ОБРАЗОВАНИЕ И ОБУЧЕНИЕ: МЕТОДОЛОГИЯ, ТЕОРИЯ, ТЕХНОЛОГИЯ

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FORMATION AND DEVELOPMENT OF INNOVATIVE INFRASTRUCTURE OF UNIVERSITIES: SYSTEMIC APPROACH

Abstract

The article discusses the process of formation and development of innovative infrastructure of higher education based on a systemic approach. The author identified the main problems, principles and tasks of the formation and development of innovative infrastructure. The innovative infrastructure of higher education is the complex of all educational, methodological, scientific and research elements that form the functional subsystems. These subsystems are designed to ensure the creation of innovative products, obtaining specific results of innovative activities, as well as guarantee the conditions for sustainable development of the economy and society. The ability to create new knowledge and put it into practice is the primary condition for the effective functioning of a country in the global economy. The formation and development of the innovative infrastructure of higher education involve the inclusion in this process of industrial enterprises, research institutes and universities. The features of the integration of educational, innovative and research processes are explained by the provisions of the theory of the "triple helix", according to which the institutions responsible for the creation of new knowledge dominate in the system of innovative development. Today, innovative infrastructure is formed in almost every university. However, the effectiveness of its use is still insufficient.

Key words: innovative infrastructure, higher education, system approach, functional subsystems, scientific research, new knowledge.

Universities today face many problems that impede the formation and development of innovative infrastructure, do not allow to sufficiently improve innovation and, as a result, increase the competitiveness of infrastructure elements. This entails a slight increase in the prestige and income of the aspects of innovative infrastructure, and the inability to use the innovative potential to the full. Initially, we can single out the main problem of the formation and development of innovative infrastructure of universities. It lies in the fact that the pace and directions of development of domestic researches do not meet the needs of the system of ensuring national economic security and the growing demand from some segments of the business sector for advanced technologies. At the same time, the world-class scientific results proposed by the Kazakhstan sector are not used in the economy. There is the imbalance of the innovation system, as well as general low susceptibility to the innovation of domestic entrepreneurship.

When analyzing the main problem based on factors that impede the formation and development of innovative infrastructure of universities, we highlight the following lower-level issues that determine the need for a systemic approach to the process under study [1].

Economic and technological problems of the formation and development of innovative infrastructure of universities. An element of the innovation infrastructure should be considered not only as a venue for scientific work but as a complex, large enterprise that requires the construction of such a management structure that it is possible to bring its products to the market quickly. It requires constant support for its competitiveness and financial stability.

Financial sustainability for elements of innovation infrastructure of universities can be defined as follows: an aspect of innovation infrastructure is managed on a sufficient financial basis if it reimburses its total economic costs and invests in its innovative activities at a pace that can provide support and development of scientific and educational potentials. These potentials, in turn, are

necessary to implement strategic plans and meet the needs of employees, partners and customers of innovation [2]. This definition assumes that the innovation infrastructure element should take into account the following key factors that can be combined into a single whole only within the framework of the implementation of a systemic approach:

- sustainable development strategy;
- operational stability, when an element of the innovation infrastructure reimburses costs and generates income to cover the costs of its ordinary, current activities;
- investments to maintain existing scientific and educational potentials and their subsequent development;
- management of risks that are inevitable when working in the field of innovation.

At this stage in the development of the innovative infrastructure of universities, the main goal is to align sustainable development strategies with investments that meet current and future needs of science, society and business. In this aspect, one of the critical problems in the formation and development of innovative infrastructure of universities is the lack of funding for infrastructure elements and innovative activities of universities at all levels.

Political and legal problems of the formation and development of innovative infrastructure of universities. Effectively, any type of activity can be carried out in modern society only if some certain norms and rights will regulate this activity. The relevance of regulatory issues of the processes of formation and development of innovative infrastructure is exceptionally high, especially in conditions when universities are trying to rise to a new level, where a certain amount of knowledge, rather than material resources, becomes the main subject of sale.

At the moment, legislative activity is fragmented and is not supported by scientific research in the field of law. The volume of legal research in the field of innovative mechanisms and relations is minimal. Therefore, the ongoing legislative activity is not supported by sound practical recommendations of a legal nature. Most of the proposals in this area develop organizational management models that ensure the implementation of the mechanism of the relationship between scientific departments and business entities. Successes are considerable, but they do not relate to the field of innovation and law, but the field of management.

Therefore, the imperfection of the regulatory framework in the field of innovation and protection of intellectual property, the lack of a real working mechanism for identifying business entities engaged in science and innovation to provide benefits and investment support leads to a slowdown in the formation and development of innovative infrastructure of universities.

Problems of increasing the potential of the innovative infrastructure of universities. According to the Great Soviet Encyclopedia, potential (from lat. potentia – strength), in the broad sense – means, stocks, sources available and able to be mobilized, put into action, used to achieve a specific goal, implement a plan, solve a problem; the possibilities of an individual, society, state in a particular area. There is also an interpretation of the economic potential as the combined ability of sectors of the national economy to produce industrial and agricultural products, carry out capital construction, transport goods, provide services to the population at a particular historical moment [3].

The economic potential is determined by the number of labour resources and the quality of their professional training, the volume of production capacities of industrial and construction organizations, agricultural production capacities, the length of transport routes and the availability of vehicles, the development of non-production sectors, the achievements of science and technology, and resources of proven mineral resources. In other words, the elements that make up the productive forces of society and depends on the size of the country's national wealth. Separately, it is specified that the essential elements of the economic potential are labour resources and the level of professional training [4].

Following these definitions, the potential for the formation and development of innovative infrastructure can be defined as the totality of the capabilities and means of universities that can and should be mobilized to introduce innovations to directly or indirectly meet the needs of society, science and business. At the moment, elements of the innovative infrastructure of universities are experiencing difficulties with the conservation and sale of intellectual property, updating the material and technical base and restoring personnel. Moreover, it is worth noting not only the traditional problem with the training and retention of scientific personnel but also the lack of administrative staff who can manage any organizational unit with the introduction of modern management models that enhance the competitiveness of the innovative infrastructure of universities.

Problems of a socio-psychological and cultural nature in the formation and development of innovative infrastructure of universities. This includes the loss of the potential for the formation and development of elements of innovation infrastructure in connection with the departure of young scientists and university graduates to third-party commercial structures or departure abroad to continue working in foreign scientific organizations. Separately, it is worth noting the resistance to innovation. All this can cause consequences such as a change in status, the need to find a new job, the restructuring of established ways of working, violation of stereotypes of behaviour, established traditions, fear of uncertainty, fear of punishment for failure, resistance to everything new that comes from outside.

The problems described above for the formation and development of innovative infrastructure of universities are formed mainly due to economic and other crises that adversely affect all the mechanisms of development of society, science and business. During such periods, many studies stop due to lack of funding. Universities are experiencing a severe shortage of funds. As a result, the level of innovation in many elements of the innovation infrastructure is declining and does not fully meet the requirements of the market. The prestige of scientific work falls along with the wages of scientists. In recent years, the situation associated with the restoration of the potential of universities and the revitalization of the elements of innovation infrastructure has been improving. Still, the current speed of development is insufficient for modernizing the national economy. It is also necessary to note the fact that to solve the above problems as the essential element of the university's innovative infrastructure in current conditions, the formation and development of small innovative enterprises is necessary.

All this emphasizes the need for the effective implementation of a systemic approach to the formation and development of innovative infrastructure of universities. The systemic approach, in this case, allows us to consider the whole range of activities that are important to overcome the above problems. In particular, it allows to critically examine the existing problems of the development of innovative activities on the elements of innovation infrastructure, with particular attention to financing innovation, preserving and increasing the potential of universities, and analyzing the regulatory support of the activities of innovation infrastructure elements. Also, the implementation of a systemic approach will allow us to develop the most rational models and structures for managing elements of the innovative infrastructure of universities. And based on strategic priority goals and objectives, develop recommendations for the formation of a new innovative model for managing higher education that meets modern requirements for the development of the scientific and educational environment of the Republic of Kazakhstan, contributing to the rapid promoting the results of innovation in foreign markets.

The implementation of a systemic approach to the formation and development of innovative infrastructure of universities should be aimed. First of all, at creating and strengthening competitive positions of infrastructure elements in existing and new markets, ensuring a monopoly and competitive position in the development of educational and high-tech goods and services. Also, the implementation of a systemic approach should help to build up the patent and copyright base, the creation and protection of know-how, as well as the skilful management of the existing intellectual property of elements of innovative infrastructure to increase the profits of universities.

When describing the main components of a systemic approach to the formation and development of innovative infrastructure of universities, it is necessary to pay attention to the fact that the elements of infrastructure interact with educational institutions and with scientific organizations. The construction of such rational interactions has as its primary goal the stimulation of innovations and innovative transformations in the relations between society, science and business.

The main criteria for selecting these components of a systemic approach to the formation and development of innovative infrastructure are:

- need to conduct practical activities to develop new goods and services by universities;
- need to focus infrastructure elements on the formation of a market for new products and services;
- need to maintain human resources for society, science and business.

It should be noted that the main principles of implementing a systemic approach to the formation and development of innovative infrastructure of universities are:

1) ensuring the increase in the added value of educational products and services for potential customers by mastering the results of scientific and technological progress, as well as expanding the share of innovative educational technologies used;

2) the continuous development of the innovative potential of universities and the achievement of the critical mass necessary for the development and implementation of innovations;

3) integrated implementation of innovations, in which technical, economic, social and psychological innovations are closely interconnected and mutually promote each other;

4) mobilization of managerial and teaching staff on innovation;

5) the economic incentive for innovation;

6) consideration of innovative risks.

The primary tasks of implementing a systemic approach to the formation and development of innovative infrastructure of universities should include:

- forecast of the main directions of scientific and technical progress and their impact on the fundamental business processes of universities, the production and organizational structures of the organization of their innovative activities;
- substantiation of priorities and directions of innovative development of universities;
- assessment of the potential of science and technology for the innovative development of universities;
- development of scenarios of the possible consequences of the innovative development of universities;
- selection and justification of the organizational process structure of universities;
- development of priority measures that contribute to increasing the level of infrastructure security of universities;
- selection and justification of the main projects and programs to increase the competitiveness of educational products and services, taking into account their impact on the development of higher professional education and the universities themselves.

It should be noted that the formation of elements of the innovative infrastructure of a new market for innovative products and services by reengineering educational processes, promoting innovations will strengthen the position of universities in their market shares. It will also give new opportunities to win potential customers both in Kazakhstan and abroad, for example, by developing remote innovative consulting or by integrating new modern methods of organizing innovative activities in economic systems into the innovation process. As part of the implementation of a systematic approach to the formation and development of innovative infrastructure of universities, it is necessary to use marketing tools to promote goods and services on the market, monitor and analyze the labour market, interact with industry enterprises, domestic and international companies as consumers of innovation and university graduates. The implementation of a systemic approach will allow universities to more sensitively feel the market conditions and train specialists and develop innovations that are in demand not only at present but also in the future when interacting with elements of innovative infrastructure.

On the other hand, the implementation of a systemic approach will significantly change the strategic priorities of the activities of the elements of the innovative infrastructure of universities, which will be associated with:

- research, development and technological works, which are aimed at creating new or improving existing products, services, technologies, etc.;
- development and introduction of new products or technologies to the market using marketing tools;
- technology transfer;
- protection of intellectual property, keeping secret know-how and other confidential information related to the scientific activities of universities.

Also, when implementing a systematic approach to the formation and development of innovative infrastructure of universities, it is essential to know and understand the necessary levels of development of this infrastructure.

The most ambitious level of development of innovative infrastructure is the global level at which the acquisition and dissemination of new knowledge are carried out through the Internet and fundamental science. At the hyper-level, innovation is carried out by transnational corporations and international associations of universities. Innovation activities carried out by the system of higher professional education within one country or its regions, refers to the macro level. Meso-level involves

innovative activities carried out by several universities at the level of network or corporate structures, mainly within one country. At the micro-level, innovation is carried out by a university that develops or produces educational products and services, as well as provides services to ensure the innovation process (finance, legal support, information). Also, an individual university employee or student may engage in innovative activities. At this nano-level, the main stage is the acquisition of knowledge, as well as investment in high technology through the acquisition of educational products and services necessary to ensure livelihoods and needs [5].

In conclusion, it should be noted that for the successful implementation of a systemic approach to the formation and development of innovative infrastructure of universities, specialized centres for the development of infrastructure elements are required today, which in turn should stimulate the process of creating high-tech products and services.

For such specialized development centres, the following areas are characteristic, which allow increasing the potential of the elements of the innovative infrastructure of universities:

- information support of innovative activities in universities;
- conducting market research, analyzing market conditions, searching for new niches for high-tech marketing products;
- organization of marketing activities of innovative products;
- attraction of such modern economic instruments as lending, leasing, risk insurance, venture financing;
- regional, interregional and international interaction with subjects of innovative activity;
- organization of service support services for new products and technological processes [6].

Thus, the strategic goal of the formation and development of the innovative infrastructure of higher education is to implement a completed innovation cycle that ensures the generation, dissemination and implementation of new knowledge, combined with the continuous professional training of elite specialists with a developed culture of innovative thinking based on the combination of the interests of science and business.

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Аңдатпа

Мақалада жүйелі тәсіл негізінде жоғары білімнің инновациялық инфрақұрылымын қалыптастыру және дамыту үдерісі қарастырылған. Инновациялық инфрақұрылымды қалыптастыру мен дамытудың негізгі проблемалары, принциптері мен міндеттері анықталды. Жоғары білім берудің инновациялық инфрақұрылымы деп функционалдық ішкі жүйелерді құрайтын барлық оқу, әдістемелік, тәрбиелік және ғылыми-зерттеу элементтерінің жиынтығы түсініледі. Бұл кіші жүйелер инновациялық өнімдерді құруды, инновациялық

қызметтің нақты нәтижелерін алуды қамтамасыз етуге, сондай-ақ экономика мен қоғамның тұрақты даму жағдайларына кепілдік беруге арналған. Жаңа білім құру және оларды практикада қолдану қабілеті бүгінде елдің жаһандық экономикада тиімді жұмыс істеуінің негізгі шарты болып табылады. Жоғары білім берудің инновациялық инфрақұрылымын қалыптастыру және дамыту осы процеске өнеркәсіптік кәсіпорындарды, ғылыми-зерттеу институттары мен жоғары оқу орындарын енгізуді көздейді. Білім беру, инновациялық және ғылыми-зерттеу үдерістерін интеграциялау ерекшеліктері «үштік спираль» теориясының ережелерімен түсіндіріледі, оған сәйкес инновациялық даму жүйесінде жаңа білім жасауға жауапты институттар басым жағдайға ие. Бүгінгі күні инновациялық инфрақұрылым әрбір ЖОО-да қалыптасқан. Алайда оны пайдаланудың тиімділігі әзірге жеткіліксіз деңгейде қалып отыр.

Тірек сөздер: инновациялық инфрақұрылым, жоғары білім, жүйелі тәсіл, функционалдық ішкі жүйелер, ғылыми зерттеулер, жаңа білім.

Аннотация

В статье рассмотрен процесс формирования и развития инновационной инфраструктуры высшего образования на основе системного подхода. Выявлены основные проблемы, определены принципы и задачи формирования и развития инновационной инфраструктуры. Под инновационной инфраструктурой высшего образования понимается совокупность всех учебных, методических, воспитательных и научно-исследовательских элементов, которые образуют функциональные подсистемы. Данные подсистемы призваны обеспечить создание инновационных продуктов, получение конкретных результатов инновационной деятельности, а также гарантировать условия устойчивого развития экономики и общества. Способность создавать новые знания и применять их на практике является сегодня основным условием эффективного функционирования страны в глобальной экономике. Формирование и развитие инновационной инфраструктуры высшего образования предполагает включение в данный процесс промышленных предприятий, научно-исследовательских институтов и вузов. Особенности интеграции образовательного, инновационного и научно-исследовательского процессов объясняются положениями теории «тройной спирали», согласно которой в системе инновационного развития доминирующее положение занимают институты, ответственные за создание нового знания. На сегодняшний день инновационная инфраструктура сформирована практически в каждом вузе. Однако эффективность ее использования остается пока на недостаточном уровне.

Ключевые слова: инновационная инфраструктура, высшее образование, системный подход, функциональные подсистемы, научные исследования, новые знания.