



Research Article

© 2025 Diana Sitenko.  
This is an open access article licensed under the Creative Commons  
Attribution-NonCommercial 4.0 International License  
(<https://creativecommons.org/licenses/by-nc/4.0/>)

Received: 21 September 2024 / Accepted: 4 February 2025 / Published: 06 March 2025

## Commercialization of University Developments: Case of Kazakhstan

Diana Sitenko

Karaganda Buketov University,  
Karaganda, Kazakhstan

DOI: <https://doi.org/10.36941/jesr-2025-0051>

### Abstract

The article discusses the main problems and opportunities for commercialization and transfer of university developments to industry in the modern legal field in Kazakhstan. The purpose of the work is to study the commercialization process at the present stage, as well as to identify opportunities for developing university-industry interaction in Kazakhstan. The necessity of interaction between science, business and industry for the commercial implementation of university scientific research is substantiated. Changes in recent years in the organizational and legal framework for commercialization, facilitating the implementation of scientific research results were observed. The mechanisms and results of the main government programs to support the commercialization of scientific developments, including joint ones with foreign development institutions, are considered. The indicators of R&D expenditures and share of innovative products in GDP as well as patent activity of applicants from Kazakhstan was assessed. The dynamics of Kazakhstan's position in the Global Innovation Index by pillars of Innovation inputs and Innovation outputs were determined. Using a SWOT analysis, the strengths and weaknesses of the commercialization process, as well as opportunities and threats, were identified. Based on the research, the article proposes an organizational and financial mechanism for interaction between a university and industrial enterprises with the participation of a venture fund and the redistribution of financial resources from subsoil users to increase the commercialization of university projects. Despite the proposed mechanisms of "university-business" interaction, further research is needed into the factors influencing all participants in the innovation process, as well as the possibilities of universities in the context of obtaining autonomy and organizing their own small innovative enterprises.

**Keywords:** commercialization, scientific developments, universities, innovations, Kazakhstan

### 1. Introduction

The strategy for economic development in the Republic of Kazakhstan is the intensification of the innovation process with the aim of introducing domestic developments into industry. The adopted Concept for the Development of Science of Kazakhstan for 2022 - 2026 pays special attention to ensuring the interaction of science, production and business, emphasizing the importance of university scientific research. The higher education system quickly responds to changes in the economic system and market conditions. Therefore, the basis for innovative development of the economy is the active inclusion of universities in the innovative processes of the region as sources of knowledge and coordinators of interaction between education, business and production.

Universities today are integrating into the region's economy by preparing a qualified workforce and realizing their social role as a source of knowledge and advanced research (Yessengeldin, 2016).

In turn, the university receives orders from the socio-economic environment to train specialists, as well as conduct research in relevant fields of knowledge. This allows all market participants to strengthen their competitive advantages. Strengthening the relationship with the business sector helps to increase funding for scientific research at universities, update the innovation infrastructure, and implement promising developments (Ardito, 2018).

Despite the large number of studies in the field of innovative economics, practical mechanisms for integrating university science into innovation processes have not been sufficiently considered. Within the framework of the changing legal field, universities need to develop their own mechanism for interaction with enterprises in the region, which would allow them to implement the accumulated scientific potential. It is also necessary to create conditions to increase interest in the entrepreneurial activity of university scientists themselves, who can become drivers for the introduction of developments into industrial production (Beck et al, 2022). Thus, the need to identify opportunities for innovative partnerships and improve the mechanism for commercialization of university developments determined the relevance of this work. The aim of the study is a comprehensive analysis of commercialization processes at the present stage, and the formation on its basis of recommendations for the development of university-industry interaction in Kazakhstan.

## 2. Methodology

The theoretical and methodological basis of this research are the works of domestic and foreign researchers in the field of regional innovative development, universities' engagement in innovation processes and commercialization of university R&D. The analytical part of the study is presented by statistical data on the current state of innovation activity in Kazakhstan for 2011-2023, which served as the information base for presenting this material as a result of a study of the technology transfer process in the republic.

The paper analyzes the secondary data of official statistics and development institutions. The data of the following organizations were used: the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (BNS RK), World Intellectual Property Organization (WIPO), National Institute of Intellectual Property (KazPatent), JSC 'Science Fund'. To determine the current state of the commercialization process in the republic's universities, a SWOT analysis was used, which allows us to assess the influence of both external and internal factors. Data on patent activity made it possible to assess the dynamics of the creation of innovative ideas and technologies, as well as to evaluate the effectiveness of the state policy in the field of R&D.

The research is based on the "Triple Helix" concept (Etzkowitz & Leydesdorff, 2000; Leydesdorff & Zawdie, 2010), in which the university is recognized as a key element of the innovative economy. The university transfers accumulated knowledge in the form of technology to industrial production. In this process, the university cooperates with the government and the business sector, and this cooperation determines the effectiveness of the commercialization of the university's technologies.

The problem issues in the process of commercialization of university developments are revealed, the directions of state support for the commercialization of projects are determined, and recommendations for enhancing the participation of universities in the innovation process are given.

## 3. Literature Review

In modern scientific literature, many works by foreign authors and researchers from the CIS countries are devoted to the issues of commercialization of university developments and intellectual property management.

The works by Etzkowitz (2004) and Shane (2004) substantiate the new role of the university in society, the so-called "third mission", when, along with education and scientific research, universities are tasked with entrepreneurial activity. This requires universities to change the structure of scientific research management and technology transfer processes. The university becomes a source of

innovative developments in the knowledge economy and, through technology transfer, contributes to technological progress and improving the welfare of society.

The university transfers accumulated knowledge to the business environment in various ways. Baldini et al (2006) considers the features of various forms of transferring academic knowledge: the creation of new business structures (small innovative firms), business-university interaction, patenting and licensing of inventions. Much attention in foreign studies is paid to the analysis of state policy in the field of commercialization, as well as the most effective strategies for transferring technologies from universities to industry (Goldfarb & Henrekson, 2003; Berggren, 2017). The adoption of legislative acts at the state level contributed to the creation of favorable conditions for greater involvement of scientists and inventors in innovation processes, creating conditions for the growth of small innovative firms (Valentin & Jensen, 2007).

The possibilities of interaction between universities and industry in the field of technology transfer are considered in the works of Balconi & Laboranti (2006). Researchers note the positive effect of interaction, namely the growth of patenting of technologies by universities. Firms, in turn, gain access to new knowledge and research groups that are not available to them in their usual activities.

In Kazakhstan, issues of commercialization of innovations began to be raised since the early 2000s. with the adoption of several strategic programs in the field of innovative development (Yessengeldin et al., 2016). The researchers focused on assessing the necessary innovative infrastructure for commercialization - the creation and operation of commercialization offices, development institutes, technology parks (Gimon, 2017; Alibekova et al., 2019). Universities were considered as sources of innovative ideas and developments, the implementation of which was assigned to industrial enterprises (Isabekov et al., 2022; Dzhonbekova et al., 2020). At the same time, less attention was paid to the development of effective mechanisms for cooperation between the university and the business sector in the implementation of technologies, assessing potential risks and benefits for all parties involved. There are no studies devoted to the systemic presentation of the commercialization process at the regional level with the participation of university scientists. In the context of changing legislation in scientific and technical policy, it is relevant to study the experience of implementing commercialization projects, as well as the development of recommendations for intensifying the process of transferring domestic technologies.

## 4. Results

### 4.1 Organizational and legal framework for commercialization

Modern research in the field of innovative development (Baldini et al, 2006; Berggren, 2017), as well as the experience of developed countries, shows that obtaining innovation itself is possible only in the case of practical implementation of existing scientific developments into production at an enterprise. The release of a new product to the market allows us to assert about the commercial implementation of R&D and the emergence of innovation.

Thus, commercialization appears to be a process during which the results of scientific activity take the form of marketable products or services. During the commercialization of innovations, knowledge is transferred and increased from scientists and inventors to investors and businessmen. Other participants are also involved - these are government bodies, intermediaries, innovative institutions, customers, buyers (Zhou & Wang, 2020).

Effective implementation of innovation requires the combined work of many factors, ranging from the technical capabilities of introducing a new technology or product, the availability of specialists in this field, and ending with the demand for the final innovative product (Sadyrova et al, 2021). Also, an important factor at all stages is financial support, which can be provided through investors and various PPP programs.

The final stage of technology transfer is implementation, the most important stage of

commercialization. At this stage it becomes possible to achieve the practical application of the technology. Having acquired a material form and entering the market, the innovation reimburses the costs incurred and generates profit for all stakeholders. In turn, the profit received becomes a source of innovation in other areas and makes it possible to achieve new production and consumption goals. This is especially important for universities that do not have large budgets for research. Without bringing it to market, the costs of the commercialization stage cannot be recovered and will be distributed among the production costs of other products, increasing their cost.

In the last decade, legislation in the field of technology commercialization has undergone changes, because of which universities had the opportunity to participate in creation of small innovative enterprises. This opportunity appeared for Kazakh universities with the adoption of the Law "On Commercialization" in 2015, which emphasized the need to create start-up companies with the participation of higher and (or) postgraduate education organizations to commercialize the results of scientific and (or) scientific and technical activities. The following mechanisms for the commercialization of research and development were also identified: a) concluding licensing agreements for the results of scientific and (or) scientific and technical activities; b) creating a start-up company; c) implementation (use) of the results of scientific and (or) scientific and technical activities in own production. Corresponding amendments were made to the Business and Tax Code of the Republic of Kazakhstan.

The most promising direction for the commercialization of scientific development for a university is the organization of a spin-off company. Spin-offs are the most popular forms of commercialization of R&D in developed countries, because they do not have the disadvantages inherent in the first two forms.

In case of carrying out scientific research commissioned by third parties and registering a license, intellectual property rights are transferred to a third party. Thus, the university loses the right to use intellectual property. The university receives only certain payments (royalties) from the company that acquires the intellectual property rights. Payments are also guaranteed to the author of the invention.

Transfer of intellectual property rights by order or through a license agreement is the most common methods of commercializing intellectual property in the CIS countries. These methods are the simplest and do not require the university to organize an innovative infrastructure and production based on spin-offs. Their main disadvantage is that the university subsequently loses its intellectual property rights. However, when organizing a spin-off, the university remains the owner of the rights to a unique development and, if the development is successfully implemented, receives most of the profit. Thus, universities that develop innovation infrastructure have great opportunities to commercialize their own scientific developments.

Among the objects of the university's innovation infrastructure, the key role belongs to the office of commercialization or technology transfer office (TTO). TTO provides methodological, scientific and technical, expert, administrative, legal, economic, and marketing support for scientific and technical projects. TTO searches, identifies and establishes connections with potential business partners, investors, business angels and coordinates the work on creating small innovative and other companies.

TTOs began to be created in the Republic of Kazakhstan in 2012 and were initially located in 9 regions. Currently, there are 56 commercialization offices in the country, 43 of which are in universities.

#### *4.2 Government support for commercialization*

Since 2016, JSC 'Science Fund' (hereinafter - Science Fund) has been designated as the Operator for grant financing of commercialization of research and developments at the republican level. Also, since 2016, Science Fund has been implementing a grant funding program for the most promising projects for the commercialization of R&D. The grant recipient in this program must be a legal entity:

a scientific organization (university), a startup company or a private partner. The program is implemented based on co-financing: 80% of the grant is financed by the state, 20% by the applicant. For the period from 2016 to 2023 Science Fund held 4 competitions for the commercialization of R&D, for which more than 1,500 applications were received. 225 projects were approved (Table 1).

**Table 1.** Government grants for R&D commercialization projects

Year	2016	2017	2018	2022 <sup>2</sup>	Total
Total number of projects	25	71	61	68	225
Including the number of projects from higher educational institutions (HEIs)	4	3	6	n/a	13

**Source:** Sitenko et al, 2024.

Projects were mainly from the following areas: agriculture, services, healthcare, industrial production. From 2008 to 2015, technology commercialization was supported by the World Bank within the framework of the Technology Commercialization Project (TCP) (Alibekova et al, 2018). A total of 1,511 applications were submitted, of which 65 (4.3%) were approved.

During the period from 2016 to 2020 a joint project of the Ministry of Education and Science of the Republic of Kazakhstan and the World Bank “Fostering Productive Innovations (FPIP)” was implemented in Kazakhstan. The total cost of the project was 81.20 million USD, of which the consortium component was 35 million USD. This project supported the commercialization of technological innovations and involved individuals and groups of scientists with innovative technologies in the final stages of development with high commercial potential (Sitenko, 2023).

The project included 5 components:

1. Development of a knowledge base for innovation.
2. Innovation consortia.
3. Consolidation of the technology commercialization cycle.
4. Strengthening the coordination of the national innovation system (NIS) and increasing the capacity of existing institutional structures.
5. Support for project implementation (Fostering Productive Innovation Project, 2020).

As a result of the project, 45 protection documents were obtained, of which 34 Kazakhstani patents, 1 Eurasian patent, 1 under the PCT procedure, 8 copyright certificates, 1 trademark. As part of the implementation of consortia based on scientific organizations and manufacturing enterprises, 6 projects were implemented in such industries as: energy - 2 projects, agro-industrial complex - 2, construction - 1, chemical industry - 1. Under the program of the consortium of inclusive innovations 8 projects were implemented with private financing: information technology - 4, mechanical engineering - 2, construction 1, medicine - 1.

With the support of SPI, several innovative projects were implemented, including:

- Development of the Sezual device to help people with visual impairments to freely navigate in space. By emitting high-frequency clicks, the device allows person to “see” objects in three dimensions within a radius of 15 meters.
- production of biological bandage with highly effective healing properties for the treatment of burns and wounds based on extracellular xenogeneic matrix.

Despite certain positive results, the process of allocating government grants has not demonstrated its effectiveness. Only several projects have been implemented under the innovation consortium component, and most of them in traditional industries. Among the shortcomings of the distribution of government grants, the “opacity” of the distribution of scientific grants was noted (Maratkyzy, 2023), as well as the lack of mechanisms for regulating conflicts of interest between scientists (Shakenova, 2022). Also, the proposed projects did not always correspond to the priority areas of economic development.

The implementation of commercialization projects did not affect the patent activity (Table 2). In recent years, compared to 2019, there has been a decrease in the total number of patent applications, as well as a significant decrease in applications by national applicants (by 14.5%). According to WIPO data, the share of applications submitted by universities in the period 2020-2022 was 16.9%. The number of patents received also decreased by 32.6%.

**Table 2.** Dynamics of filing applications for inventions and patent grants

	2019	2020	2021	2022	2023
Applications					
Filed, total	973	900	805	838	917
By national applicants	811	760	692	713	693
Patent grants					
Patent grants, total	730	709	651	585	492
By national applicants	544	573	521	473	401

**Source:** National Institute of Intellectual Property, 2024

Among the factors influencing the reduction of patent activity, we can single out a reduction in internal R&D costs, which has been actively observed since 2014 (Figure 1). Reducing R&D costs may have a negative impact on the number of patents obtained not immediately, but with a lag of several years. Another negative trend was the reduction of scientific organizations in the business sector by 15.4% in the last 3 years.

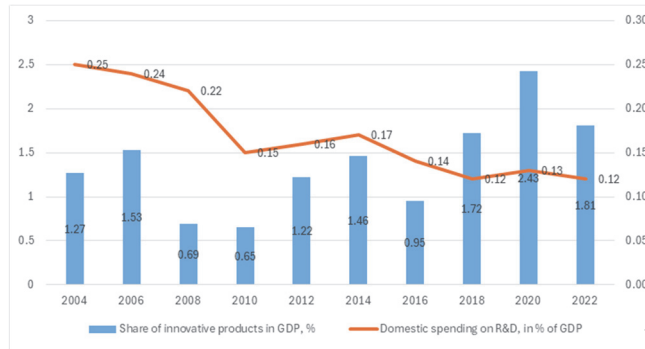
In the Global innovation index, Kazakhstan in 2023 worsened its rank by 2 positions (81) compared to indicators of 2019 and 2021 years. In general, a downward trend in ratings has been observed over the past 5 years. Despite a slight improvement in the position on Innovation outputs, the gap between costs and results in the field of innovation remains significant, which indicates the insufficient effectiveness of the measures taken by the government in the field of science and technology policy. The indicators for sub-pillars Innovation linkages (123) and University-industry R&D collaboration (117) are among the lowest in the ranking, which indicates that universities are not sufficiently integrated into the innovation system (Table 3).

**Table 3.** Kazakhstan's GII Rankings, 2019 – 2023

Indicators	2019	2020	2021	2022	2023
GII position	79	77	79	83	81
Innovation inputs	64	60	61	65	68
Innovation outputs	92	94	101	97	87

**Source:** World Intellectual Property Organization, 2023

Despite the adoption of legislation in the field of technology transfer and infrastructure development, the commercialization of university innovations faces a few problems. The most significant is the raw material orientation of the economy, as well as the low demand for innovation in the real sector of the economy. Five-year industrial and innovative development programs did not contribute to an increase in spending on R&D and, accordingly, did not produce a significant increase in innovative products (Figure 1).



**Figure 1:** Share of innovative products and domestic spending on R&D in GDP, %  
**Source:** Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan

Fundamental and applied research dominates in the composition of R&D expenditures with almost 93% in 2023 (Table 4). At the same time, only 5% and 1.7% of all costs, respectively, are allocated for design work and the production of prototypes.

**Table 4.** Internal R&D costs by type of works, million USD

Indicators	2019	2020	2021	2022	2023
Research and development, total	215.11	215.59	256.63	263.99	378.22
Basic and applied research	166.34	166.14	210.23	227.91	351.04
in %	77.33	77.06	81.92	86.33	92.81
Design, engineering and technological work	43.91	44.88	40.75	13.45	19.44
in %	20.4	20.8	15.9	5.1	5.1
production of prototypes, batches of products	3.70	3.35	4.56	21.84	6.47
in %	1.7	1.6	1.8	8.3	1.7

**Source:** Bureau of National Statistics of the Republic of Kazakhstan

Thus, in the context of types of scientific work, the theoretical research still prevails in Kazakhstani science. Compared to 2022, the share of costs to produce prototypes has decreased threefold. Two-thirds of all development costs go to design and technological work, and only one-third, or \$6.47 million, goes directly to the production of samples and new products.

Thus, analysis of the legislative framework, as well as the dynamics of indicators in the scientific and technical sphere, makes it possible to systematize the advantages and disadvantages of the commercialization of university developments in the Republic of Kazakhstan that have developed at the present stage with the help of SWOT analysis (table 5).

**Table 5:** SWOT analysis of universities' R&D commercialization in Kazakhstan

Strengths	Weakness
<ul style="list-style-type: none"> <li>- Innovation infrastructure at universities;</li> <li>- High human resources potential of universities;</li> <li>- Transfer of intellectual property rights to the university for created innovative developments, products, services.</li> </ul>	<ul style="list-style-type: none"> <li>- Insufficient development of cooperation by the business sector in the field of technology transfer;</li> <li>- Low participation of SME in financing R&amp;D;</li> <li>- Lack of innovative developments and, as a consequence, low patent activity;</li> <li>- Lack of strategic planning of scientific areas linked to the commercialization of research results.</li> </ul>

Opportunities	Threats
<ul style="list-style-type: none"> <li>- Attracting foreign researchers for joint R&amp;D;</li> <li>- Increasing the efficiency of NIS by improving interaction between the scientific sector and industry;</li> <li>- Creation of attractive conditions for private business financing of applied research within the framework of public-private partnership;</li> <li>- Creation of an effective mechanism for innovation management and financing at the regional level with the involvement of venture funds and subsoil users;</li> <li>- Training of qualified specialists in innovation management</li> </ul>	<ul style="list-style-type: none"> <li>- Maintaining the raw materials orientation of the economy due to high prices for raw materials on the world market;</li> <li>- Weakening of the country's scientific potential due to the relocation of Kazakhstani scientists and engineers to foreign countries ("brain drain");</li> <li>- High competition in R&amp;D from developing countries;</li> <li>- Lack of domestic products with high added value in world markets.</li> </ul>

Source: Sitenko &Yessengeldina, 2016; Ilmaliyev et al, 2020.

Commercialization of developments, including universities ones, in many countries is carried out with the support of venture funds (Widding et al, 2009). In Kazakhstan, venture capital financing has not received much development, even though the first venture fund appeared in 1996.

The concept for the Development of Higher Education and Science of Kazakhstan till 2029 (CDHES 2029), being considered by the government today, revises the expansion of the list of alternative sources of R&D financing, where a special role should be given to the business community, subsoil users, venture funds and foreign investors. The venture fund can become the necessary link that will connect participants of commercialization process at the regional level, financing joint projects between businesses and universities (Seitzhanov et al, 2020). The venture fund accumulates financial resources, which are then distributed for the creation and testing of technology in a commercial enterprise. At the same time, the decision on financing certain projects is made by the collegial executive body.

The mechanism of interaction between academic entrepreneurs and the business sector is presented in Figure 2.

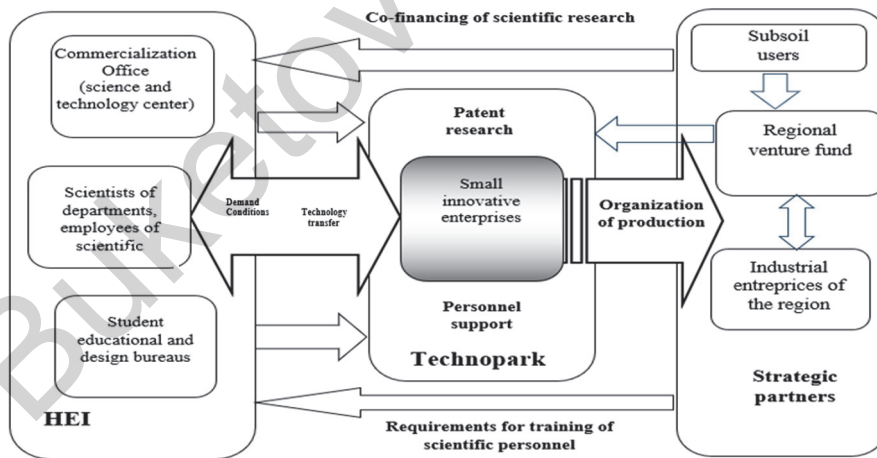


Figure 2: Mechanism of interaction between the university teaching staff and the business sector

In general, the development of academic entrepreneurship requires coordination of the efforts of all participants in the innovation process at the macro, meso and micro levels. At the macro level, the state, represented by the relevant ministries, creates the necessary conditions for coordinating the work of all elements of the innovation system including universities at the national level. The government funds priority scientific and technological research, as well as updating the university

innovative infrastructure. The most important issue is the introduction of grant funding schemes for joint projects of scientific teams and business, which allows the introduction of scientific developments into production and increasing the demand for domestic R&D from the business sector (Dimante & Sitenko (2016).

At regional level, technology parks and regional venture funds actively support the creation of small innovative firms, through which the university gets the opportunity to implement projects in priority sectors of the region. At this stage of support, in our opinion, technology parks should provide for scientists on preferential terms a technological base for obtaining experimental samples and pilot batches of high-tech products, as well as a placement for new companies.

At the micro level, it is necessary for the university to create a system of material and social incentives for teaching staff and young scientists. The development of a system for encouraging young scientists will increase the prestige of a scientist, attract talented youth to the field of scientific research, and ensure continuity of personnel.

Greater opportunities for commercialization of own developments are achieved by creating small innovative enterprises (SIE) or spin-offs on the territory of universities. Currently, the Law "On Science and Technological Policy" does not provide the possibility of creating SIE at universities. Universities of Kazakhstan can only participate in the creation of start-up companies, as well as small business entities.

The possibilities of universities in creating SIEs can expand when they acquire autonomous status. Currently, only one university has the status of an autonomous educational organization - Nazarbayev University. Thus, the prospects of a modern university in the field of commercialization are largely associated with the transition to an autonomous (self-financing) organizational form, as well as the addition of small innovative enterprises to its structure.

Autonomous educational institutions have greater economic independence than educational institutions of other forms of ownership, which is associated with a change in their financing system. Thus, an increase in the quality of the functional characteristics of a scientific and educational institution is achieved with the provision of the possibility of self-financing.

## 5. Conclusion

Commercialization of university scientific developments allows universities to implement their innovative activities and transfer accumulated knowledge in the form of development to industry for further use by society. The commercialization process consists of several stages and can vary significantly in each case depending on the form and the chosen strategy. The process itself is new for Kazakhstani universities, which requires the creation of an internal development support management system, as well as establishing connections with the business sector within the framework of the developing legal field.

Among the strengths of the process of commercialization of university developments in the Republic of Kazakhstan at the present stage, we can note the development of innovation infrastructure at universities, in particular commercialization offices, which take on the functions of searching for investors, drawing up agreements and resolving disputes. The presence of such a department at a university allows scientists to be more active in the innovation market and redistribute the funds received for new research.

The problem remains the small number of projects being implemented, despite government support in the form of grants for commercialization. There is no pronounced positive dynamics in the share of innovative products in GDP. Despite the presence of intermediary structures between science and industry, cooperation with the business sector in the field of technology transfer remains weak.

The transfer of development to commercial use is most often carried out through patenting and licensing, in which further participation of the university in the production of the finished product is limited or absent. For a more complete participation of the university in the process of introducing

technology, it is necessary to develop such forms of commercialization as a spin-off company. In the long term, this form of commercialization allows the university to participate in the commercial activities of the company and receive dividends for its invention. The mechanism proposed in the article for interaction between the innovation infrastructure of a university and industrial enterprises with the participation of a venture fund considers the proposed changes to legislation within the framework of Concept CDHES 2029. The successful implementation of this mechanism will make it possible to create long-term cooperation with the business sector and develop university research based on business needs.

The conducted research reveals a gap in the formation of effective interaction between universities and industry in the innovation process of Kazakhstan. Despite the conducted analysis and previous studies, in practice, universities and entrepreneurs may encounter barriers that are not considered by the mechanism proposed in the work. Further research is needed to identify the nature and features of the links between participants in the commercialization process, the expectations of the business sector from cooperation with universities, as well as the impact of government programs on the number of innovations implemented. It is also necessary to study the most effective models for creating SIEs that can use the potential of academia scientists and students in the implementation of applied projects.

## 6. Acknowledgments

This research is funded by the Science Committee of the Ministry of Science of Higher Education of the Republic of Kazakhstan (Grant No. AP13268750).

## References

- Alibekova, G. Zh, Tayauova, G. Zh, & Ilmaliev, Zh. B. (2018). Problems of evaluating the effectiveness of programs to promote the commercialization of scientific developments in Kazakhstan. *Kompleksnoe ispolzovanie mineralnogo syria*, (4), 181-191. <https://doi.org/10.31643/2018/6445.45>
- Alibekova, G., Tleppayev, A., Medeni, T. T., & Ruzanov, R. (2019). Determinants of technology commercialization ecosystem for universities in Kazakhstan. *The Journal of Asian Finance, Economics and Business*, 6(4), 271-279. <http://dx.doi.org/10.13106/jafeb.2019.vol6.no4.271>
- Ardito, L. (2018). Markets for university inventions: the role of patents' underlying knowledge in university-to-industry technology commercialisation. *International Journal of Technology Management*, 78(1-2), 9-27. <https://doi.org/10.1504/IJTM.2018.093934>
- Balconi, M., & Laboranti, A. (2006). University-industry interactions in applied research: The case of microelectronics. *Research Policy*, 35(10), 1616-1630. <https://doi.org/10.1016/j.respol.2006.09.018>
- Baldini, N., Grimaldi, R., & Sobrero, M. (2006). Institutional changes and the commercialization of academic knowledge: A study of Italian universities' patenting activities between 1965 and 2002. *Research policy*, 35(4), 518-532. <https://doi.org/10.1016/j.respol.2006.01.004>
- Beck, S., Bergenholtz, C., Bogers, M., Brasseur, T. M., Conradsen, M. L., Di Marco, D., ... & Xu, S. M. (2022). The Open Innovation in Science research field: a collaborative conceptualisation approach. *Industry and Innovation*, 29(2), 136-185. <https://doi.org/10.1080/13662716.2020.1792274>
- Berggren, E. (2017). Researchers as enablers of commercialization at an entrepreneurial university. *Journal of Management Development*, 36 (2). <https://doi.org/10.1108/JMD-06-2016-0117>
- Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2023). Retrieved June 23, 2024. <https://stat.gov.kz/>
- Concept for the development of higher education and science in the Republic of Kazakhstan for 2023 – 2029 (2023). Retrieved May 05, 2024. <https://adilet.zan.kz/rus/docs/P2300000248>
- Dimante, D., Sitenko, D.A. (2016). Organization of research activity of the university in the transition to innovation economy. *Bulletin of the Karaganda university*, 1(81), 118-124. [https://rep.ksu.kz/bitstream/handle/data/7196/Dimante\\_119-125\\_2016.pdf?sequence=1&isAllow ed=y](https://rep.ksu.kz/bitstream/handle/data/7196/Dimante_119-125_2016.pdf?sequence=1&isAllow ed=y)
- Etzkowitz, H. (2004). The evolution of the entrepreneurial university, *International Journal of Technology and Globalization*, 1(1), 64–77 <https://doi.org/10.1504/IJTG.2004.004551>

- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations. *Research policy*, 29(2), 109-123. [https://doi.org/10.1016/S0048-7333\(99\)00055-4](https://doi.org/10.1016/S0048-7333(99)00055-4)
- Fostering Productive Innovation Project (2020). Project components. Retrieved June 12, 2024 <http://fpip.kz/index.php/en/about-the-project/project-components>
- Goldfarb, B., & Henrekson, M. (2003). Bottom-up versus top-down policies towards the commercialization of university intellectual property. *Research policy*, 32(4), 639-658. [https://doi.org/10.1016/S0048-7333\(02\)0034-3](https://doi.org/10.1016/S0048-7333(02)0034-3)
- Guimon, J. (2017). Policies to promote science-industry links and technology commercialisation in emerging countries: the case of Kazakhstan's Technology Commercialization Project. *International Journal of Technological Learning, Innovation and Development*, 9(1), 1-16. <http://dx.doi.org/10.1504/IJTLID.2017.10003729>
- Ilmaliev, Z. B., Patihan, T., Tursunbekov, D. M., Kenzhaliyev, O. B., Sansyzbayeva, D. B., & Kassymova, G. K. (2022). Motivating factors of innovative research activities and barriers to R&D in Kazakhstan. *Jurnal Cakrawala Pendidikan*, 41(3), 619-629. <https://doi.org/10.21831/cp.v4i3.47704>
- Issabekov, B., Bayanbayeva, A., Altynbassov, B., & Barlykov, Y. (2022). University-Business Cooperation as a Key Factor in Innovative Economic Development in Kazakhstan. *Theoretical and Practical Research in Economic Fields*, 13(1), 86-101. [http://dx.doi.org/10.14505/tpref.v13.i1\(25\).07](http://dx.doi.org/10.14505/tpref.v13.i1(25).07)
- Jonbekova, D., Sparks, J., Hartley, M., Kuchumova, G. (2020). Development of university-industry partnerships in Kazakhstan: Innovation under constraint. *International Journal of Educational Development*, 79, 102291. <http://dx.doi.org/10.1016/j.ijedudev.2020.102291>
- Leydesdorff, L., & Zawdie, G. (2010). The triple helix perspective of innovation systems. *Technology analysis & strategic management*, 22(7), 789-804. <https://doi.org/10.1080/09537325.2010.51142>
- Maratkyzy, S. (2023). Problems and prospects of commercialization of innovative educational technologies in Kazakhstan. *Bulletin of the Karaganda university Pedagogy series*, 109(1), 7-13. <http://dx.doi.org/10.31489/2023Pedi/7-13>
- Sadyrova, M., Yusupov, K., & Imanbekova, B. (2021). Innovation processes in Kazakhstan: development factors. *Journal of Innovation and Entrepreneurship*, 10(1), <http://doi.org/36.10.1186/s13731-021-00183-3>
- Seitzhanov, S., Kurmanov, N., Petrova, M., Aliyev, U., & Aidargaliyeva, N. (2020). Stimulation of entrepreneurs' innovative activity: evidence from Kazakhstan. *Entrepreneurship and Sustainability issues*, 7(4), 2615. [http://doi.org/10.9770/jesi.2020.7.4\(4\)](http://doi.org/10.9770/jesi.2020.7.4(4))
- Shakenova, A. (2022). A Survey About Patents, Invention and Commercialization Processes in Kazakhstan. *Regional and Business Studies*, 14(2), 31-45. <http://dx.doi.org/10.33568/rbs.4121>
- Shane, S. A. (2004). *Academic entrepreneurship: University spinoffs and wealth creation*. Edward Elgar Publishing.
- Sitenko, D., Gordeyeva, Y., Sabyrzhan, A., & Syzdykova, E. (2023). Implementation of innovative technologies in Kazakhstan: A case of the energy sector. *Problems and Perspectives in Management*, 21(4), 179-188. [http://dx.doi.org/10.21511/ppm.21\(4\).2023.14](http://dx.doi.org/10.21511/ppm.21(4).2023.14)
- Sitenko, D., Sabyrzhan, A., Gordeyeva, Y., & Temirbayeva, D. (2024). Commercialization of R&D and opportunities for the development of academic entrepreneurship in Kazakhstan. *Problems and Perspectives in Management*, 22(3), 146. [http://dx.doi.org/10.21511/ppm.22\(3\).2024.12](http://dx.doi.org/10.21511/ppm.22(3).2024.12)
- Sitenko, D., Yessengeldina, A. (2016). Development of innovative economy in Kazakhstan. *Bulletin of the Kazakh national university*, 1(113), 116-121. <https://be.kaznu.kz/index.php/math/article/view/1192>
- Valentin, F., & Jensen, R. L. (2007). Effects on academia-industry collaboration of extending university property rights. *The Journal of Technology Transfer*, 32(3), 251-276. <https://doi.org/10.1007/s10961-006-9015-x>
- Widding, L. O., Mathisen, M. T., & Madsen, O. (2009). University-affiliated venture capital funds: Funding of university spin-off companies. *International Journal of Technology Transfer and Commercialisation*, 8(2-3), 229-245. <https://doi.org/10.1504/IJTTC.2009.024387>
- Yessengeldin, B., Sitenko, D., Murzatayeva, G., & Yessengeldina, A. (2016). Scientific potential as the basis of innovation development of Kazakhstan. *International Journal of Economics and Financial Issues*, 6(3), 1019-1024. <https://www.econjournals.com.tr/index.php/ijefi/article/view/2232>
- Yessengeldin, B., Sitenko, D., Murzatayeva, G., & Yessengeldina, A. (2016). Scientific potential as the basis of innovation development of Kazakhstan. *International Journal of Economics and Financial Issues*, 6(3), 1019-1024 <http://econjournals.com/index.php/ijefi/article/view/2232>
- Zhou, C., & Wang, R. (2020). From invention to innovation: The role of knowledge-intensive business services in technology commercialisation. *Technology Analysis & Strategic Management*, 32(12), 1436-1448. <https://doi.org/10.1080/09537325.2020.1774053>