. Визуализация взаимных динамик кривых (значений изменчивостей z-, y-переменных из матриц Z_{m8},Y_{m9}) знаний о «весах» (из C_{99}) и z-, y-изменчивостях в модели с 9 z-переменными, 9 y-переменными показала динамики модельных значений неизмеряемых показателей [2-17] проявлений мастерства учителя. Введенные в модель переменные наделены математическими и статистическими свойствами, а параметры постоянны. Они смоделированы в Оптимизационной Задаче и зависят от количеств переменных и от значений 3-х индикаторов. Как некоррелированные (y-), так коррелированные (z-) изменчивости умножаются на свои «веса» - силы проявления фактора. Получены интересные знания после визуализации.

Самым информативным является найденное событие y_4. Смысл(y_4)=«представление нового учебного материала (с силой $c^2_{44}=(1{,}0000)^2$), проводится учителем с привлечением внимания ученика (с силой $c^2_{14}=0{,}3548^2$)». Информативны еще 3 события: смысл(y_3)=«повторение уже изученного материала (с силой $c^2_{33}=0{,}6000$), проведенное учителем с уменьшением сил проявления 3-х факторов: а)сведений целях обучения (с силой $(-0{,}7165)^2$), б)представления нового учебного материала (с силой $c^2_{43}=(-0{,}1248)^2$)»;

смысл(y^2)=«привлечение внимания ученика (с силой $c^2_{12}=0{,}35022$), разъяснение целей обучения (с силой $c^2_{22}=(0{,}3502)^2$) и повторение уже изученного материала (с силой $c^2_{32}=1{,}0000)^2$)»; смысл(y_1=«усилия учителя по привлечению внимания учеников, проявленные (с силой $c^2_{11}=(+0{,}5000)^2$) уменьшают объем информации о целях обучения (с силой $c^2_{21}=(-0{,}1735)^2$)».

Изложенную структуру ситуаций, в которых модель познала неизвестные скрытые знания, можно применить для субъектов (профессор, студент), если измененить исходные данные –z-ситуации для учителя заменить на z-ситуации, присущие университетам.

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