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CONCEPTUAL MODEL OF SCIENTIFIC ACTIVITY MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS

The **subject** of study in the article is methods, models and mechanisms of management of scientific activity of higher education institutions. The **purpose** of the work is to develop a conceptual model for managing the academic activity of higher education institutions based on the concept of triple helix interaction, P2M standard and risk management methodology. The following **tasks** are solved in the article: analysis of the model of the triple helix interaction of higher education institutions, business structures and the state in the implementation of innovation activities, research of the feasibility of applying the P2M standard for the management of scientific activity of institutions of higher education, development of a conceptual model of management of scientific activity in institutions of higher education taking into account the risk management system. The following **methods** are used: project and program management methods, systems theory and systems analysis, risk management methods. The following **results** were obtained: a conceptual model of management of scientific activity of higher education institutions was developed, which allows, on the basis of risk-oriented methodology, to take into account the interests of all stakeholder groups of the University-State-Business (U – S – B) triple system. **Conclusions**: The use of the conceptual model of scientific management of higher education institutions will allow taking into account the interests of all stakeholder groups in accordance with the P2M standard by integrating various projects and processes of their activities into a common innovation program. International experience demonstrates the effectiveness of translating the results of higher education research projects into practice, with the combined efforts of universities, business entities and government institutions. The presented participants form the triple coil system "University-Business-State", which we will call the system "U – S – B". This system integrates the processes of scientific activity, production and various forms of state regulation that interact. The U – S – B model has obvious advantages - science senses production needs, the state takes incentive measures, business structures adapt to the needs of the population in new goods, services or technologies. This paradigm assumes that new knowledge and technologies resulting from the scientific activity of higher education institutions are channeled into the sphere of business and public institutions.

Keywords: research project; higher education institution; innovation program management.

Introduction

In Ukraine, innovation has not yet become a proper means of enhancing the state's competitiveness. Therefore, the task of transition to an innovative model of development is very relevant given the current external and internal trends in the development of scientific and technological sphere. The primary task of forming an effective model of innovative development in Ukraine should be to focus not only on the possibility of mechanically restoring the necessary levels of state funding for the scientific and technical sphere. In the current situation, the practical impossibility of full financial support of innovative activity in the current state of public finances can be traced. Only establishing adequate chains of interconnection of science, technology and production adequate to the modern market economy overcomes the problem of unpromising investment in the renewal of the scientific sphere. The level of support for innovation and technology transfer is reflected in the state, which is reflected in the general level of scientific and technological security, and the destruction of the financial foundations of the functioning of the scientific sector is increasingly increasing the technological dependence of the national economy.

International practice has proven the feasibility of using the triple helix model (fig. 1), which unites the efforts of universities, business structures and government bodies in implementing innovative projects [1].

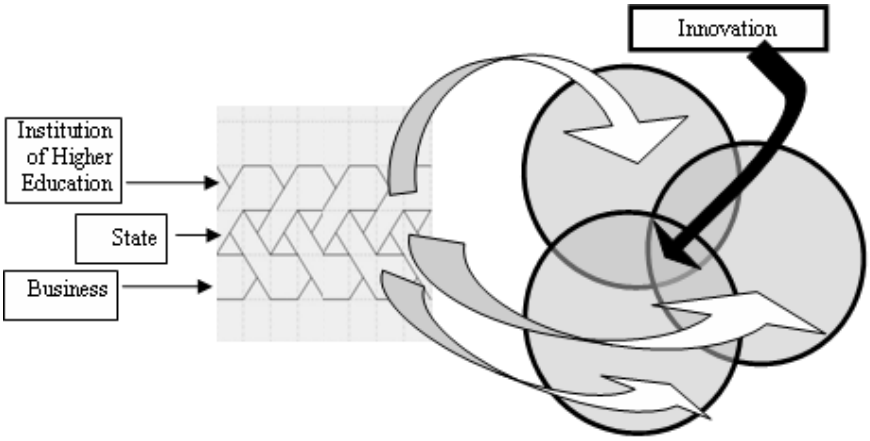

Fig. 1. Triple helix model of innovation management

This paradigm assumes that knowledge and technology arise from the actions of higher education

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institutions, business structures, and the state, which partially overlap [1]. It also implies that knowledge and technology are then transferred to an economy that is ultimately the main driver of innovation.

Analysis of recent research and publications

The experience of developing indicators of scientific activity of universities in real socio-economic conditions is studied in [2, 3].

The development of methods of evaluation, measurement, analysis of the development of the scientific and technical level of the industry, as well as models of project portfolio management under uncertainty are presented in [4, 5]. The system of enterprise standards for knowledge management in a project-managed organization is given in [6]. Innovative projects for forming the information infrastructure of the university's educational space are proposed in [7].

The study of mechanisms for managing high-tech programs and projects is given in [8]. The mathematical foundations of project management and portfolio management of high-tech industries are given in [9]. Models and mechanisms of management of educational networks and complexes, as well as planning mechanisms in the management of scientific projects are presented in [10, 11]. Development of model of organizational structure of university by means of project management system is carried out in [12]. The research conducted in [13] is devoted to the development of methodological bases of innovative project-oriented management of organizations.

The connection between the innovative component and the business opportunities is studied in [14]. In [15] mechanisms for financing the innovative development of the firm are developed. The mechanisms for managing organizational projects are described in [16]. Investigation of innovative thinking results in the formation of new project management methodologies takes place in the development of organizational systems management models presented in [17].

Regarding the problem of external environment of the innovation system and regulation of intellectual property issues, the papers [18, 19] propose mechanisms for managing the external environment of the project, which allows controlling the activities of interested persons in obtaining an innovative product. The creative technologies in program management proposed in [20] allow increasing the efficiency of program-oriented management of innovation activity. The systematic approach to project and program management, presented in [21], allows a comprehensive approach to solving the issues of effective implementation of innovative activities of the organization based on the interests of each of its participants.

The **purpose** of this article is to develop a conceptual model for managing the academic activity of higher education institutions based on the concept of triple helix interaction, P2M standard and risk management methodology.

Presentation of the main material

Higher education institutions are the most flexible of all known institutions in terms of knowledge generation and dissemination. It is the organizational structure and nature of universities that constantly supports the movement of human resources - new students come to them with their ideas, which, when they graduate, begin to work in the various fields of activity with which they share their knowledge. Acting as an equal institutional partner with business and the state, universities are one of the elements in the triple helix model and occupy a leading position in a knowledge-based society.

In this model, institutions of higher education, in the presence of the traditional role, fulfill new functions - in addition to educational activities, scientific research in the framework of cooperation with the state and business creates new knowledge. In the context of social and economic development, the new mission of universities is very often focused on the development of a specific resource in the region or of a particular invention - an innovative product resulting from the research activities of higher education institutions.

At the same time, the triple helix can be seen as an interaction between the institutional spheres: institutions of higher education, business structures and the state, as well as hybridization of the space of knowledge, the space of consensus and the space of innovation, that is, the model of the triple helix does not simply direct the necessary cooperation between institutions of the three activity, it is a model of space [1]. The basic principle of the triple helix model is to consider the institution of higher education as a key object of innovation. In the triple helix model, unlike the administrative-command model, the state has less control over business structures and universities. This allows initiatives to emerge from participants in these institutional spheres. At the same time, the state is beginning to play a more active role in promoting innovation than is happening in the market model. Thus, from different starting points there is a movement towards a more balanced hybrid model.

A key element of locally oriented international innovation policy is "smart specialization".

"Smart specialization" strategies, which are often designed to stimulate economic development and enhance the innovative competitiveness of regions, include a social dimension to deliver a more lasting impact. The use of the concept of helix in the context of the Smart Specialization Platform (RIS3) extends the popular triple helix paradigm, pointing to the fact that, alongside science, industry and the state, a key role in the innovation process is played by society, which is often the end user of innovation and therefore significantly influences innovation and creation of knowledge and technologies - through the demand and realization of the user function. Such a model is well suited to developing "smart specialization" strategies, despite the fact that such an approach requires more effort. Realizing the potential of this initiative and demonstrating its benefits implies an appropriate revision of innovation policies. In addition, there is a growing need for

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quantitative assessment techniques for "smart specialization".

The European Union formulated its view of the European social market economy in a Europe 2020 strategy aimed at addressing structural problems through progress in three interconnected priority areas (fig. 2) [22]: "smart" knowledge-based economic growth and innovation; sustainable economic growth based on a more resource-efficient, green and competitive economy; inclusive economic growth through increased employment and economic, social and territorial integration. Increasing investment in innovation and entrepreneurship is at the heart of the Europe 2020 strategy and a crucial means of responding to the economic crisis [22]. The EU consists of different countries and regions, each with a specific ecosystem of science and innovation, with a unique economic context and industrial infrastructure. Organizations strive to function as open systems operating under conditions of high turbulence, high risk, and trying to balance stability and consistency, on the one hand, and flexibility and readiness for change (to achieve higher levels of efficiency and organizational sustainability), on the other.

The triple helix model provides a stable environment of parallel relationships between national and regional authorities, the broader business community (industry) and science. This approach takes into account the role of each of these groups of innovation participants.

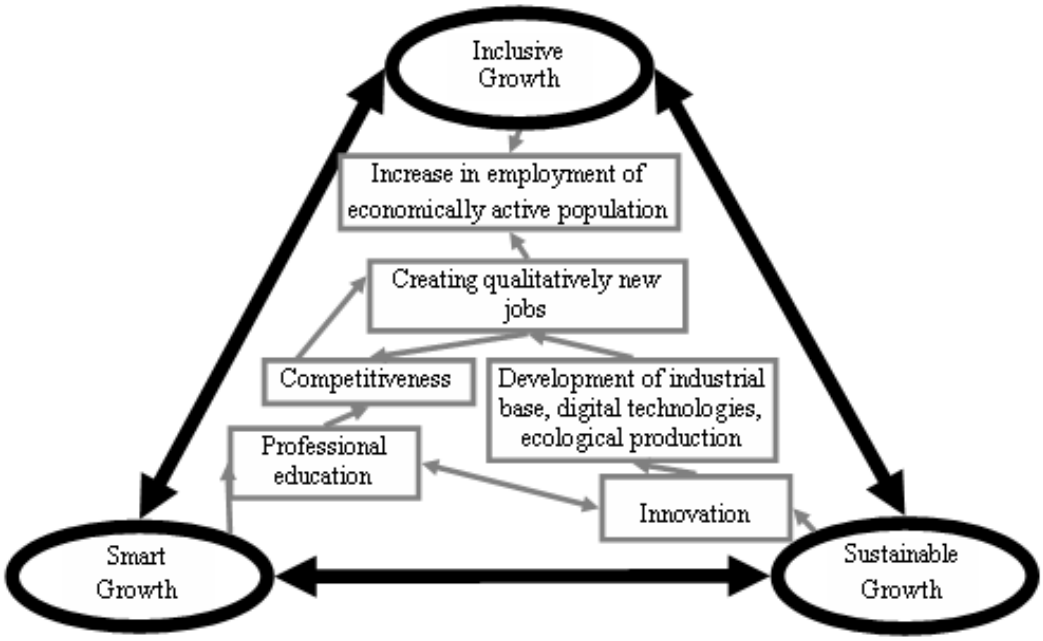

Fig. 2. Model of implementation of the Europe 2020 strategy [22]

The triple helix model integrates the efforts of higher education institutions, business structures and the state as the main drivers of the innovation process, effectively generalizing the experience of interaction between these elements of the innovation system. Their interaction promotes the development of technologies, sets the conditions for creating and implementing innovations. The triple helix model is widely used in the theory and practice of innovative development of knowledge-intensive industries in economically developed and developing countries [1]. Using this advanced knowledge of science, this model gains state and business support for the commercialization of research and development. Within the framework of the triple helix there is a gradual innovative development as a result of the constructive interaction of the scientific-educational complex (higher education institution), business and the state, both at national and regional levels. For the implementation of an innovative model at any level (national, regional) it is necessary on the one hand, the partnership of science, education, government and business, and on the other - a certain level of development of regional institutions [1]. The central core of the triple helix model is the concept of the university's third mission. For a long time, universities were thought to have two missions: education and research. In recent decades, it has become apparent that universities should become active participants in economic and cultural development processes; to develop into organizations closely related to industry and society as a whole.

Results of the study

The partnership scheme of the higher education institution, business and state within the framework of the triple helix model is presented in fig. 3. One of the basic advantages of this approach is that it takes into account the nature of the demand for innovation. The presented participants form the triple coil system "University-Business-State", which we will call the system "U – S – B". This system integrates the processes of scientific activity, production and various forms of state regulation that interact. The U – S – B model has obvious advantages - science senses the needs of production, the state takes incentive measures, business structures adapt to the needs of the population in new goods, services or technologies.

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This paradigm assumes that new knowledge and technologies resulting from the scientific activity of a higher education institution are channeled into the sphere of business and public institutions. The concept of the "triple helix" envisages a phased innovation development as a result of the constructive interaction of the scientific and educational complex, business and government at national and regional levels. The scientific direction is determined by the effective research activities of the universities that implement basic and applied research. The mechanism of interaction between the higher education institution, the state and business in the U – S – B model includes three blocks: research conducted at the higher education institution; business that includes business structures; a state represented by regional and local authorities.

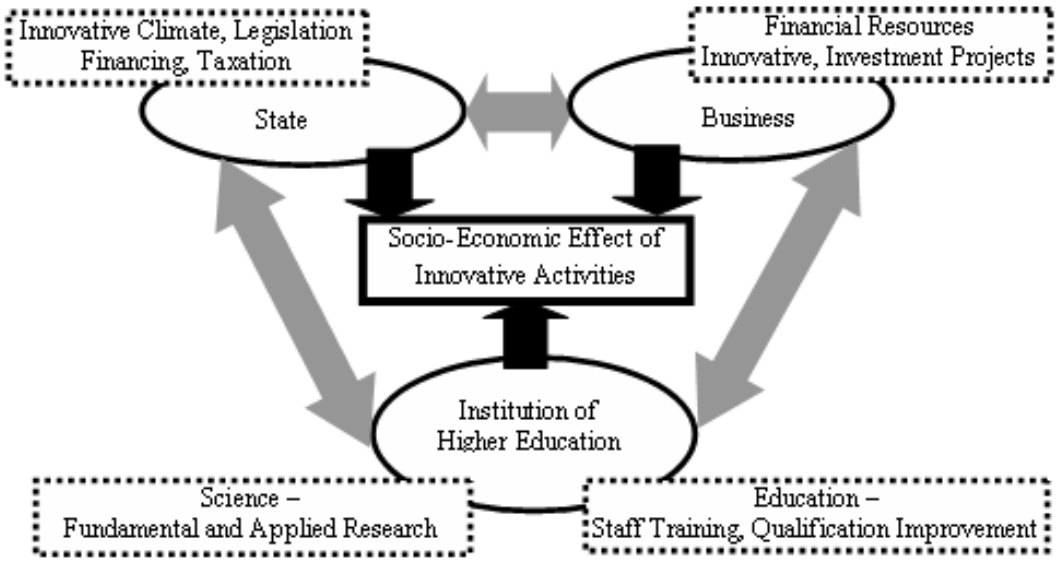

Fig. 3. Model of interaction between university, business and state in the framework of the triple helix

The system of cooperation between higher education institutions, the state and business consists of a set of state organizations, private enterprises and scientific institutions (universities), which work together to pursue effective innovation activities. Each participant of the U – S – B model makes a significant contribution to the implementation of innovative projects and the overall development of the innovative component of the region's economy. The parity contribution of the regional authorities is, first and foremost, in the provision of material and financial resources: land and structures, earmarked budget for innovation. The interaction of the higher education institution with business structures implies the active development and expansion of relations with the business environment in order to more effectively commercialize the results of intellectual and scientific activities and build the business reputation of a reliable business partner. Therefore, the appointment of such university interaction in the triple helix model implies the development of the scientific and technological complex and providing it with the necessary human resources through research, technology transfer to the economy and the formation of a system of business companies around the institution of higher education with the use of appropriate state mechanisms for managing scientific activity. Thus, a third mission of the University emerges, which assumes a significant role in the socio-economic development of the region through effective innovation activity.

The implementation of the University-State-Business model allows obtaining new opportunities for increasing the innovative potential of the state.

In this case, the application of the U – S – B model on the principles of the triple helix allows ensuring stable development of the economy based on innovations. Development of economically justified model of location of production forces and formation of points of growth allows increasing investment attractiveness and business activity in the state and development of human capital by raising educational and qualification level.

Another benefit of the U – S – B interaction model is the increase in employment through job creation, driven by innovation, and the increase in tax revenue from both innovative projects in the short and medium term and by reinvesting profits in the long run.

Thus, the application of the triple helix model "U – S – B" in the implementation of innovative activities allows us to use scientific, educational, industrial and labor potentials, which ensures the intensity and balance of development of the state innovation system. Within the U – S – B model, "higher education institutions are beginning to play an expanded role, putting the commercialization of knowledge as an academic goal.

The fundamental basis of the conceptual model of managing the scientific activity of higher education institutions is the methodology of project, portfolio and program management, according to which the scientific activity of the institution of higher education is realized through the implementation of the portfolio of scientific projects.

Definition 1. Scientific project - a complex of coordinated and managed activities implemented by a higher education institution and aimed at obtaining new

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scientific results, the realization of which is limited by time and available resources [24].

Definition 2. The portfolio of scientific projects - a set of scientific projects and other works that are limited by the available resources of a higher education institution and aimed at effectively achieving its (institution) goals [24].

As a strategic goal of a higher education institution, most experts recommend using the competitiveness of a higher education institution. There are dozens of ratings in the world to determine this figure, however, at present there is no single methodological basis that would allow comprehensive consideration of all aspects of higher education.

In terms of scientific activity, the competitiveness of a higher education institution takes into account the following indicators: the material and technical basis for carrying out scientific research; qualification level of scientific and pedagogical staff; a contingent of teachers; number of scientific schools; the number of monographs prepared; the number of articles published; the number of patents received.

As already mentioned, Ukrainian higher education institutions are not able to put the results of scientific projects into practice. International experience in this endeavor unites the efforts of universities, business structures and government institutions. The complexity of implementing the triple U-S-B model is explained by the different goals of different participants. Thus, the strategic goal of state institutions is to improve the quality of life of the population in the respective territories. The value of the complex indicator of quality of life is calculated on the basis of the analysis of the set of criteria, grouped according to the relevant directions characterizing the quality of life of the population, safety; infrastructure development, population income and the state of the environment. For business structures, economic efficiency indicators (such as profit, profitability, etc.) remain the main ones. It is possible to take into account the interests of all stakeholder groups according to the P2M standard by integrating different projects and processes of their activities into a common innovation program [23].

Definition 3. Innovation program - a set of projects united for the single purpose of obtaining the socio-economic effect of implementing the results of innovative activities (implementation of an innovative product) [24].

Model management of innovative projects and programs is formed on the basis of the mission of the program or project, which assumes the need for application of program management. Program management focuses on integration activities to fully realize the program mission and integrate project ideas, their strategies, architecture, and controls during program implementation.

If we consider the stage of scientific activity of the institution of higher education, then many scientific projects may be presented within the framework of the innovation program implementation.

However, the purpose of the work of a higher education institution that carries out innovative activity is to include in the portfolio exactly those scientific projects that will result in the higher competitiveness of a higher education institution. That is, in this case, the institution of higher education manages a portfolio of scientific projects, which allows, on the basis of setting priorities, to effectively achieve the strategic goals of the organization, taking into account the resource constraints. This situation involves obtaining income from the implementation of a portfolio of research projects, as well as dividends from the patenting of a result already obtained as a result of the pursuit of higher education by a higher education institution, which may be directed to new projects to be implemented by the organization in the future. Therefore, the institution of higher education forms and manages a portfolio of scientific projects. The scientific project is part of the innovation program.

Given the above information, the scientific project of the institution of higher education will be considered as an integral part of the innovation program, as well as the portfolio of scientific projects. The cost of research is certainly one of the necessary components of successful development, but because of the increased risk, most businesses around the world are being cautious about fundamentally new developments, preferring to slightly advance the already existing products and technologies.

The level of risk arising from the development and promotion of new products is directly dependent on the degree of novelty of the innovation: the higher the novelty, the higher the uncertainty of how the product will be perceived by the market [25].

One of the factors of successful existence and further development of an innovatively active enterprise is the ability to manage the risks of innovation, ie the ability to anticipate the financial costs necessary and sufficient to reduce the likelihood of risk situations, and in case of their occurrence, the ability to localize the negative consequences of these events. The enterprise innovation risk management system should be built on a single methodological basis, but it should have a different degree of detail depending on the type of innovation.

Thus, the activation of the innovation activity of domestic enterprises can be ensured only through the development of an effective mechanism for managing innovative risks, which minimizes the potential losses and maximizes profit through the development and implementation of risk-oriented management system in the enterprise, taking into account certain factors. Uncertainty innovation risk factors are all the risks that arise in the course of an innovation activity, which can be divided into two groups.

External factors are related to the state of the environment in which the innovation activity is implemented, and include risks related to the activities of the state, the environment and the environment.

Internal factors related to the internal environment of the scientific organization, institution of higher education, ie due to the peculiarities of the implemented scientific project: personnel risks associated with the staff of the organization, and technical risks associated with the property.

Therefore, the main sources of risk factors for innovation are stakeholders: business structures, higher

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education institutions, the state, the natural environment, suppliers, buyers, competitors, society as a whole, and the staff of the organization.

When designing an innovative risk management system, it should be taken into account that different projects and their different stages have their risks and potential profitability. Therefore, one of the main tasks of innovation activity is mutual connection of interests of all subjects of innovation activity.

Considering the above information, it is possible to propose a conceptual model of scientific project management (fig. 4).

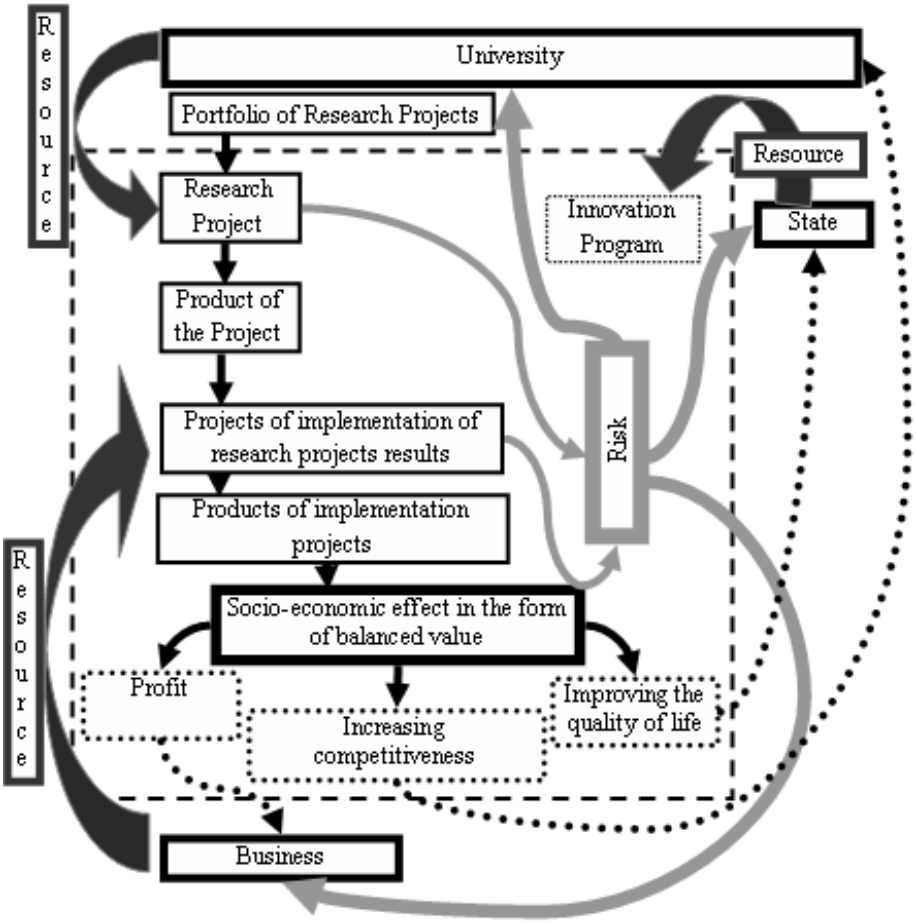

Fig. 4. Conceptual model of scientific project management

The fundamental basis of the conceptual model of managing the scientific activity of a higher education institution, as an integral part of the implementation of innovative activity, is the methodology of project, portfolio and program management, according to which the scientific activity of a higher education institution is implemented through the implementation of a portfolio of scientific projects.

Conclusions

Higher education institution is not able to put the results of scientific projects into practice. International experience in this endeavor unites the efforts of universities, business structures and government institutions. The presented participants form the triple coil system "University-Business-State", which we will call the system "U – S – B". This system integrates the processes of scientific activity, production and various forms of state regulation that interact. The U – S – B model has obvious advantages - science senses the needs of production, the state takes incentive measures, business structures adapt to the needs of the population in new goods, services or technologies. This paradigm assumes that new knowledge and technologies resulting from the scientific activity of a higher education institution are channeled into the sphere of business and public institutions. The complexity of implementing the U – S – B model is explained by the different goals of the different participants. The strategic goal of state institutions is to improve the quality of life of the population in the respective territories. It is recommended to use the competitiveness of the higher education institution as a strategic goal of the higher education institution. For business structures, the most important are the indicators of economic efficiency. It is possible to consider the interests of all stakeholder groups in accordance with the P2M standard by integrating different projects and processes of their activities into a common innovation program. A significant feature of innovation is its considerable uncertainty. The probability of successful implementation of the program should be taken into account when it is initiated and executed. To solve this problem, the concept uses risk management models and

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methods in accordance with ISO 31000. The presence of significant risks forces businesses to be cautious about participating in innovative programs. However, it is only through the introduction of investments that the organization can accelerate the movement to its goal. In the work, using the analysis of the demand-supply function, it is proved that if traditional technologies, materials and equipment are used, the performance indicators will decrease over time, that is, the movement of the organization will be slowed down. The conceptual model of scientific project management proves the necessity of developing methods and models of risk management in scientific projects of institutions of higher education, the model of innovation program architecture in the triple system "University-Business-State" ("U-S-B"), as well as the method of forming the scientific portfolio projects of higher education institution.

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КОНЦЕПТУАЛЬНА МОДЕЛЬ УПРАВЛІННЯ НАУКОВОЮ ДІЯЛЬНІСТЮ ЗАКЛАДІВ ВИЩОЇ ОСВІТИ

Предметом дослідження в статті є методи, моделі і механізми управління науковою діяльністю закладів вищої освіти. **Мета** роботи – розробка концептуальної моделі управління науковою діяльністю закладів вищої освіти на основі концепції потрійної спіральної взаємодії, стандарту P2M та методології управління ризиками. В статті вирішуються наступні **завдання**: аналіз моделі потрійної спіральної взаємодії закладів вищої освіти, бізнесових структур та держави при виконанні інноваційної діяльності, дослідження доцільності застосування стандарту P2M для управління науковою діяльністю закладів вищої освіти, розробка концептуальної моделі управління науковою діяльністю закладів вищої освіти в рамках інноваційних програм з урахуванням системи управління ризиками. Використовуються такі **методи**: методи управління проєктами та програмами, теорія систем і системного аналізу, методи управління ризиками. Отримано наступні **результати**: розроблено концептуальну модель управління науковою діяльністю закладів вищої освіти, яка дозволяє на основі ризико-орієнтованої методології врахувати інтереси всіх груп стейкхолдерів триєдиної системи "Університет–Держава–Бізнес (U–S–B)". **Висновки**: Використання концептуальної моделі управління науковою діяльністю закладів вищої освіти дозволить врахувати інтереси всіх груп стейкхолдерів відповідно до стандарту P2M шляхом об'єднання різних проєктів і процесів їхньої діяльності в загальну інноваційну програму. Міжнародний досвід показує ефективність впровадження результатів науково-дослідних проєктів закладів вищої освіти у практику за умови об'єднання зусиль університетів, бізнесових структур та державних інституцій. Представлені учасники формують триєдину спіральну систему "Університет-Бізнес-Держава", яку будемо називати системою "U–S–B". Дана система об'єднує процеси здійснення наукової діяльності, виробництва і різних форм державного регулювання, які знаходяться у взаємодії між собою. Модель "U–S–B" має очевидні переваги – наука відчуває потреби виробництва, держава здійснює стимулюючі заходи, бізнесові структури пристосовуються до потреб населення в нових товарах, послугах або технологіях. Дана парадигма передбачає, що нові знання і технології, що виникають в результаті наукової діяльності закладів вищої освіти, направляються в сферу бізнесу і державних інституцій.

Ключові слова: науковий проєкт; заклад вищої освіти; управління інноваційною програмою; ризик.

КОНЦЕПТУАЛЬНАЯ МОДЕЛЬ УПРАВЛЕНИЯ НАУЧНОЙ ДЕЯТЕЛЬНОСТЬЮ ЗАВЕДЕНИЙ ВЫСШЕГО ОБРАЗОВАНИЯ

Предметом исследования в статье являются методы, модели и механизмы управления научной деятельностью учреждений высшего образования. **Цель** работы – разработка концептуальной модели управления научной деятельностью учреждений высшего образования на основе концепции тройного спирального взаимодействия, стандарта P2M и методологии управления рисками. В статье решаются следующие **задачи**: анализ модели тройного спирального взаимодействия заведений высшего образования, бизнес-структур и государства при выполнении инновационной деятельности, исследование целесообразности применения стандарта P2M для управления научной деятельностью заведений высшего образования, разработка концептуальной модели управления научной деятельностью заведений высшего образования в рамках инновационных программ с учетом системы управления рисками. Используются следующие **методы**: методы управления проектами и программами, теория систем и системного анализа, методы управления рисками. Получены следующие **результаты**: разработана концептуальная модель управления научной деятельностью заведений высшего образования, которая позволяет на основе риск-ориентированной методологии учесть интересы всех групп стейкхолдеров триединой системы "Университет-Государство-Бизнес (U-S-B)". **Выводы**: Использование концептуальной модели управления научной деятельностью учреждений высшего образования позволит учесть интересы всех групп стейкхолдеров в соответствии со стандартом P2M путем объединения различных проектов и процессов их деятельности в общую инновационную программу. Международный опыт показывает эффективность внедрения результатов научно-исследовательских проектов заведений высшего образования в практику при условии объединения усилий университетов, бизнес-структур и государственных учреждений. Представлены участники формируют триединую спиральную систему "Университет-Бизнес-Государство", которую будем называть системой "U-S-B". Данная система объединяет процессы

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осуществления научной деятельности, производства и различных форм государственного регулирования, которые находятся во взаимодействии между собой. Модель "U-S-B" имеет очевидные преимущества – наука испытывает потребности производства, государство осуществляет стимулирующие меры, бизнес-структуры приспосабливаются к нуждам населения в новых товарах, услугах или технологиях. Данная парадигма предполагает, что новые знания и технологии, которые возникают в результате научной деятельности заведений высшего образования, направляются в сферу бизнеса и государственных институтов.

Ключевые слова: научный проект; заведение высшего образования; управления инновационной программой; риск.

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