

Problem Of Knowledge Generation In Terms Of University Innovation Ecosystem Development

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Abstract—The research paper is devoted to the search for ways of solving knowledge generation and commercialization problems in the context of the linguocultural approach, taking into consideration the specificity of national conceptual sphere. The study considers real organizational practice focused on holistic understanding of creativity. Within the framework of this understanding, it is believed that the determining basis for creativity development is socio-cultural environment of a person which determines the corresponding forms of thinking and cognitive processes. In its extreme form, such position is embodied in the formal-bureaucratic approach to the knowledge generation problem. The research paper attempts to eliminate contradictions between extreme approaches by creating an effective motivation system of creative activity and forming confidence in its commercial opportunities and results. This discrepancy could be productively comprehended only within the framework of the linguistic and cultural approach, which is based on the specifics study of national conceptual sphere where the concept of “creativity” has its own unique history. Nowadays, this concept becomes the basic unit of culture fixing its organic quality and the ability to self-reproduction. The process of knowledge generation is cyclical, and one of the possible ways of using knowledge is its commercialization. The research perspective is aimed at innovation ecosystems of the universities and their ability to generate and commercialize knowledge. It is shown that the main problems of university innovation ecosystem functioning are the gaps in its internal communications, weak interrelations with the external environment including real sector of the economy. The prospects of the university innovation ecosystem are seen in development and interaction of its basic components, ensuring knowledge generation, its commercialization based on the formation of partnership organizational culture. It is also emphasized that considerable attention should be paid to the development of fundamental knowledge with the students capable of forming their systematic way of thinking and ability for systematic analysis. In addition, the formation of the competences in the field of innovation entrepreneur, technology marketing,

intellectual property security acquires special importance. The formation of these competences must be treated as a compulsory component of higher professional education for engineering specialties. The interaction of these functional constituents of the infrastructure of the university innovation ecosystem should contribute to the reduction of barriers on the way to commercialization of innovations connected with discontinuity of communications between agents, lack of marketing research, ill-developed partnership organizational culture. All this is able to form a technology for universities innovation ecosystems development where an important position will be allocated to the procedure of priorities formation of innovation activities considering the linguistic and cultural approach that takes into account the specificity of the national conceptual sphere.

Keywords—knowledge; innovation process; university; university innovation ecosystem

I. INTRODUCTION

Knowledge has always been playing a considerable role in the life of humankind, but at the modern stage of society development its value is increasing immeasurably. Large-scale changes taking place in the modern world, caused by a brand new stage of development of scientific and technological progress, allows one talking about the fourth industrial revolution.

The basis of the fourth industrial revolution constitutes mass implementation of cyber-physical systems in manufacture and human needs service. Herewith, as Klaus Schwab noted at the world economic forum in 2016, the transition from plain digital technologies to innovations, based on the combinations of technologies the fourth industrial revolution, involves a holistic internal and external transformation of all the systems in all the countries, companies, industries and society as a whole [1]. Large-scale development and combination of new technologies leads to

the fact that worldwide economic growth and social development are more and more determined by the share of production and equipment based on progressive knowledge. Thus, in terms of the fourth industrial revolution development the main production factor becomes human capital and knowledge concentrated in it. Herewith, if knowledge forms the human capital accumulation source, then, getting education is the main way of its formation. The crucial role in knowledge production and transmission is called to be carried out by higher education system. Realization of the assigned task depends in many respects on efficiency of the process of commercialization of intellectual activity results (IAR). In many respects, the development of innovation ecosystem of a higher educational institution facilitates the solution of this problem.

The objective of this study is to analyze the problems of knowledge generation and commercialization as a valuable source of Russia's socio-economic development and searching ways for their solution in terms of innovation ecosystems development of the universities.

II. PROBLEM STATEMENT

In modern conditions, intellectual resources, knowledge constitute the core value and decisive factor in competitive struggle, scientific and technical progress consistency and innovation process intensification are totally dependable on them. Knowledge accumulation, development and management have become the most important task for economic agents of all possible scales, from the state as a whole to a small enterprise. In this connection, it is necessary to consider knowledge essential characteristics as an economic resource.

Since ancient times philosophers have tried to define the concept of "knowledge". One of the first thinkers who tried to create the concept of knowledge was Plato. According to Plato, knowledge is true proven conviction, it is static, can be preserved in books or people's heads, but it needs "reviving force". Since then, the understanding of knowledge has undergone changes and at present, it is possible to distinguish several approaches to the definition of its content. So, in scientific proceedings of Socrates, Aristotle, F. Bacon, I. Kant, G. Hegel there is an understanding that knowledge accumulates and encodes public strength of man [2]. A. Smith stressed the importance of professions related to the production of "economically useful knowledge". A. Marshall considered knowledge as the necessary factor for the implementation of entrepreneurial activity providing acceleration of the changes and importance of "new inventions" for expansion and improvement of production efficiency. In the model of economic growth by P. Romer knowledge has become the main parameter of the study. He presented knowledge as a higher unit that manages the capital use, technology development and labor qualification [3]. The given theoretical studies are confirmed by practice: according to Fortune magazine rating, nearly half of Fortune1000 companies pays significant attention to knowledge management and continues developing it as a systemic mechanism.

III. NATIONAL APPROACH SPECIFICITY

Activation of knowledge generation and commercialization as a constituent part of innovation process is an urgent problem for Russian economy on account of innovation activity reduction in recent years. Thus, according to NRU, the Higher School of Economics [4, p.19] it is marked the reduction in specific weight of organizations engaged in technological innovations to 9.5% in 2015. In 2000 that significant constituted 10.6%. Even greater gap in this significant (indicator) is typical of organizations whose activities are connected with the use of computing and information technologies - 9.4% in 2015 and 12.1% in 2000. Within this group of organizations, specific weight of innovation products and services has also significantly reduced in the total volume of goods shipped - from 16.9% in 2000 to 4.3% in 2015.

The decline in innovation activity in this group of organizations can possibly have a negative effect on the dynamics of digital economy development, which is a fundamental part of the forth industrial revolution architecture. Thus, under the need to increase innovation activity the main economic growth driver becomes its ability for production and knowledge management, and the key element of implementing this process are universities. Modern universities have to carry out not only their classical function – to be the guarantor of universal values and cultural development, but they have to make significant contribution to knowledge-based economy by means of commercialization of science-research activity results.

Therefore, the process of knowledge management at the university comprises two main components – its generation and commercialization. The process of knowledge generation is a process of its creation by processing information on the basis of common knowledge [5]. Meanwhile, the process of knowledge generation can be formed as the restoration of common knowledge from information in the flow of the learning process, as well as creation of new knowledge on the basis of common knowledge during its connection with personal experience and personal characteristic features (for instance, within the framework of the research).

Such personal characteristic features are fixed in the notion of "creativity" which has many definitions in modern science.

Thus, creativity is often treated as individual multi-level complex of personal properties that generates special creative behavioral model as an innate talent which determines the ability to generate new knowledge. This behavior involves non-standard thinking, the ability to detect deep-seated problems and find alternative approaches to problem solving.

However, real organizational practice is oriented towards a different understanding of creativity. Within the framework of this understanding, which is actively followed by some scientists, it is believed that the determining basis for creativity development is socio-cultural environment of a person which determines the corresponding forms of thinking and cognitive processes. In its extreme form, such position is

embodied in the formal-bureaucratic approach to the knowledge generation problem.

The idea of development of the university innovation ecosystem is based on the idea of discrepancy removal between these approaches by creating an effective system of creative activity motivation and building confidence in its commercial opportunities and results.

This discrepancy could be productively comprehended only within the framework of the linguistic and cultural approach which is based on the specifics study of national conceptual sphere where the concept of "creativity" has its own unique history. Moreover, today this concept becomes the basic unit of culture fixing its organic quality and the ability to self-reproduction.

So, the process of knowledge generation is cyclical, and one of the possible ways of using knowledge is its commercialization. As a rule, what is subjected to commercialization is formal knowledge, which can be intellectual activity results (IAR). Under commercialization of IAR at the university one can understand the process of transformation of Research and Development (R&D) results, preserving their market relevance and topicality, into products and services on the market with the aim of generating income from their sale, licensing, or independent use [6, p.385].

Herewith, the commercialization process implies search, assessment and selection of promising projects and developments as the results of intellectual activity for financing, fundraising, legal allocation of rights to IAR, its implementation into production, and further modification and maintenance of the manufactured product. In accordance with the current Russian legislation the commercialization of IAR at the university can be carried out through the execution of registered R&D with further patenting, by means of alienation of exclusive rights to the use of IAR by legal entities and individuals and through the creation of small innovation enterprises (SIE). However, commercialized can become informal knowledge, for example, in the form of consulting services implementation. In addition, informal knowledge, transmitted in the process of learning, interaction in the process of research work, affects directly the acquisition of formalized knowledge.

However, each of the enumerated commercialization methods of formalized knowledge or IAR presents certain problems for Russian universities.

Thus, the procedure of granting rights to the use of IAR and alienation of exclusive rights is not sufficiently developed in comparison with other countries. More than that, in Russian practice, a negative trend to reduce the number of contracts of alienation of patents and licensed agreements has appeared. In 2014, their number decreased to 5% as compared to 2013. One of the main causes of the low level of license market development is the lag (retardation) of Russia in the development of experimental-industrial production in comparison with the countries of the developed technological market.

This lag is largely connected with the breach in chain "fundamental science - applied science - implementation of

technologies" and a low level of technology implementation: only 9.5% in RF in 2015, that is considerably lower than that of Germany (70%) and even of Estonia (55%) and the Czech Republic (36%). Foreign experience indicates a relatively successful experience of the universities in the field of IAR commercialization through licensing. According to foreign studies, universities possess more than half of the patents of the license agreements [7].

In Russian economy, the share of state-owned enterprises, science-research institutes and universities, which have signed the contract on alienation of exclusive rights to inventions, patents, industrial samples (models), within the period from 2009 to 2012 had the tendency to increase, and then, in 2014 to decrease. In 2014, the given indicator increased by 6.43% if compared with 2013. For domestic universities, the most widespread way to commercialize intellectual property has become the creation of small innovation enterprises at the universities [8].

However, despite the perfection in legislation, aimed at improving investment attractiveness of small enterprises and flexibility of the processes of IAR commercialization in the universities, the activity of the latter in the creation of small enterprises has noticeably declined. In 2015 there were created small enterprises by 38.8% less than in 2014 and by 71% less than in 2010. All existing SIE at Russian universities can be conditionally divided into three groups: existing, formally existing in the form of a legal covering and those in a transitional state. Hereby, in most cases the latter two groups predominate.

On the whole, deterioration of the key indicators of IAR commercialization in universities is a reflection of the decline in their innovation potential due to the following reasons:

- ▣ scientific research and developments of the universities are often torn off from the needs of real sector;
- ▣ the activity of developers and agents of innovation university infrastructure is often only formally focused on the commercialization of innovations, but actually just on the writing of reports;
- ▣ the algorithm of the process of commercialization is nonexistent whereas the existing agents of innovation infrastructure are weakly interconnected;
- ▣ in universities there is no effective system of motivation and stimulation of researchers in IAR commercialization;
- ▣ entrepreneurial culture is not sufficiently developed in the universities.

IV. FORMATION OF UNIVERSITY INNOVATION ECOSYSTEM

The process of generation and commercialization are inseparably connected. Thus, on the one hand, knowledge commercialization is impossible without its creation. On the other hand, the objective of commercialization process is profit which, in its turn, can serve as a source of new research and knowledge emergence. Besides, in the process of knowledge commercialization comprehensive marketing

research is carried out which can also serve as a source of new knowledge. In this regard, for further successful systematic process of knowledge commercialization and generation favorable environment, adequate infrastructure and effective communications, including those with the external, environment, turn out to be of vital importance. The mentioned above forms the need for the creation of university innovation ecosystems contributing both to knowledge generation and commercialization in their inseparable unity.

The processes of generation and commercialization are inseparably connected. The notion of "ecosystem" was introduced into scientific circulation by English botanist A. Tansley; by this term he understood any set of jointly inhabiting organisms and their environment [9]. In other words, an ecosystem is a system of energy exchange, interrelations between its participants. Identification of the problems and simulation of the prospects of innovation process development, which is based on knowledge generation and commercialization, allow the best application of ecosystems concept.

The new mission of the universities is becoming a capitalization of knowledge [10, p.239]; therefore, the main directions of their work should become transfer of the results of intellectual activity, technologies into the sector of production of goods and services as well as topical scientific and scientific-technical tasks into the sector of research and developments. To solve the assigned objectives higher educational institutions must possess the necessary components which, on the one hand, will form abilities, skills, experience, competencies for innovations implementation and enterprise management, and, on the other hand, contribute to resources formation for reproduction and constant development.

Thus, ensuring effectiveness of knowledge generation and commercialization at the university can be achieved through the formation of an innovation ecosystem. An innovation ecosystem of a higher educational institution is a complex of interrelations of the agents of an innovation process with the aim of innovations commercialization. By analogy with a biological ecosystem, the activities of the agents of the innovation ecosystem can be characterized from the point of view of their communion to certain "ecological niches". To the main agents of the innovation ecosystem can be referred the following:

- ▣ the customers, who form demand for innovation products;
- ▣ the developers of innovation ideas;
- ▣ the institutions of innovation infrastructure of the university (business incubators, centres for technology transfer, management of intellectual property protection, etc.).

The innovation ecosystem of the university is an open system which occupies a certain place in a larger ecosystem, where partnership relations with the university are formed. In the basis of the university innovation ecosystem lies the principle of competencies interaction of its participants. At the same time the innovation ecosystem of the university, even possessing all the necessary infrastructure components, will

not be effective if in the future the resources, invested in research, will not be embodied into innovations, which make a profit, what, in its turn, is reflected in the commercial format of the university.

Characterization of the agents of the innovation ecosystem infrastructure can be considered from the point of view of knowledge generation and commercialization: from scientific ideas generation and development to asset formation and from assets to market transaction. D. Jackson [11] notes that the basis of any innovation system model should contain two interrelated components, one of which is aimed at providing scientific research and developments, and the other - at supporting and stimulation of the process of commercialization of intellectual activity results.

The second component of innovation ecosystem institutional composition takes into account the dynamics of complicated relationships, which are formed between its elements, whose functional task is to ensure the promotion of innovations, the provision of access to business acceleration services, the organization of access to financing on the part of business-angels and funds of pre-seed and seed investments. The majority of Russian universities has a sufficient number of structural departments which provide scientific research and developments. However, the components aimed at supporting and encouraging innovations are often not suffice. So, among nearly 200 business incubators functioning presently only 28% are created under the jurisdiction of the universities [12, p.3]. Besides, the existing agents of the innovation infrastructure function inefficiently and discretely, what is confirmed by the low level of commercialization of intellectual activity results in Russian universities.

As an example of a developed innovation infrastructure, the experience of Don State Technical University (DSTU) can be given. Considerable attention is being paid by DSTU to the process of building of the innovation infrastructure for the development of commercialization of intellectual activity results since 2011, when the Program of development of the innovation infrastructure "The development of infrastructure complex "Innovation Interface of the South of Russia" was elaborated.

Currently, the university is implementing the program for basic university development which, in its turn, required the activation of its innovation ecosystem development. The elements of university innovation ecosystem are represented by its structural departments aimed at knowledge generation as well as support and stimulation of intellectual activity results commercialization (Table 1). A number of elements of university innovation ecosystem (intellectual property management, endowment fund, accelerator, business incubator) are the participants (or contribute to) of the process of knowledge generation and the process of its commercialization and, in fact, are the link between these processes.

However, while comparing the components of DSTU ecosystems with the leading universities in Western Europe, it can be noted that the latter are not always have business incubators. Innovation ecosystems of leading US and British universities, as a rule, have venture capital funds and seed

investment funds [13]. However, the main mechanisms contributing to successful innovation commercialization at the universities of the US and Western Europe are considered to be mentoring, technology transfer centers and startup competitions [14, p.40]. The predominance of mentoring among the most significant mechanisms for innovation commercialization provides ample evidence for the importance of non-formalized implicit knowledge for the entire innovation process.

In Russian practice, the major problem of university innovation ecosystem functioning is the lack of unified standards for all its subjects' activity and their weak interrelationships.

Generalized analysis of the strong and weak points of knowledge generation and commercialization mechanisms within DSTU innovation ecosystem is given in Table 2.

In general, it should be noted that the barrier hampering the interaction between the subjects of university innovation ecosystem is the gap in communications between the developers' community and the industry, the gap between the profile divisions as well as between the profile divisions and the developers' team. Applied research works are detached from potential customers' needs of real sector economy as they are often initiated by the developers in the framework of carrying out a dissertation research or scientific grants [15].

In Europe, the issue of forming a dialogue between science and business is achieved through the formation of a network in which the request of private corporations to scientific community for the solution of specific technological tasks is carried out. Since recently there outlined a tendency towards decentralization of developments and involvement of scientific community into the corporate research process. Open queries of Procter & Gamble to chemical laboratories, the project of Roche with ChemRar, as well as an entire software industry with open source code which is successfully used by Redhat, IBM, Google and other companies can serve as examples of such models. Large companies set directions of research which can be "caught up" by those who wish.

V. CONCLUSION AND FURTHER RECOMMENDATIONS

In the authors' opinion, such functional constituent must be in the innovation infrastructure of the University along with the components for the provision of scientific research and their commercialization which would contribute to the formation of partnership organizational culture and "entrepreneurial virus" with the students. At the same time, considerable attention should be paid to the development and transfer of fundamental knowledge to the students capable of forming systematic way of thinking towards them (for example, in the sphere of systematic analysis, system management). It is also compulsory to form the competences in the field of innovation entrepreneur, technology marketing, intellectual property security. The formation of these competences must be secured as a component in the educational programme of higher professional education for engineering specialties as well as through regular advanced professional training of employees and administrators of university innovation infrastructure elements. The interaction

of these functional constituents of the infrastructure of the university innovation ecosystem should contribute to the reduction of barriers on the way of commercialization of innovations connected with discontinuity of communications between agents, lack of marketing research, ill-developed partnership organizational culture.

Thus, the prospects of development of the innovation ecosystems of the universities, contributing to successful IAR commercialization, are seen in realization of the following directions:

- ② the formation of precise priorities of scientific and innovation activity with consideration of the linguocultural approach and national conceptual sphere specifics;
- ② the interaction consolidation between different elements of the University innovation ecosystem;
- ② the development of relationships with venture capital funds and investors;
- ② the development of cooperation with enterprises of real sector of economy, including through active marketing resources of the University;
- ② the active search for projects, teams, and competences;
- ② the development of partnership organizational culture and competences of innovation entrepreneurship.

TABLE I. INSTITUTIONAL COMPOSITION OF THE OF THE UNIVERSITY INNOVATION ECOSYSTEM FROM THE PROCESSES OF KNOWLEDGE GENERATION AND COMMERCIALIZATION STANDPOINT

Elements		
Processes	Knowledge Generation	Knowledge Commercialization
Structural departments - elements of University innovation ecosystem	Chairs, research laboratories, centers of excellence, scientific-educational centers, Scientific Research Management Department	Industrial co-working "Garage", technology transfer centers, Commercialization Management Department, Southern Center for Mechanical Engineering Modernization, SIE
	Intellectual Property Management, endowment fund, accelerator, business incubator	

TABLE II. FACTORS OF DEVELOPMENT OF GENERATION AND COMMERCIALIZATION MECHANISMS WITHIN UNIVERSITY INNOVATION ECOSYSTEM

<i>Generation and commercialization mechanisms</i>		
<i>Mechanism</i>	<i>Strong points</i>	<i>Weak points</i>
Knowledge generation	<ul style="list-style-type: none"> - a wide range of scientific and educational directions; - growth of R&D volumes; - cooperation with leading Russian and foreign universities and scientific centers; - availability of highly qualified teaching staff and the system of attracting young scientific-pedagogical workers 	<ul style="list-style-type: none"> ⊠ a relatively low number of scientific publications citation; ⊠ outdated laboratory and technical base in a number of directions; ⊠ low motivation of the staff in research work implementation as well as the results of the work itself; ⊠ the dominant involvement of the teaching staff in the educational process in comparison with scientific and innovation activities; ⊠ insufficient availability of scientific-pedagogical workers for the implementation of new scientific directions
Knowledge commercialization	<ul style="list-style-type: none"> - availability of advanced developments in the field of technology transfer organization; - availability of connections with a number of subjects of real sector of economy and regional innovation infrastructure 	<ul style="list-style-type: none"> ⊠ low relative proportion of research results implementation in real sector of economy; ⊠ absence of motivation system and stimulation of technology transfer on the part of developers; ⊠ insignificant income volume from innovation activity within the structure of university's income

References

- [1] K.Schwab, The Fourth Industrial Revolution. Moscow: "Exmo", 2016.
- [2] B.Z. Milner, 'Knowledge Management in Modern Economy', Problems of Management Theory and Practice, № 9, pp. 8-13, .2006.
- [3] P.M Romer,. "Increasing Returns and Long-Run Growth", The Journal of Political Economy, October, 1986. pp.1002-1037.
- [4] I. Kuznetsov, "Crisis to Innovations – Isn't helpful", Economy and Life, No. 11 (9677), 2017.
- [5] I. Nonaka, H. Takeuchi,. Company is the creator of knowledge. Genesis and development of innovations in Japanese firms, Moscow: Olimp-Biznes, 2003.
- [6] Y.V.Bganceva, M.A. Kovazhenkov, "Innovation strategy of management of university intellectual property commercialization", Economic Sciences, №9 (58), 2009.
- [7] Yonghong Wu, Eric W. Welch, Wan-Ling Huang, "Commercialization of university inventions: Individual and institutional factors affecting licensing of university patents", Technovation, No. 36-37,pp. 12-25, 2015.

- [8] S. Makarov, E. Ugnich, "Business-catalyst as Drivers of Regional Innovation System", Foresight-Russia, No 1, vol. 9, pp.56-67, 2015.
- [9] A.G. Tansley, "The use and the abuse of vegetative terms and concept" Ecology, No. 16 (3), pp. 284-307, 1935.
- [10] H. Etzkowitz, "Innovation in Innovation: The Triple Helix of University-Industry-Government Relations", Social Science Information, No. 42 (3), pp. 293-338, 2003.
- [11] D. J. Jackson What is an Innovation Ecosystem? National Science Foundation, Arlington, VA, 2011 - <http://urenio.org/wp-content/uploads/2011/05/What-is-an-Innovation-Ecosystem.pdf> (12.02.2017)
- [12] O. Arkhangelskaya, E. Panasiouk "Problems and solutions: business-incubators and technology parks in Russia". Moscow: RVC, 2014.
- [13] B. Mercan, D. Goktas, "Components of Innovation Ecosystems: A Cross- Country Study", International Research Journal of Finance and Economics, No76, 2011.
- [14] Technology commercialization at early stage: universities, corporations, the state. M.: RVC, 2015.
- [15] I. Boguslavskiy, E. Ugnich, "The influence of organizational culture on the formation of venture ecosystem in Russia", vol. II [SGEM International multidisciplinary scientific conferences on social sciences and arts: Conference proceedings. Finance; 3-9 Sept. Bulgaria, Albena, 2014.