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NAMANGAN INSTITUTE OF CIVIL ENGINEERING

FACULTY OF TRANSPORT

DEPARTMENT OF "VEHICLE ENGINEERING"

Electronic educational and methodical complex for the academic discipline "FUNDAMENTALS OF SCIENTIFIC RESEARCH AND INNOVATION"

for students of all specialties

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CONTENT

SECTION 1 ORGANIZATION OF RESEARCH WORK IN THE REPUBLIC OF UZBEKISTAN

Topic 1.1 Organizational structure of science

In a market economy, there is a radical restructuring of science associated with the creation of competitive products, the transformation of science into the leading force of material production. The need for a scientific approach in the production of goods, economics and politics, the management environment and the education system forces science to develop at a faster pace than any other field of activity.

The direct management of scientific research in the country is carried out by a special governing body – the State Committee for Science and Technology of the Republic of Uzbekistan (SCNT).

SCNT is a republican governing body that conducts state policy, regulates and directs in the field of science, technology and informatization. The main tasks of the SCNT are:

- development and implementation of state policy in the field of science, technology and informatization;
- coordination of the activities of ministries and other republican governing bodies, associations, organizations and institutions in the field of scientific, scientific-technical, innovation and informatization, as well as international cooperation in these areas;
- implementation of a unified state policy in the field of international scientific and technical cooperation;
- ensuring control over the implementation of the legislation of the Republic of Uzbekistan on science and technology, as well as the use of public funds allocated to finance science;
- organizational and economic regulation of science and technology;
- improving the structure of the scientific and technical potential of the republic and increasing the efficiency of its use.

The highest scientific institution of the Republic of Uzbekistan is the National Academy of Sciences, which carries out fundamental scientific research in the field of social and natural sciences and coordinates such research in all scientific institutions and higher educational institutions of the country.

The Academy, founded in 1992, as of 2002, had 54 scientific organizations, 9 independent self-supporting design bureaus and experimental productions, 180 independent innovative enterprises.

The work of the Academy is supervised by the President and the selected collective body – the Presidium. The Academy conducts scientific and methodological guidance of its institutions through six departments:

- physics, mathematics and computer science;
- physical and technical sciences;
- chemical sciences and Earth Sciences;
- biological sciences;
- medical and biological sciences;
- humanities and arts.

Topic 1.2 Organization of research work in universities

A significant amount of scientific research is carried out by higher educational institutions of the country. One of the advantages of universities in carrying out scientific research over other scientific organizations is the presence of scientists and specialists of various profiles in their composition, which allows for comprehensive research at the junction of scientific disciplines, to ensure the mobility of research teams.

The academic staff, which is the main core of the higher school, is involved in the implementation of scientific research at the university. In universities that ensure high efficiency of scientific research in relevant areas, scientific institutions are organized – problem research laboratories, and in some cases independent scientific institutions (research institutes).

Departments, problem laboratories and research institutes develop mainly fundamental and search topics. Applied research is carried out, as a rule, by the teaching staff in their free time from their main work on the basis of business contracts with organizations and enterprises. To perform contractual work, departments have the right to attract additional full-time employees, part-timers, teaching and support staff, graduate students and students.

For the organization of contractual scientific research in higher education institutions, research sectors (NIS) or research units (R&D) are created. They monitor the timeliness and quality of the research performed, the correctness of financial calculations.

The concentration of scientific research in departments, in scientific institutions of higher education institutions under the guidance of highly qualified scientists with simultaneous preparation of a scientific shift through postgraduate studies, the ability to select and leave the most talented graduates in universities, creates favorable conditions for the formation of scientific schools in higher education institutions with high authority in the relevant fields of knowledge.

The tasks put forward by modern production to engineering personnel are so complex that their solution requires creative search, research skills. In this regard, a modern specialist should possess not only the necessary amount of fundamental and special knowledge, but also certain skills for creative solution of practical problems, constantly improve their qualifications, quickly adapt to changing conditions. Their formation begins at the university through the participation of students in research work.

Topic 1.3 Training and advanced training of scientific and engineering personnel

In our country, the main direction of improving the personnel policy in recent years is not so much a quantitative increase in the number of scientists, but rather an increase in the level of their training. The main source of replenishment of scientific personnel are specialists with higher education – up to 10% of university graduates are involved in the field of science.

One of the forms of training of scientific personnel is a master's degree, which is opened at higher scientific institutions. Master's degree studies are carried out on the basis of "Regulations on the multilevel system of higher education in the

Republic of Uzbekistan". This regulation defines the general provisions, requirements for training and certification for obtaining an academic degree "master". Master's degree training is carried out with in order to meet the need for specialists with in-depth scientific, technical and theoretical training, primarily to replenish scientific and scientific-pedagogical personnel, as well as senior managers and improve the educational level of specialists. The Master's degree program provides research and general education training. The general education part provides special natural science and humanities knowledge, increases the degree of proficiency in a foreign language, deepens the professional level of education. The research part is aimed at preparing the student for further scientific, teaching or managerial work by mastering modern methods of solving relevant tasks. The results of scientific research at the end of training are issued in the form of a master's thesis. The duration of the master's degree is one year.

The most important form of training of research specialists is postgraduate studies, which are opened at higher educational institutions and research institutes that have highly qualified scientists who are able to provide guidance to graduate students. Training of personnel through postgraduate studies is carried out in the specialties of researchers, the nomenclature of which is developed by the Higher Attestation Commission of the Republic of Uzbekistan. Postgraduate studies are carried out on-the-job (full-time for 3 years) and on-the-job (part-time for 4 years). Specialists under the age of 35 are accepted to full–time postgraduate studies, and up to 45 years are accepted to correspondence courses. For admission to graduate school, it is necessary to pass entrance exams, and in the process of studying, graduate students take candidate exams.

A supervisor is approved for each of the applicants to the postgraduate course, who advises the graduate student and monitors the progress of the individual plan approved by the Council of the university (faculty) or scientific institution. The topic of the dissertation work is approved for each graduate student.

After the completion of the development of the dissertation topic, a dissertation is issued, which is subject to protection in a specialized council. Such councils are organized by the Higher Attestation Commission under the Council of Ministers of Belarus (HAC) in scientific institutions and higher educational institutions with highly qualified personnel of scientists of the relevant profile. The defense of a dissertation is recognized as successful if, as a result of a secret ballot, more than 50% of the members of the council who participated in the defense voted for the award of the desired academic degree.

The Higher Attestation Commission also considers proposals from the Councils of Scientific Institutions and makes decisions on awarding academic titles of associate professor and professor.

In order to increase the effectiveness of the development of topical problems of science, technology and culture, to improve the training of highly qualified scientific, pedagogical and scientific personnel - doctors of sciences – a number of organizations operate doctoral studies as the highest level in the unified system of continuing education in the country. Doctoral studies are organized at leading

universities, scientific institutions and organizations with highly qualified scientific personnel and the necessary research and experimental base. Candidates of sciences under the age of 40 with scientific achievements who have proved themselves promising scientific and pedagogical workers are sent to it. Training of specialists in it is carried out for up to three years only on the job. Doctoral students, if necessary, can be sent to leading domestic and foreign research centers. In modern conditions, the systematic replenishment and updating of specialists' knowledge is an extremely important task. To this end, a system of advanced training has been formed in our country, consisting of advanced training institutes subordinate to the relevant line ministries and departments, and advanced training faculties organized mainly in higher educational institutions.

Every specialist of the republic is obliged to go through the professional development system once every five years and update their knowledge. Highly qualified specialists of the national economy, professors and university teachers teach at such institutes and faculties.

To train and retrain the top management of the national economy at the level of ministries, industrial associations, heads of large industrial enterprises, the Academy of Management under the President of the Republic of Uzbekistan has been organized with a training period of up to two years.

Topic 1.4 International scientific cooperation

The Republic of Uzbekistan has signed intergovernmental agreements on cooperation in the field of science and technology with 26 countries of the world, including Great Britain, Germany, India, China, Russia, the USA, Japan and others. The Republic of Uzbekistan was elected to the UN Commission on Science and Technology for Development, is a member of the European Organization for Nuclear Research, participates in the work of the Joint Institute for Nuclear Research in Dubna (Russia), joined the International Scientific and Technical Center.

Scientists and scientific organizations of the Republic of Uzbekistan take an active part in scientific programs of the European Union, such as COPERNICUS-2, INTAS, TACIS, ESPRIT, TEMPUS. These programs work within the framework of the European Scientific Space (EPP). It was created with the aim of providing the most favorable conditions for conducting scientific research in Europe, increasing the effectiveness of scientific research and strengthening innovation processes in Europe. The main task of the EPP is to ensure the most effective use of the scientific potential and material resources of the countries of the European Union (EU), taking into account their accumulated experience and achievements on the basis of the close relationship of European and national scientific policy, the exchange of knowledge and information, as well as the free movement of scientists within the borders of the EU countries.

The main incentive for the creation of EPP programs was the fact that the investments of the USA and Japan in scientific and technological development significantly exceed similar indicators of the EU countries and this gap is constantly increasing not in favor of Europe. Currently, the share of scientific research in the EU countries averages 1.8% of the European gross domestic

product (for comparison: in the USA, the same indicator is 2.8%, in Japan 2.9%). This is due to the fragmentation and unsatisfactory coordination of national and European programs.

According to the EU executive body, the European Commission, in order to remedy the current situation, it is necessary to combine the resources of the EU countries, in each of which the national scientific policy will be reformed in accordance with a single European standard. The Committee on Industry, Foreign Trade, Scientific Research and Energy of the EU called on the governments of the EU states to make efforts to ensure that at least 3% of the gross domestic product is directed to scientific research. Members of the Committee are particularly concerned that EU countries do not recognize diplomas of other states and create unnecessary legislative barriers to obtaining patents. The field of activity of the unified scientific space is very extensive in the future, so there is a place not only for EU member states.

A special role is assigned to countries with developing and transition economies. As for the CIS countries, a twofold goal is pursued here: firstly, to stabilize the scientific potential of these states, and secondly, to contribute to solving problems of mutual interest in the field of energy, non-proliferation of weapons, improving public health and ensuring environmental safety, including nuclear. The stabilization of the potential of the research sphere is based on more close cooperation and intensification of mutual exchange with the scientific communities of the EU, primarily with the help of INTAS (International Association for the Promotion of Cooperation with Scientists from the Newly Independent States of the Former Soviet Union). INTAS programs and competitions promote fundamental and applied research in all scientific fields on the basis of joint activities with more than 40 countries.

The practical creation of the EPP began with the implementation of the Sixth EU Framework Program 2002 – 2006. All her research areas are subordinated to the main goal – the unification of European science. The methods of implementation of the program are designed to provide maximum support to business, academia and research institutes. Thus, the creation of a favorable scientific and technological climate in Europe was initiated with the aim of transforming it into a world center of scientific research.

SECTION 2 METHODOLOGICAL FOUNDATIONS OF SCIENTIFIC KNOWLEDGE AND CREATIVITY

Topic 2.1 Basic methods of theoretical and empirical research

Scientific research cannot be carried out chaotically, randomly. It must have a certain system and obey a pre-developed plan. The guideline indicating the way to obtain a positive result is the research method.

A method is a way to achieve a goal, which is a program for the construction and practical application of theory. Various methods of scientific cognition, including those characteristic of research in the field of transport technology, are conditionally divided into a number of levels: empirical, experimental-theoretical, theoretical and metatheoretical.

Empirical level methods are specifically related to the phenomena under study and are used at the stage of forming a scientific hypothesis. Among them:

– observation is a way of cognition of the objective world, based on the direct perception of objects and phenomena with the help of the senses without interference in the process by the researcher;

– comparison is the establishment of a distinction between objects of the material world or finding common things in them, carried out both with the help of sensory organs and with the help of special devices;

– counting is finding a number that determines the quantitative ratio of the same type of objects or their parameters that characterize certain properties;

– measurement is the physical process of determining the numerical value of a certain quantity by comparing it with a standard.

Methods of experimental-theoretical level help the researcher to discover certain reliable facts, objective manifestations in the course of the studied processes. With their help, facts are accumulated and cross-checked. Theoretical processing of facts requires not only their collection, but also systematization, when non-random dependencies are revealed between them, causes and consequences are determined. The initial systematization of facts and their analysis are carried out by methods of the empirical level. Selection, classification, comprehension of the perceived material are carried out by methods of experimental and theoretical level. The methods of the experimental-theoretical level include: experiment, analysis and synthesis, induction and deduction, analogy, modeling, hypothetical and historical methods.

An experiment is one of the spheres of human practice in which the truth of hypotheses put forward is tested or patterns of the objective world are revealed. In an experiment, in contrast to observation, the researcher intervenes in the process being studied for the purpose of cognition. This makes it possible to study phenomena in a "pure form" by eliminating side factors. If necessary, the tests can be repeated and organized in such a way as to examine individual properties of the object, and not their totality. At the same time, some conditions of experience are isolated, others are excluded, and others are strengthened or weakened;

Analysis (analytical method) is a method of scientific cognition, which consists in the mental dismemberment of the object of research into its component parts or the allocation of its inherent features or properties for studying them separately. The analysis allows you to get into the essence of the individual elements of the object, as well as to establish the types of connections and ways of interaction between them.

Synthesis is a research method involving the consideration of a group of objects as a whole, taking into account the relationship of all its components and its inherent features. The synthesis method is typical for the study of complex systems after analyzing all its components. Therefore, analysis and synthesis are interrelated and complement each other.

The inductive method consists in the fact that from the observation of particular individual cases one comes to general conclusions, and from individual facts – to generalization. The essence of the method consists in transferring

properties from known facts and objects to unknown, yet unexplored ones. For example, from observations that recorded the expansion of iron, copper and tin when heated, a general conclusion is made that all metals expand when heated.

The deductive method is based on the derivation of particular provisions from general rules, laws, judgments. For example, in theoretical mechanics, particular dependencies are derived from general laws or axioms.

The method of induction is most common in the natural and applied sciences, and deduction is widely used in the exact sciences.

Analogy is a research method consisting in the fact that from the similarity of some features or properties of various objects in general, a conclusion is drawn about the similarity of other features or properties that have not been studied before. The degree of reliability of conclusions by analogy depends on the number of similar features in the phenomena being compared (the more of them, the more likely the conclusion is). The analogy is closely related to modeling, or model experiment.

Modeling (from Latin modulus – measure) is the study of the properties of an object not on itself, but on a model similar to the object being studied. If an ordinary experiment deals directly with the object of research, then more accessible objects are used in modeling. Modeling is discussed in more detail in Subsection 5.2.

The hypothetical method of cognition involves the development of a scientific hypothesis. A working hypothesis is a reasonable assumption about the probable cause of the observed facts or about the alleged development of a process or phenomenon. It is formed on the basis of studying the physical, chemical, and other essence of the phenomenon under study. The hypothesis put forward as a result of the study is further analyzed and, if confirmed, becomes the basis for further research.

The historical method of cognition is one of the main ones in the socio-economic and humanitarian sciences. It also sometimes turns out to be useful in natural and technical sciences. This method involves the analysis of the origin, formation and development of objects in chronological order, as a result of which the researcher receives additional knowledge about the studied object (phenomenon) in the process of its development.

The methods of the theoretical level are intended for the logical study of the collected facts, the development of concepts, judgments, and the formation of conclusions. At this level, scientific thinking is freed from empirical descriptiveness, creates theoretical generalizations. The correspondence of early scientific ideas with emerging new ones is established, and new theoretical knowledge is built over empirical ones. Logical methods of similarity, differences, and related changes are widely used here. The methods of the theoretical level include: abstraction, idealization, formalization, analysis and synthesis, induction and deduction, axiomatics, generalization, etc.

Abstraction is a mental distraction from non–essential properties, connections, relationships of objects and the allocation of several sides of interest to the researcher. It is usually carried out in two stages. At the first stage, non–

essential properties, connections, etc. are determined. At the second, the object under study is replaced by another, simpler, representing a simplified model that preserves the main thing in the complex.

Idealization is the mental construction of objects that are practically impossible (for example, an ideal gas, an absolutely solid body). It is used in a hypothetical method of cognition. As a result of idealization, real objects may be deprived of some of their inherent properties and endowed with properties corresponding to the working hypothesis.

Formalization is the representation of an object or phenomenon in the symbolic form of a symbolic language (mathematics, chemistry, etc.) and providing the possibility of studying real objects and their properties through the formal study of the corresponding signs.

The axiomatic method is a method of constructing a scientific theory in which some statements (axioms) are accepted without proof and then used to obtain the rest of the knowledge according to certain logical rules.

Generalization is the definition of a general concept, which reflects the main characteristic of objects of this class. It is a means for the formation of new scientific concepts, the formulation of laws and theories.

Metatheoretical level methods are designed to study the theories themselves and develop ways to build them. With their help, the system of provisions and concepts of this theory is studied, the boundaries of its application are established, ways of introducing new concepts, ways of synthesizing several theories are substantiated. The methods of the considered level include the dialectical method and the method of system analysis.

The dialectical method develops approaches to the development of theories based on the application of general philosophical propositions to the solution of particular problems.

System methods are used in the study of complex systems with diverse connections characterized by continuity and discreteness, determinism and randomness. Such methods include operations research, queuing theory, control theory, set theory, etc. Currently, such methods have become widespread due to the development of computers.

When analyzing phenomena and processes in complex systems, there is a need to consider a large number of factors (signs), among which it is important to be able to distinguish the main ones and exclude secondary ones that do not significantly affect the phenomenon under study. To do this, the ranking method is used. It allows for the strengthening of the main and weakening of the secondary factors, that is, placing them according to certain rules in a series of decreasing or increasing sequence according to the strength of the factor.

Topic 2.2 Basic concepts of modeling

Modeling is the substitution of one object by another in order to obtain information about the most important properties of the original object using the model object. Modeling is usually used in cases where it is difficult or dangerous to study directly on a full-scale object.

a copy of a physically real system), for example, aircraft models and their tests in wind tunnels. Physical modeling is advisable in cases where it is very time-consuming and expensive or impossible to investigate the effect of changes in design parameters on certain processes on a full-scale object.

Another type of real modeling is modeling by analogy, in which the model and the natural object or phenomenon have different physical nature, but are described by the same type of equations. Modeling by analogy is much simpler and cheaper than physical modeling, since it can be carried out on a computer or using electrical or other models. However, it is not always possible to obtain the necessary analytical expression for the process under study, and without this, modeling by analogy is impossible.

As an example of modeling by analogy, let's consider the vibrations of a car on springs. The simplified scheme of the mechanical system of the car is a body of mass m mounted on a spring with a stiffness coefficient Sp, as shown in Figure 5.1, a. The free oscillations of such a system are described by the equation

$$mz + C_{\Pi} \cdot z = 0 \tag{1.1}$$

where z is the vertical coordinate of the center of mass of the car

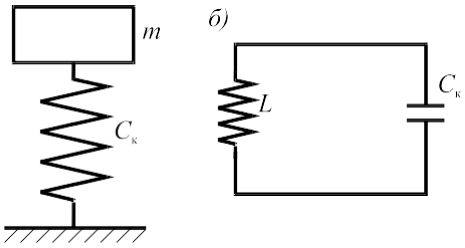

Figure 5.1 – Mechanical model and electrical analog

The equations of electrical oscillations in a circuit comprising a capacitor with an electric capacitance Sc and an inductance coil L, the scheme of which is shown in Figure 5.1, b, are described by the equation

$$L_c + \frac{1}{C_k} q = 0 \tag{1.2}$$

where q is the charge on one of the capacitor plates. If substitutions are made in equations (1.1) and (2.2)

$$\omega = \sqrt{\frac{C_{\Pi}}{m}}, \qquad \omega = \sqrt{\frac{1}{L \cdot C_k}}$$

then both equations will take the same form

$$x + \omega^2 \cdot x = 0$$

Consequently, there is an analogy of electrical and mechanical systems, and it makes sense of the circular frequency of natural oscillations, the mass of the mechanical system m corresponds to the inductance L, and the stiffness coefficient of the spring Sp corresponds to the value of the inverse electrical capacitance Sc. Mathematical modeling is understood as the process of establishing the correspondence of a certain mathematical object to a given real object, called a mathematical model, and the study of this model, which allows to obtain the characteristics of the studied full-scale object or process. Mathematical model It is a system of mathematical relations – formulas, functions, equations describing certain aspects of the studied object, phenomenon, process. At the same time, the similarity of the physical processes of the model and the original is not preserved. The type of mathematical model depends both on the nature of the real object, and on the research tasks and the required accuracy of the solution. Mathematical modeling, the methodology of which is discussed in section 7, refers to imaginary, logical modeling.

Currently, such types of mathematical modeling as structural, digital, and functional are widely used.

The first stage of structural modeling is the creation of mathematical models of individual parts of the object or process under study. As a result of their unification into a single system and arrangement in a certain sequence, taking into account the interactions between the parts, a mathematical model of a structural type is obtained.

In digital modeling, the elements that perform mathematical operations are discrete. At the present stage of technology and information technology development, such modeling is performed using a computer, therefore it is also called computer modeling. The advantage of digital models is the ability to obtain results with high accuracy.

Functional modeling is modeling carried out on installations in which the complex of simulated phenomena not only does not preserve the physical nature, but may not be formally described by the same equations. In functional modeling, phenomena are considered similar, which in some sense, in relation to some particular processes or their individual sides, give similar results.

Topic 2.3 Conditions of mechanical similarity

When creating models, one should strive for the identity of the characteristics of the model and the full-scale object. To achieve such a correspondence, a special theory of mechanical similarity has been developed.

The lowest level of similarity is geometric similarity. Similar in geometry are called shapes that have the same shape and proportional dimensions. The ratio of the lengths of the lines of the figures is called the scale, or similarity coefficient.

Mechanical similarity is a higher level of similarity. In a mechanical model, the observance of geometric similarity is mandatory. However, it is also necessary to have the similarity of the physical parameters of the model and the full-scale object, which should apply only to those characteristics that are essential for the phenomenon being studied. For example, if the internal stresses in the material of the tank boiler do not affect the process of liquid vibrations in it under study, then the model can be made of any material, including transparent, since in this case the similarity of the characteristics of the material is not necessary. The similarity of geometric and physical parameters are the conditions for the unambiguity of the model and the full-scale object.

To move from the characteristics of a full-scale object to the characteristics of the model, the concept of similarity coefficient is used. Such coefficients for this model are constant values.

To explain the principle of determining similarity coefficients, consider a situation in which it is necessary to study the dynamics of an object on a model whose dimensions are kl times smaller than the dimensions of a full-scale object. In this case, kl is called the similarity coefficient of linear dimensions. If the model is made of a material whose density is k times less than the density of the original, then the mass of the model can be calculated by the formula

$$m = \rho \cdot V$$

Since the volume of the model is (kl)3 times smaller than the volume of the full-scale object, their mass will differ by k (kl)3 times. The resulting product is the mass similarity coefficient km. The motion of such an object is described by the basic law of dynamics.

Newton's F ma , where a is the acceleration, which is determined by a twofold differentiation of linear dimensions

$$a = \frac{\partial^2 l}{\partial t^2}$$

Therefore, in order to calculate the similarity coefficient for the accelerations of the model and the full-scale object, it is necessary to divide the similarity coefficient of length by the square of the similarity coefficient of time (the signs of differentiation d do not affect the dimension):

$$k_a = \frac{k_l^{\,2}}{k_t^{\,2}}$$

Similarly, reasoning, we obtain that the similarity coefficient for strong

$$k_F = k_m \cdot k_a = k_\rho \cdot k_l^{\,3} \cdot \frac{k_l}{k_t^2} = \frac{k_\rho \cdot k_l^4}{k_t^2}$$

Thus, in order for the movement of the model to fully correspond to the movement of a full-scale object, it is necessary to differ the forces applied to it by a factor of k_F.

Sometimes it is useful to establish at what ratio between the parameters of the model and the full-scale object, the phenomena occurring in them will be physically similar. This is established using similarity criteria. To get one of these criteria, we will again consider the movement of the object and its model under the action of forces applied to them.

For both bodies , the basic law of dynamics will be written as:

$$F_i = m_i a_i, \quad a_i = \frac{d^2 l_i}{dt_i^2} \qquad F_i = m_i \frac{d^2 l_i}{dt_i^2}.$$

Dividing both parts of the equation by Fi, we get or

$$\frac{m_i}{F_i} \frac{d^2 l_i}{dt_i^2} = 1$$

Therefore, substituting the corresponding similarity coefficients in the previous equality instead of physical quantities, we obtain

$$\frac{k_m k_l}{k_F k_t^2} = 1$$

what corresponds to the condition

$$\frac{m_1 l_1}{F_1 t_1^2} = \frac{m_2 l_2}{F_2 t_2^2} = idem.$$

The latter relation establishes a correspondence between the parameters of the object under study and the model, and it is called the similarity criterion (this criterion was established by Newton, therefore it bears his name).

For many physical phenomena, the establishment of criteria is not only useful, but also extremely important, since the description of these phenomena is carried out using similarity criteria or in a criterion form. Here are some of the most common criteria for mechanical, hydrodynamic, electrical and thermal similarity.

1 The object is moving at an accelerated rate in the gravitational field. In this case, the Froude similarity criterion Fr is used:

$$\mathrm{Fr} = \frac{v}{\sqrt{gl}}$$

where *v* - is the velocity of the object; *g* - is the acceleration of gravity.

2 If, among other forces, elastic forces obeying Hooke's law act on the moving object of study and its model, then the Cauchy similarity criterion C is applied:

$$C = \frac{\rho v^2}{E},$$

where is the density; E - is the modulus of elasticity.

3 The object moves with acceleration in a viscous incompressible fluid. In this case of modeling, in addition to the general criterion of Newton's similarity, the Reynolds criterion should be taken as the determining criterion.:

$$Re = \frac{vd}{\nu} = idem$$

where d is the hydraulic diameter; v is the kinematic viscosity of the liquid. idem

All similarities obey some general laws that are established by similarity theorems [12]. The main purpose of these theorems is to substantiate the possibility of writing equations describing complex nonlinear systems in a dimensionless form. This form allows us to find out the general patterns of behavior of the systems under consideration and to establish the influence of various factors on the parameters of the processes under study.

An essential feature of similarity criteria is their dimensionlessness. The physical characteristics included in the expression of any criterion are such that all dimensions are reduced, so the value of the criterion is an abstract number and thus retains the same value in any system of units.

Criteria for the similarity of the process can be found if its mathematical description is known, or at least the set of parameters that can characterize the phenomenon under study in this problem and under these conditions. However, history gives many examples when the creators of models did not know the similarity criteria and did not use them. This was the case at the dawn of modeling in technology. A similar situation, in particular, is observed in those fields of science (for example, in biology and medicine) where, for one reason or another, mathematics has not yet sufficiently come to the aid of scientists and quantitative assessments of phenomena are just beginning to penetrate into the methodology of such research.

SECTION 3 TASKS AND METHODS OF CREATIVE RESEARCH

And to make the trees and flowers grow faster, I will play the flute in the morning.

And so that cranes do not fly away from us, Seeing the first snow, to dream of summer… Victor Luferov "I will build a house..."

Why explore creativity? So that it can be predicted? So that you can control it? So that it would be possible to force the bearer of the creative rhythm to work in the right direction, spending thousands on it, to get billions?..

The author adheres to the idea that you can explore anything: emptiness, infinity, creativity, etc. But recently there has been a lot of speculation on this topic.

Is it possible to explore creativity? Of course, it's possible. We explore anything and, funniest of all, in any way, but does it make sense, and does it make sense in this question?

Research always has some kind of working purpose. What is the purpose in psychological research of creativity? The stated goal of psychological research is only one head from the hydra "Goal". For example, the goal of "exploring creativity" is impossible; if the goal is "to learn to find geniuses in our society, carriers of creative rhythm", then let's try; if the goal is to prove to yourself that you are a creative person,

– this is nonsense; if the goal is self-actualization or professional growth, please, just don't bother others about this; if the goal is your own self–promotion, then creativity is not the best object, since you will have to step on someone's hairy calluses, and thousands more if…

It is clear that depending on the purpose of the experiment, the experimenter chooses a method; based on how he understands creativity, so he tries to explore it. The object of a particular study dictates a method adequate to its study.

Topic 3.1 Methods:

- Objective-analytical

The general trend of this work was the desire for scientific sobriety in the psychology of art, the most speculative and mystically obscure field of psychology Vygotsky L. S. Psychology of Art.

Within the framework of this method, works of art are mainly analyzed in order to reveal the psychological mechanisms of the author's creative process, to reveal the psychological laws "lying" in the work and to reveal the influence of the product of creativity on readers, on their emotional experiences.

Adherents of this method are guided by the study of the products of the creativity of others, creations. Often trying to present their derivative product as a creation. Sometimes it is. The study of the emotional aesthetics of experiencing the perception of creations is certainly important, but what does the study of creativity have to do with it. Within the framework of this research method, allegories may appear, for example, that creativity is life unconscious, or creativity is spontaneous and not planned. However, by forcing creativity into a certain framework, trying to prove that IT has been found and explained, researchers lose its meaning, but most importantly, you can't explain creativity by playing with words and concepts. This

is a dead-end direction in the research of creativity due to the fact that creativity is an activity, and it is possible to analyze only this activity in dynamics, and not by products. There are infinitely many possible and existing creations of the creative process; it is pointless to study a computer using papers printed from a printer.

Formative experiment. Most often, adherents of this approach conduct their research on preschoolers. They believe that the older the child gets, the less opportunity there is to implement a formative experiment, it is almost impossible to control the student's life activity at school. Here is an experimental example of an event, within the framework of a formative experiment, which represents an unexpected solution to the problem: "An evil sorceress kidnapped a princess, the princess turned out to be even angrier and threw the sorceress off the broom during the flight." I am sure that if we discuss and play this game not only with preschoolers, but also with adults for a couple of weeks, then we can only "wonder" together with the authors of the formative materials why children begin to demonstrate aggressive behavior. In 1994, while researching the formation of the mental picture of the Middle Ages among preschoolers, I met with the results of the work of a graduate student who studied phobias in children. After the diagnosis, it turned out that there were no bright phobias in the studied group of children. Then she made a Baba Yaga mask and showed it to the children. Several people had phobias. She tried out psychotherapeutic techniques on them, some children got rid of phobias... Six months later, when I was conducting my research, I observed three boys with vivid phobias of Baba Yaga. After that, I think that studies on preschoolers that include aggressive effects on children are unethical. Only ascertaining experiments or observation are ethically possible.

- Self-observation. The most ancient, main and proven, rejected and all the time used method in psychology. I have been trying to know creativity for 20 years using this method, but in the end I had to state that you cannot know creativity by self-observation. (For more information, see Appendix No. 1.)

"There are many heroes in Russian literature who reflect on the mystery of the impact of art on a person. I. A. Bunin has a story "An Unknown friend". These are letters from a woman to a writer. She doesn't know him, but she loves his books. And asks him questions: what is art, what is a creative gift, what books does he read… Finally, about the secret of the influence of literature on the reader's soul: "...explain what it is, this feeling? And what do people experience when exposed to art in general? The charm of human skill, strength? The excited desire for personal happiness that always, always lives in us and especially comes to life under the influence of something that acts sensually-music, poetry, some imaginative memory, some smell? Or is it the joy of feeling the divine charm of the human soul, which is revealed to us by a few like you, who remind us that it

still exists, this divine charm? ...what does it mean? Maybe it means: how wonderful life is after all!"

Therefore, we choose books. And they talk about us, not about the writer, but about us. We're talking about art. And we discover our understanding of life. Everything is interconnected here (Kuzicheva A. P. 1991). The recipe for creative longevity is accuracy, order and the organization, according to Zoshchenko. In fact, any psychological work is similar to psychological training, when a client says that it is socially desirable, passionately keeping silent about the innermost. S. Dovlatov wrote that a poet is not given literary talent, but is given the talent of a bad life: the worse life, the better poems. The thought of the creator's beggary most often visits the creator-the rich man.

This book is not a creative act – "Notes at the head of the bed." In fact, we are not exploring creativity as such, we are exploring the accompanying life and qualities of some media. Paradoxically, anything can be a carrier of creativity. Not only a person, an individual, but also a society, a group, a collective carrier, a social system, a social system of animals, nature, even the air itself.

- Biographical.

The biography of the artist should be adequate to his work. V.M.Allahverdov "Psychology of art" "Literature shapes the reader. But the reader also determines the level of literature. Mass literature. Created according to the accepted "rules". Comfortable, restful, desired by both such literature and such a reader.

Does the viewer want entertainment, simple, digestible entertaining stories? You are welcome. The Russian stage of this time was filled with vaudevilles, farces, one-act comedies with the titles "The English system, or a Kiss with a hot samovar", "The newspaper messed up", "Who cuts it without a knife", "The father's love is cunning for fiction", "Cupid's Arrows", etc.

Does the reader want familiar, quiet plots with happy endings, stormy passions, extraordinary feelings? Writers compose such novels, novellas, and short stories. Stamps wander from essay to essay. Familiar techniques, plots, that is, routine, template, fill the pages of newspapers and magazines.

Chekhov rebelled against such literature early on. In 1889, he advised his brother, a writer: "Remember, by the way, that love explanations, infidelities of wives and husbands, widows, orphans and all sorts of other tears have long been described..." (Kuzicheva A. P. 1991).

Initially, the biographical method was limited to a retrospective description of the past stages of a person's life or the entire life path of a historical character of the past. In the future, they began to include an analysis of current and anticipated future events (future autobiography, controlled fantasy, life schedules, causometry), as well as studies of the circle of communication (additional

biographies, lines of relations of the subject). Nowadays, they are based on the study of personality in the context of the history and prospects for the development of its individual existence and relationships with significant others, while research is aimed at reconstructing life programs and scenarios of personality development.

SECTION 4 OBJECTIVES AND METHODS OF INNOVATION ACTIVITY. INNOVATIVE LAWS

Topic 4.1 Objectives of innovation activity

Innovation activity is a complex dynamic system of action and interaction of various methods, factors and management bodies involved in:

- scientific research, creation of new types of products, improvement of equipment and labor items, technological processes and forms of production organization based on the latest achievements of science and technology;
- planning, financing and coordination of scientific and technological progress;
- improvement of economic levers and incentives;
- development of a system of measures to regulate a set of mutually dependent measures aimed at accelerating the intensive development of scientific and technological progress and increasing its socio-economic efficiency.

Innovative activity is aimed at using and commercializing the results of scientific research and development to expand and update the nomenclature and improve the quality of products (goods, services), improving the technology of their manufacture with subsequent implementation and effective implementation in domestic and foreign markets. As the general principles of the organization of innovative activity of the enterprise , researchers call:

1. Target orientation, i.e. the organization of innovation activities should contribute to the continuous flow of the innovation process. Continuity here refers to the integrity of the innovation system, which should help to overcome the negative aspects in the transmission of information on the stages of the innovation cycle;
2. Consistency of innovation activity, i.e. the presence of clearly defined functions, their performers and interactions between them;
3. Adaptability as the most adequately reflecting the influence of factors of the external, internal environment of the enterprise on the processes of innovation creation, taking into account the trends of their changes;
4. Optimal combination of authority and responsibility of departments;
5. Cost-effectiveness, i.e. the organization of innovation activities should contribute to the optimal effectiveness of the innovation process by reducing the innovation cycle, increasing the competitiveness of new products, timely response to consumer requests, etc.;

6. Hierarchy, i.e. ensuring hierarchical interaction between the elements of innovation activity at any vertical and horizontal levels of the system.

Along with this, the company's innovation practices have chosen specific principles of its organization:

1. Creating an atmosphere that encourages the search and development of innovations;

2. The focus of innovation on the needs of the consumer;

3. Priority directions of innovative work follow from the goals and objectives of the enterprise;

4. The organization of innovations is carried out on the principle of parallelism of their implementation;

5. Innovative activity is within the competence of the head and his functions are to form strategic innovative problems, goals and directions of organizational development;

6. Departments engaged in innovation activities should have the unity of the tasks to be solved and their set should be optimal;

7. The entire potential of the enterprise is involved in innovation activities.

The key objectives of the organization of innovative activity of any enterprise are:

1. Planning of innovative activity of the organization. The planning of innovation activity begins with the formulation of the mission, which is expressed in the orientation of the organization's activities to innovation. The next step is to identify strategic directions of innovation activity and set goals in each of them. Then the management of the organization chooses the optimal innovative development strategy for each direction. Based on the innovation strategy, long-term, medium-term and short-term plans are formed, which are implemented on the basis of specific actions of managers and employees.

2. Organization of innovation activities. This function is to form processes and structures that support innovation. If the formation and implementation of strategies aimed at development through innovation is not very rare today, then the creation of specific structures that allow managing ideas (potential innovations) is typical only for a small number of companies.

3. Motivation of participants of innovative activity. Motivation is one of the most discussed issues in management. The formation of a favorable organizational culture; the creation of a creative team capable of achieving goals; the establishment of an effective remuneration system — all these are tasks of staff motivation.

4. Systematic evaluation of the results of innovation activity. Innovation activity must be constantly evaluated in order to verify the correctness of the chosen strategy and take corrective actions in time.

The overall goal of the innovation activity of any organization is the survival and development of the enterprise by releasing new/improved types of products and improving the methods of its production, delivery and sale.

The objectives of the organization's innovation activity from the perspective of its internal needs are to increase production efficiency by updating all production systems, increasing the competitive advantages of the enterprise on the basis of scientific, scientific-technical, intellectual and economic potentials.

In a market economy, innovative activity should contribute to the intensive development of the economy, accelerate the introduction of the latest achievements of science and technology into production, better satisfy consumers in a variety of high-quality products and services, and for this it is necessary formulate those necessary tasks that are ready to fully disclose these problems and ways out of them.

The innovative activity of the organization should be focused on solving the main tasks:

- carrying out research and design work on the development of the idea of innovations, laboratory research, production of laboratory samples of new products, new designs and products;

- selection of new types of raw materials, materials for the manufacture of innovations; - selection of new technologies, know-how and creation of a technological process for the production of new products based on them;

- designing, manufacturing, testing and mastering samples of new equipment, machines, mechanisms, devices;

- design, planning, implementation of new organizational and management solutions aimed at the implementation of innovations; - training, training, retraining and recruitment of personnel;

- information support of innovation activities; - carrying out work on the acquisition of necessary documentation for the registration of patents, licenses, know-how, technological regulations, testing techniques, etc.;

- organization and conduct of marketing research and organization of sales channels for innovations;

- organization of pilot production and development of innovations;

- technological preparation of production and introduction of innovations;

- production and sale of new products, products.

As a result of competently set tasks of innovation activity, new ideas, new and improved products, new or improved technological processes are born, new forms of organization and management of various spheres of the economy and its structures appear. The specific tasks of an organization's innovation activity are determined by the resource capabilities of the organization itself. And resource

opportunities affect the scale of innovation activity, the completeness of coverage of socio-economic problems, the order of their solution and obtaining final results.

Topic 4.2 Methods of innovation activity

Usually, the formation of innovative potential in order to ensure the effective innovation activity of the company is associated with the need to solve the most complex methodological, and in some cases, methodological problems. Innovative activity, on the one hand, requires additional efforts from the management, the labor collective and the employees of the enterprise separately, which are not characteristic of them in regular situations. Such additional costs of time, resources and effort are not compensated in any way, at least at the stage of innovation initiation. This means that the top management of the enterprise should create special organizational forms that would provide some other, not quite traditional incentives for implementation of innovative activities. But, on the other hand, by its nature, innovative activity leads to deepening and expanding the diversification of the company's economic portfolio, and this inevitably complicates its organizational and production structure.

In practice, a manager should try to solve such problems by different methods through the creation of specific organizational forms. Let's consider the classification of forms and methods of organization of innovative activity of the company.

Topic 4.3 Dual management system and formation of a dual budget

The peculiarity of this method is that all departments of the enterprise participate in the preparation of a strategic plan. The specificity of such a unified plan was that it allocates budgets and priorities according to strategic and operational areas of activity. The operational part of the plan is a certain set of tasks, goals, budgets and programs for extracting current profits. All divisions of the enterprise are engaged in the implementation of such programs. The strategic part is a set of independent innovative projects that are aimed at the development of the company. Special management groups are formed to coordinate the activities of the enterprise within the strategic part of the plan:

- councils, committees and working groups for the development of technical policy;
- departments and central services for the development of new products that coordinate innovation activities;
- committees on innovative projects, the main task of which is to create conditions for effective interaction of departments engaged in operational activities and participants in the innovation process.

The dual system has a significant drawback, which is expressed in the fact that the power and responsibility for the strategic development of the company are separated from the operational management. In such a situation, project managers

cannot always perceive and understand the problems of current economic activity and, accordingly, vice versa.

Formation of a double budget, the essence of which consists in the simultaneous formation of two existing budgets. One of them is operational, and the second is strategic, aimed at innovative development. The purpose of the first one is to preserve the current profit of the company due to the existing production capabilities at the present time. The purpose of the execution of the second, strategic budget, is to improve the strategic competitive position of an economic entity. This is usually an investment in more promising areas of diversification of activities.

The formation of a double budget can manifest itself in the form of special innovation funds formed to stimulate the introduction of innovations from profit. Often these funds act as a venture fund, funds from which are invested in their own or independent venture companies in which the company is interested.

Note: The key advantage of a dual budget is that financial resources can be optimally allocated to achieve long-term goals.

In addition, it is possible to compare the results and costs of strategic and operational activities separately. But the problems of structuring the production and management system will remain unresolved.

Topic 4.4 Creation of dedicated temporary organizational structures

The essence of this method is that target groups of specialists or entire departments are established that develop an innovative program to one degree or another. In practice, there is usually a fairly large variety of such structural formations, differing in composition, goals, powers and other characteristic features.

Note: The Research and Development Department is a traditional division whose purpose is to create a new product. Their role at large enterprises has recently been growing due to the need to develop and bring to the stage of mastering a new promising idea.

Analytical groups that include managers, specialists and researchers, the main purpose of their activities is to predict the development of scientific and technological progress in a given field of knowledge, in evaluating and ranking the most promising ideas, etc.

Temporary target groups bring together specialists from different departments to develop individual planning steps and implement a specific innovative project.

Temporary innovation projects are the most common form of organization of innovation activities at domestic enterprises. The main problems of temporary innovation projects are usually the following:

- the need to rationally allocate the time of each of the project participants between his current and innovative activities;

- project participants are additionally motivated, which is why there is a desire to extend the work in the project as long as possible.

Internal venture projects are based on the allocation of a certain group of specialists, functional and line managers who are necessary and sufficient to implement a comprehensive innovation. At the same time, unlike an internal innovation project, in which team members act by combining their current job responsibilities with innovative activities, in venture projects, these specialists are sent to the designated manager for the duration of the implementation of the innovation project and obey only his instructions. The key drawback of an internal venture project is the juxtaposition of the operational and innovative functions of the enterprise.

A common positive aspect for temporary innovation and internal venture projects is that with the successful implementation of innovation, such groups often become the core of a new subsidiary. Foreign experience shows that it is project-target groups that are the main form of organization of the innovation process. This method of organizing innovative activity at the enterprise as a whole significantly increases its effectiveness.

Topic 4.5 Strategic business units

Note: The essence of this method is that independent divisions are added to the existing organizational structure of the enterprise, focused on strategic prospects with a targeted focus on obtaining current profits in the future. Such a structure can take the form of a development center, whose task is to gain market positions by increasing sales. Internal venture divisions are created either on the basis of departments engaged in development, or on the basis of pilot production (separate production workshops). The activities of such divisions are entirely focused on the creation of an innovative product. Therefore, there are no disadvantages characteristic of temporary and venture projects. At the same time, the problem is the accounting of mutual services, or services provided to the venture unit by other units related to the overall structure of the enterprise.

The main disadvantage of this method is the complexity of management, in fact, built-in innovation-oriented structure. In addition, the idea of combining entrepreneurial and current goals has no organic solution. As a result, this can lead to the division of the organizational structure, and in the limit of the enterprise as such, into two constituent parts. One will work for the future, and the other will work to achieve current goals.

An important point is how the organization implements all its functions, including innovative ones. Another distinctive feature of innovation activity is that it is objectively focused on expanding the boundaries of the economic portfolio of

the enterprise. Which means that when entering another market (not previously mastered) with an innovative product, the company's management may encounter new management problems that were not relevant before, and, consequently, both the staff and the management structure have no experience and knowledge in solving them.

SECTION 5 ORGANIZATIONAL FORMS OF INNOVATION ACTIVITY

Innovative activity is characterized by a variety of organizational forms. This is due to the fact that the innovation process covers a variety of fields of activity: scientific and technical, financial, informational, marketing, and various organizations interacting with each other participate in its implementation: research institutes, financial and consulting organizations, venture firms, insurance companies.

The most common organizational forms of innovation activity are business incubator, technopark, technopolis, strategic alliance. Business incubators are a form of support for the formation and development of a new company.

A business incubator is an organization that solves problems limited by the problems of supporting small, newly created firms and start-up entrepreneurs who want, but do not have the opportunity to start their own business.

A business incubator can be autonomous, that is, an independent business organization with the rights of a legal entity, or operate as part of a technopark (in this case, it can be called a "technology incubator").

Technoparks and technopolises are one of the promising forms of innovative entrepreneurship development.

Technopark is an organization that forms a territorial innovation environment with the aim of developing entrepreneurship in the scientific and technical sphere by creating a material and technical base for the formation, development, support and preparation for independent activity of small innovative enterprises and firms, industrial development of scientific knowledge and high-tech technologies. The technopark provides conditions for the implementation of the innovation process - from the search (development) of innovations to the release of a sample of a commercial product and its implementation. The subject of the technopark's activity is a comprehensive solution to the problems of accelerated transfer of research results into production and bringing them to the consumer on a commercial basis.

Technopolis is a larger area of economic activity compared to the technopark. It consists of universities, research centers, technology parks, business incubators, industrial and other enterprises whose practical activities are based on the results of scientific and technological research, is an integral part of the international division of labor system and has a habitat purposefully formed for

scientists, specialists, and highly qualified workforce. Technopolis maintains close ties with similar structures at the national and international level. In Russia, science cities and academic towns can serve as the basis for the formation of technopolises.

A science city is an administrative-territorial entity whose infrastructure has been formed around a scientific organization, which determines the scientific and industrial orientation of its production structures. The purpose of creating science cities is to preserve and develop the existing scientific potential, increase its effectiveness and create conditions for sustainable development (solving defense tasks). Aspiration expanding the customer base, geography of presence or sphere of influence of the company leads to the creation of partnerships or alliances. Consolidation has become the most common phenomenon in modern business.

Strategic alliances are temporary cooperative agreements between companies that do not involve mergers or full partnerships. The strategic advantages of creating joint ventures and alliances in the implementation of innovation activities are as follows: the use of economies of scale in the production and/or marketing of a new product; access to the partner's developments and know-how; the ability to penetrate hard-to-reach markets.

SECTION 6 FUNDAMENTALS OF INNOVATION ECONOMICS

Topic 6.1 Content of the national innovation system

The national innovation system is a system of exchange of technologies, knowledge and information between people, enterprises, institutions; exchange, which is an integral condition for the development of innovative processes in the country. Participants of the innovation process, interacting, turn an idea into a technology, process, product or service and bring it to the market. According to the modern theory of innovation systems, innovation and technological development of a country is the result of a complex of relations between participants in a complex system that includes enterprises (national companies), universities, laboratories, research institutes, government agencies. Today, there are various definitions of the national innovation system. This:

- a system of public and private sector institutions whose activities and interaction initiate, introduce, modify and disseminate new technologies [5]
- a set of institutions whose interaction determines the innovative performance of national companies
- a set of elements and connections that interact during the production, dissemination and use of new, economically beneficial knowledge, and which are either located within or have their origin within the territory of a national state
- a set of certain institutions that, together and each by itself, contribute to the development and dissemination of new technologies, which create a structure within which governments form and implement policies to influence the innovation process. It is a system of interconnected institutions within which the

creation, storage and transfer of knowledge, experience, products containing new technologies are carried out

The concept underlying the theory of national innovation systems is based on the premise that understanding the connections and relationships between participants in the innovation process is the key to the development of innovative productivity. Innovation and technological progress are the result of a complex set of relationships and relationships between participants in the innovation process, producing, distributing and using new knowledge.

The innovative development of a country depends to a large extent on how effectively these participants interact with each other as elements of a collective system of knowledge creation and their use for technological progress and competitiveness development.

Participants in the innovation process include, first of all, private enterprises (national companies), universities, laboratories, research institutes, as well as people working in these organizations. The interaction of participants can result in joint research, exchange of information and employees, cross-patenting, collective purchase of equipment and other types of joint activities. It is the variety of forms, types and methods of interaction of participants in the innovation process that makes it difficult to formulate a definition of the national innovation system. However, from a practical point of view, the main thing remains that this is a system of interrelated elements, and the influence on these elements or the relationship between them can make the process more efficient, increasing the efficiency of the entire national innovation system.

The concept of the national innovation system allows using a systematic approach to the development and improvement of the innovation process in the country. In addition, its value lies in the recognition of the crucial importance of knowledge and innovation for the economy, and the ability to involve new elements and new participants in the process of creating, distributing and using knowledge.

The knowledge-based economy rests on four pillars: the innovation system, the information society, continuing education, and the state innovation policy.

The innovation systems of different countries are different, as well as the innovation strategies of states are different. This is due to differences in the level of industrial development, technological development, investment in innovation, and other factors, including historical and national characteristics. There is no optimal national innovation system, just as there is no single, most effective innovation strategy of the state. Meanwhile, national innovation systems have certain common features, and the experience of economically and technologically more competitive countries can and should be adopted by less competitive countries. To determine

the national innovation system, it is necessary, first of all, to identify the sources of innovation. Innovations can be attributed to two main types:

1. Import of existing technologies and knowledge from abroad, their adaptation to local conditions and use taking into account the peculiarities of the national economy;

2. Creation of knowledge and technologies that are new not only for the national system, but also at the global level.

The creation of a national innovation system consists in the formation of a relatively holistic system that effectively transforms new knowledge, no matter whose -

—your own or someone else's, in new technologies, products and services that find their real consumers in national or global markets. This system is commonly called the national innovation system. At the same time, the transition to a knowledge economy does not necessarily require the priority development of fundamental research. The current innovation system, still half administrative and command, does not know how to effectively transform new knowledge into products and technologies that are useful for society and the economy. Moreover, the structure of the distribution of public funds should flexibly respond to the emergence of bottlenecks in the structure of the cycle. Now, for example, such a bottleneck is a clear shortage of capacities that effectively transform knowledge into a commodity. These capacities are embodied in organizational structures (small innovative firms, etc.); trained personnel (innovative entrepreneurs); as well as in various kinds of services provided by innovative infrastructure - production, financial, information. In other words, the effectiveness of innovation processes in the economy depends not only on how effective it is integrated firms - leaders of national and global economies - with many firms of the IIB sector engaged in pioneering, risky innovation and technological activities.

Topic 6.2 Innovative economy: basic concepts and features

The concepts widely used in recent years — new economy‖, —knowledge-based economy‖ mean that in this type of economy, the main growth factor is the large-scale use of new knowledge in practical economic activity. Its characteristic features are: the formation of knowledge-intensive industries; the increasing role of immaterial forms of wealth (intellectual property objects); the increasing role of the human factor; the transition to an intensive type of reproduction. The need for an innovative economy is exacerbated, on the one hand, by the competition of Western firms in terms of high technical level and product quality, and, on the other hand, by the price competition of Asian countries (China, India, South Korea) based on low prices and cheap labor. [3]

The results of the implementation of the new innovative economy should be the achievement of a high level of social orientation of scientific and technological

progress, an increase in the standard of living of the population as a result of an increase in the efficiency of public production, a qualitatively different level of resource conservation and the greening of the economy.

Innovation process, i.e. the process of creation, distribution and consumption by economic entities of scientific, technical, organizational, managerial, etc. innovation is the main content of the process of modernization of the economy. Innovation activity is usually measured in two ways: by the results of surveys and by formal statistical reporting through the indicator of the share of enterprises implementing new technologies. The value of this indicator is very small today - about 5%. In the developed part of Europe and in the USA, this indicator is much higher - up to 25-30% of enterprises show innovative activity here. But they have a developed, multicomponent, innovative system. With us, it is just being built. The subsystem of small innovative business is growing. These are pioneer firms in the risky high-tech sector, where business testing of technical innovations is underway. However, for the development of such firms, and not only them, we need a developed infrastructure - material (innovation and technology centers and technology parks), financial (venture funds, trading platforms, etc.), organizational and informational.

It seems to me that the economy of a society is innovative if the society:

- any individual, group of persons, enterprises anywhere in the country and at any time can receive on the basis of automated access and telecommunication systems any necessary information about new or known knowledge, innovations (new technologies, materials, machines, organization and management of production, etc.), innovative activities, innovative processes;

- modern information technologies and computerized systems that ensure the implementation of the previous paragraph are produced, formed and available to any individual, group of persons and organizations;

- there are developed infrastructures that ensure the creation of national information resources in the amount necessary to maintain constantly accelerating scientific and technological progress and innovative development, and the society is able to produce all the necessary multidimensional information to ensure dynamically sustainable socio-economic development of society and, above all, scientific information;

- there is a process of accelerated automation and computerization of all spheres and branches of production and management; radical changes in social structures are being carried out, which result in the expansion and activation of innovative activities in various spheres of human activity;

- they take kindly to new ideas, knowledge and technologies, are ready to create and introduce innovations of various functional purposes into wide practice at any necessary time;

- there are developed innovative infrastructures capable of promptly and flexibly implementing innovations based on high production technologies that are necessary at a given time and deploying innovative activities; it should be universal, competitively implementing the creation of any innovations and the development of any industries;

- there is a well-established flexible system of advanced training and retraining of professionals in the field of innovation and innovation activities, effectively implementing complex projects for the restoration and development of domestic industries and territories.

The basic concepts of an innovative economy are innovation, innovative activity, and innovative infrastructure. The tactics and strategy of forming an effective innovative economy in the country largely depend on their correct understanding. Innovations, innovative activity, innovative processes are concepts that currently have the most diverse and broad interpretations. The development and extension of these concepts to processes related to everything new, including new ideas and inventions, new scientific achievements, new knowledge and technologies, new results of fundamental and exploratory research, etc., are generated by the everyday representation and mixing of two concepts: innovative and new.

THE PRACTICAL PART

Science and development of social production

1.1 Basic concepts of science

Science is a complex social phenomenon, a special sphere of purposeful human activity based on obtaining and mastering new knowledge and using it to solve practical problems. Science performs two main functions: cognitive and practical. In accordance with these functions, we can talk about science as a system of previously accumulated knowledge, that is, an information system that serves as the basis for further knowledge of objective reality.

Science as a social, social system with relative independence consists of three inextricably linked elements: accumulated knowledge, the activities of people and relevant scientific institutions.

The system of scientific knowledge is captured in scientific concepts, hypotheses, laws, empirical (based on experience) scientific facts, theories and ideas that make it possible to anticipate events, recorded in books, journals and other types of publications. This systematized experience and scientific knowledge of previous generations have a number of features, the most important of which are the following:

a) universality, that is, belonging of the results of scientific activity, the totality of scientific knowledge, not only to the whole society of the country in which this activity took place, but also to the whole of humanity;

b) the verifiability of scientific facts; the knowledge system can only claim to be called scientific when each fact can be verified to clarify the truth;

c) reproducibility of phenomena, closely related to verification; a certain law of nature exists and an open phenomenon is included in the system of scientific knowledge if a researcher can repeat a phenomenon discovered by another scientist by some method;

d) the stability of the knowledge system, the rapid obsolescence of knowledge indicates insufficient depth of study of the accumulated material or inaccuracy of the accepted hypothesis.

In the XVII century, the English philosopher Francis Bacon developed the first classification of sciences adopted by the French enlighteners Diderot, J. Dalembert, Holbach, Montesquieu, Voltaire, Rousseau. All existing and possible sciences F. Bacon divided, respectively, the three faculties of the human mind: memory corresponds to history, imagination – poetry, reason – philosophy as a science of nature and man.

The modern classification of sciences is carried out according to various criteria:

– by branches of knowledge: natural sciences (about nature), social sciences (about society), technical sciences (sciences about the purposeful transformation of natural bodies and phenomena into technical objects, about the functioning of mechanical objects in the system of social production);

– scientific disciplines: mathematics, physics, resistance of materials, theoretical mechanics, etc.;

– results of scientific activity: publications (books, articles), patents, design developments, etc.

Scientific activity, scientific work or scientific work is a creative activity aimed at obtaining, mastering, processing and systematization of new scientific knowledge, the results of which are characterized by the following main features:

a) novelty and originality;

b) uniqueness and non-repeatability (the results of scientific activity cannot be serial, repeated work loses its novelty, therefore, a mandatory requirement for the researcher is his information awareness about the object and subject of research);

c) probabilistic nature and risk (it is always difficult to predict whether the planned study will end successfully and whether the expected result will be obtained);

d) evidence, that is, the credibility of the results of scientific work and their reproducibility.

Scientific activity is classified:

– for the intended purpose: development of theory, development of new technology, improvement of technology, etc.;

– types of scientific work: fundamental, applied research, development;

– the range of research works: directions in science, scientific problem, scientific topic, scientific question;

– research method: theoretical, experimental, mixed.

Scientific institutions, regardless of their subordination, name, rank, in addition to scientific staff, must have the means of scientific activity (scientific equipment:

– measuring, computing, etc.), objects of scientific work (objects or phenomena under study), an information array (library and patent funds), as well as a psychological microclimate for scientific activity.

In relation to the sphere of human activity , scientific institutions of the Republic of Uzbekistan are classified as follows:

– the non-production sphere includes academic institutes that are part of the National Academy of Sciences of the Republic of Uzbekistan, research institutes of general scientific and humanitarian profiles, as well as universities of non–production profile (medical, legal, etc.);

– the production sphere includes all industry institutes - design and design bureaus, scientific and production complexes and associations, technical universities.

1.2 Characteristic features of modern science

Currently, the scientific and technological revolution is playing an increasingly important role in the economy, politics and social life of society. It is a complex dynamic system that includes science, technology and production. In this system, science serves as a generator of ideas, technology implements their material embodiment, which is realized through production. The development of science leads to deep, revolutionary changes in technology and technology, which, of course, revolutionizes material production.

The first and most characteristic feature of modern science is that it becomes a direct productive force. This means that technological progress is directly based on the development of science. Even technical design has become a branch of scientific work (almost always new scientific problems are solved during design). Of course, not all science "works" exclusively on technology. In the total volume of science, a significant place is occupied by research that solves the "own" problems of science. And yet we can talk about the industrialization of science not only from the point of view of its equipment, but also from the point of view of its links with production.

The second characteristic feature of modern science is its scale. Single scientists, who are relatively free to choose scientific issues and terms of research,

have been replaced by a mass of people relying on a powerful technical base, whose scientific work is planned and managed.

A sharp acceleration of the pace of scientific and technological progress is the third characteristic feature of modern science. It leads, firstly, to the development of science in the direction of its internal differentiation, which, in turn, causes a narrow specialization of researchers, and, secondly, to a colossal increase in the volume of accumulated knowledge, which requires new scales and forms of systematization of the transfer of scientific information.

Along with the process of fragmentation and specialization in modern science, the opposite process of "joining" not only related, but also very distant sciences, for example: economics and mathematics, the operation of motor transport and mathematical logic, is also manifested. This is the fourth characteristic feature of modern science, which can be called the close interaction of sciences. This is especially evident in the deep penetration of mathematical methods into a variety of not only exact, but also the humanities.

In recent years, another fifth characteristic feature of a systematic approach to the study of research objects has been revealed in science. This means that the researcher reveals not only the structure and properties of the object under study, but also tries to understand the way its parts and subsystems are connected, to understand the functions performed by each element. With a systematic approach, the object under study is considered as a complex whole with the properties of maintaining stability and qualitative certainty in various conditions of its existence.

These characteristic features of science determine its priority areas. For the Republic of Uzbekistan at the present stage , they are as follows:

1 Energy – energy supply, unconventional and renewable energy sources, energy conservation and efficient use of energy; creation of energy- and resource-efficient architectural and structural systems of a new generation.

2 Machines and mechanisms – mechanics of machines, ensuring the reliability and safety of technical systems, increasing the competitiveness of mechanical engineering products.

3 New materials and substances, modified biological forms – physical, chemical, biological and genetic methods and technologies for obtaining new substances, materials, modified biological forms, nanomaterials and nanotechnologies.

4 Technologies of prevention, diagnosis, treatment and rehabilitation. Medical equipment, medical devices, medicines – development of new therapeutic, diagnostic, preventive and rehabilitation technologies, devices and medical devices, medicinal and immunobiological preparations, cellular and molecular biological technologies.

5 Food security and efficiency of the agro–industrial complex - improving the efficiency of the agro-industrial complex and the level of food security, the development of intensive and resource-efficient farming technologies.

6 Mathematics, physics, information technology – mathematical and physical modeling of systems, structures and processes in nature and society, information technology, creation of modern information infrastructure.

7 New devices, electronics, laser-optical technology – competitive products of radio, micro, nano, microwave and power electronics, microsensors, laser-optical technology, development of new types of devices, including for scientific purposes.

8 Nature management and ecology – minerals and subsoil of Belarus, methods of effective use and renewal of natural resources, environmental problems, methods of prevention and elimination of consequences of emergency situations.

9 Socially-oriented innovative economy – theoretical and methodological foundations of the formation of an innovative socially-oriented economy in the Republic of Uzbekistan, ensuring its sustainable development in interaction with the world economic system.

10 People, society, culture, education – philosophical and ideological prerequisites and logical and methodological foundations of social progress and social stability, personal development, culture and education, formation of the ideology of Belarusian society.

11 Defense capability and national security – scientific support for strengthening the defense capability and increasing the level of national security of the Republic of Uzbekistan.

2 Discussion. Principles of its organization

2.1 Discussion

Discussion (from lat. discussion — consideration, research) — discussion of any controversial issue, problem. An important characteristic of a discussion that distinguishes it from other types of dispute is reasonableness. Discussing a controversial (debatable) problem, each side, opposing the opinion of the interlocutor, argues its position.

Discussion can also mean a public discussion of any problems, controversial issues at a meeting, in print, in conversation. A distinctive feature of the discussion is the absence of a thesis, but the presence of a topic as a unifying beginning. Discussions organized, for example, at scientific conferences, cannot be subject to the same requirements as disputes, the organizing beginning of which is the thesis. Discussion it is often considered as a method that activates the learning process, the study of a complex topic, a theoretical problem.

2.2 Group discussion

In psychology, the method of group discussion (group discussion) is used as a method of group psychotherapy. The members of the therapeutic group communicate with each other (argue) and in the course of this specially organized communication resolve their psychological problems.

In sociology, the method of group discussion (group discussion) is used as a method of data collection, which combines elements of methods of group and in-depth interviews and sociological observation. The essence of the method is the organization of a purposeful conversation in a small group on issues of interest to the researcher.

2.3 Reasonableness of the discussion

In logical theory and argumentation theory, discussion is examined not from the side of its psychological or sociological function, but according to the content, according to the argumentative arsenal.

In accordance with the classification of argumentation proposed by Aristotle, there are four types of discussion:

Apodictic discussion is a discussion with the aim of achieving the truth. Such a discussion follows the logical rules of inference.

Dialectical discussion is a discussion that claims only to achieve plausibility.

An eristic discussion is a discussion aimed at persuading an opponent to his opinion (or a dispute for the sake of a dispute).

Sophistic discussion (sophistic dispute) is a discussion with the aim of winning by any means. In such a discussion, logical tricks - sophisms are used (including those based on manipulating the meaning of the word), misleading the interlocutor, etc.

2.4 Organization of discussions at the PSV working site

I. General rules for conducting discussions at the PSV site

1. The purpose of the discussion is to find the truth, a solution to the issue, a way out of the situation;

2. Stick to the fixed goal throughout the discussion. In no case should you write about things that are not relevant to this discussion;

3. Explain your opinion;

4. Every reasoned opinion should be respected, it has the right to exist, even if you do not share it;

5. Create a friendly working atmosphere. Treat your interlocutor carefully and with respect.

II. The rules of the discussion at the PSV site

1. Determine the start time of the discussion and its duration (there are two options here: with a time limit and without a limit);

2. Determine the method and procedure for investigating the issue;

3. Determine the place of the discussion.

III. The technology of the discussion at the PSV site

1. Statement of the question (problem):

- determination of the initial data of the conversation during the situational analysis;
- fixing the source data;
- statement of the problem to be solved during the discussion;
- fixing the task;

2. Analysis of the issue (probem):

- De Bono methods:
- - consider the pros, cons and interesting sides of an object, process or phenomenon;
- - to consider the consequences and results to which the state of the object, process or phenomenon in question may lead;
- - to look at an object, process or phenomenon through the eyes of other people or social groups that are somehow connected with this situation;
- - create (predict) alternative ways and options for the development of the situation;
- - To determine the priority priorities in solving this issue;
- Other methods: ...

3. Summing up and summarizing the result.

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We offer ideas for organizing discussions. This includes both rules of communication, regulations, and methods and tools with which this discussion can be directed in the required direction.

3 Structure of scientific knowledge

There are three levels in the structure of scientific knowledge: empirical, theoretical and metatheoretical. The level of scientific knowledge is understood as qualitatively different types of scientific knowledge in terms of subject, methods and functions (?), combined into a single system within one scientific discipline.

Empirical knowledge is a set of statements about empirical or abstract objects obtained by mental (rational) processing of the results of observations and experiments and recorded using certain linguistic means (single observation sentences, graphs, natural classifications). It is worth paying attention to the fact that the subject of empirical knowledge is not really existing objects and not their "sensory" (?) interpretation, and abstract objects. An abstract object is the result of abstracting a sensory object. The object obtained as a result of the abstraction procedure contains only part of the sensory data, but is supplemented with other information that does not follow from the sensory data in any way (point, triangle). Any sensory data becomes scientific only after their mental processing and

presentation in the form of a set of terms and sentences of the empirical language of a certain science, Empirical knowledge is not sensory, but rational, i.e. rational.

The main qualitative difference between theoretical and empirical knowledge is the object. Ideal objects act as the object of theoretical knowledge. Ideal objects can be constructed both on the basis of empirical objects with the help of idealization (i.e., the absolutization of the properties of empirical objects), and introduced by definition (mathematics). Ideal objects are not observable in principle. Thus, during the transition from empirical knowledge (the observable world) to theoretical knowledge (the world of rational thinking), a qualitative leap occurs, which is why these levels of knowledge are not reducible to each other. However, they are interrelated. This connection is carried out with the help of special "tools" - interpretative sentences, in which the identity of the meanings of the corresponding terms of theoretical and empirical languages is established. The independent role of interpretative sentences is clearly demonstrated by the experimental verification of theories. To establish the relationship between theory and experience, the theory is first translated into the language of empiricism, i.e. its empirical interpretation will be obtained. Further, a certain empirical conclusion is made from the system "theory + its empirical interpretation". The correspondence of the data of the verification experiment to this conclusion or non-compliance just indicates the truth or error, BUT NOT of the THEORY, but of the system of the system "theory + its empirical interpretation". Recall that many interpretations correspond to one theory. Thus, the problem of the truth of the theory cannot be solved only by its experimental verification. The solution of this problem requires the involvement of additional funds, in particular metatheoretical prerequisites and foundations of scientific knowledge.

The third, meta-theoretical level of scientific knowledge consists of general scientific knowledge and the philosophical foundations of science. General scientific knowledge includes, firstly, a private scientific and general scientific picture of the world, and secondly, private scientific and general scientific epistemological, methodological, logical and axiological principles (?). A private scientific picture is a set of ideas about the world prevailing in any science. It is based on the ontological principles of the paradigm theory for this science. The private scientific picture of the world is a concretization of a certain philosophical ontology. The general scientific picture of the world is most often the prevailing private scientific picture of the world at this time in the world. The philosophical foundations of science provide a link between philosophy and science, just as interpretative proposals do with respect to theoretical and empirical levels.

Each level has relative independence, is not a generalization or consequence of the other, but at the same time there is an organic relationship between all levels of scientific knowledge in the process of functioning of scientific knowledge as a

whole. The interrelation of different levels of scientific knowledge is carried out by interpreting the terms of one level in terms of another. It is the unity and interconnection of all levels that provides a separate scientific discipline with relative independence, stability and the ability to develop on its own basis.

4 Probabilistic and statistical methods of research

4.1 Types and tasks of experimental research, their classification

The most important component of scientific research is an experiment, the basis of which is a scientifically formulated experience with precisely accounted for and controlled conditions. The word experiment itself comes from Lat. experimentum – trial, experience. In scientific language and research work, the term "experiment" is usually used in the meaning common to a number of related concepts: experience, purposeful observation, reproduction of the object of cognition, organization of special conditions for its existence, verification of prediction. This concept includes the scientific formulation of experiments and the observation of the phenomenon under study under precisely considered conditions, allowing to monitor the course of the phenomenon and recreate it every time these conditions are repeated. By itself, the concept of "experiment" means an action aimed at creating conditions for the implementation of a particular phenomenon as often as possible, i.e. not complicated by other phenomena. The main objectives of the experiment are to identify the properties of the objects under study, to test the validity of hypotheses and, on this basis, a broad and in-depth study of the topic of scientific research. The setting and organization of the experiment are determined by its purpose.

The structure of the experiment includes: building a model of the object of study, conscious and systematic change, combining experimental conditions and effects on the object, obtaining experimental data, processing them. At all stages of research, compliance with the objective laws of science should be monitored. Conclusions are formed based on the results of the experiment.

Experimental studies that are conducted in various branches of science are classified according to a number of characteristics.

According to the method of forming conditions, natural and artificial experiments are distinguished.

Natural involves conducting experiments in the natural conditions of the existence of the object of study (most often used in biological, social, pedagogical and psychological sciences).

In an artificial experiment, artificial conditions are formed (widely used in natural and technical sciences).

According to the research objectives, transformative, ascertaining, controlling, searching and decisive experiments are distinguished.

A transformative (creative) experiment involves an active change in the structure and functions of the object of study in accordance with the hypothesis put forward, the formation of new connections and relationships between the components of the object or between the object under study and the environment. It deliberately creates conditions that should contribute to the formation of new properties and qualities of the object.

The ascertaining experiment is used to test certain assumptions. In its process, the presence of a certain connection between the impact on the object of research and the result is established, the presence of certain facts is revealed.

The controlling experiment is reduced to monitoring the results of external influences on the object of study, taking into account its condition, the nature of the impact and the expected effect.

A search experiment is carried out if the classification of factors affecting the phenomenon under study is difficult due to the lack of sufficient preliminary data. According to its results, the significance of the parameters is established, the insignificant ones are screened out.

A decisive experiment is set up to test the validity of the main provisions of fundamental theories in the case when two or more hypotheses are equally consistent with many phenomena. Its purpose is to identify the most fair hypothesis.

According to the organization of the conduct, there are laboratory and field experiments.

The laboratory experiment is carried out in laboratory conditions using standard instruments, special modeling installations, stands, equipment, etc., and not the object itself is studied, but its sample. This experiment allows us to study the influence of some characteristics while varying others, to obtain scientific information with minimal time and resources. However, such an experiment does not always fully simulate the real course of the process being studied, so there is a need to conduct a full-scale experiment.

The full-scale experiment is carried out in natural conditions and on real objects. It is often used in the testing process of manufactured systems. Depending on the location of the tests, full-scale experiments are divided into production, field, landfill, semi-natural, etc. A full-scale experiment always requires careful thinking and planning, rational selection of research methods. In almost all cases, the main scientific problem of a full–scale experiment is to ensure that the experimental conditions are adequate to the real environment in which the object being created will work. The main objectives of the full-scale experiment are to study the characteristics of the environmental impact on the test object, identify the statistical and dynamic parameters of the object, evaluate the effectiveness of the

functioning of the object and check it for compliance with the specified requirements.

According to the structure of the studied objects and phenomena, simple and complex experiments are distinguished.

Simple is used to study objects with a small number of interconnected and interacting elements that perform the simplest functions and do not have a branched structure.

In a complex experiment, phenomena or objects with a large number of interrelated and interacting elements and performing complex functions are studied. They have a branched structure in which hierarchical levels can be distinguished. A high degree of connectivity of elements leads to the fact that a change in the state of any element or connection entails a change in the state of many other elements of the system.

According to the nature of external influences on the object of research, material, energy and information experiments are distinguished.

Material – considers the impact of the impact of physical bodies on the state of the object of study.

The energy experiment is used to study the influence of various types of energy (electromagnetic, thermal, mechanical, etc.) on the object of study. This type of experiment is widespread in the natural sciences.

An information experiment is used to study the impact of certain information on the object of research. It is most often used in biology, psychology, cybernetics, etc.

By the nature of the interaction of the means of experimental research with the object of research, there are ordinary and model experiments.

An ordinary (or classical) experiment includes the experimenter as a cognizing subject, as well as the object or subject of experimental research and the means of its implementation (tools, instruments, experimental installations). Moreover, experimental means directly interact with the object of research.

A model experiment, in contrast to the usual one, deals with a model of the object under study. The model is part of the experimental setup, replacing not only the object of research, but often also the conditions in which a certain object is studied. The difference between a model and a real object can become a source of errors, which requires additional time and theoretical justification of the properties of the model.

According to the type of models studied in the experiment, material and mental experiments are distinguished.

In a material experiment, material objects of research are used.

The tools of a mental (mental) experiment are mental models of the objects or phenomena under study (sensory images, figurative-sign models, sign models).

It is also called an idealized or imaginary experiment. A thought experiment is one of the forms of mental activity, during which the structure of a real experiment is reproduced in the imagination. The similarity of a thought experiment with a real one is largely determined by the fact that every real experiment, before being carried out in practice, is first carried out by a person mentally (by thinking and planning). Therefore, a thought experiment often acts as an ideal plan for a real experiment, anticipating it. At the same time, a thought experiment can also be performed in cases where it is impossible to conduct real experiments.

According to the controlled values, the experiments are divided into passive and active.

A passive experiment involves changing only selected indicators (parameters, variables) as a result of observing an object without artificial interference in its functioning. An example of a passive experiment in solving transport problems is the controlled operation of vehicles. In this case, a special group of controlled vehicles is allocated, during which information about all failures and malfunctions is recorded and accumulated, at which mileage they occurred or were detected, data on loads, the type of cargo transported, etc. A passive experiment is essentially an observation that is accompanied either by instrumental measurement or by recording selected indicators of the state of the object of study. The advantages of a passive experiment include its reliability. The main drawback is that the information is too "late", i.e. time the feedback is very high. For example, several years pass from the development of a node to the receipt of information about its reliability from the field of operation. To eliminate this drawback, to obtain operational information about reliability, allow: processing the results of incomplete tests using special mathematical methods, the use of statistical modeling methods based on preliminary results of a passive experiment, as well as conducting special active experiments.

An active experiment is associated with the selection of input signals (factors) and controls the input and output of the system under study. In this case, the researcher organizes and actively influences the course of the experiment by setting various loads, changing the duration of their exposure, changing the number and types of input parameters and their variation. Currently, active experiments are carried out according to special plans (programs) that are developed before they are carried out. The plan of an active experiment includes: the purpose and objectives of the experiment; the choice of variable factors; justification of the scope of the experiment, the number of experiments; the procedure for the implementation of experiments, determining the sequence of changes in factors, setting intervals between future experimental points; justification of measuring instruments; description of the experiment; justification of methods for processing and analyzing the results of the experiment. The

solution of these questions is made on the basis of a special mathematical theory of experiment planning, which makes it possible to optimize the volume of research and increase their accuracy.

According to the number of variable factors, there are single-factor and multi-factor experiments.

A one-factor experiment involves the exclusion of insignificant factors, the identification of significant factors and their alternate variation.

The essence of a multifactorial experiment is that all variables vary simultaneously, and the influence of each is evaluated based on the results of all experiments conducted in this series of experiments.

Of course, other features can be used for classification. The above classification of experimental studies cannot be considered complete, since with the expansion of scientific knowledge, the scope of application of the experimental method also expands. In addition, depending on the tasks of the experiment, its various types can be combined to form a complex or combined experiment.

4.2 Computational experiment

Recently, due to the rapid development of computer technologies, a computational experiment has become of great importance – a study based on the application of applied mathematics and computers as a technical base when using mathematical models.

The computational experiment is based on the creation of mathematical models of the studied objects, which are formed with the help of some special mathematical structure capable of reflecting the properties of the object manifested by it in various experimental conditions. However, these mathematical structures turn into models only when the elements of the structure have a specific physical interpretation. The resulting mathematical structures, together with a description of the correspondence to the experimentally detected properties of the object, are the model of the object under study. They reflect in a mathematical, symbolic (symbolic) form objectively existing in nature dependencies, connections and laws. The model can correspond visually to a real device or any of its elements.

The computational experiment is based both on a mathematical model and on the techniques of computational mathematics, which consists of many sections that develop along with the development of computer technology. For example, discrete analysis has appeared relatively recently, which makes it possible to obtain any numerical result only with the help of arithmetic and logical actions. The problem of computational mathematics here is reduced to the representation of solutions (exactly or approximately) in the form of a sequence of arithmetic operations, that is, the solution algorithm.

On the basis of mathematical modeling and methods of computational mathematics, the theory and practice of computational experiment have been

developed, the technological cycle of which is usually divided into a number of stages.

1 For the object under study, a model is built, usually first a physical one, fixing the division of all factors acting in the phenomenon under consideration into main and secondary, and secondary factors that are not essential to the issue under consideration are discarded at this stage of the study. The assumptions and conditions of applicability of the model are formulated, the boundaries in which the results obtained will be valid. The model is written in the form of mathematical relations, usually in the form of differential equations.

2 A method for solving a formulated mathematical problem is being developed, on the basis of which an algorithm is being built in the future. Each specific calculation in a computational experiment is carried out at fixed values of all parameters. When optimizing the design of the device, it is necessary to carry out a large number of calculations of the same type of problem variants that differ in the values of some initial data. This determines the effectiveness of the use of computer technology.

3 A program for solving the problem on a computer is being developed. Currently, researchers, as a rule, do not program independently, but use ready-made universal engineering software complexes in which standard algorithms for solving applied problems have already been implemented.

4 Carrying out calculations on a computer. The result is obtained in the form of some digital information, which will then need to be analyzed. The accuracy of the solution is determined in a computational experiment by the reliability of the model underlying the experiment, the correctness of algorithms and programs (preliminary tests are carried out "test" tests).

5 Processing of calculation results, their analysis and conclusions. At this stage, there may be a need to refine the mathematical model (complication or, conversely, simplification), as well as proposals for creating simplified engineering solutions and formulas that make it possible to obtain the necessary information in a simpler way.

Computational experiment becomes of exceptional importance in cases when full-scale experiments and the construction of a physical model are impossible. One can especially vividly illustrate the value of computational an experiment in the study of the scale of modern human impact on nature. What is commonly called climate – a stable average distribution of temperature, precipitation, clouds, etc. – is the result of a complex interaction of physical processes occurring in the atmosphere, on the surface of the earth and in the ocean. The nature and intensity of these processes are currently changing much faster than in the relatively close geological past due to the effects of environmental pollution. The climate system can be investigated by building an appropriate mathematical

model, which should consider the interaction between the atmosphere, ocean and land in development. Physical experiments on the climate system are not only extremely expensive, but also very dangerous, as they can unbalance it. However, a global climate experiment is possible, but not a full-scale one, but a computational one, conducting research not on a real climate system, but on its mathematical model.

In science and technology, there are many areas in which computational experiment is the only possible way to study complex systems. In addition, it is often economically more profitable than a full-scale experiment.

4.3 Methods of experimental work

To conduct an experiment of any type, it is necessary to carry out a number of preliminary actions: to develop a hypothesis to be tested, to create a program of experimental work, to determine methods and techniques of intervention in the object of research, to provide conditions for carrying out the procedure of experimental work, to develop ways and techniques for recording the progress and results of the experiment, to prepare experimental means (devices, installations, models, etc. P.), provide the experiment with the necessary maintenance personnel.

Of particular importance is the correct development of experimental methods. A technique is a set of mental and physical operations arranged in a certain sequence, according to which the purpose of the study is achieved. It should include the following components:

– conducting preliminary targeted observation of the studied object or phenomenon in order to determine the initial data (hypotheses, selection of variable factors);

– creation of conditions under which experimentation is possible (selection of objects for experimental exposure, elimination of the influence of random factors);

– determination of measurement limits;

– systematic observation of the development of the phenomenon under study during the experiment and accurate descriptions of the facts;

– carrying out systematic registration of measured values by various means and methods;

– creating repetitive situations, changing the nature of conditions and cross-effects, creating complicated situations in order to confirm or refute previously obtained data;

– transition from empirical study to logical generalizations, to analysis and theoretical processing of the received factual material.

An important stage of preparation for the experiment is the definition of its goals and objectives. The volume and complexity of research depend on the degree

of accuracy of the accepted measuring instruments and the depth of theoretical developments. The more clearly the theoretical part of the study is formulated, the smaller the volume of the experiment. The number of tasks for a particular experiment should not be too large (as a rule, 3 – 4, up to a maximum of 10).

In order to select variable factors before the experiment, that is, to establish the main and secondary characteristics that affect the process under study, it is necessary to analyze the calculated (theoretical) schemes of the process. In this case, the ranking method is used (see subsection 5.1). The main principle of determining the degree of importance of a characteristic is its role in the process under study. To do this, the process is studied depending on one variable with the remaining constants. This principle of conducting an experiment justifies itself only in cases when there are no more than three such characteristics. If there are many variables, the principle of multivariate analysis is appropriate.

When registering values during the same process, repeated readings on the instruments are usually not the same. The deviations are explained by various reasons – heterogeneity of the properties of the studied body, the error of the instruments, subjective characteristics of the experimenter, etc. The more random factors influencing the experience, the greater the discrepancy between the values obtained during measurements. This leads to the need for repeated measurements. The establishment of the required minimum number of measurements is of great importance, since it makes it possible to obtain the most objective results with minimal time and money. It should provide a stable average value of the measured value satisfying a given degree of accuracy.

In order to justify a set of measuring instruments (instruments), the experimenter must be well acquainted with the measuring equipment produced in the country (with the help of regularly published catalogs, according to which one can order certain measuring instruments). Naturally, first of all, standard, mass-produced machines and devices should be used, the work on which is regulated by official documents. In some cases, there is a need to create unique devices, installations, stands, machines for theme development. For these purposes, it is desirable to use ready-made components of manufactured devices or reconstruct existing ones. Moreover, the feasibility of manufacturing new equipment should be carefully justified by both theoretical calculations and practical considerations.

An important section of the methodology is the choice of methods for processing and analyzing experimental data. Data processing is reduced to systematization of all values, classification, analysis. The results of the experiments should be summarized in readable record forms – tables, graphs, formulas that allow you to quickly compare and analyze the results obtained. The dimension of all parameters must correspond to a single system of physical quantities. Special attention in the methodology should be paid to mathematical

methods of processing and analysis of experimental data, including the establishment of empirical dependencies, approximation of relationships between variable characteristics, the establishment of criteria and confidence intervals.

4.4 Metrological support of experimental studies

The crucial moment in conducting any experiments is to establish the accuracy of measurements and errors. Measurement methods should be based on the laws of the special science of metrology – the science of measurements, methods and means of ensuring their unity and ways to achieve the required accuracy.

The main components of metrology are:

– general theory of measurements; units of physical quantities (quantities that are assigned a numerical value equal to one by definition) and their systems (a set of basic and derived units formed in accordance with certain principles);

– methods and means of measurement;

– methods for determining the accuracy of measurements;

– the basics of ensuring the uniformity of measurements, in which the measurement results are expressed in legalized units, and measurement errors are known with a given probability, which is possible with the uniformity of measuring instruments (measuring instruments must be graduated in legalized units and their metrological properties comply with the norms).

The founder of metrology as a science in our country was D. I. Mendeleev, who created in 1893 the Main Chamber of Weights and Measures, which carried out, in particular, a lot of work on the introduction of the metric system in the former USSR.

The Metrological Service of the Republic of Uzbekistan is connected with the entire standardization system in the country, as it ensures the reliability, comparability of quality indicators embedded in the standards, provides methods for determining and controlling such indicators. The Metrological Service is an extensive network of scientific and control and testing organizations capable of performing significant work in both scientific and theoretical and applied aspects of accurate measurements. Currently, all work on standardization and metrology in the country is headed by the State Committee for Standardization, Metrology and Certification under the Council of Ministers of the Republic of Uzbekistan (Gosstandart), whose tasks are to improve the system of standardization and metrology, expand the scope of their use to improve the technical level and quality of products of all sectors of the national economy, strengthen and develop the state metrological service, standardization of methods, measuring instruments, etc. Its activity is based on the Law of the Republic of Uzbekistan "On ensuring the uniformity of measurements", adopted in 1995.

The most important values in metrology are assigned to measuring instruments and standards. According to the RMG 29-99 standard (Interstate Recommendations on standardization

"Metrology. Basic requirements and definitions"), measurement is finding a physical quantity experimentally with the help of special technical means. The essence of the measurement is the comparison of the measured value with a known value taken as a unit (standard). Standards include measuring instruments (or a set of measuring instruments) that ensure the reproduction and storage of a unit in order to transfer its size to lower measuring instruments.

To check the working (technical) measuring instruments that are constantly used directly in research, exemplary measuring instruments are used. The transfer of unit sizes from standards or model measuring instruments to working means is carried out by state and departmental metrological bodies. Their activity ensures the unity of measurements and uniformity of measuring instruments.

4.5 The use of SI units in research. Metric system of units

The metric system of units is the common name of the international decimal system of units, the basic units of which are the meter and the kilogram. With some differences in details, the elements of the system are the same all over the world. The metric system grew out of the resolutions adopted by the French National Assembly in 1791 and 1795 to define the meter as one ten-millionth of the portion of the earth's meridian from the North Pole to the equator. Defining a meter as a ten-millionth of a quarter of the earth's meridian, the creators of the metric system sought to achieve invariance and accurate reproducibility of the system. They took a gram as a unit of mass, defining it as the mass of one millionth of a cubic meter of water at its maximum density.

The International Commission on the Meter in 1872 decided to take the length as the standard.

The "archive" meter, which was a ruler made of platinum alloy with ten percent iridium, the cross section of which was given an X-shaped shape to increase bending stiffness. There was a longitudinal flat surface in the groove of such a ruler, and the meter was defined as the distance between the centers of two strokes applied across the ruler at its ends, at a standard temperature equal to 0 ° C. In 1875, many countries of the world signed an agreement on the meter, and this agreement established a procedure for coordinating metrological standards for the world scientific community through the International Bureau of Weights and Measures and the General Conference on Weights and Measures. Similarly, the members of the Commission took the mass of a cylinder with a height and diameter of about 3.9 cm, made of the same platinum-iridium alloy as the standard of the meter, as a standard of mass.

International prototypes of standards of length and mass – meters and kilograms – were deposited with the International Bureau of Weights and Measures, located in Sevres– a suburb of Paris. They were selected from a significant batch of identical standards made at the same time. Other standards of this batch were transferred to all participating countries as national prototypes (state primary standards), which are periodically returned to the International Bureau for comparison with international standards.

The metric system was very favorably received by scientists. Its main advantages were ease of use and independence of reproducing units of measurement. Based on the elementary laws of physics, researchers began to introduce new units for different physical quantities, linking them with units of length and mass of the metric system. If it was possible to coordinate units of measurement in mechanics, then in the field of electricity and magnetism for a long time there were several different systems of units.

To eliminate confusion between them, at the beginning of the XX century, a proposal was put forward to combine practical electrical units with corresponding mechanical ones based on metric units of length and mass, and to build some kind of coherent system. In 1960, the XI General Conference on Weights and Measures adopted the Unified International System of Units (SI), defined the basic units of this system and prescribed the use of some derived units, "without prejudging the question of others that may be added in the future." Thus, for the first time in history, an international agreement adopted the International System of Units, which is currently accepted as legal by most countries of the world.

The International System of Units (SI) is an agreed system in which only one unit of measurement is provided for any physical quantity. Some of the units are given special names, an example is the pressure unit – pascal, while the names of others are formed from the names of those units from which they are produced, for example, the unit of speed – meter per second. The SI system includes 7 basic units of measurement (meter, kilogram, second, kelvin, mole, ampere, candela) and 2 additional units (radian and steradian).

Currently , the official definitions of the main and additional units of the SI system are as follows:

– meter (m) is the length of the path traversed in vacuum by light in 1/299 792 458 fraction of a second;

– a kilogram (kg) is equal to the mass of the international prototype of a kilogram;

– second (s) – duration of 9 192 631 770 periods of radiation oscillations corresponding to transitions between two levels of the hyperfine structure of the ground state of the caesium-133 atom;

– kelvin (K) is equal to 1/273.16 of the thermodynamic temperature of the triple point of water;

– a mole is equal to the amount of a substance that contains as many structural elements as atoms in the carbon-12 isotope weighing 0.012 kg;

– ampere (A) is the force of a constant current, which, when passing through two parallel rectilinear conductors of infinite length with an infinitesimal cross–sectional area located in a vacuum at a distance of 1 m from each other, would cause an interaction force equal to 2 • 107 N. on each section of a conductor 1 m long.

– candela (cd), formerly called a candle, is a unit of light intensity in a given direction of a source emitting monochromatic radiation of a frequency of 540 •1012 Hz, whose energy intensity of light radiation in this direction is 1/683 W/cf. This roughly corresponds to the light intensity of a spermaceti candle, which once served as a reference.

– the radian (rad) is equal to the plane angle between two radii of a circle, the arc length between which is equal to the radius;

– the steradian (sr) is equal to a solid angle with a vertex in the center of the sphere, cutting out on its surface an area equal to the area of a square with a side equal to the radius of the sphere.

The definitions given show that at present all the basic units of the SI system, except the kilogram, are expressed in terms of physical constants or phenomena that are considered unchangeable and reproducible with high accuracy. For example, the meter is determined through the speed of light. It can be reproduced independently in any well-equipped laboratory. With the development of laser technology, such measurements have become very simplified, and their range has significantly expanded. The margin of error does not exceed one billionth. Similarly, a second in accordance can be implemented in a competent laboratory with an accuracy of the order of 10-12. Time and its inverse, frequency, are unique in that their standards can be transmitted by radio. Therefore, each person can receive signals of the exact time and reference frequency.

As for the kilogram, no way has yet been found to implement it with the degree of reproducibility that is achieved in the procedures for comparing various mass standards with the international prototype of the kilogram. Such a comparison can be carried out by weighing on spring scales, the error of which does not exceed 10-8.

With the help of basic and additional units, all derivatives are formed. Of these, the most important are the unit of force – Newton, the unit of energy – joule and the unit of power – watt. Newton is defined as the force that gives a mass of one kilogram an acceleration equal to one meter per second squared. The joule is equal to the work that is performed when the point of application of a force equal

to one Newton moves a distance of one meter in the direction of the force. Watt is the power at which work in one joule is performed in one second.

5 Selection of formulas for approximation of statistical series

5.1 Selection of empirical formulas

The process of constructing an empirical formula for a functional dependence established from experience splits into two stages: first, the type of formula is selected and after that the numerical values of the parameters for which the approximation turns out to be the best (in a sense) are determined.

If during the experiment a dependence was investigated, the nature of which is known, then the type of empirical formula can be determined from theoretical considerations. So, for example, when studying the dependence of the current strength on any section of an electrical circuit containing only linear elements (for example, resistors) on the voltage in this section, it is quite natural to expect that the dependence will be linear

$$I = k \cdot U$$

which simply follows from Ohm's law for a section of the chain $I = U / R$

The situation is different if the nature of the studied dependence is unknown, and no theoretical considerations can be made about this. In such cases, proceed as follows. According to experimental data, a dot graph is constructed. Then a smooth curve is drawn, reflecting the nature of the location of the points in the best possible way. The curve obtained in this way is compared with graphs of simple analytical functions and on the basis of such a comparison, an empirical formula is chosen.

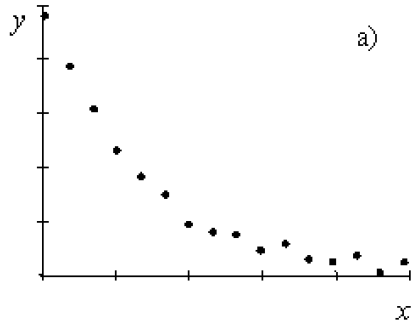
The following functions are most commonly used:

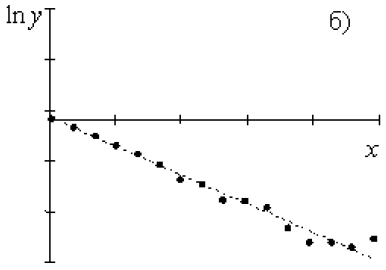
1) $y = a + bx$ 2) $y = a + bx + cx^2$ 3) $y = a\,\exp(bx)$

4) $y = ax^b$ 5) $y = \dfrac{1}{a + bx}$ 6) $y = a + b \ln x$

Since the similarity of the graphs, determined roughly by eye, can be deceptive (especially if the scale is chosen unsuccessfully), it is necessary to select a formula before determining the values of the parameters, to check the possibility of its application by the alignment method.

5.2 Alignment method (data linearization)





To describe the alignment method, consider an example. In Fig.4.5(a) a dotted graph constructed from experimental data is presented. From the view of the graph, it can be assumed that the dependence is exponential:
Prologarithm the right and left sides of this equation:

It is not difficult to notice that the quantities and x are connected by a linear relationship.

If experimental data, i.e. pairs of points are really connected by exponential dependence, then according to (*), the graph of dependence from should be close to linear (Fig. 4.5b). If this is the case, then the choice of the empirical formula is made correctly.

Thus, the alignment method is as follows: assuming that there is a dependence of a certain kind between x and y, some quantities and are found, which, under the assumption made, are shown to be connected by a linear dependence. Then, for the given
values and calculate the corresponding values and and depict them graphically. From the graph, it is easy to see whether the relationship between and is close to linear and, therefore, whether the chosen formula is suitable or not.

Transformations that reduce a nonlinear dependence to a linear one are called linearizing transformations.

In the example above, the transformations that linearize (align) the exponential dependence have the form:

The table below shows the linearizing transformations for some elementary functions.

Table 1.

Функция	x^{ℓ}	y^{ℓ}	a	b
$y = ax^{b}$	$\ln x$	$\ln y$	$\mathrm{e}^{a'}$	b'
$y = a\mathrm{e}^{bx}$	x	$\ln y$	$\mathrm{e}^{a'}$	b'
$y = a + bx$	x^{2}	y	a'	b'
$y = \frac{1}{a + bx}$	x	$\frac{1}{y}$	a'	b'
$y = a + b\ln x$	$\ln x$	y	a'	b'
$y = a + \frac{b}{x}$	$\frac{1}{x}$	y	a'	b'
$y = \frac{x}{ax + b}$	$\frac{1}{x}$	$\frac{1}{y}$	a'	b'

6 Application of multi-purpose optimization methods to form the optimality criterion

6.1 Main component method

It consists in the fact that the quality criterion is associated with one of the indicators selected as the main one. Restrictions are imposed on the main indicators. In this case, the criterion of optimality is implemented for the main indicator, and for the rest - suitability. For example, if there is a vector of a useful effect in the form

$$W<k> = <W1, W2, ... Wk>, (7.1)$$

Where Wi(i=1,2...k) are the components of the vector, for example, for a machine: productivity, environmental friendliness, reliability, cost, etc., then the method of the main component consists in arbitrarily selecting one of the components as the main one, according to which optimization is performed and a solution is selected. At the same time, the remaining components are transferred to the category of restrictions.

This method is simple, clear and often used in machine-building practice, but its fundamental disadvantage is arbitrariness in choosing the main criterion. There are many examples from the history of science and technology when an arbitrary and incorrect choice of this criterion leads to tragic consequences or, at least, to ineffective results.

In the literature devoted to the optimization of logging programs, the main indicator is chosen, for example, their cost or the volume of forest use. When optimizing the metal structures of forest machines – metal consumption. When technological problems of forest production are solved, it is customary to use productivity as the main component.

For tasks where the criteria are not equivalent, another solution method is used - concessions. Before solving the task by the method of concessions, it is necessary:

arrange the criteria according to their significance (the most important is considered the first); find the optimal value of W1* objective function W1 ;

make a concession on the first efficiency indicator, i.e. worsen the value of W1* to the value of W1**=k1W1*;

introduce an additional constraint W1i W1** into the problem; find the optimal value W2* of the objective function W2 ;

make a concession on the second efficiency indicator, i.e. worsen the value of W2* to the value of W2**=k2W2*;

introduce an additional constraint W2i W2 into the task**;

a new task with two additional constraints should be solved according to the third efficiency indicator, etc.;

the process of solving the problem ends when the solution is obtained for all indicators. The final plan will be the most rational - the optimal value of the least important criterion is obtained, provided that the values of the previous performance indicators are guaranteed.

Example 7.1. Solve the problem according to two criteria, considering the most preferable.

Its deviation from the maximum value is 10%: W1 = x1 + 2 x2 (r) max;
W1 = x1 + 2 x2 (r) min; x1 + 2 x2 i 6;
x1 J 4;
x2 J 5;
x1 i 0; x2 i 0.

Solving the linear programming problem according to the first efficiency indicator W1, for example in the EXCEL package environment or graphically, we get that the maximum value of the objective function W1* = 14 is reached at x1 = 4 and x2 = 5. We make a concession by 10%, i.e. we reduce the value W1* = 14 to the value W1 ** = 14H 0.9 = 12.6. Adding an additional restriction to the task x1 + 2 x2 i 12,6.

Further, solving the linear programming problem while minimizing the second efficiency indicator, we have W2* = 7.6 with x1 = 2.6 and x2 = 5. At the same time, the value of the efficiency indicator W1 has not changed and is equal to 12.6.

7 Registration of the results of scientific work

In order for the results of scientific activity to be used in practice, it is important not only to competently organize and conduct the study of the object, but also to correctly formalize the results of scientific research. An object containing scientific and technical information and intended for its storage and use is a scientific document. It can be a report, a report, an article, etc.

When preparing a scientific manuscript, along with clarity of presentation, consistency and consistency in the presentation of the material, it is necessary to comply with certain design requirements.

The text of the manuscript should be divided into paragraphs. The criterion for such a division is meaning. Proper breakdown makes it easier to read and assimilate the content. Repetitions should be avoided in the manuscript, no transition to a new thought is allowed until the first one has received a complete expression. Quotations in the manuscript should have accurate references to sources. It is better to give all the auxiliary material in the form of an appendix.

Any scientific work includes a number of constituent elements. Let's list the main requirements for them.

The title of the work should be short, specific, corresponding to the content of the study, since the scientific work will be classified in the library catalog according to it.

The Table of Contents is intended to reveal to the reader in a brief form the content of the work by designating the main sections, parts, chapters and other constituent elements of the manuscript. Sometimes, when making a scientific paper, it becomes necessary to give a preface.

It sets out the external prerequisites for the creation of scientific work: what caused it when and where the work was performed, the organizations and persons who assisted in the performance of this work are listed.

In the introduction, the author should introduce the reader to the range of problems under consideration in order to prepare for a better assimilation of the material presented. It defines: the significance of the problem, its relevance, the goals and objectives set by the author when writing a scientific paper, the state of the problem at the moment.

Following the introduction, a brief review of the literature on the issue under consideration is given, which should describe the development of research on the problem under consideration and determine the position of the work being prepared in the general structure of scientific documents on this topic.

The main content of the work includes materials, methods, experimental data, generalizations and conclusions of the study itself. To facilitate perception, the text can be accompanied by illustrations. In particular, it is advisable to present digital material in the form of tables, diagrams, graphs.

Conclusions should be placed at the end of the work as the final material in the form of briefly formulated individual theses or in a coherent, but extremely concise presentation. In them it is necessary to observe the principle: from the particular to the most general and important provisions. Conclusions should correspond only to the material that is presented in the work, and the emphasis should be placed on the new results obtained by the author.

In conclusion, a generalization of the most significant provisions of the scientific work is given. A person familiar with research in this area, after reading the conclusion, should clearly present the qualitative essence of this work (without its methodological and specific quantitative aspects), draw certain conclusions about possible directions for further research.

At the end of the work, a list of literary sources is given based on the ordinal numbers indicated in the text. The numbering should correspond to the order in which literary sources are mentioned in the text or be arranged alphabetically by the authors' surnames (if the number of authors is more than three, then the location in the list is determined by the title). The description of each literary

source (books, magazines, articles, etc.), as a rule, should include the surnames and initials of the authors, title, place and year of publication, volume in pages.

If necessary, an appendix is given at the end of the work, which includes auxiliary tables, graphs, additional texts and other materials. At the same time, each material, table, schedule is assigned an independent serial number, which is indicated in the text when referring to the materials of the application.

Often, based on the text of the work, it is necessary to prepare an abstract or abstract, the main requirements for which are contained in GOST 7.9–95.

An abstract is a brief description of a scientific work, which includes the type of work, the main topic, the problem, the object, the purpose of the work and its results. The main function of the annotation is signaling. It outlines the range of issues considered in this work, and indicates the category of readers for whom it is intended. When writing an abstract, phrases with verbs are used in the reflexive form ("considered", "discussed", "investigated", etc.) or passive ("considered", "investigated", "proved", etc.). Its average volume is 500 printed characters. Annotations they are placed in books, brochures, thematic plans of publishing houses, etc. (in books they are usually located on the back of the title page).

The abstract is an abbreviated summary of the content of the scientific work with basic information and conclusions. According to GOST 7.9–95, the abstract should include the title of the abstract (as a rule, coinciding with the title of the primary document) and its text. The text of the abstract includes the topic, subject, nature, purpose of the work, methods of conducting the work, its specific results (theoretical, experimental, descriptive), while preference is given to new and proven facts, results of long-term significance, discoveries important for solving practical issues, as well as conclusions, characteristics of the scope of the work. The average volume of the abstract, depending on the volume of the reviewed documents, should not exceed printed characters: 500 – for notes and short messages; 1000 – for most articles, patents; 2500 – for large-volume documents. The main function of the abstract, unlike the annotation, is cognitive, so it can include phrases expressed in any grammatical form. Abstracts are placed in abstract journals and collections, information maps, etc.

The main document that is drawn up based on the results of research work is a scientific and technical report. According to GOST 7.32–2001, it should include an abstract and an abstract with a summary of the research objectives and the results obtained, an introduction with a description of domestic and foreign achievements on the problem under study and the text of the report. The text of the report includes: statement of the problem, formulation of the terms of reference, analysis of known methods of solving the problem, justification of the choice of the method of solving the problem, calculations and experimental results, conclusions with comparison and analysis of theoretical and experimental data

obtained in the course of research, conclusion with evaluation of the results and indication of ways to use them.

8 Automated research systems

Automation of scientific research is of particular importance for increasing the efficiency of science, which makes it possible to obtain more accurate and complete models of the objects and phenomena under study, accelerate the progress of scientific research and reduce their labor intensity, study complex objects and processes, the study of which is difficult or impossible by traditional methods. The use of automated systems for scientific research and complex testing of new technology samples (ASNI) is most effective in those modern fields of science and technology that deal with the use of large amounts of information. These primarily include:

- nuclear physics (collection and processing of experimental data obtained at reactors, accelerators and fusion plants);
- plasma and solid state physics;
- radiophysics and electronics;
- astronomy and radio astronomy;
- space research (processing of information received from artificial satellites for the needs of the national economy);
- geology and geophysics (mineral exploration);
- ocean research, environmental research, weather forecasting and natural disasters;
- biology and medicine (research in the field of molecular biology, microbiological synthesis, diagnosis of diseases);
- chemical technology (modeling of technological processes, obtaining materials with specified properties);
- research of complex technological processes in industry;
- research and development in the field of energy (power plants, power transmission networks, energy systems);
- research and development in the field of transport communications, communication networks and computer networks;
- full-scale and bench tests of complex technical objects (aircraft, transport devices, machines, structures);
- economics, social studies, law and linguistics.

Automated systems of scientific research and complex tests of samples of new equipment provide a significant economic effect. This effect is formed by increasing labor productivity in research and testing units, improving the technical and economic characteristics of the objects being developed on the basis of obtaining and using more accurate models of these objects, reducing expensive

field tests, eliminating some stages of development work, which ultimately leads to a reduction in the cost of developing new equipment.

ASNI differ from other types of automated systems (ACS, automated control system, CAD, etc.) by the nature of the information received at the output of the system. First of all, these are processed or generalized experimental data, but the main thing is the mathematical models of the objects, phenomena or processes under study obtained on the basis of these data. The adequacy and accuracy of such models is ensured by the entire complex of methodological, software and other means of the system. ASNI can also use ready-made mathematical models to study the behavior of certain objects and processes, as well as to refine these models themselves. ASNI are therefore systems for obtaining, correcting or researching models that are then used in other types of automated systems for management, forecasting or design.

As a rule, all types of ASNI should be created on the basis of serial computer equipment of wide application (processors, memory devices on magnetic tapes and disks, printing devices, displays, etc.). However, special equipment for interfacing computers with the objects under study can also be used in ASNI. This equipment should provide a variety of information preprocessing functions, have a flexible structure and maximum interchangeability of modules and blocks.

Therefore, the creation of computer interface equipment with objects is one of the most important areas of work that ensure the effective development and development of various types of ASNI. The blocks and modules of the interface equipment must be mass-produced in accordance with international standards.

These guidelines were developed by the Provisional Scientific and Technical Commission formed by the Resolution of the USSR State Committee for Science and Technology No. 121 dated April 4, 1979.

When developing Industry-wide guidelines for the creation of automated systems for scientific research and complex testing of samples of new equipment, State standards and industry-wide guidelines for the creation of automated systems for various purposes were taken into account.

8.1 Purpose and application of guidance materials

These Industry-wide guidelines establish the main provisions on the purpose, functions, structure and procedure for creating automated research systems.

The guidance materials are intended for ministries, departments and research organizations and enterprises working on the creation of ASNI or using subsystems and components of ASNI.

The guidance materials are aimed at carrying out a unified technical policy in the creation, operation and development of ASNI in research organizations and enterprises.

It is recommended to use the guidance materials when developing plans for the creation of ASNI, as well as at all stages of the creation and development of ASNI.

Methodological, technical, as well as guidance materials and standards related to the establishment of ASNI should be developed by ministries, departments, organizations and enterprises, taking into account the main provisions of these guidelines.

8.2 Objectives of the ASNI creation

ASNI are created in organizations and enterprises in order to:

- ensuring high rates of scientific and technological progress;
- improving the efficiency and quality of scientific research based on obtaining or refining mathematical models of objects, phenomena or processes under study using ASNI, as well as using these models for design, forecasting and management;
- improving the efficiency of objects developed with the help of ASNI, reducing the cost of their creation;
- obtaining qualitatively new scientific results, the achievement of which is fundamentally impossible without the use of ASNI;
- reducing the time, reducing the complexity of scientific research and complex testing of samples of new equipment.

The achievement of the goals of the creation of the ASNI is ensured by:

- systematization and improvement of scientific research and testing processes based on the use of mathematical methods and computer technology;
- complex automation of research work in a research organization with the necessary restructuring of its structure and personnel;
- improving the quality of scientific research management;
- application of effective mathematical methods of organization and planning of experiments;
- the use of methods for processing and presenting the results of scientific research and testing in the form of mathematical models having a given form;
- automation of labor-intensive work;
- replacement of full-scale tests and mock-ups with mathematical modeling.

8.3 Definition of ASNI

The automated system of scientific research and complex tests of samples of new equipment (ASNI) is a software and hardware complex based on computer technology designed for conducting scientific research or complex tests of samples of new equipment based on obtaining and using models of the objects, phenomena and processes under study.

The ASNI hardware and software complex consists of methodological, software, technical, informational and organizational and legal support.

The interaction of the studied object, phenomenon or process with the ASNI is carried out through the interface equipment, which is part of the hardware and software complex.

The interaction of departments of a research organization or enterprise with the ASNI is regulated by the means of organizational and legal support of the system.

8.4 ASNI Functions

The main function of the ASNI is to obtain the results of scientific research (complex tests) by automated processing of experimental data and other information, obtaining and researching models of objects, phenomena and processes based on the application of mathematical methods, automated procedures, planning and control of the experiment.

Automated procedures in the ASNI consist in the fact that research (testing) of objects, phenomena and processes, obtaining and researching mathematical models is carried out through user interaction with the ASNI in a dialogue mode.

Automatic procedures can be carried out in the ASNI, in which data processing, identification or construction of mathematical models are carried out without human participation.

The ASNI can also apply procedures for planning and managing an experiment, in which the use of modeling corrects the conditions of the experiment, and experimental information is used to select a mathematical model from a given set of such models.

The result of the functioning of the ASNI is the confirmation (rejection) of hypotheses or a set of completed mathematical models that meet the specified requirements, as well as the processed results of research, observations and measurements.

The functioning of the ASNI should ensure the receipt of output documents executed in a given form and containing the results of scientific research or testing, as well as recommendations on the use of these results for forecasting, management or design.

8.5 ASNI structure

The main structural links of ASNI are subsystems.

The ASNI subsystem is a part of the ASNI allocated according to some signs, which ensures the implementation of certain automated research (testing) procedures and the receipt of appropriate output documents.

There are object-oriented (object-oriented) and service subsystems of ASNI.

The object subsystem receives and processes experimental data from some object.

Object-based subsystems can be, for example:

- processing of experimental data obtained from specialized installations (accelerators, spectrometers, test benches);
- data processing on ships, systems for seismic exploration, etc.;
- collective use for a cluster of homogeneous experimental installations or stands.

The service subsystem performs information management and processing functions that do not depend on the characteristics of the phenomenon, object or process under study.

Service subsystems can be, for example:

- ASNI management;
- dialog procedures;
- numerical analysis;
- planning and optimization of the experiment;
- input, processing and output of graphic information;
- information retrieval procedures.

The ASNI subsystem consists of components united by a common procedure for this subsystem.

A component is an element of software that performs a specific function in the ASNI subsystem.

The structural unity of the ASNI subsystem is provided by the connections between the components of various means of support that form the subsystem.

The structural integration of ASNI subsystems into the system is provided by the connections between the components included in the subsystems.

The means of providing ASNI consist of the following components:

- methodological support;
- software;
- technical support;
- information support;
- organizational and legal support.

The components of methodological support are documents that set out in full or with reference to primary sources: theory, methods, methods, mathematical models, algorithms, algorithmic special languages for describing objects, terminology, standards, standards and other data that provide the methodology of scientific research or testing in ASNI subsystems.

Components of mathematical and linguistic support can be distinguished from the methodological support.

The components of the software are documents with program texts, programs on machine media and operational documents that ensure the functioning of the corresponding ASNI subsystems.

The software is divided into system-wide and application-based. Components of system-wide software are, for example, operating systems, standard control programs based on operating systems, translators from algorithmic and control languages, emulators.

Application software components are programs and application software packages designed to carry out research or testing procedures.

Components of technical support are devices of computing and organizational equipment, means and devices of communication with the object, measuring and other devices or their combinations that ensure the functioning of the corresponding subsystems of the ASNI.

The set of components of technical support forms a complex of technical means of ASNI.

The components of the information support are documents containing descriptions of standard procedures, standard mathematical models, basic laws, formulas, constants and other data, as well as files and data blocks on machine media with the recording of these documents, ensuring the functioning of the relevant subsystems of the ASNI.

The set of components of information support forms the information base (database) of the ASNI.

The components of the organizational and legal support of the ASNI are methodological and guidance materials, regulations, instructions, orders, staffing tables, qualification requirements, instructions for users and other documents that ensure the interaction of departments of an organization or enterprise during the creation, operation and development of the ASNI.

8.6 Basic principles of ASNI creation

When creating and developing ASNI, it is recommended to apply the following principles:

- consistent expansion of the field of automation of scientific research;
- ASNI integration;
- typing, unification and standardization of ASNI components;
- replication of typical subsystems and components of ASNI;
- application of a unified methodology for the creation and development of ASNI;
- a systematic approach to design;
- adaptability;
- development of criteria for the effectiveness of ASNI;
- orientation to the methods of the leading collectives in the subject;
- advanced development of basic solutions in parent organizations.

The consistent expansion of the field of automation of scientific research involves:

- introduction of automation tools into new areas of scientific research, primarily in those areas where obtaining new significant results is impossible without the use of automation tools;

- expansion of the contingent of users of automated research systems - from experimenters to managers of large scientific programs;

- automation of all stages of scientific research from planning and management of experiments to analysis and long-term planning of the main directions of scientific research.

Thematic, functional and territorial integration of ASNI should be aimed primarily at creating systems for collective use:

- for large experimental, research and experimental installations and complex production tests of various technical facilities in research and design organizations, universities, enterprises, landfills, etc.;

- for individual large research organizations, conducting complex studies of complex objects;

- for interconnected by a single program of work or related groups of research and design organizations;

- for geographically united groups of research and design organizations, some republican academies of sciences, academic and departmental research centers.

ASNI integration includes:

- creation of multi-machine hierarchical measurement and computing complexes for collective use, serving several experiments;

- development of the information base (creation of centralized and distributed scientific data banks, exchange of scientific data through communication channels between ASNI in agreed formats, unification of data structures and typification of database management systems);

- development of system-wide software (unification of the operating environment, use of standard and creation of specialized telecommunication access methods, creation of multi-subscriber real-time systems operating in multi-access modes).

Typical, problem-oriented or specialized measuring and computing complexes should be used as the basis for the creation of ASNI

(IVK), which include serial measuring equipment, as well as standard software.

Special attention should be paid to the standard equipment of computer interface with the object of research, the creation of standard software-controlled modular systems for collecting information and managing complex objects. The requirements for this equipment are formed on the basis of relevant state and international standards in order to ensure maximum compatibility of ASNI

hardware and software produced by various organizations and in different countries. It is necessary to use CAMAC standards that ensure hardware and software compatibility of ASNI subsystems and components.

The most important condition for the unification and typification of ASNI components and subsystems is the widespread use of aggregate measuring and computing equipment in them that meet the requirements of constructive, informational, operational, energy and other types of compatibility.

In the development of new ASNI components, it is necessary to widely apply the hardware implementation of the most typical data processing functions, operating systems and other operating environment management functions.

The replication of typical subsystems and components of ASNI is based on the typification, unification and standardization of design solutions when creating subsystems and components of ASNI, which creates conditions for the mass industrial production of these components.

Promising, for example, creation and replication:

- standard ASNI for experimental research in the departments of research organizations, higher educational institutions and enterprises;

- standard mobile ASNI for field reconnaissance, for research vessels and other mobile objects, as well as landfill research;

- typical problem-oriented measuring and computing complexes for collecting and processing information at research facilities and in the laboratory.

A unified methodology for the creation of ASNI should take into account achievements in related fields of science and technology and use the mutual influence of trends in the development of technology, technology and production, on the one hand, and automation of scientific and industrial experiments, on the other. This requirement is provided by:

- orientation of automation development in research organizations of the USSR Academy of Sciences, as well as ministries and departments to a single methodological, technical and software basis of open systems technology;

- typification, unification and standardization of design solutions when creating ASNI, regardless of their scope of application;

- convergence of principles and technology of the largest scientific and industrial experiments;

- using the experience of creating and operating automated process control systems (automated process control systems);

- development of the same type of methods and automation tools for large scientific experiments, on the one hand, and industrial experiments, tests of technical facilities and systems and pilot production, on the other.

A systematic approach to design involves designing on the basis of a system analysis, including the solution of a complex of technical, economic,

organizational issues, the solution of which together will ensure the creation of ASNI in an optimal way.

Adaptability implies the easy adaptability of ASNI to the change of the tasks solved with its help - scalability.

The development of criteria for the effectiveness of the ASNI should allow an objective assessment of the economic or other effect obtained from the implementation of the ASNI.

When creating or borrowing ASNI components, the requirements for these components arising from the system-wide principles set out above should be ensured.

It is recommended to create methodological support components based on:

- promising methods of automation of scientific research, search for new principles of action and technical solutions;
- effective methods of mathematical modeling of the object under study and its elements;
- using the methods of formalized description and simulation modeling;
- application of methods of planning and optimization of the experiment;
- use of standard and standard data processing procedures;
- standard computational and computational methods.

It is recommended to create software components using the following requirements:

- maximum application of standard and serial software of open systems technology;
- adaptability to various computer configurations and their operating systems - openness, portability, interaction;
- providing multi-program operation, time-sharing mode, dialog mode operation;
- modular construction, expansion and updating;
- providing monitoring and diagnostics;
- the use of programming languages and systems recommended by the SCNT;
- automation of document turnover;
- the technical specifications for the development of software components include requirements that oblige developers to use the programming technologies recommended by the SCNT, which increase the productivity of programmers.

The components of the technical support should be created on the basis of:

- serial general-purpose computer equipment;
- serial aggregate means of general-purpose measuring equipment;
- specialized technical means, if their use in ASNI is technically and economically justified;

- modern general-purpose technical means for interfacing computers with research objects.

Information support components should be created on the basis of:

- maximum use of serial hardware and software;
- flexible organization and open structure adapted to the replenishment and integration of open systems;
- possibilities of logical structuring of data according to formal features;
- the possibility of simultaneous use of data by several ASNI subsystems;
- ensuring the accuracy of standard and regulatory data;
- access control and protection of files and data blocks;
- compliance with international standards of open systems.

The components of the organizational and legal support of the ASNI should be created on the basis of:

- progressive methods of scientific research and testing;
- standards and regulatory documents regulating scientific research in the industry;
- modern methods of planning and management;
- analysis of economic efficiency and application of financial incentive measures.

The development (improvement) of ASNI components is carried out by creating new modifications (including new editions, versions, types) of these components.

9 Management of innovative projects

innovation is an implemented innovation that provides a qualitative increase in the efficiency of processes or products that are in demand by the market. It is the end result of a person's intellectual activity, his imagination, creative process, discoveries, inventions and rationalization. An example of innovation is the introduction to the market of products (goods and

services) with new consumer properties or a qualitative increase in the efficiency of production systems.

— a new or significantly improved product (product, service) or process introduced into use, a new sales method or a new organizational method in business practice, workplace organization or in external relations.

Innovative projects are characterized by the fact that the work includes tasks for which there are problems for which solutions have not yet been invented. And how much time the inventor will take to solve the problem is not yet clear.

This is the most obvious complexity of such a project – high uncertainty, which begins with the requirements for the project's products. Even if the requirements are clear, there are difficulties in finding satisfactory solutions that will help to implement these requirements. In these conditions, it is difficult for the

project team to estimate labor costs, and this leads to uncertainty with the assessment of the timing of the project result and budget.

In many scientific papers devoted to the topic of the introduction of innovative ideas, the authors already recognize the need to use the discipline of "project management" to get results from an innovative idea.

Some innovative products require fundamental or applied scientific research. As soon as there is a need to conduct scientific research within the framework of a project to develop an innovative solution, a huge number of risks associated with them appear. If these risks are assessed by the project manager or experts as important (a high probability of risk materialization and a serious impact on the project), then the main strategy for dealing with important risks usually becomes an avoidance strategy. Risk avoidance is reduced to finding a solution by which the risk is completely eliminated, and risky work is often forced out of the project. For an innovative project, the displacement of research works from the design work is impossible, because it is they that lead to the verification of those hypotheses that the innovator has.

Thus, an innovative project should be built in such a way that during it it is possible to quickly test hypotheses arising from the project team. From this point of view, an iterative life cycle is more suitable for an innovative project.

When using an iterative lifecycle for a single iteration, the project team may set a goal to test one (or several) hypotheses. Thus, one of the objects of management of an innovative project can be considered hypotheses, the verification of which occurs in the iterations of the project.

Among the existing standards, methods and sets of knowledge on project management today, there is no document that is well suited for project management, in which innovations will be created.

An ideal situation for managing an innovative project.

- The number of hypotheses to be tested is known in advance
- There is an understanding that the number of unintended hypotheses will not exceed some fraction of the original number
- The time resources of the hypothesis testing participants are known
- The number of iterations of the project required to test all hypotheses can be calculated before the start of the project

It is clear that the real situation is far from the ideal described, and in this regard, risks arise in the project. Working with risks in project management is well described in many approaches and there is even a separate area of knowledge – risk management.

In any case, creating an approach for managing innovative projects is a challenge for project management methodologists.

PRESENTATION ON THIS TOPIC

10. Search for the necessary information on the global information network Internet

The Internet is growing at a very fast pace, so finding the right information among hundreds of billions of Web pages and hundreds of millions of files is becoming increasingly difficult. Special search engines are used to search for information, which contain constantly updated information about the location of Web pages and files on hundreds of millions of Internet servers.

Search engines contain thematically grouped information about the information resources of the World Wide Web in databases. Special robot programs periodically "bypass" the Web servers of the Internet, read all the documents encountered, highlight keywords in them and enter the Internet addresses of documents into the database.

Most search engines allow the author of a website to enter information into the database by filling out a registration form. In the process of filling out the questionnaire, the site developer enters the site address, its name, a brief description of the site content, as well as keywords that will make it easier to find the site.

10.1 Keyword search

The document is searched in the search engine database by entering queries into the search field.

The request must contain one or more keywords that are the main ones for this document. For example, to search for the Internet search systems themselves, you can enter the keywords "Russian Internet information search system" in the search field.

Some time after sending the request, the search engine will return a list of Internet addresses of documents in which the specified keywords were found. To view this document in the browser, it is enough to activate the link pointing to it.

If the keywords were chosen unsuccessfully, then the list of document addresses may be too large (it may contain tens or even hundreds of thousands of links). In order to reduce the list, you can enter additional keywords in the search field or use the search engine catalog.

One of the most complete and powerful search engines is Google (www.google.ru), which has 8 billion Web pages stored in its database and 5 million new pages are entered into it by robot programs every month. In Runet (the Russian part of the Internet), extensive databases containing 200 million documents each have Yandex search engines (www.yandex.ru) and Rambler (www.rambler.ru).

10.2 Search in a hierarchical directory system

In the database of the search engine, Web sites are grouped into hierarchical thematic catalogs, which are analogs of the thematic catalog in the library.

Top-level thematic sections, for example: Internet, Computers, Science and Education, etc., contain nested directories. For example, the Internet directory may contain subdirectories Search, Mail, etc.

The search for information in the catalog boils down to choosing a specific catalog, after which the user will be presented with a list of links to the Internet addresses of the most visited and informative Web sites. Each link is usually annotated, i.e. it contains a short comment on the content of the document.

The Aport search engine has the most complete multilevel hierarchical thematic catalog of Russian-language Internet resources (www.aport.ru). The catalog contains a detailed annotation of the content of Web sites and an indication of their geographical location.

10.3 File Search

To search for files on file archive servers, there are specialized search engines, including the FileSearch search engine (www.filesearch.ru). To search for a file, enter the file name in the search field, and the search engine will give the Internet addresses of the file archive servers where the file with the specified name is stored. Search for information in the Russian-speaking part of the Internet using the most search engines: Google, Rambler, Aport, Yaps1ex and the Research file search engine can be produced using an integrated search engine Google.ru . To do this, just enter keywords into the search bar, use the switches to set the type of information you need and click on the button with the name of the search engine Google.ru . To do this, just enter keywords into the search bar, use the switches to set the type of information you need and click on the button with

the name of the search engine.

10.4 Internet search methods. Three ways to search the Internet

The Internet in general and the World Wide Web, in particular, provide subscribers with access to thousands of servers and millions of Web pages that store an unimaginable amount

information. How not to get lost in this "information ocean"? To do this, you need to learn how to search and find the necessary information on the web.

As already mentioned, there are three main ways to search for information on the Internet.

1. Specifying the page address. This is the fastest way to search, but it can only be used if the exact address of the document is known.

2. Moving through hyperlinks. This is the least convenient way, since with its help you can search for documents that are only close in meaning to the current document. If the current document is dedicated, for example, to music, then using

the hyperlinks of this document, it is unlikely to be possible to get to a site dedicated to sports.

3. Accessing the search server (search engine). Using search servers is the most convenient way to search for information. Currently, the following search servers are popular in the Russian-speaking part of the Internet: Yandex, Rambler, Aport.

There are other search engines. For example, an effective search system is implemented on the mail service server mail.ru .

Search servers

The most accessible and convenient way to search for information on the World Wide Web is to use search engines. At the same time, information can be searched by catalogs, as well as by a set of keywords characterizing the text document being searched.

Let's look at the use of search servers in more detail. The search server contains a large number of links to a variety of documents, and all these links are systematized into thematic catalogs. For example: sports, movies, cars, games, science, etc. Moreover, these links are installed by the server independently, in automatic mode by regularly viewing all Web pages appearing on the World Wide Web. In addition, search servers provide the user with the ability to search for information by keywords. After entering keywords, the search server begins to view documents on other Web servers and displays links to those documents in which the specified words were found. Usually the search results are sorted in descending order by a special document rating, which shows how fully a given document meets the search conditions or how often it is requested on the network.

10.5 Search engine query language

A group of keywords formed according to certain rules - using the query language, is called a query to the search server. The query languages to different search servers are very similar. You can learn more about this by visiting the "Help" section of the desired search server. Let's consider the rules for forming queries using the Yandex search engine as an example.

PRESENTATION ON THIS TOPIC

11. Business development planning

11.1 The basic essence of business planning

Planning is an integral part of the management process and in a concentrated form expresses the future vision of the company and the goals and objectives to which it aspires. It is obvious that every manager (entrepreneur) constantly carries out planning related to determining the prospective needs of the company in financial, labor, production and material resources. Therefore, the future success and effectiveness of management decisions depends on the quality of planning, its flexibility, consideration of external and internal factors. Thus, planning in a

market economy is essential from the point of view of forming a long-term program (strategy) for the development of an enterprise, through linking internal resources and capabilities of the organization with environmental factors, through risk forecasting.

11.2 Planning forms

Subjects of microeconomics (enterprises, organizations and firms) not only obey the laws of the market (for example, the law of value, supply and demand, market equilibrium, etc.), but also strive for independent decision-making, their behavior is more conscious. One of the tools of conscious behavior of market actors is activity planning.

From the point of view of microeconomics, planning is a way of implementing actions based on conscious, volitional decisions of microeconomic entities; a mechanism that complements market laws. According to many experts, economic planning consists in justifying the economic goals adopted by the company, choosing the optimal ways to implement them, justifying the types of economic activities, the volume and timing of production, the technologies used, and the use of limited production resources. Thus, the planning of the company's economic activity serves as the basis for the implementation of such management functions as goal setting, organization, accounting, control, regulation and stimulation. The essence and specificity of economic planning allows us to distinguish two forms of planning:

- planning of the company's activities in the market (external);
- intra-company (intra-corporate) planning.

These two aspects of planning are closely interrelated. The planning of a firm's activities in the market is connected with taking into account market laws and microeconomics laws, their interpretation in accordance with the company's objectives and objectives, its position in the market, the characteristics and characteristics of the target market (the specific market niche in which the firm operates). Market planning of the company's activities is aimed at external entities – consumers, competitors, suppliers. In a concentrated form, it is expressed in the development and implementation of a marketing strategy. Intra-company planning is based on the fact that in the internal environment of the firm, the price mechanism is almost completely replaced by conscious actions and authoritative decisions of entrepreneurs and managers.

The entrepreneur consciously determines the main directions of intra-company activity in accordance with the goals and objectives of the company's activities in the market. That is, the internal nature of the company as a whole is based on a system of planned decisions. Employees as participants in intra-company activities lose the freedom of action characteristic of independent and independent market entities. Their behavior is under the control of the managers of

the enterprise. Planning as a system of strong-willed, consciously made decisions displaces the market in the internal activities of the company. This is due to the fact that the limited size of the company allows you to control the actions taking place inside it, and thus minimize the uncertainty of the market environment and its negative consequences. Using external and internal planning, the company eliminates unjustified additional costs, optimizes the structure of the use of internal resources, adapts more successfully to changes in the external environment.

11.3 The place of planning in the management cycle

Planning is one of the stages of the management cycle, which can be divided into three key stages: analysis – planning – execution. All stages of the management cycle include both external and internal planning, as a result of which it becomes possible to compare the internal capabilities and reserves of the company and environmental factors. In Western methods, the management cycle is considered as a PDCA (plan – do – check – act) cycle, which determines the sequence of steps and management decision-making and, in general, in the implementation of the company management process.

11.4 The concept of a business project. Classification of its varieties

A business plan is a program for the implementation of business operations, company actions, containing information about the company, the product, its production, sales markets, marketing, organization of operations and their effectiveness.

The implementation of the company's overall competitive strategy and a set of functional strategies requires their detailing and feasibility study. In this case, the main tool for detailing the company's strategies is a business plan that allows solving the following tasks as part of the implementation of the corporate strategy:

- to identify logical connections and the order of events for the implementation of the company's set of strategies;
- evaluate the economic efficiency and capital intensity of specific tactical measures and strategic goals and objectives;
- organize effective control over the implementation of the planned strategy;
- assess the company's resource capabilities and the need to attract external resources;
- organize the management of the implementation of the planned strategy using the mechanism of delegation of authority;
- improve the organizational structure of the company in accordance with the forecast of an increase in the production, marketing, investment and financial activities of the company;
- focus on building competitive advantages and expanding the target market.

The variety of business plans that one has to face in real life is extremely large. They may differ significantly in the scope of the application, the

composition of the subject area, the scale, activities, the composition of participants, the degree of complexity, the impact of the results, etc.

A wide variety of business projects can be classified on various grounds:

project type – technical, organizational, economic, social, mixed;

project class – according to the composition and structure of the project and its subject area;

the scale of the project is based on the size of the project itself, the number of participants and the degree of influence on the surrounding world;

project duration – according to the duration of the project implementation period;

the complexity of the project – for example, by the degree of financial, technical or other complexity;

type of project – by the nature of the subject area of the project.

According to the proposed grounds, the main types of business plans can be distinguished:

the type of project - technical, organizational, economic, social, mixed;

project class – mono-, multi-, megaproject.

As the name of each of the three classes of projects implies:

a single project is a separate project of different type, type and scale; a multiproject is a complex project consisting of a number of single projects and

requiring the use of multi-project management;

megaproject – targeted programs for the development of regions, industries and other entities, including a number of mono and multi-projects.

The scale of the project can be small, medium, large and very large. This division of projects is very conditional. The scale of projects can be considered in a more specific form – interstate, international, national, interregional and regional, intersectoral and sectoral, corporate, departmental, projects of one enterprise.

A business plan is the main component of a business project. It is compiled to make an informed decision and an action plan, what and when to do in order to meet expectations regarding the effectiveness of a business project. The business plan is the main document for creditors and the main tool for executors. Obtaining approval of the project and its viability depend on the correctness of this document.

When drawing up a business plan, answers to the following questions are given: Is it such a good idea?

Who is the new product or service designed for?

Will this product or service find its buyer? Who will you have to compete with?

11.5 Business planning process

The main elements of the business plan are:

- title page

- introductory part (summary);
- analytical section;
- content section (the essence of the project);
- sections of intra-company planning.

The key points of business planning are the evaluation by the initiators of the project:

- opportunities, needs and volume of output of products (services);
- potential consumers;
- competitiveness of the product in the domestic and foreign markets;
- your own market segment;
- indicators of various types of efficiency (commercial, regional, budgetary);
- capital adequacy of the initiator of the business idea and possible sources of financing;

From the above, we can conclude that a business plan is:

- presentation of the system of evidence convincing the investor of the profitability of the project;
- determination of the degree of viability and future sustainability of the enterprise;
- foreseeing the risks of entrepreneurial activity;
- concretization of business prospects in the form of a system of quantitative and qualitative indicators of development;
- developing a forward-looking (strategic) view of the company and its working environment by gaining valuable planning experience.

The process of business planning from the emergence of an economic plan to the receipt and distribution of profits among its participants.

11.6 Functions and principles of business planning

Business planning, as a necessary control element, performs a number of important functions in the system of entrepreneurial activity, among which the following are of the greatest importance:

- initiation – activation, stimulation and motivation of planned actions, projects and transactions;
- forecasting – foreseeing and substantiating the desired state of the company in the process of analyzing and taking into account a set of factors;
- optimization – ensuring the choice of an acceptable and best option for the development of an enterprise in a specific socio-economic environment;
- coordination and integration – taking into account the interdependence of all structural divisions of the company with their focus on a single overall result;
- management security – providing information about possible risks for timely proactive measures to reduce or prevent negative consequences;

- ordering – creating a single common order for successful work and responsibility;

- control – the ability to promptly monitor the implementation of the plan, identify errors and possible adjustments;

- education and training – the beneficial effect of samples of rationally planned actions on the behavior of employees and the possibility of teaching them, including mistakes;

- documentation – presentation of actions in a documentary form, which can be proof of successful or erroneous actions of the company's managers.

When developing business plans, it is necessary to observe the fundamental principles of planning that create prerequisites for the successful operation of an enterprise in a specific economic environment:

1) Necessity. Mandatory application of plans in any field of activity is the rational behavior of people. Before acting, everyone should know what they want and can do.

2) Continuity. The planning process should be carried out continuously by consistently developing new plans at the end of the plans of previous periods and rolling planning.

3) Elasticity and flexibility. The adaptation of initial plans to changing conditions is carried out by introducing planned reserves for key indicators, the use of eventual (in case) planning for various situations and data distribution, the use of operational plans to account for emerging environmental changes; the use of alternative plans.

4) Unity and completeness (consistency). Consistency is achieved in three main ways: by having a single economic goal, drawing up a common consolidated plan for socio-economic development, including in the plan all factors that may be important for decision-making.

5) Accuracy and detail. Any plan must be drawn up with a sufficiently high degree of accuracy to achieve the goal.

6) Economy. The costs of planning should be commensurate with the benefits received from it. The contribution of planning to efficiency is determined by improving the quality of decisions made.

7) Optimality. At all stages of planning, the choice of the most effective solutions should be ensured. Optimality is expressed in maximizing profits and other performance indicators of the company and minimizing the cost, with predictable constraints.

8) Communication of management levels. It is achieved in three ways: by detailing plans

"top-down", by enlarging plans "bottom-up", by partial delegation of authority.

9) Participation. The active participation of staff in the planning process enhances their motivation for behavior. Planning for yourself is psychologically and economically more effective than for others.

The fundamental principles of planning are closely related to each other and ultimately orient entrepreneurs to a comprehensive justification of the planned indicators and the achievement of the best socio-economic results of the enterprise. They determine the content and orientation of the planned work at all stages of the project justification and its consistent implementation.

In addition to the listed basic principles, the general economic principles of scientific, priority, dynamism, directivity, efficiency, completeness, etc. are usually taken into account in the planning process.

11.7 The sequence of developing a business plan

It is necessary to start developing a business plan directly with a description of products (services), paying special attention to competitiveness and patent and licensing issues. Then the marketing and sales sections are developed with the definition of the market and sales volumes. These sections are key – without solving the issue of product sales, the development of the remaining sections does not make sense.

The generalized order of business plan development stages is as follows:

1. Collection and analysis of information about the product (service) and its description;
2. Collection and analysis of information on the sales market;
3. Analysis of the state and capabilities of the enterprise and promising industry;
4. Determination of the need and ways to provide space, equipment, personnel and other resources;
5. Calculation of required capital and sources of financing (Financial Plan);
6. Determination of the direction and scale of the project, calculation of efficiency;
7. Development of the organizational structure, legal support and project implementation schedule;
8. Resolving issues of risks and guarantees;
9. Selection of materials and preparation of applications;
10. Preparation of a summary of the project;
11. Preparation of an abstract for the project;
12. The design of the title page.

Taking into account the specific purpose of developing a business plan, its content, structure, volume and level of detail of economic and financial calculations are determined. When implementing large-scale and complex projects (for example, projects related to the construction of a new enterprise and the

launch of production), the calculations made in the business plan are often supplemented by a feasibility study and design estimates. However, most business plans have a similar (typical) structure that allows the most complete description of the state of the company, its development prospects, its position on the market, production, investment and financial activities.

Such a typical business plan structure should include the following sections:

1. Title page. It contains the name of the project, the name of the applicant company, the terms of implementation and the period of calculation of the project indicators, contact information.

2. Summary. In a concentrated form it represents the essence, goals and objectives of the investment project, the volume of investments, integral indicators of the commercial efficiency of the project.

3. Description of the industry (target market). The section provides a general description of the situation in the industry (in the target market) where the project will be implemented.

4. Product description. The general technical, economic and consumer characteristics of the manufactured (planned for release) products (goods and services) are given.

5. Marketing plan. The marketing strategy of the company is presented in a detailed form during the implementation of the project, a description of the price, sales, product policy and the policy of promoting products to the market is given.
6. Production plan. Detailed characteristics and requirements for the organization of the production process, production plan, fixed and variable costs, personnel plan are given.

7. Organizational plan. It includes a description of the organizational structure of the company, its transformation and capabilities, a description of the regulatory framework, the organization of project implementation management.

8. Financial plan. It contains financial and economic calculations and justifications for the project, including the financing strategy, tax and other payments, profit statement, cash receipts and payments plan, the company's balance sheet.

9. Risk analysis, sensitivity and sustainability of the project. This section provides an analysis of possible risks in the implementation of the project, presents the results of the analysis of the sensitivity and sustainability of the project, analysis of financial coefficients.

10. Applications. The application includes the necessary accompanying documents – a description and photo of the products, the necessary documentation (copies of licenses, certificates, permits, acts), design and estimate documentation, etc.

11.8 The most common areas of BP:

1. Creation of business lines (product lines or investment projects), which represent a set of property rights, long-term competitive advantages, special and universal property, technologies, contracts that provide the opportunity to receive certain monetary income.

2. Development of special-purpose, financial and economic business plans (issue of shares of a joint stock company, sale of a privatized enterprise, preparation for the sale of bankrupt enterprises, repurchase of shares, shares of a joint stock company or partnerships upon withdrawal from the founders (shareholders)).

3. Justification of options for the rehabilitation of bankrupt enterprises. Every entrepreneur, starting his activity, must clearly understand the need for financial, material, labor and intellectual resources in the future, the sources of their receipt, and also be able to accurately calculate the efficiency of resource use in the course of the company's work.

It should be noted that when developing a business plan, at each step, an analysis and determination of the possibilities of reducing risk, costs and deadlines for the implementation of the project are carried out.

It is necessary to start development directly with a product description, paying special attention to competitiveness and patent and licensing issues. Then the marketing and sales sections are developed with the definition of the market and sales volumes. These sections are key – without solving the issue of product sales, the development of the remaining sections does not make sense.

It is necessary to devote sufficient time to the initial collection and analysis of information, since most likely it will be necessary to draw up several variants of a business plan for various purposes. It is also very important to take into account the effectiveness of the project, possible risks and guarantees of return on investment.

A business plan is necessarily a written document summarizing business opportunities and prospects and explaining how these opportunities can be implemented by the existing management team (managers). Mastering the art of developing a business plan is necessary, at least for the following five reasons: Firstly, the new economic conditions require new entrepreneurs and give them the opportunity to try to realize their entrepreneurial abilities.

Secondly, the changing economic environment also puts experienced managers of enterprises in front of the need to calculate their future steps differently and prepare for an unusual struggle with competitors, in which there are no trifles.

Thirdly, the business plan is a link between the organizer of production and the investor. If an entrepreneur counts not only on his own funds, but wants to

attract funds from the outside, that is, to interest potential investors, including foreign ones, to invest money in the proposed business, then it is necessary to prove to them the effectiveness of such an investment, to show the ability to think realistically and evaluate both positive and negative aspects of the use of invested funds.

Fourth, the business plan will allow you to clearly see the prospects of your business, assess the existing economic situation and your capabilities, determine effective directions for the development of the company, analyze your ideas, check their reasonableness and realism. Fifth, the business plan will serve as a standard for you and your employees, with which you will compare the results of practical activities for its implementation and make the necessary adjustments to this activity. It will allow employees to clearly understand their tasks and see their own personal perspectives related to the common business for all.

PRESENTATION ON THIS TOPIC

12 Methods of processing the results of the experiment

Statistical information and processing of experimental data is usually aimed at building a mathematical model of the object or phenomenon under study.

The ultimate goal of processing experimental data is to put forward hypotheses about the class and structure of the mathematical model of the phenomenon under study, to determine the volume and composition of additional measurements, and to select possible methods for subsequent statistical processing.

To achieve these tasks, the following steps must be performed:

1. Analysis, culling, recovery of abnormal or missed measurements

2. Experimental verification of the laws of distribution of experimental data, evaluation of parameters and numerical characteristics of observed random variables or processes

3. Grouping of initial information with a large volume of experimental data

4. Combining several groups of measurements obtained at different times for joint processing

5. Identification of statistical relationships and mutual influence of various measurable factors and variables, consecutive measurements of the same quantities. The selected factors are used for further processing.

The sample size will depend on the purity of the experiment. m.b. small samples, medium and large. Any sample estimate is a random variable, the accuracy of which determination and possible errors must be controlled.

The numerical series obtained as a result of the experiment is analyzed, gross errors are excluded and suspicious values are checked. There are three types of errors:

1. Rough – differ by a large deviation from the center of grouping of the sample and are eliminated at the stage of primary analysis of materials

2. Systematic – constant in determining each element of the sample and depend on the technical level of measuring equipment and experimental techniques

3. Random – due to the influence of a large number of factors. Their appearance varies and is random from measurement to measurement, and cannot be taken into account beforehand due to both the dependence on changes in measurement conditions and the variability of the measured quantities themselves. However, with a large number of experiments, the total value of random errors, varying approximately equally in the positive and negative directions, approaches zero.

Measurement accuracy is characterized by relative and absolute values, errors, which in turn consist of the sum of systematic and random errors.

13. Information search

The term "information search" was first introduced by Kelvin Moore in 1948 in his doctoral dissertation, published and used in literature since 1950.

At first, automated IP systems, or information retrieval systems (IPS), were used only to control the information explosion in the scientific literature. Many universities and public libraries have started using IPS to provide access to books, journals and other documents. IPS became widespread with the advent of the Internet. Among Russian-speaking users of the most popular search engines Google, Yandex and Rambler.

13.1 Information retrieval as a process

The search for information is the process of identifying in a certain set of documents (texts) all those that are devoted to the specified topic (subject), satisfy a predetermined search condition (query) or contain the necessary (corresponding to the information need) facts, information, data.

The search process includes a sequence of operations aimed at collecting, processing and providing the necessary information to interested parties.

In general, the search for information consists of four stages:

1. definition (clarification) of the information need and formulation of the information request;

2. determination of the totality of possible holders of information arrays (sources);

3. extraction of information from identified information arrays;

4. familiarization with the information received and evaluation of search results.

13.2 Types of search

Full—text search - search through the entire contents of the document. An example of a full—text search is any Internet search engine, for example www.yandex.ru,

www.google.com. As a rule, full-text search uses pre-built indexes to speed up the search. The most common technology for full-text search indexes is inverted indexes.

Metadata search is a search for certain attributes of a document supported by the system — document name, creation date, size, author, etc. An example of a search by details is the file system search dialog (for example, MS Windows).

Image Search — search by image content. The search engine recognizes the content of the photo (uploaded by the user or the URL of the image added). In the search results, the user receives similar images. This is how search engines work:

- Xcavator
- Retrievr
- PolarRose
- Picollator Online by Recogmission

13.3 Search methods

Address search

The process of searching for documents on purely formal grounds specified in the request.

The following conditions are required for implementation:

- Whether the document has an exact address

- Ensuring a strict order of documents in the storage device or in the system storage.

- Addresses of documents can be addresses of web servers and web pages and elements of bibliographic records, and addresses of storing documents in the repository.

Semantic search

The process of searching for documents by their content.

Conditions:

- Translation of the content of documents and queries from natural language to information retrieval language and compilation of search images of the document and query.

- Compilation of a search description, which specifies an additional search condition.

The fundamental difference between address and semantic searches is that in address search, a document is considered as an object from the point of view of form, and in semantic search - from the point of view of content. Semantic search finds a lot of documents without specifying addresses. This is the fundamental difference between catalogs and card files. A library is a collection of bibliographic records without specifying addresses.

Documentary search

The process of searching in the repository of the information retrieval system for primary documents or in the database of secondary documents corresponding to the user's request.

Two types of documentary search:

1. Library, aimed at finding primary documents.

2. Bibliographic, aimed at finding information about documents presented in the form of bibliographic records.

Factographic search

The process of searching for facts corresponding to an information request. Factual data includes information extracted from documents, both primary and secondary, and obtained directly from the sources of their occurrence.

There are two types:

1. Documentary-factual, consists in searching for fragments of text containing facts in documents.

2. Factual (description of facts), which presupposes the creation of new factual descriptions in the search process by logical processing of the found factual information.

13.4 Information search as a science

Information retrieval is a large interdisciplinary field of science that stands at the intersection of cognitive psychology, computer science, information design, linguistics, semiotics, and librarianship.

IP considers searching for information in documents, searching for documents themselves, extracting metadata from documents, searching for text, images, video and sound in local relational databases, in hypertext databases such as the Internet and local Intranet systems.

There is some confusion related to the concepts of data search, document search, information search and text search. Nevertheless, each of these areas of research has its own methods, practical developments and literature.

Currently, IP is a rapidly developing field of science, the popularity of which is due to the exponential growth of information volumes, in particular on the Internet. IP is devoted to extensive literature and many conferences. One of the most famous is TREC, organized in 1992 by the US Department of Defense together with the Institute of Standards and Technology (NIST) in order to consolidate the research community and develop methods for assessing the quality of IP.

13.5 The request and the object of the request

When talking about IP systems, they use the terms request and request object.

A request is a formalized way of expressing the information needs of a system user. The language of search queries is used to express information needs,

the syntax varies from system to system. In addition to a special query language, modern search engines allow you to enter a query in natural language.

The query object is an information entity that is stored in the database of an automated search system. Despite the fact that the most common object of the request is a text document, there are no fundamental restrictions. In particular, it is possible to search for images, music and other multimedia information. The process of entering search objects into the IPS is called indexing. The IPS does not always store an exact copy of the object, often a surrogate is stored instead.

13.6 Information retrieval tasks

The central task of the sole proprietor is to help the user meet his information need. Since it is technically difficult to describe the user's information needs, they are formulated as some kind of query, which is a set of keywords that characterize what the user is looking for.

The classic task of the IP, with which the development of this area began, is to search for documents that satisfy the request within some static collection of documents. But the list of IP tasks is constantly expanding and now includes:

- Modeling issues;
- Classification of documents;
- Document filtering;
- Clustering of documents;
- Design of search engine architectures and user interfaces
- Extraction of information, in particular annotation and abstracting of documents;
- Query languages, etc.

14 Patent search

Patent search is a time–consuming, but necessary event. After all, the use by legal entities and individuals of inventions owned by other persons leads to large fines, including the possible ruin of companies.

14.1 Objectives of patent information search

- verification of the uniqueness of the invention;
- defining the features of a new product;
- search for inventors or companies that have received patents for inventions in the same field;
- identification of other areas where the new product can be applied;
- finding the latest innovations in the field under study;
- search for patents for inventions in areas that are adjacent to the study;
- finding out whether your invention encroaches on someone else's intellectual property, etc.

14.2 Types of patent search

Thematic search is the most common. During it, a technical task is formulated, with the help of choosing a category, classification, the thematic area is limited, and then those materials that relate to this area are identified and analyzed for the required period of time.

Nominal, corporate — used when the name of the inventor or the names of companies is known. This type is an addition to the subject.

Numbering — is carried out if the number of the security document is known and it is required to find out other data regarding the invention, utility model or industrial design.

In order to identify patents that were issued in any one country and then patented in other countries, a search for analog patents is carried out. This type is relevant if the patent of interest is found in a rare language, and with the help of analog patents it is possible to get acquainted with the description of this invention in more accessible languages.

PRESENTATION ON THIS TOPIC

15 Methods of finding new technical solutions

15.1 Brainstorming method

The brainstorming method is one of the most well-known and used for the collective search for solutions. It was created in the 30s by the American researcher A. Osborne. The main purpose of the method is to set up a group of specialists so that each of them makes as many suggestions as possible on the problem under discussion. The work is carried out in several stages: preparation, storming, evaluation and selection of ideas, elaboration and development of the most valuable of them.

At the preparation stage, the task is clearly formulated and written down (in general terms), then it is divided into the maximum number of subtasks. At the same time, special questions can be used: why it is necessary, where it should be done, who should do it, what exactly and how it should be done, etc. The preparation also includes the selection of factual material (an analogue of the object, data on the principles of action, causes of failures, various kinds of restrictions, etc.). At the same stage, the participants of the search group are selected, which are divided into generators (people with a rich creative imagination and imagination) and experts (people with an analytical mindset, qualified specialists). Experts do not take part in the search for solutions. They then evaluate them.

Thanks to certain rules for organizing and conducting brainstorming (prohibition of criticism of ideas expressed, psychological compatibility of participants, encouragement of jokes, puns, interest of participants, a free, relaxed form of discussion, etc.) in a short period of time, you can get a large number of

various solutions to the task facing the participants. From these ideas, experts then select and develop the best ones. Preliminary training of participants is not required, usually instruction is enough. The brainstorming session is led by a so-called leading specialist with experience in conducting scientific discussions and posing problems. The number of participants is usually 5-15 people, the assault lasts 30-45 minutes. The discussion is conducted at a fast pace. All ideas are recorded, for which they use tape recordings or shorthand.

There are several types of brainstorming. In particular, there is a known variant when participants write down their ideas independently on special cards (10 minutes are given for this), and then read them aloud in turn, the rest write down on their cards the thoughts caused by what they heard. Writing ideas on cards reduces the time it takes to classify results.

Of particular interest is the so-called reverse brainstorming. It is used to solve specific tasks. At the first stage, all attention is focused on identifying all possible shortcomings of the object. The analysis reveals the shortcomings, limitations, defects and contradictions that exist in a particular idea or technical object that needs to be developed or improved. Their preliminary assessment is carried out by the participants of the session, a more thorough one is carried out by experts who cross out obviously erroneous statements, thereby clarifying the list of detected shortcomings. At the second stage of the reverse assault, they are searching for ways to eliminate shortcomings, and they use the rules of ordinary brainstorming.

One of the main disadvantages of brainstorming is the lack of time for deep awareness of the task. In addition, for many people, the process of individual creativity is more effective.

In order to eliminate these shortcomings, J. V. Hefele proposed the so-called notebook method.

15.2 Hefele Notebook method

In accordance with the recommendations given by J. V. Hefele, the topic is asked to the participants long before the collective discussion session. They are also given notebooks in which they need to record their ideas twice a day. This organizational form is supplemented with methodological recommendations; participants are also given questionnaires with a list of control questions.

It makes sense to cite some of these questions here.

Is it possible to use the design for other purposes if nothing is changed or minor changes are made?

What can the design be compared with? What can be changed in it?

What can be increased (quantity, time, frequency, strength, height, length, thickness, cost, number of components, etc.)?

What can be reduced?

Is it possible to replace the structure (or its components) with something? What can be done the other way around?

It should be noted that when using the questionnaire, each of the questions is alternately modified until it turns out to be directly related to the problem posed, the object being improved. J. V. Hefele points out that the formulation of a particular question cannot be considered correct or incorrect, since the questions are just blanks for identifying optimal options. Some questions should be kept in mind throughout the study. These include, for example, the question: "what can be done the other way around", which, according to the author of the method, has great heuristic value.

J. V. Hefele's book "Creativity and Innovation" provides examples of such transitions "on the contrary". This is, in particular, a hydraulic cylinder: a piston moves - a cylinder moves; a trolley on wheels - a roller; a rotating arrow - a rotating dial; a stretching spring - a compressing spring.

15.3 Focal object method

This method was proposed by the American specialist Ch . It is used for the purpose of searching for new, original versions of a given object, searching for additional functions compatible with it. The principle of the method consists in transferring new, bright, unexpected properties and qualities to a given object and identifying original and heuristically valuable combinations.

The sequence of steps for executing this method is as follows.

1. Formulate the purpose of the work (define the object being improved and the purpose of its improvement).

2. Randomly select several objects from memory or from catalogs, dictionaries, random books, or they are called by the participants of the work.

3. For each of the randomly selected objects, a list of characteristics, signs is compiled.

At the same time, it is advisable to invite the participants of the work to perform the second and third steps before the announcement of the object of analysis, which allows for an unbiased choice of characteristics.

4. Signs of randomly selected objects are transferred to the object being improved.

5. Analyze the obtained combinations, while paying special attention to seemingly incompatible, "wild" combinations, the development of which, as a rule, leads to the most interesting solutions.

6. Evaluate the solutions received.

In the USA, the method is widely used to search for new advertising, original design of goods. In domestic practice, the method has found application in the search and improvement of objects of mass demand. The method can also be useful as a means of training imagination, imagination.

15.4 The garland method of associations and metaphors

The method was proposed by the Soviet researcher G. Ya. Bush. Its purpose is to ensure that the developer searches for solutions to inventive tasks with a shortage of information, i.e. when it is impossible to use logical means. In this case, one of the means is the use of chains (garlands) of associations and metaphors, which allows you to make a transition to a new field of knowledge, interpret previously developed ideas in a new way. Thus, the associative memory of the developer acts as a kind of information fund.

The main stages of the method in improving a given object are the following.

1. The definition of synonyms of the object and the formation of the first garland from them - a garland of synonyms.

2. Arbitrary selection of random objects. Quite arbitrarily, in any way, for example, by memory or from an encyclopedic dictionary, several nouns are chosen, which do not necessarily have to denote even technical objects. From the selected words form a second garland - a garland of random objects.

3. Making combinations of elements of a garland of synonyms and a garland of random objects. The combination consists of two elements, connecting sequentially each synonym of the object in question with each random object.

4. Compiling a list of signs of random objects. Determine their signs. At the same time, it is necessary to determine the largest possible number of signs within a limited time, for example, in two to three minutes. The success of the search largely depends on the breadth of coverage of the features of random objects. It is therefore advisable to list both the main and minor, insignificant signs. For convenience, you can make a table of signs.

5. Generating ideas by alternately attaching features of randomly selected objects to a technical object and its synonyms. Similarly, they form a list of new constructions obtained by alternately attaching synonyms of signs of other random objects to the garland.

6. Generating garlands of associations. Garlands of free associations are generated from the signs of random objects identified in the fourth step. For each individual feature, garlands can be of virtually unlimited length, so generation should be limited in time or by the number of garland elements. If the generation of a garland of associations is carried out in a team, then each of its members does it independently.

7. Generating new ideas. The elements of the garland of synonyms of a technical object are alternately trying to attach the elements of garlands of associations. At this step, the question is solved whether there is a sufficient number of original and tempting ideas among the combinations of synonyms of a technical object with elements of garlands of associations. If, according to a

preliminary assessment, there are few such ideas, you can continue to form garlands of associations, starting with some new element of the garlands created at the sixth step.

8. Evaluation and selection of rational variants of ideas. Generating new solutions to problems in the previous steps usually gives a fairly large set of options. Among the many irrational, trivial and even ridiculous ideas, as a rule, there will always be original and rational ones. It is recommended to select options in several stages.

First, obviously irrational options are crossed out, then original ones of dubious usefulness are selected, but attracting with their surprise. It is advisable to study the list of such options with the involvement of experts or a creative team. The list of rational solutions includes options that best meet the set goals and production requirements.

9. The selection of the best option from the rational ones is carried out in different ways. The method of expert assessments is very simple and effective.

The author points out that the above modification of the method is simplified and recommends expanding and strengthening it with the help of such additional procedures as, for example, metaphorical description and analysis of a problem situation, construction of etymological and paradigmatic clusters of concepts and their interpretation, construction and interpretation of clusters and garlands of metaphors.

The "CARUS" system is connected with the method of G. Y. Bush.

15.5 The CARUS system

The design method, called the "Karus" system, was also developed by the Soviet researcher V. A. Molyako. It includes five main strategies.

1. The strategy of analogization or search for analogues is associated with the use of a previously known object or part of it, a separate function when creating a new object.

2. The strategy of combining (or combinatorial actions) involves the joint use of a wide variety of objects and their functions to build a new object. This strategy, according to the author, is associated with various permutations, reducing and increasing the size, changing the location of parts in an existing structure.

3. The reconstructive strategy (or reconstructive actions) is based on the implementation of the "vice versa" principle. If, for example, a rotational movement was performed in the design, then when implementing a reconstructive strategy, the direction of rotation or even the type of transmission can be changed, the rectangular part is replaced by a round one, etc. According to the author of the system, this strategy implements the most creative approach.

4. The universal strategy involves the use of analogization, combination and reconstruction.

5. The strategy of random substitutions complements the classification of strategies to the full. The essence of such substitutions is to abandon the plan and carry out a blind search.

All five of these strategies are aimed, according to the author, at structural and functional transformations. These strategies within the framework of the method are carried out with the help of specific actions, the combination of which constitutes a certain tactic.

The main tactics are listed below.

The interpolation tactic involves the inclusion of a new part in an already existing object that will correspond to the desired function.

The extrapolation tactic is related to the external addition of an element to an object.

Reduction tactics are based on reducing the size, speed, etc. Hyperbolization tactics involve an increase in size, shape, and speed.

Duplication tactics are related to the exact use of a known part, node, or function in a new object.

The tactics of reproduction involves the use of not one, but two or more identical parts in the object, or several elements, nodes perform the same function.

The replacement tactic is aimed at the complete replacement of a certain part, node in the object. Modernization tactics are aimed at adapting the facility to new conditions.

Convergence tactics are associated with transformations that are based on a combination of two opposite features or structures in some part (for example, the device uses reciprocating motion in combination with oscillatory motion).

The tactics of deformation (transformation) involves certain changes, for example, devices, which, however, do not affect the essence of the structure or function.

The tactic of integration means that some new object is being built from already known parts.

The tactics of the basic detail implies the use of some one part of the object, which serves as the basis for the subsequent construction of all other parts.

Automation tactics are associated with the allocation of a separate part of the whole object and the subsequent restructuring of other parts.

The tactic of sequential subordination provides for actions along the chain in a certain sequence, when all parts of the object are built in turn without omissions.

The tactics of displacement or permutation are aimed at changing the location of any part within the same object.

Differentiation tactics are aimed at a special separation of structures and functions in objects.

In addition to the tactics listed above, the following methods are also used in the Karus system.

The method of time constraints (MBO) provides training in order to take into account the influence of the time factor on mental activity, as well as solving problems in conditions of information scarcity.

The method of sudden prohibitions (MVZ) consists in prohibiting the problem solver from using certain means (usually well-mastered). The use of this method makes it possible to train the flexibility of thinking.

The method of high-speed sketching (ITU) is used to diagnose mental activity, helps to increase control over this activity.

The method of new options (EOM) is based on the requirement to find all new solutions to the problem.

The method of information insufficiency (MIN) is used when the task of special activation of activity is set at the first stages of the solution. The essence of this method is to formulate a problem with a clear lack of data necessary for the solution. The missing information is given only at the request of the trainees.

The method of information oversaturation (MIP) is based, respectively, on the inclusion of obviously superfluous information in the task condition.

The method of absurdity (MA) consists in a proposal to solve a deliberately impossible task and is used to identify the style of creative activity.

The method of situational dramatization (MSD) is associated with the introduction of interference in the course of the solution. These may be questions from the teacher that confuse the solution of the problem, or the introduction of new conditions in the process of work.

An analysis of the methods used in the "Karus" system shows that, in essence, they serve as exercises designed for individual work.

Experienced inventors have proposed a number of additional tools that help the developer find the best ideas. Such, for example, is the list of recommendations proposed by the American researcher E. Crick.

15.6 List of Crick recommendations

1. Make the necessary efforts. It is impossible to create without mental effort.

2. Don't dive too deep into the quagmire of details. If you get stuck in it, it will be difficult to turn to radically different ideas. Try to think broadly at first, focusing on the solution as a whole and postponing consideration of the details to a later date. Having started to develop the details of the first "good" solution found, you will interfere with yourself and will not be able to think any other way. In addition, if you do this and eventually come to the best solution, you will give preference to the first one, since a lot of time and effort has already been spent on figuring out its details.

3. Ask yourself more often: why? Persistent application of this simple but very effective question is especially useful. Find out in this way the main goals of the task, limitations, characteristics of existing and proposed solutions, etc.

4 Look for more possible solutions. If you can find the maximum number of solutions, then there will probably be useful ones among them.

5. Avoid conservatism. Don't be confused by ideas that are radically different from one another. If you have managed to make a big leap, there is always a tendency to return and abandon what you have achieved. It seems natural to take time-tested ideas. They are therefore highly trusted. Avoid hasty decisions. Do not rush to reject what you have found. Some ideas, when first considered, may seem undeserving of attention or even useless. Naturally, therefore, the desire to immediately discard them. But in this way, you can lose some solutions worthy of consideration. Moreover, after some time, these ideas can be applied after a small modification. One of the qualities of a qualified engineer is his persistence in applying new ideas that are radically different from all previous ones.

6. Avoid premature satisfaction with the work done. Don't be tempted by the first "good" idea that comes across or improves an existing solution when further searches are actually justified. It is very easy to be blinded by the brilliance of the first idea that comes along and neglect further active searches. There is a great way to avoid this. One should always assume that there is a better solution than the known one. If you follow this rule, you will rarely make mistakes.

7. Ask for ideas for similar tasks. Try to mentally solve similar problems, but in different situations.

8. Consult with others. Actively collect information from engineers, customers, consumers, sellers, etc. Such conversations not only expand the engineer's knowledge, but can also give him the right idea.

10. Try to distract yourself from existing solutions, although it is not easy. Existing solutions "press" with their authority, but with a certain discipline of the mind, it is possible to distract from them.

11 Try the group method of finding new solutions.

12. Always remember about the unlimited possibilities of a person in the process of creating ideas. If an engineer is constantly aware that false limitations may arise, if he tries not to be overly conservative and not to jump to conclusions, then he is taking an important step in overcoming trends that literally "stifle" ingenuity.

PRESENTATION ON THIS TOPIC

16 Methods of activation of innovative activity of the individual

Currently, the problem of modern educational practice is the organization of innovative activity of teachers.

Improving the skill level of teachers is a priority area of methodological work in the mode of innovation, in the management system of a preschool institution, in an integrated system of professional development of teaching staff, as well as in the activation of the teacher's personality, the development of his creative personality.

Providing a continuous process of improving the professional skills of each educator, methodical work is proactive and is responsible for the development and improvement of all work with teachers, in accordance with new achievements. Therefore, methodical work is not only a service for correcting mistakes in the activities of the educator, but also providing real, effective and timely assistance to teachers when they are not consulted as students, but are consulted with them.

Traditional forms of methodological work, in which the main place was given to reports, speeches, have lost their importance due to their low efficiency and insufficient feedback. Today it is necessary to use new, active, innovative forms of work, which are characterized by the involvement of teachers in activities and dialogue, involving a free exchange of opinions.

The value of innovative forms is that they provide feedback, a frank exchange of opinions, and form positive relationships between employees. The core of these forms of work with personnel are collective discussions, reasoning, reasoning of conclusions, competitions of minds and talents. The importance of innovative interactive methods is the achievement of such important goals as: stimulating interest and motivation for self-education, increasing the level of activity and independence, developing skills of independence and reflection of one's activities, developing the desire for cooperation.

Their advantage: the motivation of teachers' professional activity increases, those aspects of a person that are not used in everyday, rather monotonous life are realized, experience of collective activity, mutual respect, support, cooperation is gained, creative thinking develops, the ability to find a non-standard way out of problematic situations.

All methods and forms of methodical work are divided into groups:

- traditional (pedagogical council, seminar, consultation, round table, brainstorming, discussion, workshop);

- new (pedagogical ring, debates, business game, exhibition-fair of pedagogical ideas, bank of ideas, creative hour);

- the latest (master class, quality circles, pedagogical workshop, quick setup, court sessions, game modeling, project method, etc.).

The most effective, although traditional, form of work with teachers of preschool educational institutions

- training (rapid response, rapid learning). Teachers find themselves in the most difficult situation, since their work, even in stable times, was characterized by

high emotional workload. The negatively colored psychological state of the teacher reduces the effectiveness of the process of upbringing and teaching children, increases conflict in relationships with colleagues, administration, parents.

Pedagogical ring - orients teachers to study the latest research in psychology and pedagogy, methodological literature, helps to identify various approaches to solving pedagogical problems, improves logical thinking skills and argumentation of their position, teaches conciseness, clarity, accuracy of statements, develops resourcefulness, a sense of humor.

A debate is a discussion based on pre-agreed speeches by representatives of two opposing groups.

"Court session" is a discussion simulating a trial (hearing a case).

Pedagogical situations, impromptu - a method of activating pedagogical cognition in the process of everyday communication, interaction with children, parents, colleagues. For example, a child informs the teacher that mom and dad have separated, and he will now have a new dad. What can be the reaction of the teacher.

An effective form is the holding of an exhibition - fair of pedagogical ideas, an auction. This form of work encourages teachers to be creative and

self-education. The main result is a noticeable professional and personal growth of educators. Conditions are created for teachers to publicly present the best examples of their professional activities, the emergence of new ideas, the establishment and expansion of business and creative contacts with colleagues.

Another form that can be used before open events

- "Quick setup" – teacher's attitude to successful work:

If you want people to like you, smile! A smile is a ray of sunshine, an antidote created by nature from troubles.

You are the best and most beautiful, let all the models of the world envy you.

There are people like a gold coin: the longer they work, the more expensive they are valued.

There is no better beloved friend than your favorite job: it does not age, and it does not let you grow old

The bank of ideas is a rational way to collectively solve problems that cannot be solved by traditional methods at this stage of the DOW.

The disadvantage of traditional forms of work (along with the advantages) is that not all educators act as active participants. Business play and other innovative forms of work with teaching staff contribute to the elimination of this disadvantage.

Business game is an effective method of interaction between teachers. This is a form of improving development, perception of the best experience, asserting

oneself as a teacher in many pedagogical situations. A necessary condition for the effectiveness of the business game is the voluntary and interested participation of all teachers, openness, sincerity of answers, their completeness. The business game can be used not only as a test lesson in according to the results of a theoretical seminar relevant to the DOW problem, but also in the development of solutions to a new problem.

The main goal of the game is a live simulation of the educational process, the formation of specific practical skills of teachers, faster adaptation to the updating of content, the formation of their interest and culture of self–development; the development of certain professional skills, pedagogical technologies.

There are business games: simulation, management, research, organizational and business, trainings, projective games.

When organizing and conducting a business game, the role of the head of the game is different – before the game he is an instructor, during its conduct he is a consultant, at the last stage he is the head of the discussion.

Game modeling – allows you to combine methods and techniques of teacher activation in order to assist educators in organizing the pedagogical process, learning and acquaintance with new methods of working with children. Thanks to game modeling, a wide field of activity unfolds, it becomes possible to individualize this work, on the one hand, and to create a cohesive team, on the other. Game modeling is also effective in the final part of the methodological event.

The master class is an open pedagogical system that allows you to demonstrate new possibilities of pedagogy of development and freedom, showing ways to overcome conservatism and routine.

Features of the master class:

- a method of independent work in small groups, allowing for an exchange of views;
- creating conditions for the inclusion of all in active activities;
- formulation of a problem problem and its solution through the playback of various situations;
- techniques that reveal the creative potential of all participants of the master class;
- forms, methods, technologies of work should be offered, and not imposed on participants;
- the form of interaction is cooperation, joint search.

The approximate algorithm of the master class should consist of the following components: highlighting the problem - grouping to solve the problem – working with the material – presentation of the results of the work – discussion and

correction of the results of the work – reflection (the last and mandatory stage is the reflection of feelings, sensations that the participants had during the master class).

Summing up, we can say that a competently constructed system of innovative forms of work with teaching staff will lead to an increase in the level of educational and educational work of preschool institutions and will unite the team of teachers.

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The compiler of the work program:

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Chairman of the Council I.Sayfullayev

EXPLANATORY NOTE

The principal feature of engineering activity in the modern era is its creative nature, the presence of a fund of technologies and discoveries, the leading role of science and, first of all, information technology in the creation of new technology, the systematic nature of the activity. The central figure in this activity is an engineer, whose main task is to create new systems, devices, organizational solutions that are cost-effectively implemented by both well-known and newly developed technologies. The systemic nature of engineering activity determines the style of engineering thinking.

The purpose of the discipline is the formation of knowledge about fundamental and applied scientific research, the laws of the development of science, the principles of innovation.

The main tasks are: mastering the basics of organizing scientific research, analyzing and synthesizing the theoretical and experimental results obtained, mastering the basics of innovation.

The discipline refers to special disciplines mastered by students of engineering specialties.

The discipline is based on the disciplines previously studied by students "Fundamentals of Energy Conservation", "Fundamentals of Intellectual Property Management", special disciplines of the relevant specialties.

As a result of mastering the discipline, the student must:

know:

- the goals and objectives of fundamental and applied research;
- methodological foundations of experimental work;
- innovative laws and objectives of innovative activity;
- content, methods of innovation activity and the basics of its organization;
- patterns of formation of innovative strategies;
- methods of innovative design and business planning of developments;
- the main legislative and regulatory acts in the field of innovation;
- foreign and domestic experience in the field of innovations in the energy sector;

be able to:

- conduct research on new technologies, equipment, projects and solutions in order to assess their innovative potential;
- define the goals of innovation and how to achieve them;
- apply methods of analysis and organization of innovation implementation.

As a result of studying the discipline, the student must develop the following academic (AK), social–personal (SLK) and professional competencies (PC):

AK-1. Possess systematic and comparative analysis.

AK-2. Possess research skills.

AK-3. Be able to work independently.

AK-4. Be able to put forward new ideas.

AK-5. Possess an interdisciplinary approach to solving problems. SLK -1. Have the ability to interpersonal communication; SLK -2. Be able to work in a team.

PC-1. To search, systematize and analyze information on the prospects for the development of the industry, innovative technologies, projects and solutions.

PC-2. Determine the goals of innovation and how to achieve them.

PC-3. Work with scientific, technical and patent literature.

PC-4. Evaluate the competitiveness and economic efficiency of the developed equipment and technologies.

Teaching methods (technologies)

The main methods (technologies) of teaching that meet the objectives of studying the discipline are:

- elements of problem-based learning (problem presentation, variable presentation);

- elements of educational and research activities, the implementation of a creative approach, the search for solutions in the uncertainty of information and non-standard situations.

Organization of independent work of students

When studying the discipline , the following forms of independent work are used:

- supervised independent work in the form of solving individual tasks in the classroom during practical classes under the supervision of a teacher in accordance with the schedule;

- preparation of reports and essays on individual assignments;

Diagnostics of students' competencies

The assessment of the student's intermediate academic achievements is made in accordance with a ten-point scale of assessments.

To assess the student's achievements, the following diagnostic tools are used (in parentheses – which competencies are being tested):

- protection of individual tasks performed in practical classes (AK-3, AK-5, PC-2 – PC-4);

- conducting current control surveys on specific topics (AK-1, AK-3, AK-5, PK-1 – PK-4);

- passing the test in the discipline (AK-1, AK-3, AK-6, SLK-1, PK-1 – PK-4).

Approximate distribution of classroom hours by type of classes: a total of 50 hours, including lectures – 16 hours, practical classes – 16 hours. The total number of classroom sessions is 32 hours.

Approximate thematic plan of the discipline

Topic No.	Title of topics	Lectures	Practical classes	Total List	List of formed competencies
1.	Organization of research work in the Republic of Uzbekistan	2	2	4	АК-1, АК-5 АК-6, СЛК-1,ПК-3
2	Methodological foundations of scientific knowledge and creativity	2	2	4	АК-2, АК-3 АК-4, АК-5, АК-7, СЛК-1, ПК-1 ПК-3
3	Tasks and methods of creative research	4	4	8	АК-2, АК-3 АК-4, АК-6, АК-7, СЛК-2, ПК-1 ПК-3
4	Goals and methods of innovation activity. Innovative laws.	2	2	4	АК-2,АК-3 СЛК-1, ПК-1
5	Организационные формы инновационной деятельности	2	2	4	АК-1, АК-3 АК-5, АК-6, СЛК-1, СЛК-2,ПК-2 ПК-4
6	Fundamentals of innovation economics	4	4	8	АК-5, АК-6, СЛК-1, СЛК-2, ПК-2,ПК-3
	Total	**16**	**16**	**32**	

The content of the academic discipline

1. Organization of research work in the Republic of Uzbekistan

Introduction. The concept of science and its role in the life of society. Classification of sciences. Technical sciences. Management in the field of science. Academic degrees and titles. Scientific public organizations. Research work in student scientific circles, during industrial practices, when performing course and diploma projects. Stages of research work.

2. Methodological foundations of scientific knowledge and creativity

The concept of a scientific title (cognition, concept, thinking, judgment, inference, scientific idea, hypothesis, law, theory). Methods of theoretical and empirical research (observation, comparison, measurement, experiment, generalization, abstraction, analysis and synthesis, induction and deduction, system methods of analysis). Creation. Sources of scientific information.

3. Tasks and methods of creative research

Research objectives. The use of mathematical methods in research. Analytical and probabilistic-statistical methods of research. Physical, analog and

mathematical similarity and modeling. Experimental studies. Computational experiment. Processing of experimental research results. Registration of the results of scientific work.

4. Goals and methods of innovation activity. Innovative laws

Basic concepts and terminology. The essence and content of the concept

"innovation". Types of innovations. The place and role of innovation in the development process. Goals and methods of innovative activity, innovative laws. The innovation process, its phases, innovation criteria, the nature of the innovation process.

5. Organizational forms of innovation activity.

State innovation policy. Staffing. Management of innovative projects. Organization of research and development work. Organization of design. The choice of an innovative strategy of the organization's behavior.

6. Fundamentals of innovation economics

Search, systematization and analysis of innovative technologies, projects, solutions. Factors of competitiveness. Fundamentals of risk management in innovation. Applied aspects of innovation activity.

An approximate list of practical and seminar classes

1. Science and development of social production (seminar)
2. Discussion. Principles of its organization (seminar)
3. Structure of scientific knowledge (seminar)
4. Probabilistic and statistical methods of research
5. Selection of formulas for approximation of statistical series
6. Application of multi-purpose optimization methods to form the optimality criterion
7. Registration of the results of scientific work
8. Automated systems of scientific research (seminar)
9. Management of innovative projects (seminar)
10. Search for the necessary information on the global information network Internet (seminar)
11. Business development planning (workshop)
12. Methods of processing the results of the experiment
13. Information search and preparation of essays on applied areas of innovation (for the relevant specialty)
14. Patent search and preparation of essays on applied areas of innovation (for the relevant specialty)
15. Methods of finding new technical solutions (seminar)
16. Methods of activation of innovative activity of the individual (seminar)

Information and methodological part of the main literature

1. Fundamentals of scientific research / Edited by V.I. Krutova, V.V. Popova: Textbook. – M.: Higher School, 1989.

2. Fatkhutdinov R.A. Innovative management: Textbook. 6th ed. – St. Petersburg: Peter, 2008.

3. Selivanov S.G., Guzairov M.B., Kutin A.N. Innovatika: Textbook. – Ufa State University . Aviation Technical University, 2008.

4. Marenkov N.L. Innovatika: Textbook. – St. Petersburg: Librocom, 2009.

5. Innovative economy. /Edited by A.A. Dynkin, N.I. Ivanova - M.: 2001.

6. L.I. Leontiev. On the forms and methods of stimulating innovation activity. - M.: RIC ISPI RAS, 2001.

Additional literature

1. Papkovskaya P.Ya. Methodology of scientific research. – Minsk: Informpress, 2007.

2. Gamidov G.S., Kolosov V.G., Osmanov N.O. Fundamentals of innovation and innovative activity. - St. Petersburg: Polytechnic, 2000.

3. Demchuk M.I., Yurkevich A.T. System methodology of innovation activity: Textbook. - Minsk, Riga, 2007.

4. Volkov D.P. Fundamentals of scientific research: Textbook. – M.: Stroyizdat, 1992.

5. Zavlin P.N. Innovation management. Textbook – St. Petersburg: Nauk, 2007. – 356 p

. 6. On the development of a system of optimal functioning of the economy, M., 1968

GLOSSARY

But An advance project is a type of initial technical documentation containing the rationale for product development and its indicators, initial requirements and proposals for the development, production and operation of products. [7] The author (co-authors) of scientific and technical information is a person (persons) whose creative work has created scientific and technical information as a result of intellectual activity. [2]

Author's supervision (in production / operation/ products) is a set of measures carried out by the developer in specific conditions of production / operation / products developed by him, to ensure compliance with their established requirements and timely elimination of identified product deficiencies. [7]

An author's sample is a sample of products made by the author or authors for its demonstration. [7]

Aggregation is a method of designing machines and equipment from standard and unified parts and assemblies. [7]

Accreditation of a scientific organization is a form of state recognition of the competence of a legal entity in carrying out research, development and experimental technological work. [3]

The act of the acceptance commission is a document containing an assessment of the prototype (experimental pariah) and recommendations on the production of products and, after approval, is a permit for the production of products as a whole, as well as its components for self—delivery. [7] Approbation of the results of scientific research is a type of scientific activity that consists in verifying the results of scientific research in order to establish their suitability for achieving specific goals. [3]

Certification of highly qualified scientists is a type of scientific activity, which includes holding events for awarding academic degrees and awarding academic titles. [3]

Audit (verification) is a systematic, independent and documented process of obtaining audit certificates (verification) and their objective evaluation in order to establish the degree of compliance with the agreed audit criteria (verification). [8]

Auditor — a person who has demonstrated personal qualities and competence to conduct an audit (audit). [8]

B

A basic product is a product that is a constructive basis for creating its modifications. [7]

A business incubator; an incubator firm is a subject of innovation infrastructure created for the purpose of forming new enterprises,

jobs and economic development of the region on the basis of an integrated method of organizing the innovation process. [6]Note. There

are three types of entities: non—profit — subsidized by local authorities, organizations; profitable - private organizations; branches of higher educational institutions.

Marriage is a product, the transfer of which to the consumer is not allowed due to the presence of defects. [7]

Bulletin is a document agreed upon and approved in accordance with the established procedure, on the basis of which products that are in operation, under repair or in storage are modified, or operational or repair documentation for these products is changed. [7]

I

Validation is confirmation by providing objective evidence that the requirements intended for a specific intended use or application have been met. [8]

Commissioning is an event that records the readiness of the product for its intended use and documented in accordance with the established procedure. [7]

A venture project is a complex of works on the creation and implementation of innovations, organization and (or) development of the production of high-tech goods (works, services), including through the creation of an innovative organization. [4]

Note. In this definition, when creating subjects of innovation infrastructure, an innovative organization is understood as an organization that creates and implements innovations, produces high-tech goods (works, services) or plans to produce such goods (works, services) with the involvement of venture capital organizations, including those created (created) in the form of an economic partnership or company, the founder (participant) of which is a venture organization.

A temporary scientific collective is a voluntary association of individuals without the formation of a legal entity, created for the purpose of carrying out scientific activities in the manner and on the terms determined by legislation and the contract. [3]

Input control — control of the supplier's products that have been delivered to the consumer or customer and are intended for use in the manufacture, repair or operation of products. [7]

G

Warranty time — the time of production within the warranty period. [7]

Warranty obligations — obligations of the supplier or contractor to the customer or consumer to guarantee, within a specified period and (or) operating time, compliance with the quality of the supplied products or work performed with the established requirements and to eliminate defects detected during this period

free of charge, or to replace defective products if the customer or consumer complies with the established requirements for storage, transportation, installation and operation of products. [7] Warranty period — the time interval during which the warranty obligations are valid. [7]

The head sample is a product manufactured according to newly developed working documentation for use by the customer with simultaneous development of the design and technical documentation for the production and operation of subsequent products of this batch or series. [7]

The head developer (product) is a product developer who coordinates the work of the co—executors of the development and is responsible for the development of the product as a whole. [7]

The state innovation policy is a part of the state socio—economic policy related to the complex of organizational, economic and legal measures implemented by the state aimed at the development of innovation activities. [6]

Finished products — manufactured products recognized as suitable for supply and (or) use. [7]

Grant — funds provided to individuals and (or) legal entities in cash or in kind for conducting scientific research on the terms determined by the contract and legislative acts. [3]

D

Test data — values of the characteristics of the properties of the object and (or) test conditions, developments, as well as other parameters registered during testing, which are the initial ones for subsequent processing. [7] The holder of the originals of technical documentation is an organization that records, stores, makes changes and restores the originals of technical documentation. [7]

A part is a product made of a material that is homogeneous in name and brand, without the use of assembly operations. [7]

Defect — each individual non-compliance of products with the established requirements. [7]

A defective product unit is a product unit that has at least one defect. [7]

Finishing tests (Ndp. design tests) are research tests carried out during product development in order to assess the impact of changes made to it in order to achieve the specified values of its quality indicators. [7]

Documented scientific and technical information is scientific and technical information recorded on a material carrier with details that allow it to be identified. [2] Completion of the prototype — work carried out based on the results of preliminary or acceptance tests of samples in order to ensure their compliance with specified requirements, eliminate identified deficiencies or implement the adopted additional requirements. [7]

E

Unit of production — a separate copy of piece products or a quantity of non-piece or piece products determined in accordance with the established procedure. [7]

A single product is a separate product or batch of products of a specified volume, manufactured according to a single documentation and not intended for re—production. [7]

W

The product life cycle is a set of interrelated processes of successive changes in the condition of products from the formation of initial requirements for it to disposal. [7]

Z

The customer of the product is a legal or natural person, according to the application or contract with which the development (modernization), production and (or) delivery of products is carried out. [7]

A spare part is a component part of a product intended to replace the same part in operation in order to maintain or restore the serviceability or operability of the product. [7]

Application (for the development and development of products) — the initial technical document of the customer containing proposals for the development and development in the production of the products he needs, including the timing of these works, technical and economic requirements for the ordered products and the volume of its production. [7]

And

Manufacturer — a legal or natural person engaged in the production of products. [7]

A product is a unit of industrial production, the quantity of which can be calculated in pieces (copies). [7]

Document modification is any correction of a document, deletion or addition of any data to it, carried out in accordance with the established procedure without changing the designation while maintaining the legal status of the modified document. [7]

An invention is a technical solution that is new, has legal protection, inventive level and is industrially applied. [7]

An invention is a technical solution that is new, has legal protection, inventive level and industrial application. [6]

Innovation investment is a set of material and intellectual values invested in the implementation of an innovation project. [6]

Individual execution — products manufactured on the basis of serial products by order and taking into account the individual requirements of a

particular consumer, not previously reflected in the current technical documentation. [7]

Initiative development is a development carried out without a customer. [7] Innovation is a field of knowledge that includes the methodology and organization of innovation activities. [6]

Innovations (innovations) — new or improved technologies being created (mastered), types of marketable products or services, as well as organizational and technical solutions of an industrial, administrative, commercial or other nature that promote technologies, marketable products and services to the market. [1]

Innovations (innovations) — new or improved technologies being created (mastered), types of marketable products or services, as well as organizational and technical solutions of an industrial, administrative, commercial or other nature that promote technologies, marketable products and services to the market. [4]

Innovations; innovations — new or improved technologies, types of products or services, as well as organizational and technical solutions of an industrial, administrative, commercial or other nature that contribute to the movement of technologies, marketable products and services to the market. [6]

Note. Innovation is the final result of the implementation of a new or improvement of a product sold on the market, technological process and organizational and technical measures used in practical activities.

Innovation activity is an activity that ensures the creation and implementation of innovations. [1, 4, 6] Note. The process of creating innovations, which includes applied research, preparation and start—up of production, as well as activities that ensure the creation of innovations - scientific and technical services, marketing research, training and retraining of personnel, organizational and financial activities.

Innovation infrastructure is a set of legal entities, resources and means that provide logistical, financial, organizational and methodological, informational, consulting and other services for innovation activities. [6] Note. Innovation infrastructure includes organizations that promote innovation: innovation and technology centers, technology incubators, technology parks, educational and business centers and other specialized organizations.

Innovation infrastructure is a set of subjects of innovation infrastructure that provide logistical, financial, organizational and methodological, informational, consulting and other support for innovation activities. [4]

Innovation program — a set of innovative projects and activities, coordinated by resources, performers and their deadlines implementation and providing an effective solution to the tasks of mastering and distributing fundamentally new types of products (technologies). [6]

Innovation sphere is the field of activity of producers and consumers of innovative products (works, services), which includes the creation and dissemination of innovations. [6]

Innovation-active enterprises — enterprises engaged in the development and implementation of new or improved products, technological processes or other types of innovative activities. [6]

An innovative enterprise is an enterprise (association of enterprises) that develops, manufactures and sells innovative products and (or) products or services. [6]

Innovative engineering is a system of providing a complex of engineering and consulting works and services of a commercial nature for the preparation and provision of production and sales processes, maintenance and operation of industrial, agricultural and other facilities by a consultant organization to a client organization in the implementation of innovative projects. [6]

Innovative consulting — consulting on a wide range of issues of economic and foreign economic activity of enterprises, firms, associations and other structures in the implementation of innovative projects. [6]

Innovative marketing — identification and market research of innovations, development of a marketing proposal for the commercialization of innovation. [6]

Note. The components of the marketing offer are product offers, pricing, sales promotion, forms of bringing innovation to consumers.

Innovation management is a set of principles, methods, means and forms of innovation process management in order to increase the efficiency of investments invested in its implementation. [6]

Innovation potential is a set of resources of various types, including material, financial, intellectual, scientific, technical and other resources necessary for the implementation of innovative activities. [6]

An innovative project is a project whose content is the conduct of applied scientific research and (or) development, their practical use in production and implementation. [6] Note. An innovative project, for example, includes a comprehensive action plan aimed at creating or changing a specific system by turning an innovation into an innovation and providing for certain conditions for its implementation (deadlines, finances, equipment, organization methods, etc.).

The innovation process is the process of consistently carrying out work on converting innovations into products and introducing them to the market for commercial use. [6] Note — In general, the innovation process may include:

research and development; mastering in production; manufacturing; assistance in implementation, application, maintenance; disposal after use.

An innovation center is a subject of innovation infrastructure that carries out joint research with firms, educates students, retraining and advanced training of students in the basics of innovation and organizes new commercial companies that it finances at the stage of their formation. [6]

Service innovation is an innovation related to the direct interaction of the subjects of innovative activity to meet the needs in the process of this activity. [6]

A foreign customer is an organization (department) of a foreign country, on whose orders the production and delivery of products is carried out. [7]

Inspection control — periodic and operational control over the conformity of products that have passed the confirmation of compliance with the requirements of technical regulatory legal acts in the field of technical standardization and standardization, carried out by accredited certification bodies. [10]

Integrating innovation is an innovation obtained through the use (integration) of an optimal set (complex) of previously accumulated and proven in world practice achievements (knowledge, technologies, equipment). [6]

Intellectual property is a set of exclusive rights to the results of creative activity and equated to them, in terms of methods of protection, means of individualization of a legal entity, products, works and services performed. [7]

The R&D Information Card [R&D] is an information document of the established form containing brief information about the completed research, development work or its stage and about the documentation developed in the course of work. [7]

An information center is a specialized organization that carries out scientific and informational activities in an industry or region. [2]

Tests — experimental determination of quantitative and (or) qualitative characteristics of the properties of the test object as a result of exposure to it, during its operation, when modeling the object and (or) impacts. [7]

Research tests are tests conducted to study certain characteristics of the properties of an object. [7]

To The map of the technical level and quality of products is a technical document containing information about the technical and economic indicators of products that characterize the level of its quality in comparison with the best domestic and foreign analogues and promising samples. [7] Quality is the degree to which a set of its own characteristics fulfills the requirements. [8]

Product quality is a set of product characteristics related to its ability to meet established and anticipated needs (STB 1.0). [7]

Qualification tests are control tests of the installation series or the first industrial batch carried out in order to assess the manufacturer's readiness to produce products of this type in a given volume. [7]

Competence is the expressed ability to apply knowledge and skills. [8]

A complex is two or more specified products that are not connected by assembly operations by the manufacturer, but are intended to perform interrelated operational functions. [7]

A set is two or more products that are not connected by assembly operations by the manufacturer and represent a set of products that have a common operational purpose of an auxiliary nature. [7]

Spare parts kit — spare parts, tools, accessories and materials necessary for the maintenance and repair of products and completed depending on the purpose and features of use. [7]

A component product is a supplier's product used as an integral part of a product manufactured by the manufacturer. [7]

Product competitiveness is the ability of products to meet the requirements of a particular market for the period under review. [7] Design documentation; CD — a set of design documents containing, depending on their purpose, data necessary for the development, manufacture, control, acceptance, delivery, operation, repair and disposal of the product. [7]

Control — control over the compliance of conformity assessment objects that have passed conformity assessment, certified by relevant conformity assessment documents, with the requirements of technical regulatory legal acts in the field of technical standardization and standardization, carried out by officials of Gosstandart, as well as accredited certification bodies. [9] Control sample — a unit of production or a part, or a sample approved in accordance with the established procedure, the characteristics of which are taken as a basis for the manufacture and control of the same products. [7] A co—operated product is a component product received by the customer in a ready-made form and manufactured according to its technical documentation. [7]

Correction of technical documentation is the process of developing and making changes to the approved technical documentation. [7] Audit criteria (verification) — a set of policies, procedures or requirements. [8]

L

Licensor is a party that transfers the right to use the license object to the licensee in accordance with the license agreement. [7] Licensee is a party that receives the right to use the license object in accordance with the license agreement. [7]

License agreement is an agreement or contract under which one party transfers to the other party the right to use the license object under certain conditions. [7]

M

Layout (product) is a simplified reproduction on a certain scale of a product or part of it, on which individual characteristics of the product are examined, as well as the correctness of the technical and artistic decisions made is evaluated. [7]

Marketing is a management system of production and sales activities based on a comprehensive market analysis and ensuring the effectiveness of product sales through meeting the needs and needs of the consumer. [7]

Material is the initial object of labor used for the manufacture or maintenance of the product. [7]

Quality management is a coordinated activity for the management and management of an organization in relation to quality. [8]

Test procedure is an organizational and methodological document that is mandatory for implementation, including a test method, means and test conditions, sampling, algorithms for performing operations to determine one or more interrelated characteristics of object properties, forms of data presentation and evaluation of accuracy, reliability of results, safety and environmental requirements. [7]

Product modeling is the study of an object (product) by experimental study of a physical and mathematical model that reproduces or simulates individual properties of an object (product). [7]

A product model is a product that reproduces or imitates the specific properties of a given product and is manufactured to test the principle of its operation and determine the characteristics. [7]

Modernization of (manufactured) products is the development of a product carried out in order to replace the manufactured product with a product with new or improved individual quality indicators by a limited change in its design. [7]

Modernization during operation — a set of works to improve the technical and operational characteristics of the product in use operation, by replacing individual components with more advanced ones. [7]

Upgraded products — products with new or improved quality characteristics obtained as a result of the modernization of manufactured products. [7]

Product modification is a type of product created on the basis of a basic product in order to expand or specialize the scope of its use. [7]

Modification is a type of product development based on a basic product in order to expand or specialize the scope of its application. [7]

Installation of equipment is a complex of works on assembly, installation and debugging of machines, technical, power and other installations and related equipment. [7]

N

Reliability is the property of an object to keep in time within the established limits the values of all parameters characterizing the ability to perform the required functions in the specified modes and conditions of use, maintenance, storage and transportation. [7] Note — Reliability is a complex property, which, depending on the purpose of the object and the conditions of its use, may include reliability, durability, maintainability and preservation, or certain combinations of these properties (GOST 27.002).

Reliability is a collective term used to describe the properties of readiness and the properties of reliability, maintainability and availability of maintenance and repair that affect it. [8]

Scientific activity is creative activity aimed at obtaining new knowledge about nature, man, society, artificially created objects and using scientific knowledge to develop new ways of their application. [3]

A scientific organization is a legal entity carrying out research, development and experimental technological work, one of the governing bodies of which, in accordance with the constituent documents, is the scientific (scientific and technical) council and which has been accredited by a scientific organization in accordance with the established procedure. [3]

Scientific and informational activity is a set of actions related to the creation, collection, systematization, analytical and synthetic processing, fixation, storage, dissemination and provision of scientific and technical information to the user (consumer). [2]

Research work (on the creation of products); research and development — creative activity aimed at obtaining new knowledge and ways of their application. [7]

Scientific and technical activity — an activity that includes conducting applied research and development in order to create new or improvements to existing methods and means of implementing specific processes. [1, 6]

Note. Scientific and technical activities also include scientific and methodological, patent-licensing, software, organizational, methodological and technical support for the direct conduct of scientific research and development, as well as their dissemination and application of the results.

Scientific and technical information products are the materialized result of information scientific and technical activities designed to meet the information needs of users (consumers) of scientific and technical information. [2]

Scientific and technical information — information about documents and facts obtained in the course of scientific, scientific and technical, innovative and social activities. [2]

Scientific and technical products — products containing new knowledge or solutions, recorded on any information medium, as well as models, layouts, samples of new products, materials and substances. [6, 7]. Notes. Scientific and technical products include scientific products, design and technological documentation, software, accompanying documentation, models, layouts, prototypes of products, materials, substances, regulatory documents. Scientific products include the results of research contained in research reports, reports, descriptions, monographs and other printed publications.

Scientific and technical report is a scientific and technical document containing systematized information about the work performed (development of an advance project, research work, experimental design work) or its stage. [7]

Scientific research (research works) is a creative activity aimed at obtaining new knowledge and ways of applying it. Scientific research can be fundamental and applied. [1, 6]

A scientific foundation is a non—profit organization that finances scientific activities based on the results of open competitions on behalf of the state on special instructions, on its own behalf or on behalf of individuals and (or) legal entities that participated in the establishment of this foundation. [3]

The national innovation system is a set of legislative, structural and functional components that ensure the development of innovation activity in the country. [6] Note. The structural components are private and public sector organizations that, in cooperation with each other within the framework of legal and informal norms of behavior, provide and conduct innovative activities on a state scale. These organizations operate in all areas related to the innovation process in research and development, education, production, sales and maintenance of innovations, financing of this process and its legal support.

The National Conformity Assessment System of the Republic of Uzbekistan is an established set of conformity assessment subjects, regulatory legal acts and technical regulatory legal acts in the field of technical standardization and standardization, defining the rules and procedures for conformity assessment and the functioning of the system as a whole. [9]

An unspecified product is a product that has no component parts. [7]

New products — products manufactured for the first time in the country (at the enterprise) or differing from those produced by improved properties or characteristics and receiving a new designation. [6, 7] Note. Scientific products include the results of research contained in research reports, reports, descriptions, monographs and other printed publications.

Innovation is scientific knowledge that has new or significantly different solutions from existing ones. [6]

Regulatory document; ND — a document containing rules, general principles or characteristics concerning various types of activities or their results. [7]

Know-how (from the English know how — "to know how" or the secret of production) is technical, organizational or commercial information that has actual or potential commercial value due to its unknown to third parties, which is not freely available on a legal basis; the owner of the information takes appropriate measures to protect its confidentiality. [6]

Know-how is fully or partially confidential information, including information of a technical, administrative and financial nature, which has actual or potential commercial value due to its unknown to third parties. [7]

About

Quality assurance is a part of quality management aimed at creating confidence that quality requirements will be met. [8]

The scope of accreditation is the field of activity in which an accredited certification body or an accredited testing laboratory (center) has been granted the right to perform conformity assessment work or conduct product testing. [9]

A product sample is a unit of a specific product used as a representative of this product during research, control and evaluation. [7, 10]

Sample-model — a sample of a product approved in accordance with the established procedure and intended to fulfill individual orders of the population for the manufacture of such products. [7]

A reference sample is a sample of products approved in accordance with the established procedure and intended to compare manufactured products with it during its acceptance and delivery. [7]

The volume of output is the number of products of certain names, sizes and designs manufactured by the enterprise or its division during the planned period of time. [7, 10]

Mandatory certification is a form of conformity assessment of conformity assessment objects included in the List of products, services, personnel and other conformity assessment objects subject to mandatory conformity assessment in the Republic of Uzbekistan, carried out by an accredited certification body. [9]

Pilot testing is the formation and study of consumer demand for the developed products based on the results of the implementation of the pilot batch. [7] Pilot batch — a set of prototypes or a certain volume of products manufactured over a specified period of time according to the newly developed same documentation to control the conformity of products with specified requirements and make a decision on putting it into production. [7]

Pilot operation is the operation of a specified number of products according to a special program in order to take into account the actual operating conditions,

control the technical characteristics of the product under these conditions and determine the need to change the design, technical and repair characteristics of the product, making changes to operational documents. [7]

Development work; R&D — a set of works performed during the creation or modernization of products — development of design and technological documentation for prototypes (pilot batch), production and testing of prototypes (pilot batch). [1, 6, 7] Experimental and technological work; OTP - a complex of works on the creation of new substances, materials and (or) technological processes and on the production of technical documentation for them. [1, 6, 7]

Organizational innovation is an innovation related to the creation or improvement of the organization and management of production, processes, and human resources. [6]

Organizational and methodological center for conformity assessment is a center that develops organizational and methodological documents and provides methodological assistance in confirming compliance by types of products, services, and individual requirements. [9]

Organizational and administrative documentation - documentation that ensures the organization of management processes and managerial work. [7]

Mastering production is an integral part of putting products into production, including working out and checking the prepared technological process and mastering practical techniques for manufacturing products with stable values of indicators and in a given volume of output. [7]

Mastered products are products of established industrial production, produced in a given volume according to a regulatory document approved in accordance with the established procedure. [7]

The main consumer (of products) is a consumer who uses or sells a large share of the volume of products. [7]

Failure is an event consisting in a violation of the functional state of the object. [7]

A repaired product is a product that has been repaired and is suitable for further operation in accordance with the established requirements. [7]

A patent research report is a scientific and technical document containing systematized information about completed patent research. [7]

Conformity assessment is the activity of determining the conformity of conformity assessment objects with the requirements of technical regulatory legal acts in the field of technical standardization and standardization. [9] P

A batch of products is a set of units of products of the same name and designation intended for control, produced within a certain time interval under the same conditions, accompanied by a commodity transport document. [10]

Patent purity is the independence of an object of technology from the protected rights of third parties to objects of industrial property. [7]

Patent research (products) is the study of the technical level and trends in the development of products, their patentability, patent purity and competitiveness. [7]

A patent form is a technical document that defines the state of an object of technology in relation to the protection of industrial property. [7]

Patentability — compliance of the proposed object of industrial property with the criteria necessary to obtain legal protection under the patent legislation of a particular country (region). [7]

Periodic tests are control tests of manufactured products carried out in volumes and within the time limits established by a regulatory document in order to control the stability of product quality and the possibility of continuing its production. [7]

Quality planning is a part of quality management aimed at setting quality goals and determining the necessary operational processes of the product lifecycle and the appropriate resources to achieve quality goals. [8]

Training of highly qualified researchers is a type of scientific activity that includes training activities and conducting scientific research in order to acquire a highly qualified researcher. [3]

Pre—production is an integral part of putting products into production, containing measures to prepare and ensure the technological process of its manufacture or repair in a given volume of output. [7]

Controlled operation is the operation of a specified number of products in accordance with the current operational documentation, accompanied by additional control and consideration of the technical condition of products in order to obtain more reliable information about changes in the quality of products of this type under operating conditions. [7] Contractor — a legal entity or individual who carries out works for the customer or consumer that ensure the commissioning of the facility, including construction, installation and commissioning, as well as repairs. [7]

Conformity assessment is a type of conformity assessment, the result of which is a documentary certificate of compliance of the object of conformity assessment with the requirements of technical regulatory legal acts in the field of technical standardization and standardization. [9]

A purchased product is a component product purchased ready—made and manufactured according to the supplier's technical documentation. [7]

Quality policy — the general intentions and directions of the organization's activities in the field of quality, officially formulated by the top management. [8]

A semi—finished product is an object of labor that is subject to further processing by the consumer. [7]

The recipient (of the product) is a legal entity or an individual to whom the products are delivered in accordance with the established procedure. [7]

Product delivery — fulfillment of obligations by the supplier to provide the consumer or customer with products. [7]

Supplier (of products) — a legal entity or individual who supplies products in accordance with the established procedure. [7]

Putting products into production is a set of measures to organize the production of newly developed, modernized or previously mastered by other manufacturers of products. [7]

The consumer (of the product) is a legal entity or an individual who uses this product for its intended purpose. [7, 10]

Consumer properties of products — a set of technical, aesthetic and other properties of products that create its beneficial effect and attractiveness for consumption. [7]

Preliminary tests are control tests of prototypes and (or) experimental batches of products carried out in order to determine the possibility of their presentation for acceptance tests. [7]

Acceptance of products — the technical control service and (or) the customer's representative carry out acceptance control of products and registration of documents on its suitability for supply and (or) use. [7]

Acceptance tests — control tests of products during acceptance control. [7]

The acceptance commission is a collegial body appointed to determine the possibility and expediency of putting newly developed products into production or commissioning a prototype and (or) single—production products. [7]

Acceptance tests are control tests of prototypes, experimental batches of products or single—production products, carried out respectively in order to resolve the issue of the expediency of putting these products into production and (or) use for their intended purpose. [7]

Acceptance control is the control of products, based on the results of which a decision is made on its suitability for supply and (or) use. [7]

Applied scientific research is research aimed at applying the results of fundamental scientific research to achieve specific practical goals. [3]

Priority innovation project is an innovative project related to one of the priority areas of innovation activity approved by the state. [6]

The test program is an organizational and methodological document that is mandatory for implementation, establishing the object and objectives of the tests, the types, sequence and scope of the experiments conducted, the procedure, conditions, place and timing of the tests, provision and reporting on them, as well as responsibility for ensuring and conducting the tests. [7]

Product-innovation is an innovation related to the development and implementation of new or improved products (products) or already implemented in the production practice of other enterprises and distributed through technological exchange (patent—free licenses, know-how, consultations). [6] Note. Product innovation is aimed at the production and introduction to the market of new products (products) for which the intended scope (use), functional characteristics, features, design, additional services, as well as the composition of the materials and components used are new or significantly differ in comparison with previously manufactured products (products). Such innovations are usually based on fundamentally new technologies or on a combination of new and existing technologies.

Products are the result of activities or processes. [7]

Auxiliary production products are products intended only for the manufacturer's own needs. [7]

Single production products are products produced in single copies or periodically in separate units. [10]

Mass production products are products that are continuously manufactured for a long time with a large volume of output. [10]

Main production products are products intended for delivery or direct sale to a third—party consumer. [7]

Industrial and technical products - products for use as means of industrial and agricultural production. [7]

Mass—produced products are products manufactured in recurring batches. [10]

A derivative product is a product in which the aggregates and components of the base product are used, the properties and parameters of which provide it with additional special operational qualities that are absent from the base model and its modifications. [7]

Production documentation — working documentation intended for use at workplaces in the manufacture, control, acceptance and delivery of products. [7]

Production cycle — the time interval from the beginning to the end of the production process of manufacturing or repairing a product. [7]

Production — organization and manufacture or repair of products. [10] Industrial production (products) — organization and implementation of industrial manufacturing or repair of products. [7]

An industrial design is a new artistic and artistic design solution that determines the appearance of the product, suitable for industrial production, protected in accordance with the established procedure, having an author's certificate, and to which legal protection is provided. [7]

The simplest consumer goods are products that meet the following conditions: products do not consume, produce or transmit any types of energy; only geometric parameters, mass, color are indicated in the technical specification; drive (if available) it is carried out by muscular force; the products are not designed to move people.

Test report is a document containing the necessary information about the test object, the methods, means and test conditions used, the test results, as well as the conclusion on the test results, issued in accordance with the established procedure. [7]

Process-innovation is an innovation associated with the development and implementation of new or significantly improved production processes involving the use of new production equipment, new methods of organizing the production process or their combination. [6]

Note. The innovation process also includes new or improved methods and technologies that have already been implemented in the production practice of other enterprises and distributed through technological exchange (patent—free licenses, know-how, consultations).

Work on complaints is a set of measures taken by the supplier of products to eliminate inconsistencies in its quality and (or) completeness with the established requirements detected by the recipient or consumer during the warranty period. [7]

P

Working documentation is a set of design documents intended for the manufacture, control, acceptance, delivery, operation and repair of the product. [7]

Development is an activity aimed at creating or improving methods and means of implementing processes in a specific field of practical activity, in particular, the creation of new products and technologies. [1, 6] Note. The development of new products and technologies includes carrying out experimental design (when creating products) and experimental technological work (when creating materials, substances, technologies).

Development of an advance project is a type of work preceding the development of products, performed by its future developer on the instructions of the customer or the main consumer for the purpose of feasibility study of the feasibility of product development and ways of its creation, production and operation of products. [7]

Product development is the process of creating technical documentation and samples necessary for the organization of production. [7]

Developer — a legal or natural person who develops products in accordance with the established procedure. [7]

A rationalization proposal is a technical solution providing for the creation or modification of the product design, production technology and equipment used,

the composition of the material, which is new and useful for the legal entity to which it was received, as well as a new organizational solution for it, providing for the economy and rational use of labor, fuel, energy and material resources or other positive effect. [5]

Note. A proposal is new for a legal entity if, prior to submitting an application for a rationalization proposal (hereinafter referred to as an application), in the prescribed form, this proposal: was not used by a legal entity, except in cases when it was used at the initiative of the author for no more than 3 months before submitting the application; was unknown to the legal entity; was not provided for mandatory for a legal entity technical regulatory legal acts. An offer is useful for a legal entity if this offer allows you to get any positive effect.

The R&D Registration card [R&D] is an information document of the established form containing brief information about the research [development] work being started. [7]

A resident of a scientific and technological park is a legal entity with an average number of employees up to 100 people, an individual entrepreneur using movable and immovable property of a scientific and technological park in accordance with the legislation, including premises of various functional purposes, carrying out innovative activities. [4]

The test result is an assessment of the characteristics of the properties of the object, the establishment of compliance of the object with the specified requirements according to the test data, the results of the analysis of the quality of the functioning of the object during testing. [7]

Effectiveness — the degree of implementation of planned activities and achievement of planned results. [8]

A complaint is a duly executed statement of the recipient or consumer to the supplier or contractor for the non—compliance of the quality and (or) completeness of the delivered products or the work performed with the established requirements, as well as the requirements for the restoration or replacement of defective products (re-performance of work) detected during the warranty period. [7]

Repair is a complex of operations to restore the serviceability or operability of products and restore the resources of products or their components. [7]

Repair documents — documents containing data for carrying out repair work at specialized enterprises. [7]

Resource — the total operating time of an object from the beginning of its operation or its resumption after repair to the transition to the limit state. [7]

Resources of scientific and technical information - documented scientific and technical information organized into reference and information funds and databases of scientific and technical data. [2]

The decision to withdraw products from production is a document defining the composition and procedure for performing the necessary work related to termination of production, and being the basis for its withdrawal from production. [7]

With An assembly unit is a product whose component parts are to be connected to each other at the manufacturer by assembly operations. [7]

Serial production — products manufactured according to the same technical documentation and produced in the form of a sequential series of units (batches) according to a regulatory document approved in accordance with the established procedure. [7]

Certificate of competence is a document certifying the professional competence of an individual in performing certain works and services. [9]

Certificate of conformity is a document issued in accordance with the rules of the certification system, indicating that the necessary confidence is provided. that this product, process or service complies with a specific standard or other regulatory document. [7]

Certificate of conformity is a document certifying the conformity of the object of conformity assessment with the requirements of technical regulatory legal acts in the field of technical standardization and standardization. [9] Certification tests are control tests of products carried out in order to establish compliance with the characteristics of their properties with national and (or) international regulatory documents. [7]

Certification is a procedure by which a third party certifies in writing that a product, process or service meets specified requirements. [7]

Note. Specified requirements mean the requirements set out in a specific standard or other regulatory document.

Certification is a form of conformity assessment carried out by an accredited certification body. [9]

Certification of an expert auditor on quality is an assessment by the National Conformity Assessment Body of the Republic of Uzbekistan of the qualifications of an expert auditor on quality in order to determine its compliance with the established requirements. [9]

Certified products — products that have passed certification. [7, 10]

Certified products — products declared for certification. [10]

Quality management system is a management system for the management and management of an organization in relation to quality. [8]

The system of scientific and technical information is an ordered set of resources of scientific and technical information and organizational and technological means that implement the processes of creation, collection,

processing, systematization, search and provision of scientific and technical information to meet the needs of the state, legal entities and individuals. [2]

A quality management system is a part of a general management system that includes organizational structure, planning, responsibility, methods, procedures, processes, resources necessary to ensure the quality of products and (or) services. [9]

The environmental management system is a part of the overall management system, including organizational structure, planning, responsibility, methods, procedures, processes, resources that ensure compliance with environmental requirements. [9]

Decommissioning is a set of measures to stop industrial production of products. [7]

Decommissioning is an event that records the impossibility or inexpediency of further use for the intended purpose and repair of the product and documented in accordance with the established procedure. [7] Improvement of (manufactured) products — improvement of the quality of manufactured products by making changes to the current technical documentation while maintaining the values of the main quality indicators and interchangeability with previously manufactured products. [7] Document approval is an official confirmation by interested parties of agreement with the developed document and the possibility of its approval. [7]

Certification Agreement — a document establishing the mutual responsibility of the authority for the correctness of conformity assessment procedures and the applicant for the manufacture of products that meet the requirements of technical regulatory legal acts in the field of technical standardization and standardization and tested samples, as well as certifying that a legal entity or individual entrepreneur is granted the right to present products with a certificate of conformity and (or) label certified products a sign of compliance when fulfilling the terms of the agreement. [10]

Co—executor of the development is a developer who performs a certain share of joint work on product development on the basis of the relevant document. [7]

A component part of a product is a product that performs certain technical functions as part of another product and is not intended for independent use. [7]

Note. The concept of "component part" should be applied only to the specific product in which it is included. Any product (part, assembly unit, complex and kit) can be an integral part.

Social innovation is an innovation related to the improvement of social and living conditions, ecology, occupational hygiene and safety, culture and leisure. [6]

A specified product is a product consisting of several components. [7]

Means of technological equipment — a set of production tools necessary for the implementation of the technological process. [7]

Shelf life is the period after which the product is considered unsuitable for its intended use. [7]

The stage of the product life cycle is a part of the product life cycle characterized by a certain state of the product, the type of work provided and their final results. [7]

A standard product is a product manufactured according to a standard that fully and unambiguously determines its design and quality indicators. [7]

Bench tests are tests of an object carried out on test equipment. [7]

Subcontractor — a legal entity or individual who carries out work under an agreement with the contractor. [7]

Conformity assessment scheme is an established sequence of actions, the results of which are considered as evidence of compliance of the object of conformity assessment with the requirements of technical regulatory legal acts in the field of technical standardization and standardization. [9]

Certification scheme (declaration of conformity) is a conformity assessment scheme used for certification (declaration of conformity). [9]

T

Technical documentation (for products) is a set of documents necessary and sufficient for direct use at each stage of the product life cycle. [7]

Technical control — verification of compliance of the object with the established technical requirements. [7]

Technical design is a type of design design documentation for a product containing final technical solutions, giving a complete picture of the design of the product being developed and including data necessary and sufficient for the development of working design documentation. [7]

The technical level of products is a relative characteristic of product quality based on a comparison of the values of indicators characterizing the technical perfection of the evaluated products with the basic values of the corresponding indicators. [7]

Terms of reference for research work; Technical specification of research — the initial technical document for conducting research work, establishing requirements for the content, scope and timing of these works. [7]

Process-innovation is the initial technical document for product development and technical documentation for it, which establishes a set of requirements for products, as well as for the content, volume and timing of work. [7]

Maintenance; maintenance (Ndp. preventive maintenance) — a set of operations or an operation to maintain the operability or serviceability of the product when used for its intended purpose, waiting, storage and transportation. [7]

Technical description is a regulatory document for a specific product (a group of homogeneous products), developed in cases provided for by the standard (specifications) for this product (a group of homogeneous products) or a standard (guidance document) defining the procedure for setting up the production of the simplest consumer goods, approved by the developer (manufacturer) of the product. [7]

Technical proposal is a type of design documentation containing a feasibility study of the feasibility of developing a product and clarifying the requirements for the product obtained on the basis of the analysis of the terms of reference and elaboration of options for possible technical solutions. [7]

Technical condition is a set of product properties subject to change, characterized at a certain point in time by the actual values of quality indicators, the nomenclature of which is established in the technical documentation. [7]

Technological documentation is a set of technological documents that define the technological process. [7]

Technological innovation is an innovation related to the development and development of new or improved technological processes. [6] Note. Innovation in the field of organization and management of production, social or information technologies does not belong to technological innovation.

Technological equipment — means of technological equipment that complement technological equipment for performing a certain part of the technological process. [7]

Technological preparation of production is a set of measures that ensure the technological readiness of production. [7]

A technology park is a subject of innovation infrastructure that creates conditions favorable for the development of entrepreneurship in the scientific and technical sphere in the presence of an equipped information and experimental base and a high concentration of qualified personnel. [6]

A technological policy is a subject of innovation infrastructure that ensures the most dense integration of science with production. [6]

Note. The components of a technological policy, as a rule, are the presence of two or three most advanced industries, a powerful group of public or private universities, research institutes, as well as a residential area with a well-developed network of roads, schools, shopping and cultural centers, and a neighborhood with a fairly developed city.

Technological process is a part of the production process that contains purposeful actions to change and (or) determine the state of the object of labor. [7]

Technological equipment — means of technological equipment in which materials or blanks, means of influencing them, as well as technological equipment are placed to perform a certain part of the technological process. [7]

A typical product is a product belonging to a group of products of a similar design that has the largest number of structural and technological features of this group. [7]

A typical representative of a number of products is a sample selected by the developer from a standard—sized series of products, which accumulates the main properties of these products to the greatest extent, the parts and assembly units of which are used for other representatives of this series of products. [7]

Standard tests (Ndp. verification tests) are control tests of manufactured products carried out in order to assess the effectiveness and expediency of changes made to the design, formulation or technological process. [7]

Standard product samples are product samples selected from the nomenclature of the same type of products, manufactured according to the same type of schematic diagrams and a typical technological process, of the same design and corresponding to the same established safety requirements. [10]

Standard size; type — a set of several parameters of one product included in the standard size range. [7]

A trademark is a designation registered in accordance with the established procedure, placed on goods, packaging or in documentation related to the sale of goods, and serving to distinguish homogeneous goods from different manufacturers. [7]

Consumer goods are products intended for sale to the public for the purpose of direct use to meet material and cultural needs. [7]

Transportation of products — the movement of products in a given state with the use, if necessary, of transport and lifting equipment, starting with loading and ending with unloading at the destination. [7]

A requirement is a need or expectation that is established, usually assumed, or is expected. [8]

Y

Customer satisfaction is consumers' perception of the degree of fulfillment of their requirements. [8]

Quality improvement is a part of quality management aimed at increasing the ability to meet quality requirements. [8] A unified product is a product used in the design documentation of several products. [7]

Quality management is a part of quality management aimed at meeting quality requirements. [8]

Operating conditions — a set of factors acting on the product during its operation. [7]

Established production is the production of products according to the final design and technological documentation. [7] Installation repair series — a batch of products repaired according to the technological documentation of serial repair

during the development of specialized repair production in accordance with the established requirements for the repaired product. [7] The installation series is the first industrial batch produced during the development of production according to the documentation of serial or mass production in order to confirm the readiness of production to produce products with established requirements and in specified volumes. [7]

Outdated products are products whose quality indicators do not meet modern requirements and are uncompetitive in the market. [7] Document approval is an official certificate of an authorized official or body that the developed document is being put into effect. [7]

Disposal — the use of products that are not suitable for use for their intended purpose and are not subject to restoration, for other needs. [7] Note. Disposal: one of the means of environmental protection, resource conservation and maintenance of the raw material base, implemented at almost all stages of the product life cycle: during development — disposal of used layouts, models, components, consumables, etc.; during production — disposal of production waste, defective products and components that have spent the life of equipment, tooling, tools, etc.; during operation — disposal of decommissioned defective products, repair or restoration of which is impossible or economically impractical, their components, aggregates, assemblies, disposable products, spent operational materials, etc. Examples of disposal can be disassembly (dismantling) of the product and separation of its components into homogeneous groups, its translation into a textbook, use for other purposes, etc. Incineration, burial or other methods of destruction of products are not disposal.

F Form of conformity assessment — the established procedure for documenting the conformity of the object of conformity assessment to the requirements of technical regulatory legal acts in the field of technical standardization and standardization. [9]

Fundamental scientific research is theoretical and (or) experimental research aimed at obtaining new knowledge about the basic laws of the development of nature, man, society, artificially created objects. [3] Note. Fundamental scientific research can be oriented, that is, aimed at solving scientific problems related to practical applications.

H

Storage of products — the content of products in the place of its placement in accordance with the established rules providing for ensuring its preservation before use for its intended purpose for a specified period. [7]

Artistic product design is an integral part of product design aimed at working out the compositional and aesthetic characteristics of the product in mutual connection with its functional purpose. [7]

E

Economic innovation is an innovation related to improvement in the financial, payment, accounting spheres of activity. [6] Experiment is a system of operations, impacts and (or) observations aimed at obtaining information about an object during research tests. [7]

An experimental sample is a product sample that has the main features of the product being planned for development, manufactured in the process of conducting research work (R&D) in order to verify the proposed solutions and clarify individual characteristics for use in the development of these products. [7]

An expert quality auditor is a specialist in a certain field who is qualified to carry out conformity assessment work, certified in accordance with the established procedure. [9]

Examination of technical documentation is a study of compliance of technical documentation with the established requirements with an assessment of the technical and artistic solutions embedded in it. [7]

Expert opinion — a document containing the results of the examination. [7]

Operational documents — documents intended for use in the operation, maintenance and repair of products during operation. [7]

Operational tests — tests of an object carried out during operation. [7]

Operation is the stage of the product life cycle at which its quality is realized, maintained and restored. [7]

Export bulletin is a bulletin on the basis of which products supplied for export are modified or operational or repair documentation for these products is changed. [7]

A preliminary design is a type of design documentation for a product containing basic design solutions that give a general idea of the design and principle of operation of the product, as well as data determining its compliance with the purpose. [7]

Efficiency is the ratio between the achieved result and the resources used. [8]