Choosing the direction of scientific research

A scientific direction is a field of research by a scientific team dedicated to solving major fundamental theoretical and experimental problems in a particular branch of science. Structural units of the direction are complex problems, themes and questions.

The problem is a complex scientific problem. It covers a significant area of research and should be of long-term value. The problem consists of a number of topics

A topic is a scientific task covering a certain area of scientific research. It is based on numerous research questions, which are understood as smaller scientific problems. When developing a topic or question, a specific task is put forward in the study: to develop a design, new material, technology, etc. The solution of the problem sets a more general task, for example, to solve a complex of scientific problems, to make a discovery

The choice of a problem statement or a topic is a very complex and responsible task and includes a number of stages:

- formulation of the problem;
- development of the structure of the problem (highlight topics, sub-topics and questions);
- establishing the relevance of the problem, i.e. its value for science and technology.

The purpose of scientific research is a reliable and comprehensive study of an object, process or phenomenon, their structure, connections and relationships on the basis of scientific principles and methods of cognition developed in science, as well as obtaining and introducing into production results useful for humans.

The object of scientific research is a material ideal natural or artificial system. The subject of scientific research is the structure of the system, the patterns of interaction both inside and outside it, the patterns of development, qualities, its various properties, etc.

The completion of the cycle of activity (project) is determined by three phases:

1) the design phase, the result of which is a built model or a scientific hypothesis as a model of the new scientific knowledge system being created and a plan for its implementation;

2) the technological phase, the result of which is the implementation of the system, i.e. hypothesis testing;

3) a reflexive phase, the result of which is the assessment of the constructed system of new scientific knowledge and the determination of the need for either its further correction or the “launch” of a new project, i.e. building a new hypothesis and its further testing

SCIENTIFIC RESEARCH

Basic scientific research	Applied Research	Developments
search engines	Research	Development

Fundamental scientific research is aimed at discovering and studying new phenomena and laws of nature, creating new principles and research methods in order to expand the scientific knowledge of society and establish their practical suitability.

Applied scientific research is aimed at finding ways to use the laws of nature, creating new and improving existing means and methods of human activity. They are based on the knowledge gained during fundamental research.

When conducting exploratory research, factors influencing the object are established, ways to create new equipment and technologies are found. As a result of research work, new technologies, pilot plants, devices, and models of equipment are being created. When performing development work, the selection of design characteristics is carried out, which make up the logical basis of the created machine, device, structure.

The development is aimed at creating new and improving existing equipment, materials, structures and technologies. Its ultimate goal is to prepare the results of applied research for implementation.

Scientific research according to the degree of importance for the national economy is divided into:

- for the most important work performed under special resolutions of state bodies;

– for work carried out according to the plans of sectoral ministries and departments;

– for work carried out on the initiative and plans of research organizations.

Depending on the sources of funding, scientific works are also subdivided:

- on the state budget, financed from the state budget;

– for economic contracts financed by customer organizations on the basis of economic contracts;

- for unfunded, performed under cooperation agreements and on personal initiative.

A complex problem is a set of several problems united by one goal:

- a problem is a set of complex theoretical and practical problems, the solution of which is relevant for society;

- the topic of scientific research is an integral part of the problem related to a certain range of scientific issues;

- scientific question - these are small scientific tasks related to a specific topic of scientific research.

Statement of scientific and technical problem. Stages of research work

The choice of a problem, direction, topic of scientific research and the formulation of scientific questions is a very important task. As a rule, the most relevant areas of scientific research are formulated in state directive documents and in documents of sectoral ministries and departments. Starting to formulate a scientific and technical problem in any particular field of knowledge or branch of the national economy, it is necessary to conduct a deep analysis of the tasks determined by the needs of society and social demands. The main economic problems are presented in the form of various targeted and comprehensive programs of national or regional significance.

First, when defining the problem and the topic of scientific research, on the basis of the contradictions of the research direction, the problem itself is formulated, and the expected results are defined in general terms, and then its structure is developed, questions are identified, their relevance is established, and the main performers are determined.

At the planning stage, due to insufficient awareness of scientists, false or imaginary problems are sometimes chosen. This leads to a waste of money and labor of scientists.

To analyze the scientific and technical information in the area of knowledge under consideration, it is necessary to conduct a brief literature review on this issue.

The process of performing research work includes six stages.

1. Formulation of the topic. At this stage, a general acquaintance with the scientific topic or problem on which the work is to be done and a preliminary acquaintance with the literature are assumed, after which the research topic is formulated. Then a plan is drawn up, terms of reference are developed and the expected economic effect is determined.

2. Formulation of the purpose and objectives of the research. This stage includes the selection of literature and the compilation of bibliographic lists, the conduct of patent research on the topic of research, the annotation of sources and the analysis of the processed information. In conclusion, the aim and task of the study is stated.

3. Theoretical research. When performing this stage, it is supposed to study the physical essence of the phenomenon, form hypotheses, select and justify a physical model. Then the mathematization and analysis of the model and the obtained solutions is carried out.

4. Experimental studies. After the development of the goal and objectives of the experimental study, the experiment is planned, methods for its implementation and the choice of measuring instruments are developed. Experimental studies are completed by conducting a series of experiments and processing the results.

5. Analysis and design of scientific research. At this stage, the experimental results are compared with theoretical data and the discrepancies are analyzed. Then theoretical models are refined and additional experiments are carried out, on the basis of which it becomes possible to turn hypotheses into a theory. Scientific work at this stage ends with the formulation of scientific conclusions and the preparation of a scientific and technical report.

6. Implementation of research results into production, determination of the economic effect. Each theoretical study requires a lot of mental work, so there may be failures. The experimental part is the most time-consuming and material-intensive, especially when there is a need for repeated studies.

The process of performing research work differs from the stages of research work. The stages of research work involve:

1) formulation of the topic, purpose, objectives of the study;

2) studying the literature, conducting research (if necessary) and preparing for technical design;

3) technical design with the development of various options;

4) development and feasibility study of the project;

5) detailed design;

6) production of a prototype and its production testing;

7) finalization of the prototype;

8) state tests

Relevance and scientific novelty of the study

The relevance in the scientific aspect is justified by the following factors:

- the tasks of fundamental research require the development of this topic to explain new facts;

- it is possible and urgently needed in modern conditions to clarify the development and resolve the problem of scientific research;

- the theoretical provisions of scientific research allow eliminating existing disagreements in understanding a process or phenomenon;

– the hypotheses and regularities put forward in the scientific work allow us to generalize the empirical data known earlier and obtained by the applicant.

In the applied aspect, the relevance is determined by the following factors:

- the tasks of applied research require the development of questions on this topic;

– there is a need to solve the problems of scientific research for the needs of society and production;

- scientific work on this topic significantly improves the quality of the developments of creative research teams in a particular field of knowledge;

- new knowledge obtained as a result of scientific research contributes to the improvement of staff qualifications or can be included in the curricula of student education.

To identify elements of scientific novelty, the following conditions must be present:

- a thorough study of the literature on the subject of research with an analysis of its historical development. A very common mistake of researchers is that what is already known, but not in their field of vision, is presented as new;

– consideration of all existing points of view. Critical analysis and comparison of them in the light of the objectives of scientific research often leads to new or compromise solutions;

- involvement in scientific circulation of new factual and digital material, for example, as a result of a successful experiment, and this is already an application for originality;

- detailing an already known process or phenomenon.

New scientific results can be obtained in the following cases:

1) when a completely new, previously unexplored subject area is being investigated;

2) when new technologies, means or methods of cognition have already been applied to the studied subject area. Examples are: the application of a new research approach in any subject area; application of any theory from another field of scientific knowledge; the use of mathematical apparatus that has not previously been used in research; the use of new devices, etc.;

3) when a new subject area is simultaneously explored using the latest technologies.

4) the variant is impossible in principle, since it is impossible to obtain new results or make large generalizations by considering an already well-studied subject area and using well-known technologies.

Proposing a working hypothesis

There are three ways to know the truth.

The first - it is often called strict. This method is based on solving equations, which are a mathematical model of the process or phenomenon under study, when comparing the results obtained with practice (or experiment) and certain conditions.

The second is trial and error.

The third way of knowing is based on the statement of some assumption or working hypothesis. This method is based on induction, prior experience and intuition of the researcher. The hypothesis is used as an intermediate link and is refined and verified during the research process. If it is confirmed, a logical or mathematical scientific theory is built. The third method is one of the most common

When formulating a working hypothesis, it is necessary to carefully study domestic and foreign literary sources, as well as production reports on similar studies.

All the information received should be analyzed in order to find out what has already been achieved and developed, what gaps, ambiguities and contradictions still remain.

Then, in the accepted working hypothesis, it is necessary to highlight the decisive and important cause-and-effect relationships and interactions, outline the expected directions and course of development of the object under study. A working hypothesis should be logically simple and experimentally verifiable in all details.

Depending on the direction and topic of the research work, the working hypothesis can be stated verbally, supplemented by graphic images of the alleged functional relationships.

The mathematical model of the working hypothesis should be quite simple and allow the possibility of changing the structure of the formulas, the nature of the parameters (variables) included in it, and the boundary conditions in accordance with the results of the experiment. Sometimes it is useful to supplement the mathematical model with tables, graphs and diagrams with explanations.