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ENGINEERING PLATFORM AS A TOOL TO IMPROVE THE EFFICIENCY OF R&D COMMERCIALIZATION

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ABSTRACT

The article presents a conceptual model of a network engineering platform that provides commercialization of R&D between the environment of knowledge generation (universities, research institutes), the environment of their technologization (industry) and equipped environment of development catalysis (venture funds and Agency organizations). On the basis of the analysis, a model of a network engineering platform was created, which connects research with production and is aimed at rapid commercialization and bringing the results of scientific and technical activities to the market.

Keywords: commercialization R&D, innovation, technology transfer, innovation partnership, engineering platform, scientific and technical research.

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1. INTRODUCTION

The large-scale technological modernization of the country's economy in a short period requires radical growth and efficient spending of funds allocated from the budgets of all levels for research, as well as the concentration of the country's scientific potential in the priority areas of scientific and technological development. However, at the same time, it is necessary to create fundamentally new mechanisms of organizational interaction between institutional economic agents of innovation infrastructure in all regions of our country. The basis for creating a favorable investment climate and conditions for the development of innovative activity in the regions should be the active involvement in the innovation processes of the largest possible number of private investors, innovation-active enterprises and other institutional economic agents of innovation infrastructure, as well as the expansion of the use of modern methods of innovation. This approach will allow at the regional level to form additional competitive advantages associated with the use of existing innovative potential and commercialization of R&D results. An important role in the implementation of this approach is to be played by the introduction of new forms of interaction between institutional economic agents in the practice of management, for example, the expansion of the involvement of engineering companies for the implementation of complex innovative projects. As such a link (bridge) is the "Engineering platform", which is a modern organization related to innovation infrastructure. Because of this, the research of the tasks, role, purpose and essence of engineering centers, created based on effective technical universities and science-intensive enterprises, requires more in-depth theoretical study, as currently engineering, as an important element of the technological chain, in the Kazakh industry is in its infancy. The relevance of this research is the need to develop theoretical provisions for the use of the potential of commercialization of innovations through engineering and engineering centers in an environment where the sanctions regime is not only a threat and risk to the economy, but also a chance for innovation and technological breakthrough in the future.

The essence of engineering in the market conditions ultimately consists in the realization of knowledge as a commodity on a commercial basis. The value of engineering is determined by the fact that it serves as a link between applied research universities and industrial enterprises and can eliminate the traditional gap between science and production. Engineering, performing the functions of innovative infrastructure, creates the basis for the implementation of the concept of "full product life cycle". This is especially necessary for the final stage of the life cycle of innovative products, which commercializes the results of R&D obtained by the scientific and technical activities.

2. ANALYSIS OF THE LATEST PUBLICATIONS

Disclosure of the essence of the problem involves the consideration of the basic concepts of "commercialization", "engineering", "engineering platform". Some aspects of technology commercialization and some aspects of the importance of innovation in different areas are explored by the renowned foreign and Kazakh scientists such as Markman, G.D. [3], Slater, S.F. [4], Rasmussen, E. [5], Markman, G.D. [6], Chen, C.J. [7], Grimpe, C. [8], Amadi-Echendu, J.E. [9], Kim, S.K. [10], Mu, J. [11], Von Raesfeld, A. [12], Ismail, K. [13], Cho, J. [14], Jacobsson, S. [15], Datta, A. [16], Dmitriev, V. [17], Novikova, N. N. [18], Gao, J.H.H. [19], Ziyadin, S. [20], Ziyadin, S. [21], Watkins, M. [22], Weckowska, D.M. [23] etc.

Foreign researchers consider terms and categories of engineering since the middle of the last century, but in Kazakhstan, this direction of consulting services in its modern sense is still relatively new. Therefore, it seems appropriate to focus on the main definitions in this area. In the most General case, engineering often means providing a range of services in the industrial, commercial, scientific and technical fields. At the same time, there is no exact list of types of

work that should be included in the "engineering complex". Their composition depends on the choice of the customer and the industrial characteristics of a sphere of production. Typically, this wide range of works and services provided by the consulting company includes preparation of technical specifications and design proposals, engineering and survey works, including the construction of new and reconstruction of existing industrial facilities, development of machinery, equipment and technological operations, as well as economic, financial and other consultations [24]. Most often, the definition of engineering activity is associated with ingenuity, innovation, knowledge (from Latin - ingenium). Therefore, the American Council for professional development under engineering understands the creative application of scientific methods and principles to the design and development of buildings (structures), machines, apparatus, production processes and methods of their use separately or in combination; to forecasts of behaviour of all this in specific conditions of construction and operation-taking into account the functional purpose, efficiency of use and safety for life and property [25]. In the 80s of the last centuries, the economic Commission for Europe developed the "Guidelines for drawing up international engineering contracts". In this document, "engineering" is defined as a special activity associated with the construction and operation of enterprises and infrastructure. Thus, engineering includes a set of design and operational works and services related to the engineering field and necessary for technological assistance in the process of construction of the object and its operation [26]. On the basis of the above it can be seen that engineering is at the junction of science, R&D and production, and thus serves as the basis for the formation of the technological base of production activities. Despite significant number of scientific investigations in the sphere of commercialization scientific and technical developments, there are many complex issues, which need further development. One of such issues is the commercialization of R&D by engineering organization.

3. METHODOLOGICAL FRAMEWORK

The development of the world economy entails the emergence of new complex and large-scale services that meet the needs of modern society. Today, a characteristic feature of the knowledge economy is the fact that for the modernization of existing or construction of new industries, it is necessary, along with the competent organization of the workflow, to consider a number of technical discoveries and scientific achievements. In addition, when planning the activities of any production, it is necessary to initially represent the full range of its financial, managerial, marketing, personnel and other components based on which it will operate. The need for an integrated approach in the preparation and promotion of innovative projects was the impetus for the emergence of a new direction in the field of consulting services - engineering.

In recent years, Kazakhstan has been implementing a number of active measures at the state level to develop knowledge-intensive sectors of the economy. However, Kazakhstan's expenditures on research and development work in 2016 amounted to 0.14% of the gross domestic product [27], while this figure is in Israel - 4.25%, Korea - 4.23%, Sweden - 3.25%, the United States - 2.74% [28].

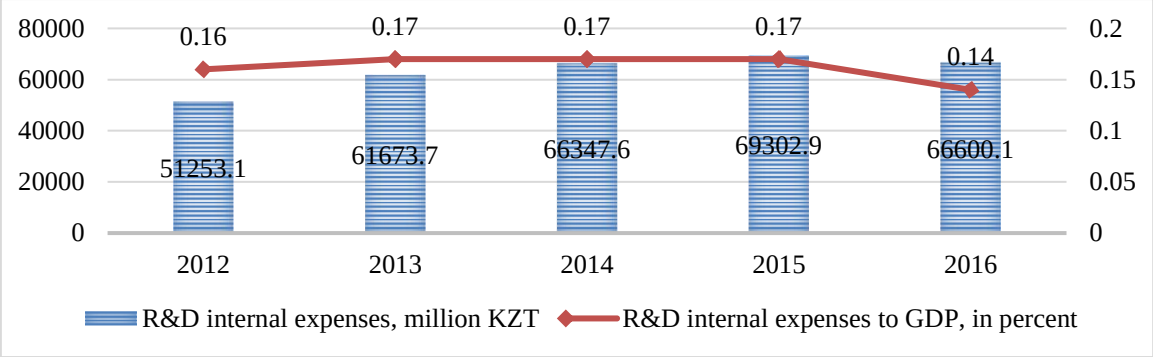

Figure 1 R&D internal expenses

Despite the general increase in the funding of science, a significant part of the results of research and development work is not implemented in the real sector of the economy, does not generate revenue for developers and does not provide revenues to the budget due to the lack of organizational and economic mechanisms for the commercialization of technologies and developments.

According to the Agency of the Republic of Kazakhstan on Statistics [27] in 2016, of the 1,305 enterprises reported, 383 were engaged in research and development (R&D), of which 100 were research institutions in the public sector, 103 were higher education institutions, 149 organizations of the business sector, and 31 non-profit organizations (Table 1).

Table 1 Number of organizations engaged in R & D, by ownership units

	2012	2013	2014	2015	2016
Total	345	341	392	390	383
state property	100	98	112	106	102
private property	240	236	270	276	272
property of other states, their legal entities	5	7	10	8	9

One of the main problems of the development of science in the republic was a low applied nature and low commercialization of the results of scientists' work (Table 2).

Table 2 R&D internal expenses by types of work million KZT

	2012	2013	2014	2015	2016
R&D internal expenses	51 253,1	61 672,7	66 347,6	69 302,9	66 600,1
fundamental research	12 063,4	18 197,0	15 260,7	15 838,8	13 809,2
applied research	28 898,0	33 369,4	38 394,7	36 959,0	35 841,1
developmental engineering	10 291,7	10 106,3	12 692,1	16 505,1	16 949,8

The overall reduction in domestic costs has had the most negative impact on the financing of basic research. Compared to 2016, their volume fell by 12.8%, applied research fell by 3.0%. At the same time, it should be noted that the amount spent on development work increased by 2.7% and its share by 1.6 percentage points. Thus, one of the important issues of the scientific

sphere is to increase the demand for scientific results in the real sector of the economy. It is necessary to increase the share of commercialized research results, to attract the private sector to finance research, as well as to increase the importance of experimental development, to create conditions for conducting semi-industrial tests and to ensure their implementation and use in production through preferential funding. In broad terms, it is necessary to resolve issues of legislative support for the introduction of the results of scientific research into production, which are in high demand among producers. At the same time, it is necessary to work out the mechanism for applying innovative achievements in production. The largest design and research organizations companies operating in Kazakhstan are united in the Union of engineering companies. The Union includes companies and organizations from Kazakhstan, Russia, and foreign countries specializing in the provision of design and research, consulting, construction, manufacturing and other engineering services for various sectors of the economy. The activities of the Union are aimed at ensuring the coordination of participants in the market of engineering services, to integrate the positions of participants in key development issues. Despite the functioning of the Union of the above-mentioned Union and maximum state support of engineering services, there is a low level of commercialization of R&D results. An important direction of the development of the scientific sphere remains creation of a common contact pad in the institution areas of business, University, scientific and industrial production. It is necessary to further expand cooperation with international organizations, publishing houses, scientists.

In this connection, the authors propose to evaluate the results and efficiency of the process of participation of engineering companies in the work of technological platforms using the indicator – the competitiveness coefficient of technological platforms.

Under the competitiveness of the technology platform is the ability of the technology platform effectively and efficiently to carry out innovative activities compared to other technological platforms. The competitiveness coefficient by the author's method can be calculated based on the data:

1. Financing the cost of technological innovation.
2. The share of value added in GDP.

The competitiveness coefficient of technological platforms is calculated on the basis of the formula:

$$C_p = \frac{F_r * VA}{F_a} \quad (1)$$

where, C_p – competitiveness of the technological platform;

F_r – financing the costs of technological innovations at the expense of the real sector of the economy;

VA – share of value added in GDP, %;

F_a – financing of expenditure on technological innovation at the expense of all sources of funding.

The higher the value of the competitiveness coefficient of the technological platform, the higher the competitiveness of the corresponding technological platform. According to the authors, it is possible to classify technological platforms into three groups depending on the level of competitiveness:

1st group – with a high value of the competitiveness coefficient (more than 0.6);

2nd group – with the average value of the competitiveness coefficient (from 0.3 to 0.6);

3rd group – a technology platform with a low value of the coefficient of competitiveness (less than 0.3).

4. RESULTS

Table 3 shows the coefficients of competitiveness, technological platforms in the Republic of Kazakhstan for 2017, according to the Agency of the Republic of Kazakhstan on Statistics [27].

Table 3 Competitiveness factors of technological platforms in the Republic of Kazakhstan for 2015-2016

Technology platform	**The coefficient of competitiveness of the technology platform**
Agriculture, forestry and fisheries	0,095
Mining and quarrying	0,096
Manufacturing industry	0,136
Electricity, gas, steam and air conditioning	0,154
Water supply; Sewerage system, waste collection and distribution control	0,076
Construction	0,039
Wholesale and retail trade; repair of motor vehicles and motorcycles	0,06
Transport and storage	0,06
Accommodation and food services	0,1
Information and communication	0,16
Financial and insurance activities	0,083
Professional, scientific and technical activities	0,177
Administrative and support activities	0,05
Education	0,063
Health and social services	0,022

As can be seen from table 3, the competitiveness groups of technology platforms have not changed in 2017 compared to 2016. The low level of competitiveness of technological platforms in the Republic of Kazakhstan is explained by the lack of a chain of interaction, going from the units of the technological level to the target segments of the market, the main products and services, key consumers.

In this connection, the authors propose the engineering platform model for commercialization of R&D results. The main structural and functional feature of the developed model is the implementation of a network scheme for managing distributed assets that provide

the generation and technological transformation of knowledge. This scheme systematically organizes innovation processes in a vast institutional field filled with chaotically interacting subjects of technological, scientific, educational and financial markets. There is actually a comprehensive and in-depth engineering, operating both within and at the intersection of intellectual processes, equipment and technological exchange in the transformation of knowledge, technical objects, in the innovation sphere and capital (Figure 2).

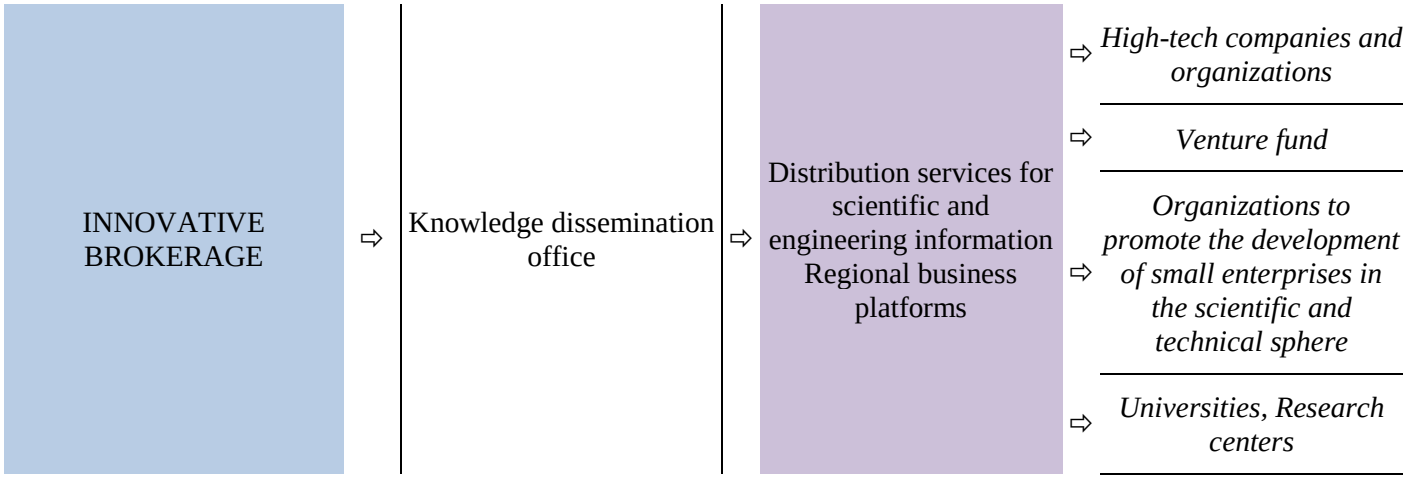

Figure 2 Engineering platform model for commercialization of R&D results

The model, which implements and optimizes strategies for interaction in the field of distributed resources and agents, always, provides for network engineering, which cannot be reduced to a method of knowledge transfer; it acts as a global tool for establishing and ensuring effective social, epistemic and technical-economic relations. In our case, it is the network engineering of innovations, that is, a tool for creating, technologizing and distributing a generalized innovation cycle. In particular, he is responsible for building in the innovation process schemes for the use of generalized resources (a kind of technical and cognitive logistics), ways of interaction of scientific and technical teams, trajectories of technologization of knowledge.

5. CONCLUSIONS

Today, industrial structure is facing growing difficulties in "seeding" innovative problems in a variety of environments containing potential performers. It turned out that the orders that the industry formulates do not have a specialized communication environment for broadcasting to competent developers. The culture of technological interaction in Kazakhstan is focused not on the initiative, but on institutional providers that provide Directive transactions between the spheres of development and technical materialization. Obviously, in the absence of regulating such exchange processes of state authorities, this environmental niche can be a place of application of private initiative, that is, a contact platform on which the organization of business, science, education and industry will be able to form a joint transfer structure. Modern economic science cannot yet determine the full impact of the integration processes at the global level. Th is not due to the complexity of calculating the results of the integration and plurality effects in time and space. [29]

One of the ways to overcome the existing innovation gap is to create platforms that combine the knowledge generation environment with the environment of their technologization and provide deep engineering in the interaction of these environments. Within the framework of such platforms (their operational structure), business groups of engineers, scientists and commercialization specialists support and provide the processes of technological innovations production implementation, and research structures of universities and research institutes together with R&D departments of high-tech enterprises develop innovative tasks facing the industry. The ideology of open innovation, implemented with the help of such organizations, can change production and technological culture and dramatically increase the speed of knowledge metabolism, that is, complex exchange processes that allow production to access new knowledge, convert it into technology or product, to include in economic turnover.

In the future, effectively built contact platform can concentrate a significant flow of bilateral transactions carried out in the innovation system of Kazakhstan. As a potential global player in the R&D market, it is of interest to domestic and foreign investors and partners. It should also be borne in mind that the leading experts in the field of innovative business to improve the efficiency of technology transfer centers in our country consider it important to create a "network responsible for coordinating the technological needs of the industry and technological proposals of the scientific community."

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