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PORTFOLIO METHOD OF SCIENTIFIC ACTIVITY MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS

The **subject** matter of the article is models and methods of portfolio management of research projects of higher education institutions. The **goal** of the work is to create methods of portfolio management of scientific activities of institutions of higher education on the example of the Odessa National Maritime University. The following **tasks** were solved in the article: analysis of the innovation model of state development, the formation of a model for managing the scientific activities of higher education institutions, the development of a method for forming a portfolio of research projects of a higher education institution using the example of Odessa National Maritime University. The following **methods** used are – project and program management methods, systems theory and systems analysis, mathematical modeling methods. The following **results** were obtained – developed mechanisms for scientific projects management of higher educational institutions, developed a method for forming a portfolio of scientific projects of a higher education institution that takes into account the strategic goals of the university and available resources. **Conclusions**: using the portfolio management method of research projects of a higher education institution allowed the university to increase the effectiveness of scientific activities, form an effective portfolio of research projects, based on determining the organization's planned trajectory length when implementing strategic research goals, allowed the university to achieve its strategic goal as part of an innovative program mission. Based on the proposals received for each research project, the specific length of the trajectory was determined as the ratio of the length of the trajectory to be held by the institution of higher education (Odessa National Maritime University) in case of successful implementation of a certain scientific project to the planned trajectory length. On the basis of the proposed system of management of scientific activities of higher education institutions, which has a four-level structure, temporary standards for the implementation of research projects in the portfolio of higher education institutions are distributed. Comparative assessments of research projects of Odessa National Maritime University have been obtained, allowing to include in the portfolio scientific projects "SP3", "SP2", "SP1", which contribute to the achievement of the strategic goal of the university as part of the mission of the innovation program.

Keywords: project management; portfolio management; research project; higher education institution.

Introduction

The following types of innovative models of economic development are determined in Ukraine [1]:

1) resource model without high-tech production (natural resources - production - money);

2) innovative model (transformation of money to the research into knowledge - transformation of knowledge into the skills of workers and innovation – the transformation of innovation into goods - money);

3) intellectual-donor model (abridged version of the innovation model, from which the stage of production is withdrawn).

According to the practical experience of world countries with different levels and efficiency of economic development, the second model of economic reproduction is the most effective [1]. However, in Ukraine today, the first and third models dominate: resource without high-tech production and intellectual-donor [1].

The mentioned models in the strategic perspective have a relatively low level of efficiency, as they lead to the depletion of the country's resources, the leak of factors of production of the national economy abroad and make it impossible to ensure high indicators of the welfare of the population.

A national strategy focused on the formation of an innovative development model should combine:

- direct actions of the national and regional levels, implemented for direct budgetary financing, which will contribute to the improvement of the qualitative characteristics of the domestic scientific and technological potential, the intensification of the mastery of scientific knowledge and new technologies, the comprehensive development of human capital and science in higher education institutions;

- implementation by national economy subjects of innovative activity and innovation investment in a competitive environment, increasing the supply of innovative products, technologies and knowledge;

- growth of demand of the subjects of the national economy and citizens for innovative products, technologies, knowledge, creation of favorable conditions for introduction of innovations into production activity and population of the population.

Analysis of recent research and publications

In order to increase the efficiency of innovation activities, Ukraine should use the experience of modernizing the scientific and technical sphere in the leading countries of Europe and the United States, which achieved the significant results of the implementation of an innovative model of country's development.

The program to approve the plan for reforming the system of financing and management of scientific and technical activities [2] does not take into account the actual situation in Ukrainian science and the role of higher education institutions, that takes the main position among scientific organizations and determine the ways of development of fundamental and applied science, and carry out the basic amount of basic research in Ukraine. In spite of this, the program does not foresee the development of the university sector of science.

Stimulating the development of innovation activities cannot be limited to the single stimulation of only one type of research or development at the expense of budget financing (direct financing or taxation).

Attempts to implement sectoral "technological leaps"

in the face of maintaining the general unfavorable business and investment climate in the country, excessive fiscal pressure and the ineffectiveness of the institutional structure of the economy turn into losses from other sectors of the economy [3]. High-tech industries do not find sales in other industries due to the high technological gap and the lack of motivation for use, which significantly reduces the synergistic effect of innovation, so the effectiveness of such "growth points" is offset on a public scale [3].

State stimulation of innovation through, for example, preferential taxation of scientific activity and innovation, which is torn away from the introduction of effective incentives for investment activity, leads to the squandering of public funds and the gap between science and domestic production.

Therefore, the main task of innovation policy should be the balanced provision of interaction of the scientific, business and public spheres, as well as the development and implementation of a mechanism for activating innovation activities of higher education institutions, state and business entities with a view to disseminating innovations in all spheres of the national economy.

The methodological principles of project management of the activities of organizations, in particular, management of scientific activities are presented in the works of famous scientists. Studies conducted in [4–6] by Prof. Bushuyev S.D., refer to the development of methods and models of project management in the creation of high-tech enterprises that take an active part in the innovative development of the state.

Methods and models of proactive management of organizational development projects in conditions of uncertainty were developed by Prof. Bushuyeva N.C. in works [7].

In the work of Prof. Chernov S.K. [8] the methodological principles of the formation of organizational structures of knowledge-intensive enterprises as one of the participants of the innovation program are presented.

In the works of prof. Chumachenko I.V. the process of formation of the holistic value of innovative projects and programs is described [9] and the adaptive team of the project is formed [10].

The models, methods and mechanisms for the creation and operation of a project-managed organization are developed in the works [11–14]. New methodology of innovative development of design-managed organizations is developed in [15-17]. The concept of project, portfolio, and program management as the basis for the effective development of the information society is given in [18]. The results of the study, conducted in [19], became a compositional-modular approach to the formation of models of project portfolio management while performing investment and innovation activities. With regard to the problem of the external environment of the innovation system and the regulation of intellectual property issues, [20] proposed mechanisms for managing the external environment of the project, which allows monitoring of the activities of stakeholders in obtaining an innovative product. Mechanisms for the formation of value in the activities of project-managed organizations are presented in [21]. The methodological bases of application of information technologies in project management are presented in works [22–23]. Conceptual bases of quality management in project management and management of innovative projects and programs are presented in [24–27].

The purpose of this article is to create a method of portfolio management of the scientific activity of higher education institutions on the example of Odessa National Maritime University

Presentation of the main material

The strategy for creating an economic model of innovation development in Ukraine includes a set of measures in the tax, budget, monetary, institutional and foreign economic sectors.

It is important to pay special attention to institutions of higher education, in which the largest number of scientists are engaged in innovation activity.

The analysis of the amount of financing of scientific activities in the academic sector, the sector of higher education, the indusrial sector, and the factory sector shows that in 2018 the largest amount of funds - 2352.98 million UAH. 71.9% of the total financing of scientific activity, 79.1% - 2017) is directed to the academic sector of science [28].

If we consider the quantitative indicators of the results of scientific activity, then the greatest number of innovative products in 2017 was created by higher education institutions [28].

However, if we analyze the dynamics of changes in the cost of conducting research by the Ministry of Education and Science of Ukraine and the National Academy of Sciences of Ukraine, one can safely assert that ineffective distribution of financial resources between institutions engaged in scientific activity [28].

The largest number of scientists (approximately 150 thousand scientific and pedagogical workers) in Ukraine work in institutions of higher education. Each year they realize more than 20,000 scientific projects [28].

Most of the results of scientific research are not introduced into production but remain in the form of final reports on the shelves of libraries. First and foremost, this is due to the lack of financial resources both in higher education institutions and in the state. As analytical studies show, the publication activity of scientists, which increases every year, does not affect the level of implementation of the results of scientific activity conducted in institutions of higher education.

Scientists spend a lot of time and money on the preparation of monographs, the publication of articles in collections that are included in international science and technology databases, but there are no real results of the use of newest products and technologies developed in production.

Patent activity of scientists also does not have a significant impact on the level of implementation of the

results of scientific activity. The realities of the present show that obtaining a patent by a scientist does not guarantee its real use in the production of innovative products through the purchase of a security document by business entities. The main reason for this situation is that most experts consider the lack of an effective, scientifically sound management system for innovation activity.

Having analyzed the directions of state policy in the field of scientific activity, one can confidently state that financing is carried out in a not entirely understandable scheme. That is, the Ukraine does not finance the process of scientific activity but sends money to support the state of the scientific institutes, transferring funds for heating, other utilities, housing maintenance, etc., which negatively affects the scientific process. The funds are not for researchers but spent on financing various types of structures. The low level of wages in the scientific sphere leads to the outflow of qualified specialists from Ukraine.

Over the past decade, Ukrainian science has undergone significant changes. Once one of the leading countries in the world with numerous schools, traditions, material and technical bases, Ukraine has become a state in which all attempts to increase the efficiency of innovation activity are in decline.

However, a simple increase in funding will not bring tangible results. Historically, the system of financing science in Ukraine is constructed so that the state finances utility research institutes and pays meagre wages to employees.

As noted above, the Cambridge Technopark and the Silicon Valley Technopolis are examples of business incubators that have proven themselves to be effective innovation organizations. Foreign countries are dynamically developing innovation activities based on the triple helix model. Unfortunately, in Ukraine, unfortunately, in addition to the slogans that it is necessary to create and implement innovations in all spheres of society, in practice attempts to transition to an innovative way of development end with failure. All known world-wide approaches to innovation management in Ukraine are not implemented.

Modern international tendencies testify the importance of developing a new methodology for sustainable project-oriented management of organizations based on the "Magic Triangle", which is harmonized with social, economic, and environmental aspects as factors of the project environment.

The urgency of the study is due to the current unfavorable innovation climate in the state, which was formed in the context of the lack of effective state regulation of the innovation sphere, the rapid decline of Ukrainian science, its actual separation from entrepreneurship.

In such a situation, there is an urgent need to develop new theoretical and methodological approaches and mechanisms based on the best practices of developed countries that would allow to increase the effectiveness of the interaction of participants in innovation activities, namely institutions of higher education, which occupy the largest share in the field of scientific activity in the state.

It is necessary to change the concept of management of the organizational and financial component of innovation activity, namely to move to the application of modern methodologies for managing the scientific activity of higher education institutions in Ukraine, taking into account the leading international experience.

The system of criteria for assessing the effectiveness of scientific activity will be considered as a multi-purpose system based on the union of three subsystems, each of which is aimed at solving a specific task of assessing the quality of the results of scientific projects of higher education institutions. Each subsystem serves as a generalized factor of the University's academic performance in relation to the main areas of activity of higher education institutions: educational and pedagogical subsystem (assessment of the impact of the results of completed scientific projects on education, the degree of implementation of scientific results in the educational process of institutions of higher education, the quality of training of scientific and pedagogical staff); scientific and business subsystem (assessment of scientific results and the degree of their introduction into production, the level of commercialization of the results of scientific projects) and the qualification subsystem (assessment of the level of professional development of academic institutions of higher education in the implementation of scientific projects).

If the main characteristic of fundamental research is their relevance, theoretical novelty, conceptuality, evidence, promising and the possibility of implementation of the results in practice, then when considering applied research their practical relevance and significance, the possibility of implementation in practice, the effectiveness of the results should be the first and foremost.

Economic efficiency is characterized by cost-effective indicators of economy derived from the use of the results of scientific projects of institutions of higher education and their comparison with the costs of implementation of projects.

The scientific and technical efficiency of scientific projects of institutions of higher education characterizes the growth of new scientific knowledge intended for the further development of science and technology.

Social efficiency manifests itself in raising the quality of living standards of people.

The abovenamed types of efficiency of scientific projects of institutions of higher education are interrelated, and also fully correspond to the united mission of innovative programs.

In assessing the effectiveness of scientific projects carried out in higher education institutions, all the complex of works related to scientific activity is taken into account: conducting researches, preparing doctors and candidates of sciences, inventive and patent-licensing work, research work of students, level commercialization of the results of scientific activity.

The scientific potential of institutions of higher education plays an essential role both in the direct execution of scientific projects and in the achievement of the final results. The level of the scientific potential of institutions of higher education largely depends not only

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on the existing structure of scientific and pedagogical staff, scientific information and material and technical provision but also on the effective management of scientific activity.

The problem of evaluating the effectiveness of scientific activity has two aspects since the institution of higher education can be regarded as a training center. Hence, two types of scientific work efficiency: economic - from the implementation of the results of completed studies; cognitive – from writing monographs and scientific articles, reading new courses of lectures, based on scientific achievements in scientific work, holding conferences, seminars, wide involvement of students in scientific research.

The specificity of carrying out scientific research in higher education institutions is manifested not only in the fact that it requires specially trained personnel, special for one or another branch of science equipment, a special item of expenses, but also how the results will be used and what effect will yield the final results. developed scientific projects.

Determination of the economic efficiency of the executed scientific projects in the conditions of innovative activity of business structures involves the study of the effectiveness of the introduction of innovative products through the acquisition of patents for higher technology patents for new technological processes, improvement of the management system, etc.

Consequently, the economic effectiveness of scientific projects of institutions of higher education, depending on the industry and the problem under consideration, is primarily determined at the stage of the feasibility study of the topic, is determined by the final result of the work performed and compared with the results of the practical implementation. Thus, in a scientific project, along with the choice and justification of the research topic, the implementation of the project as an important stage is the commercialization of scientific results and their introduction into the practice of one or another system.

Eight expert working groups were created to analyze the results of scientific research in the ONMU in seven priority areas for the development of science, technology and technology (table 1) and from fundamental research. Each group consisted of five to six people. For all groups, the same procedure for an expert survey was defined.

Table 1. *Priority directions of scientific activity*

No.	Title of the direction
1	System analysis and decision making theory
2	Actual problems of economy and management
3	Information systems and technologies
4	Management of projects and programs of innovative development
5	Management of the operation and development of production transport and logistics systems
6	Designing a seaport safety management system
7	Theoretical basis of risk assessment during the construction and operation of hydraulic structures

Each expert, based on personal data, received a qualifying category h and four categories were defined: $h \in \{I; II; III; IV\}$. The personal data of each expert is $(g, b, v) \in G \times B \times V$, where G, B, V – set of alternative statements, with: $G = \{g_1; g_2; g_3\}$ defines higher and post-University education of the expert; $B = \{b_1; b_2; b_3\}$ defines the scientific training of the expert; $V = \{v_1; v_2; v_3\}$ determines the experience of the expert in this priority direction.

The meaning of the variables included in the set G, B, V, is defined as follows.

Higher and post-University education: g_1 – coincides with the profile of the priority direction; g_2 – basic education in a related speciality; g_3 – basic education in another speciality.

Scientific training: b_1 – Academician, Corresponding Member of the National Academy of Sciences of Ukraine, Transport Academy of Sciences of Ukraine; b_2 – Professor, Doctor of Sciences; b_3 – Ph.D., Associate Professor.

Work experience by profile: v_1 – not less than ten years; v_2 – not less than five years; v_3 – not less than one year.

Decision rule $h: G \times B \times V \to \{I; II; III; IV\}$, which defines the qualification category of the expert, is given by the function:

$$h = \begin{cases} I, & if \ \ v_1 \bar{g}_3 b_1 \vee v_2 b_1 g_1 \vee v_1 b_2 g_1, \\ II, & if \ \ v_3 b_1 g_1 \vee v_2 b_2 g_1 \vee v_1 b_3 g_1 \vee v_2 b_1 g_2 \vee v_1 b_2 g_2 \vee v_1 b_1 g_3, \\ III, & if \ \ v_3 \bar{b}_1 g_1 \vee v_2 b_3 g_1 \vee v_3 b_1 g_2 \vee v_2 b_2 g_2 \vee v_2 b_1 g_3 \vee v_1 b_2 g_3, \\ IV, & if \ \ v_3 \bar{b}_1 \bar{g}_1 \vee \bar{v}_3 \bar{b}_1 g_3 \vee v_3 b_1 g_3 \vee v_2 b_2 g_3. \end{cases} \quad (1)$$

At the same time, the experts, classified in the category IV, do not take part in the expert examination.

The examination procedure is based on the Delphi method, which provides for a number of activities that ensure the productive work of the expert commission and the consistency of expert evaluation. The survey procedure is conducted anonymously in several stages. The expert appoints assessments based on his own experience gained during the work on this topic and on the basis of objective data on the state of scientific activity of institutions of higher education in the priority direction. In addition, the expert in the process of work adjusts his estimates, in agreement with the opinion and arguments of other experts.

The examination is conducted in three stages. At the first stage, experts are informed of the purpose of the examination, distributed questionnaires, provided basic

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and auxiliary information. The purpose of the examination is to place the quality assessments submitted for consideration of the scientific project and to assess the contribution of the scientific project to the innovation program.

The information received from the expert comes to the disposal of the analytical group that organizes the survey and also handles the interim and final results of the examination. The analytical group, based on the data obtained, determines the highest and lowest ratings, the average opinion of the experts - the median, the spread of expert assessments and fixes arguments and special opinions. The analysts receive from the experts the following assessments: an assessment of the quality of each scientific project and the assessment of the contribution of the scientific project to the innovation program.

At the second and third stage, the experts return the average expert opinion and arguments of the experts who gave the highest and lowest marks. Rationale and estimates are made anonymously. When conducting an examination by the university's research team, which plans to implement a scientific project, provides experts with information indicating the expected results of research in the framework of the implementation of the scientific project.

Also, the research team of the university provides experts with a description of the authors' list for each of the scientific projects, indicating quantitative indicators.

In addition, the scientific level of research results should be documented: publications in domestic and foreign publications, information on patents, grants. Information about the possibility of introducing research results should be documented with the design of a letter supporting the scientific project from the side of business structures.

On the basis of the higher education information provided by the research teams, independent qualified experts from the members of the Scientific and Technical Council submit expert assessments.

The following expert examination mechanism is proposed to assess the quality of the submitted scientific project.

Each scientific project is described $q \in (x; y; z; d; c; a)$, where $X = \{x_1; x_2; x_3\}$ – a set of alternative assessments of the scientific level of the expected results of a scientific project; $Y = \{y_1; y_2; y_3\}$ – a set of alternative estimates of the expected depth of scientific development; $Z = \{z_1; z_2; z_3\}$ – a set of alternative estimates of the probability of success of a scientific project; $D = \{d_1; d_2; d_3\}$ – a set of alternative assessments of the prospect of using the results of a scientific project; $C = \{c_1; c_2; c_3\}$ – a set of alternative assessments of the magnitude of research; $A = \{a_1; a_2; a_3\}$ – a set of alternative assessments of the completion of the expected results of a scientific project.

The substantive entity of the tuple $(x; y; z; d; c; a)$ consists of the following statements.

The novelty of the results of the scientific project: x_1 – fundamentally new results, a new theory, the discovery of a new regularity; x_2 – some general laws, methods, methods, allowing to create fundamentally new products; x_3 – a positive solution based on simple generalizations, analysis of the relationships of factors, the dissemination of known principles to new objects.

The depth of scientific development: y_1 – the implementation of complex theoretical calculations, verification of a large amount of experimental data; y_2 – low complexity of calculations, verification on a small amount of experimental data; y_3 – theoretical calculations are simple, the experiment is not planned to be carried out.

Degree of probability of success of a scientific project: z_1 – high; z_2 – middle; z_3 – low.

Perspectives of using the results of a scientific project: d_1 – results can be applied in many scientific areas; d_2 – the results will be used in the development of new technical solutions; d_3 – the results will be used in further scientific projects.

Scale of realization of results of a scientific project: c_1 – national economy; c_2 – a separate branch; c_3 – separate business structures.

Completion of the results of the scientific project: a_1 – technical task for research and development; a_2 – recommendations, detailed analysis, suggestions; a_3 – review, information.

Decision rule q, reflecting the set $X \times Y \times Z \times D \times C \times A$ indicators describing the expected effectiveness of the scientific project, on the set of integral indicators U, is constructed as follows. Every tuple $(x; y; z; d; c; a)$ unequivocally corresponds to the element u of the set $U = \{1, \ldots, 216\}$. Scales $x; y; z; d; c; a$ such as alternatives – objects that have received expert estimates are well-ordered:

$$(x_1; y_1; z_1; d_1; c_1; a_1) \succ (x_1; y_1; z_1; d_1; c_1; a_2) \succ \ldots \succ$$
$$\succ \ldots \succ (x_1; y_2; z_3; d_4; c_5; a_6) \succ (x_1; y_3; z_4; d_5; c_6; a_1) \succ \ldots \succ \quad (2)$$
$$\succ \ldots \succ (x_6; y_6; z_6; d_6; c_6; a_6).$$

Then the monotonous decisive rule $q \in (x; y; z; d; c; a) \rightarrow u$ sets the element $(x; y; z; d; c; a)$ of the ordered set $X \times Y \times Z \times D \times C \times A$ to each element u of the ordered set U.

Research results

The higher management of the institution of higher education on the example of the Odessa National Maritime University has identified the following strategic objectives in the field of scientific research (table 2).

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Table 2. *Strategic goals of Odessa National Maritime University in carrying out scientific activity*

Expected results	W	KB
Publication of the article in the journals included in the Web of Science; Scopus	5	0,15
Publication of an article in professional editions of Ukraine, in foreign journals, the publication of English language abstracts at international conferences included in the Web of Science; Scopus	6	0,1
Publication of the monograph and (or) sections of the monograph	4	0,1
Publication of a monograph and (or) sections of a monograph in foreign publications in the official languages of the European Union	3	0,15
Implementation of scientific results through the conclusion of economic contracts, sale of licenses, grant agreements outside the organization-executor	2	0,2
The defence of the dissertation of the doctor of philosophy	1	0,1
The defence of the dissertation of the doctor of sciences	1	0,2

The planned length of the trajectory of the organization is:

$$L = \sqrt{\sum_{i=1}^{7}(W_i \cdot K_B^i)} = 1,7 \,. \qquad (3)$$

Six scientific projects have been received by the Scientific and Technical Council of the Odessa National Maritime University.

Scientific project managers pointed out the information given in the table 3 and table 4.

Table 3. *Indicators of the expected results of the implementation of the scientific project*

Expected results	SP1	SP2	SP3	SP4	SP5	SP6
Publication of the article in the journals included in the Web of Science; Scopus, w_1	1	3	5	4	2	6
Publication of an article in professional editions of Ukraine, in foreign journals, a publication of English language abstracts at international conferences included in the Web of Science; Scopus w_2	6	3	5	2	4	1
Publication of the monograph and (or) sections of the monograph, p.p, w_3	2	1	4	1	3	1
Publication of a monograph and (or) sections of a monograph in foreign publications in the official languages of the European Union, p.p, w_4	1	2	3	1	1	0
Introduction of scientific results through the conclusion of economic contracts, sale of licenses, grant agreements outside the organization, w_5	0	1	2	0	0	0
The defence of the dissertation of the doctor of philosophy, w_6	1	1	1	0	0	0
The defence of the dissertation of the doctor of sciences, w_7	0	0	1	0	1	0

Table 4. *Proceedings of the authors of scientific projects*

Proceedings of the authors of scientific projects	SP1	SP2	SP3	SP4	SP5	SP6
Articles in magazines included in the Web of Science; Scopus, w_8	4	2	7	4	2	3
Articles in Ukrainian professional journals, in foreign journals, English language theses of reports at international conferences, included in the Web of Science; Scopus, w_9	6	5	15	9	12	7
Monograph and (or) sections of the monograph, p.p., w_{10}	2	3	4	1	2	5
Monograph and (or) sections of the monograph in foreign publications in the official languages of the European Union, p.p., w_{11}	3	4	2	1	4	2
The received patents, certificates of copyright, w_{12}	3	4	4	1	2	0
Protected theses of the doctor of philosophy by performers, w_{13}	3	5	4	4	0	1
Protected dissertations by the doctor of sciences performers, w_{14}	1	1	2	1	3	1
Individual grants (scholarships), scholarly internships in Ukraine and abroad funded by the State Budget of Ukraine and/or foreign organizations (total number of months for the head and 5 project implementers), months, w_{15}	2	3	6	2	6	0
Performers worked on grants funded by foreign organizations (number of grants), w_{16}	1	0	2	1	1	0
h-index of the project manager at Sorsus, w_{17}	0	0	2	0	0	1
Total h-index in Scopus of 5 project executors (except project manager), w_{18}	1	0	3	2	0	1

For the formation of a portfolio, scientific projects "1" – "6" were sent for examination. The number of experts from among the members of the Scientific and Technical Council of the Odessa National Maritime University made $m = 12$. The qualification category of experts is shown in the table 5.

Table 5. *The qualification category of experts*

Expert	Education, G	Scientific training, B	Work experience, V	Qualification category
E1	Basic education by another speciality	Academician of the Transport Academy of Sciences of Ukraine	25	I
E2	Basic education coincides with the profile of the priority direction	Academician of the Transport Academy of Sciences of Ukraine	8	I
E3	Basic education in a related speciality	Academician of the Transport Academy of Sciences of Ukraine	6	II
E4	Coincides with the profile of the priority direction	Doctor of Technical Sciences, Professor	12	I
E5	Basic education in a related speciality	Doctor of Technical Sciences, Professor	7	III
E6	Basic education by another speciality	Academician of the Transport Academy of Sciences of Ukraine	17	II
E7	Coincides with the profile of the priority direction	Doctor of Technical Sciences, Professor	15	I
E8	Basic education by another speciality	Corresponding Member of the Transport Academy of Sciences of Ukraine	12	II
E9	Basic education coincides with the profile of the priority direction	Candidate of Technical Sciences, Associate Professor	15	II
E10	Basic education by another speciality	Candidate of Technical Sciences, Associate Professor	18	III
E11	Coincides with the profile of the priority direction	Doctor of Technical Sciences, Professor	18	I
E12	Basic education coincides with the profile of the priority direction	Candidate of Technical Sciences, Associate Professor	11	II

Each expert evaluated the submitted scientific projects in accordance with the established criteria.

The results of the evaluation of scientific projects are given in table 6.

Table 6. *Evaluation of scientific projects*

	w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9	w_{10}	w_{11}	w_{12}	w_{13}	w_{14}	w_{15}	w_{16}	w_{17}	w_1	Σ
SP1	1	2	1	2	0	2	0	8	4	1	6	5	6	13	4	4	0	1	60
SP2	3	1	1	4	2	2	0	4	2	1	8	5	6	13	4	0	0	1	57
SP3	5	1	2	4	2	2	3	10	6	3	4	5	6	13	6	6	2	1	81
SP4	3	1	1	2	0	0	0	8	6	1	2	2	6	13	4	4	0	1	54
SP5	1	1	1	2	0	0	3	4	6	1	8	2	0	13	6	4	0	1	53
SP6	5	1	1	0	0	0	0	6	4	3	4	0	6	13	0	0	2	1	46

Taking into account the determination of the weighting coefficient of the i-th indicator of the expected results and developments of the authors of scientific projects, based on the processing of the information presented in fig. 1, the length of the trajectory of the organization L is determined with the successful implementation of scientific projects.

	A	w₁	w₂	w₃	w₄	w₅	w₆	w₇	w₈	w₉	w₁₀	w₁₁	w₁₂	w₁₃	w₁₄	w₁₅	w₁₆	w₁₇	w₁₈	T	U
1		w₁	w₂	w₃	w₄	w₅	w₆	w₇	w₈	w₉	w₁₀	w₁₁	w₁₂	w₁₃	w₁₄	w₁₅	w₁₆	w₁₇	w₁₈		
2	SP1	1	6	2	1	0	1	0	4	6	2	3	3	3	1	2	1	0	1		
3	SP2	3	3	1	2	1	1	0	2	5	3	4	4	5	1	3	0	0	0		
4	SP3	5	5	4	3	2	1	1	7	15	4	2	4	4	2	6	2	2	3		
5	SP4	4	2	1	1	0	0	0	4	9	1	1	1	4	1	2	1	0	2		
6	SP5	2	4	3	1	0	0	1	2	12	2	4	2	0	3	6	1	0	0		
7	SP6	6	1	1	0	0	0	0	3	7	5	2	0	1	1	0	0	1	1		
8																					
9		w₁	w₂	w₃	w₄	w₅	w₆	w₇	w₈	w₉	w₁₀	w₁₁	w₁₂	w₁₃	w₁₄	w₁₅	w₁₆	w₁₇	w₁₈	Total	L
10	Kв	0,05	0,03	0,01	0,03	0,03	0,10	0,20	0,05	0,03	0,03	0,05	0,10	0,04	0,07	0,04	0,04	0,05	0,05		
11	SP1	0,05	0,18	0,02	0,03	0,00	0,10	0,00	0,20	0,18	0,06	0,15	0,30	0,12	0,07	0,08	0,04	0,00	0,05	1,63	1,28
12	SP2	0,15	0,09	0,01	0,06	0,03	0,10	0,00	0,10	0,15	0,09	0,20	0,40	0,20	0,07	0,12	0,00	0,00	0,00	1,77	1,33
13	SP3	0,25	0,15	0,04	0,09	0,06	0,10	0,20	0,35	0,45	0,12	0,10	0,40	0,16	0,14	0,24	0,08	0,10	0,15	3,18	1,78
14	SP4	0,20	0,06	0,01	0,03	0,00	0,00	0,00	0,20	0,27	0,03	0,05	0,10	0,16	0,07	0,08	0,04	0,00	0,10	1,40	1,18
15	SP5	0,10	0,12	0,03	0,03	0,00	0,00	0,20	0,10	0,36	0,06	0,20	0,20	0,00	0,21	0,24	0,04	0,00	0,00	1,89	1,37
16	SP6	0,30	0,03	0,01	0,00	0,00	0,00	0,00	0,15	0,21	0,15	0,10	0,00	0,04	0,07	0,00	0,00	0,05	0,05	1,16	1,08

Fig.1. Trajectory length with successful implementation of scientific projects

On the basis of the received information on scientific projects for each of them the specific length of the trajectory is calculated:

$$\overline{L}_1 = \frac{1,28}{1,7} = 0,75;. \quad \overline{L}_2 = \frac{1,33}{1,7} = 0,78;. \quad \overline{L}_3 = \frac{1,78}{1,7} = 1,05;$$

$$\overline{L}_4 = \frac{1,18}{1,7} = 0,69;. \quad \overline{L}_5 = \frac{1,37}{1,7} = 0,8;. \quad \overline{L}_6 = \frac{1,0}{1,7} = 0,63.$$

For each scientific project, experts determine the value of the priority factor of the j-th project K_{Pr} and the ratio of achievable goals of the j-th project K_D (table 7).

Table 7. *Priority and achievability ratio of the objectives of the scientific project*

	K_{Pr}	K_D
SP1	0,9	0,7
SP2	0,8	0,9
SP3	0,9	0,9
SP4	0,3	0,4
SP5	0,2	0,4
SP6	0,4	0,3

At the next stage, the final rating of each of the scientific projects is determined:

$$Raiting\ SP1 = 0,75 \cdot 0,9 \cdot 0,7 = 0,47;$$

$$Raiting\ SP2 = 0,78 \cdot 0,8 \cdot 0,9 = 0,56;$$

$$Raiting\ SP3 = 1,05 \cdot 0,9 \cdot 0,9 = 0,85;$$

$$Raiting\ SP4 = 0,69 \cdot 0,3 \cdot 0,4 = 0,08;$$

$$Raiting\ SP5 = 0,8 \cdot 0,2 \cdot 0,4 = 0,06;$$

$$Raiting\ SP6 = 0,63 \cdot 0,4 \cdot 0,3 = 0,08.$$

As the calculations show, the portfolio of scientific projects includes projects SP3, SP2, SP1.

The head of the scientific project submits to the scientific and technical council the scientific load of the executives of the scientific project (table 8). At the same time, the condition for not exceeding the load of scientific and pedagogical workers, who plan to execute the relevant scientific project, approved by the leadership of the ONMU value (no more than 500 hours per academic year), is checked.

Table 8. *Load of executors of scientific projects, hours/academic year*

Scientific supervisor of SP3 project	150	Scientific supervisor of SP2 project	200	Scientific supervisor of SP1 project	250
Executor of SP3	350	Executor of SP2	480	Executor of SP1	270
Executor of SP3	270	Executor of SP2	350	Executor of SP1	320
Executor of SP3	450	Executor of SP2	240	Executor of SP1	220
Executor of SP3	460	Executor of SP2	420	Executor of SP1	150
Executor of SP3	420				

As the table 8 shows the scientific load of the executors of scientific projects meets the established requirements.

At the same time, the total time load corresponds to the time standard allocated by the management of the ONMU for the implementation of a portfolio of scientific projects (5000 hours per academic year).

Conclusions

In carrying out experimental calculations, objective and reliable information about the submitted scientific projects, scientific publications of the executors of scientific projects, as well as expert assessments, presented by groups of experts who are members of the Scientific and Technical Council of the institution of higher education.

Based on the received proposals, for each scientific project, the specific length of the trajectory was calculated as the ratio of the length of the trajectory to be held by the institution of higher education (Odesa National Maritime University) in the case of successful implementation of the defined scientific project to the planned trajectory length.

The comparative estimations of scientific projects of the Odessa National Marine University have been obtained, which allow to include in the portfolio scientific projects "SP3", "SP2", "SP1" allowing to achieve the strategic goal of the university within the framework of the mission of the innovation program.

The proposed conceptual model of management of scientific activity of institutions of higher education allows to determine the planned length of the trajectory of the organization when implementing strategic goals in the field of scientific research. On the basis of the proposed system for managing the scientific activity of higher education institutions, which has a four-tier structure, the distribution of time standards for the implementation of scientific projects in the portfolio of higher education institutions is carried out.

The proposed models and methods of management of innovative activity of higher education institutions were used in the management of the scientific work of the Odessa National Maritime University. Implementation of the portfolio method of management of scientific activity allow to achieve the strategic goal of the University within the framework of the implementation of the mission of the innovation program.

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ПОРТФЕЛЬНИЙ МЕТОД УПРАВЛІННЯ НАУКОВОЮ ДІЯЛЬНІСТЮ ЗАКЛАДІВ ВИЩОЇ ОСВІТИ

Предметом дослідження в статті є моделі і методи управління портфелями наукових проектів закладів вищої освіти. **Мета** роботи – створення методів портфельного управління науковою діяльністю закладів вищої освіти на прикладі Одеського національного морського університету. В статті вирішуються наступні **завдання**: аналіз інноваційної моделі розвитку держави, формування моделі управління науковою діяльністю закладів вищої освіти, розробка методу формування портфелю наукових проектів закладу вищої освіти на прикладі Одеського національного морського університету. Використовуються такі **методи**: методи управління проектами і програмами, теорія систем і системного аналізу, методи математичного моделювання. Отримано наступні **результати**: розроблено механізми управління науковими проектами закладів вищої освіти, розроблено метод формування портфелю наукових проектів закладу вищої освіти, який враховує стратегічні цілі університету та ресурси, що він має в наявності. **Висновки**: Застосування портфельного методу управління науковими проектами закладу вищої освіти дозволило підвищити ефективність наукової діяльності університету, дало змогу сформувати ефективний портфель наукових проектів, на основі визначення запланованої довжини траєкторії організації при реалізації стратегічних цілей в області наукових досліджень, дозволило досягти стратегічної мети університету в рамках реалізації місії інноваційної програми. На підставі отриманих пропозицій для кожного наукового проекту був обчислена питома довжина траєкторії, як відношення довжини траєкторії, що пройде заклад вищої освіти (Одеський національний морський університет) у випадку успішної реалізації визначеного наукового проекту до запланованої довжини траєкторії. На основі запропонованої системи управління науковою діяльністю закладів вищої освіти, яка має чотирьохрівневу структуру, здійснюється розподіл часових нормативів на реалізацію наукових проектів в портфелі проектів закладів вищої освіти. Отримано порівняльні оцінки наукових проектів Одеського національного морського університету, що дозволяють включити в портфель наукові проекти "НП3", "НП2", "НП1", які дають змогу досягти стратегічної мети університету в рамках реалізації місії інноваційної програми.

Ключові слова: управління проектами; портфельне управління; науковий проект; заклад вищої освіти.

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ПОРТФЕЛЬНЫЙ МЕТОД УПРАВЛЕНИЯ НАУЧНОЙ ДЕЯТЕЛЬНОСТЬЮ ЗАВЕДЕНИЙ ВЫСШЕГО ОБРАЗОВАНИЯ

Предметом исследования в статье являются модели и методы управления портфелями научных проектов высших учебных заведений. Цель **работы** – создание методов портфельного управления научной деятельностью учреждений высшего образования на примере Одесского национального морского университета. В статье решаются следующие **задачи**: анализ инновационной модели развития государства, формирование модели управления научной деятельностью учреждений высшего образования, разработка метода формирования портфеля научных проектов учреждения высшего образования на примере Одесского национального морского университета. Используются следующие **методы**: методы управления проектами и программами, теория систем и системного анализа, методы математического моделирования. Получены следующие **результаты**: разработаны механизмы управления научными проектами высших учебных заведений, разработан метод формирования портфеля научных проектов учреждения высшего образования, который учитывает стратегические цели университета и ресурсы, которые он имеет в наличии. **Выводы**: Применение портфельного метода управления научными проектами учреждения высшего образования позволило повысить эффективность научной деятельности университета, сформировать эффективный портфель научных проектов, на основе определения запланированной длины траектории организации при реализации стратегических целей в области научных исследований, позволило достичь стратегической цели университета в рамках реализации миссии инновационной программы. На основании полученных предложений для каждого научного проекта была определена удельная длина траектории, как отношение длины траектории, которую пройдет учреждение высшего образования (Одесский национальный морской университет) в случае успешной реализации определенного научного проекта к запланированной длине траектории. На основе предложенной системы управления научной деятельностью учреждений высшего образования, которая имеет четырехуровневую структуру, осуществляется распределение временных нормативов на реализацию научных проектов в портфеле проектов высших учебных заведений. Получены сравнительные оценки научных проектов Одесского национального морского университета, позволяющие включить в портфель научные проекты "НП3", "НП2", "НП1", которые способствуют достижению стратегической цели университета в рамках реализации миссии инновационной программы.

Ключевые слова: управление проектами; портфельное управления; научный проект; учреждение высшего образования.