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## THE CURRENT STATE OF INNOVATION AND TECHNOLOGY TRANSFER IN UKRAINE

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**Introduction.** The implementation of modern tools for the transfer of innovative technologies from research centers to the business environment is one of the main criteria for Ukraine to enter the globalization space of technologically advanced countries. In view of the above, the analysis of the current state of innovation and technology transfer in Ukraine in order to form development priorities with a focus on advanced global models becomes relevant.

**Research hypothesis.** It is assumed that the implementation of modern tools for the transfer of innovative technologies from research centers to the business environment will be the basis for the creation of a new type of university, the effectiveness of which will be measured by the introduction of enterprises in various fields of innovation and projects.

**The purpose of the article** is to analyze the current state of innovation and technology transfer in Ukraine.

**Research methods:** statistical analysis and logical generalization – to study trends in the field of technology transfer in Ukraine.

**Results:** the current state of innovation and technology transfer in Ukraine is analyzed. Ukraine's place in the global innovation index is assessed according to the main indicators. Factors of efficiency of commercialization of university inventions are allocated. The functioning of effective technology transfer centers on the example of Spain is considered.

**Conclusions:** technology transfer is a promising mechanism for economic stabilization of a country. In Ukraine, due to weak interaction between science and business, technology transfer is not developed at the proper level. To overcome such negative trends, it is necessary to use institutional factors – improving the legal framework in the field of technology transfer and developing public policy on the commercialization of intellectual property, intensifying the development of technology market infrastructure and involving enterprises in working with intellectual property.

**Keywords:** technology transfer; university; business environment; global innovation index; patent; utility model.

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## СУЧАСНИЙ СТАН ІННОВАЦІЙ ТА ТРАНСФЕРУ ТЕХНОЛОГІЙ В УКРАЇНІ

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**Вступ.** Для України імплементація сучасного інструментарію передачі інноваційних технологій від наукових осередків до бізнес-середовища є одним з головних критеріїв входження до глобалізаційного простору технологічно розвинених країн світу. З огляду на вищезазначене, актуальності набуває аналіз сучасного стану інноваційної діяльності та трансферу технологій в Україні з метою формування пріоритетів розвитку з орієнтацією на передові світові моделі.

**Гіпотеза наукового дослідження.** Передбачається, що імплементація сучасного інструментарію передачі інноваційних технологій від наукових осередків до бізнес-середовища стане основою для створення університетів нового типу, результативність роботи яких вимірюватиметься упровадженням у практичну діяльність підприємств різних галузей інноваційних розробок і проєктів.

**Метою** статті є аналіз сучасного стану інноваційної діяльності та трансферу технологій в Україні.

**Методи дослідження:** статистичного аналізу та логічного узагальнення – для дослідження тенденцій розвитку сфери трансферу технологій в Україні.

**Результати:** проаналізовано сучасний стан інноваційної діяльності та трансферу технологій в Україні. Оцінено місце України за основними індикаторами к глобальному індексі інновацій. Виокремлено фактори ефективності комерціалізації університетських досліджень. Розглянуто функціонування дієвих центрів трансферу технологій на прикладі Іспанії.

**Висновки:** трансфер технологій є перспективним механізмом економічної стабілізації держави. В Україні, через слабку взаємодію науки і бізнесу, трансфер технологій не розвинуто на належному рівні. Для подолання таких негативних тенденцій необхідно задіяти інституційні чинники – вдосконалення законодавчої бази у сфері трансферу технологій та розроблення напрямів державної політики щодо комерціалізації результатів інтелектуальної діяльності, активізацію розвитку інфраструктури ринку технологій і залучення підприємств до роботи з інтелектуальною власністю.

**Ключові слова:** трансфер технологій; університет; бізнес-середовище; глобальний індекс інновацій; патент; корисна модель.

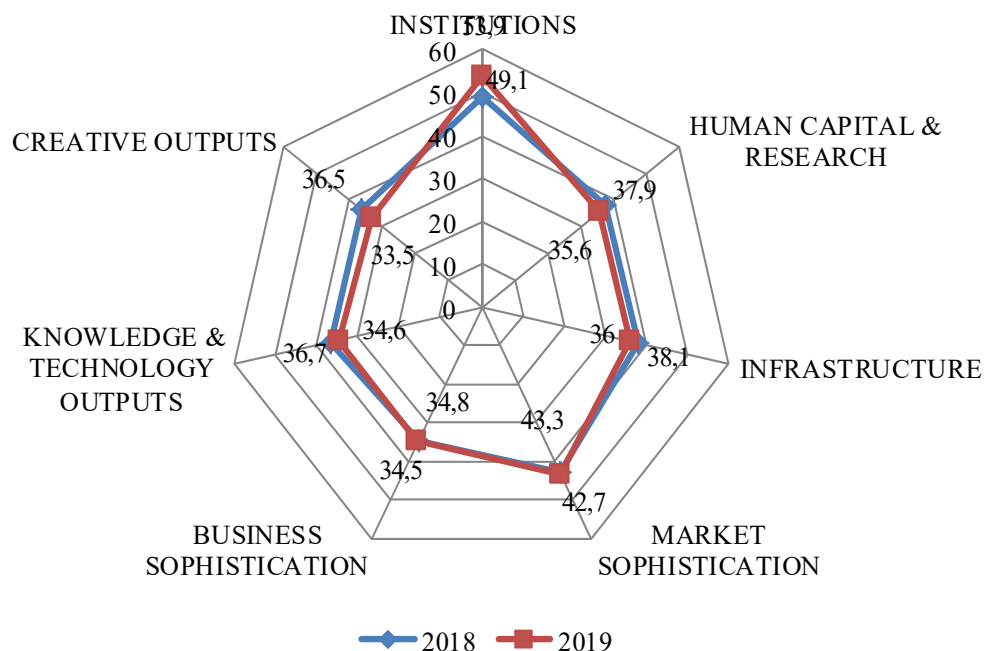
**Formulation of the problem.** The innovative way of economic development is one of the priority directions in the global sphere. The positive experience of the developed countries of the world confirms the primary role of scientific centers in the formation of the country's innovation potential. Research and development (R&D) is an activity aimed at gaining new knowledge and their practical application in creating a new product or technology. In developed countries, such as Canada, the United States, Germany and Japan, 70% of total R&D expenditures are concentrated in a small number of powerful research centers. Among such research centers, universities and research institutions play an important role. For the successful transfer of technology from universities to business, it is necessary to realize the importance of close cooperation between the inventor and the company. The commercialization of university research today is becoming an important economic and globalization stimulus for a country. In addition, the cooperation of universities with business in the field of research, licensing agreements, the possibility of establishing joint ventures, can bring additional income to the universities and employment opportunities for academic researchers and students.

For Ukraine, the implementation of modern tools for the transfer of innovative technologies from research centers to the business environment is one of the main criteria for entering the globalized unity of technologically advanced countries. In view of the above, the analysis of the current state of innovation and technology transfer in Ukraine, in order to form development priorities with a focus on advanced global models, becomes relevant.

**Analysis of recent research and unresolved part of the problem.** An analysis of previous research on the effectiveness of technology transfer from the research community to the business environment has shown that most scientists emphasize the importance of establishing a relationship between science, innovation and business [3–7]. In most developed countries, universities aim to facilitate the rapid and effective conversion of their know-how into commercial use [8]. Veugelers R. argues that in order to achieve this goal, universities need to create an effective strategy aimed at developing guidelines for technology transfer management [9]. D. Siegel notes that a barrier to the commercialization of university research is the inability of scientists to disclose their inventions to a wide range of business environments. Overcoming this barrier is possible through the creation of technology transfer centers in universities [10]. Clearly defined license agreements can act as a mechanism to encourage inventors to disclose their inventions and participate in the commercialization process [6, 11].

**Research results.** The main indicator of innovation development on a global scale is the estimated Global Innovation Index. Ukraine is among the top 50 countries that have maintained a relatively stable rating since 2014.

According to the Global Innovation Index, Ukraine in 2019 ranked 47th among 129 countries. The Global Innovation Index includes 81 indicators of innovation activity and is divided into seven areas: 1) Institutions; 2) Human capital & research; 3) Infrastructure; 4) Market sophistication; 5) Business sophistication; 6) Knowledge & technology outputs; 7) Creative outputs. Global Innovation Index – calculated as the average between the sub-indices of innovation resources (Innovation Input Sub-Index) and innovation results (Innovation Output Sub-Index). Estimates of Ukraine on the main indicators to the global index of innovations in comparison with 2018 and 2019 are presented in Figure 1.



Source: based on data [8].

**Figure 1. Estimates of Ukraine on the main indicators of the global index of innovations in comparison between 2018 and 2019**

Since the focus of this study is on science and technology, the greatest interest in the global innovation ranking is the "Knowledge & technology outputs" indicator, because it reflects the development of science and technology. The analysis of this indicator shows a paradoxical trend for Ukraine. On the one hand, the number of patent applications for inventions filed with the national patent authority per billion dollars of GDP and the number of patent applications for utility models, Ukraine is in the lead. On the other hand, the GDP growth rate due to the introduction of new technologies is less than 1%, while in developed countries it is 60–90% (Table 1). This situation necessitates a thorough analysis of the effectiveness of innovation for Ukraine.

Table 1

**The place of Ukraine in the world ranking  
of Knowledge & technology outputs**

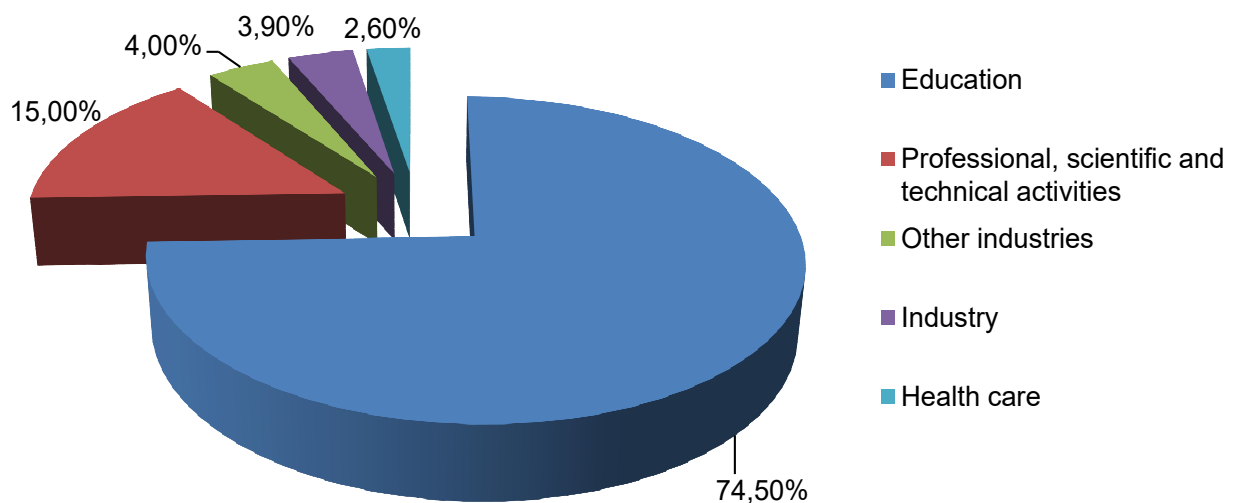
Indicator	Score	Place
Patents by origin/bn PPP\$ GDP	6.2	17
PCT patents by origin/bn PPP\$ GDP	04	38
Utility models by origin/bn PPP\$ GDP	24.3	1
Scientific & technical articles/bn PPP\$ GDP	9.2	54
Citable documents H-index	15.0	49
Growth rate of PPP\$ GDP/worker, %	3.2	22
New businesses/th pop. 15–64	1.5	60
Computer software spending, % GDP	0.5	19
ISO 9001 quality certificates/bn PPP\$ GDP	3.5	70
High- & medium-high-tech manufactures, %	0.2	56
Intellectual property receipts, % total trade	0.2	43
High-tech net exports, % total trade	2.0	53
ICT services exports, % total trade	4.8	11
FDI net outflows, % GDP	0.1	96

Source: [8].

One of the indicators that characterizes innovation activity and the possibility of creating a facility for technology transfer is the number of applications for inventions and utility models. It should be noted that in the first quarter of 2020, the number of applications for inventions and utility models submitted by national applicants – judicial person decreased compared to the corresponding period of 2019 by 42.7% and amounted to more than 1 thousand. Accordingly, their share in the total number of applications decreased (59.8% against 65.0% in 2019). Individual applicants submitted 685 applications for inventions and utility models, and their activity decreased by 28.6%.

The distribution of the submitted applications by types of economic activity of the applicants allows to determine the industries with the largest number of applications. 74.5% of the total number of applications for inventions and utility models were submitted by organizations working in the field of Education, 13.5% – in the field of Research and Development, and only 12.0% of applications were in other fields. In the first quarter, there was a sharp decline in the number of applications for inventions and utility models in the field of "Education" (–44.6%), in the field of "Research and Development" (–48.5%) compared to the same period last year. It should be noted that the number of applications submitted by educational institutions annually exceeds the number of applications submitted by scientific organizations [1].

The level of inventive activity in industry remained quite low. Thus, industrial enterprises submitted 40 applications for inventions and utility models, which is 3.9% of the total number of applications. The most active in submitting applications in the industry were enterprises for the production of machinery and equipment (16 applications), vehicles (8 applications), electrical equipment (4 applications), computers and metallurgical production (3 applications each) (Figure 2).



Source: [1].

**Figure 2. Distribution of applications for inventions and utility models submitted in the first quarter of 2020, by type of economic activity of applicants**

The American and European experience shows that in order to manage the transfer of technology between the main providers of innovation (universities) and those who can potentially commercialize them, universities must create specialized intermediary structures. Technology transfer centers are generally the most important intermediaries in the commercialization of university research.

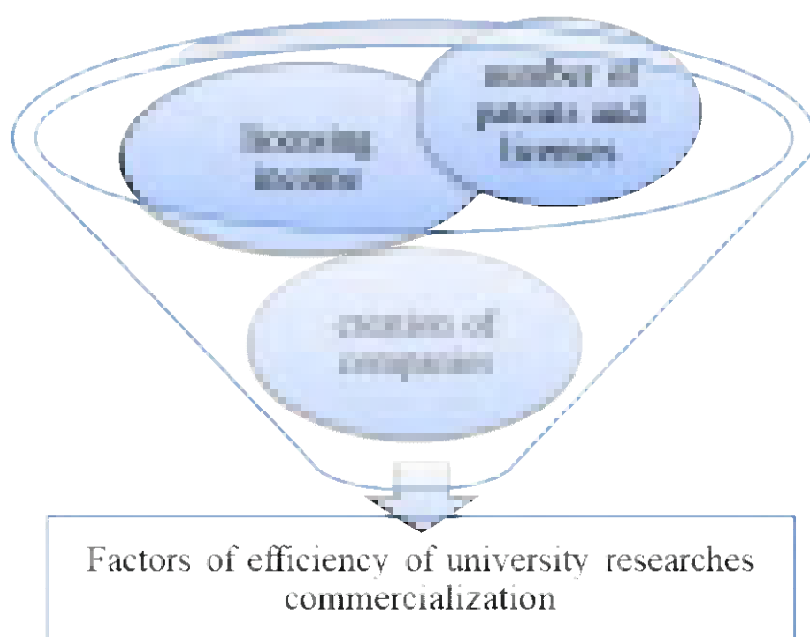
The analysis of 147 institutions of higher education of Ukraine showed that, in 29 institutions there is no activity on technology transfer and academic entrepreneurship at all, 118 institutions have relevant departments. With regard to the structural unit responsible for technology transfer issues, 10 institutions of higher education and research institutions reported the absence of such unit in their structure, 108 – indicated the existence of a separate unit, or a specialist responsible for such activities (in 96 institutions of higher education and scientific institutions the issues of technology transfer belongs to the competence of 1 structural subdivision, in 7 – to the competence of 2–3

structural subdivisions, in 5 – such activity is assigned to one specialist). Such statistical analysis shows a very low level of development of technology transfer university centers.

Regarding the structural subdivision, which is responsible for academic entrepreneurship, 50 institutions of higher education reported the absence of such a subdivision in its structure, 68 – indicated the existence of a separate subdivision or a specialist responsible for carrying out such activities. Thus, in 58 institutions of higher education the issues of academic entrepreneurship belong to the competence of 1 structural subdivision, in 3 institutions – to the competence of 2 structural subdivisions and in 3 institutions – such activity is carried out by only one specialist.

Thus, the results of the study confirm the presence of a problem regarding the existence of effective technology transfer centers in Ukrainian institutions of higher education.

It should be noted that the effectiveness of the commercialization of university research depends on many factors. The most influential among them are – patents and licenses, income from licenses and the formation of companies through start-ups (Figure 3).



**Figure 3. Factors of efficiency of university researches commercialization**

In addition to the listed factors of effectiveness of university research commercialization, university science parks can also play a positive role in generating knowledge clusters and improving technology transfer between universities and industries. The effectiveness of scientific developments in the higher education sector can be assessed by the number of applications for

copyright documents. It is noteworthy that higher education institutions submit the largest share of the total number of applications for the issuance of copyright documents in Ukraine. Ukraine shows relatively high activity in the field of patenting, although the levels of patenting in some sectors differ significantly.

A good example of the implementation of experience in the formation of effective technology transfer centers is Spain. Virtually every Spanish university has a technology transfer center that provides a number of services, including: quality assessment of inventions, support for patent applications, negotiation of license agreements, support for researchers in creating university spin-offs. About half of all Spanish universities have a science park. Geographical proximity optimizes information flows, reducing the cost of finding and monitoring technology consumers and increasing the likelihood of a successful relationship between the university and the business environment. In addition, science parks provide infrastructural support for further development of inventions. Given that most university inventions are in the process of implementing innovation at the time of patenting, science parks take on the process of developing and testing new technology and bringing it to market needs.

Successful technology transfer depends not only on the quality of research and involvement of inventors, but also on the size and experience of the technology transfer center. Successful and experienced technology transfer centers have a high-quality portfolio of inventions, which gives them certain competitive advantages in the market of innovative technologies.

In addition, research shows that universities that give a higher share of royalties to the inventor generate more inventions and higher licensing income. This stimulating effect seems to work both by streamlining scientists and by streamlining the efforts of scientists.

Insufficient funding remains one of the main factors hindering the transition of universities to the full application of the model of innovative development. This is due to a number of reasons: the general economic crisis, the lack of a sufficient number of competitive educational products, the imperfection of the mechanisms of interaction between universities and the business environment, foreign partners and so on. This causes a devaluation of the innovation potential of most domestic free economic zones.

Thus, Ukraine has great potential for technology transfer from universities to the business environment, but even some technological breakthroughs cannot provide the main result – a new competitive economy based on innovation. This requires a set of measures based on effective public administration, successful interaction between universities, business, government and society, and so on.

**Conclusions and suggestions.** In the environment of globalization and integration, the level of economic development of the country is determined by



the ability to commercialize the results of R & D and the efficiency of technology transfer. Technology transfer is a promising mechanism for economic stabilization of a country. In Ukraine, due to weak interaction between science and business, technology transfer is not developed at the proper level. Due to the insufficient spread of advanced technologies, the opportunities to use the strategy of building innovation potential in priority areas are lost, which threatens to consolidate the extensive model of economic development. To overcome such negative trends, it is necessary to use institutional factors – improving the legal framework in the field of technology transfer and developing public policy on the commercialization of intellectual property, intensifying the development of technology market infrastructure and involving enterprises in working with intellectual property.

Today, technology transfer is becoming one of the most important factors in ensuring sustainable socio-economic and environmentally safe development of both individual countries and the world as a whole. For the effective implementation of the link "higher education – research – innovation" it is necessary to provide conditions for the creation and active operation of new types of universities, the effectiveness of which will be measured by the introduction into practice of enterprises in various fields of innovation and projects.

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