Logistical approach to universities integration in the Russian innovation economy

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Abstract. New stage of economy development requires from universities implementation of new function, providing acceleration of interaction among main actors in national innovation system. The main factors of activity and efficiency of higher schools are sufficient funding and stimulating policies of the government. We have reviewed last world indicators of R&D financing and the structure of such financing. Also we have examined the existing approach to interpreting the new integration function of universities, offered our vision and showed the location of such function in a triple-helix model. In the end we have described the practical example of carrying out integration function by high school. It could be proved that the universities should be considered as the logistics integral providers acting as coordinating of both the government and the business agents in economic relations.

1 Introduction

Professor Kalinina O. V. developed a concept of the progressive scale taxation as universal mean for social orientated measures [1] which could be treated as innovative driver in knowledge-based-economy. Our hypothesis is the following: low innovative activity arises due to the non-use of the university factor. In a society based on knowledge, a triple-helix model plays a key role in innovative development. It is a close interaction of universities, government and business. The triple-helix is an exceptionally successful find, since the parallel becomes evident between the innovation system and living organism or ecosystem, there is the need to harmonize the relationships of individual branches of each helix and their joint aspirations to a general goal.

A group of American scientists led by the Dutch scientist Loet Leydesdorff [2] applied the information-theoretical approach based on the K. Shannon entropy calculations to their research of the American economy’s knowledge base and calculated the synergy of innovations, which is expressed in the negative value of entropy.

This approach was also used to study the national innovation system of Hungary [3], Germany [4], Sweden [5] and China [6]. According to the methodology, innovation based on knowledge can arise from repeated combinations of technological opportunities, market

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prospects and geographic advantages, or limitations. On the basis of Shannon's information theory, the uncertainty of a system with two variables $x$ and $y$, taking into account the relative frequency $p$, can be calculated that way:

$$H_{xy} = -\sum_{xy} p_{xy} \log_2 p_{xy} \quad (1)$$

In the event that two variables interact with one another, the uncertainty of the system is reduced in triple-helix relations through joint information and is found by the formula:

$$T_{xy} = (H_x + H_y) - H_{xy} \quad (2)$$

When three variables interact, the synergy is calculated as follows:

$$T_{xyz} = H_x + H_y + H_z - H_{xy} - H_{xz} - H_{yz} + H_{xyz} \quad (3)$$

The result is measured in bits of information and in this case it can turn out both positive and negative. When the value is positive, the historically observed variation prevails, with a negative indicator, excessive information is generated, which implies maximum entropy, and subsequently the relative uncertainty is reduced by adding previously unrealized options to the system. The increase in the number of options for further development plays an important role for the viability of the innovation system. L. Leydesdorff on the basis of this methodology provides a variant of dimension of the economy’s knowledge base in a model of triple helix [7], studies as an example for calculating the synergy of knowledge.

Russian scientists using this methodology have calculated the knowledge base of Russia’s economy [8]. According to the research, the main innovation potential is realized by large companies, while at the level of small business innovation activity is low despite the high demand for innovations. When the sectors are decomposed according to the criteria of the science intensity, it is seen that, production with high and medium level of technology is not integrated at the regional level. Companies with an average level of technology make a greater contribution to integration at the district level than at the national level, while high-tech companies influence the innovation process primarily at the national level (i.e. in Moscow). Thus, our hypothesis on the need to increase the importance of the university factor, which is capable of activating innovation activity at the regional level, is confirmed.

The model of the triple helix adequately determines and measures the relationships of the participants in the innovation system, namely, the authorities, business and university, through which, as famous economist L. Leydersdorff assumes, the synergy or integral effect of innovation achieves [2]. There is not one example in the world where the national innovation system operates effectively outside the principles of the triple helix, wherever universities are not at the center of these events. The logic of reliance on universities is simple – just due to the efforts of young generation a new economy can be built. These people are only in one place - in universities, therefore, it is exactly that place, first of all, where the resources for the development of innovative processes should be concentrated [9].

The effectiveness of the academic environment could be understood from the point of view of logistics provider like logistical integrational services in coordination of the efforts of the number of agents taking part in economic relations for the purpose of achieving summary result, in other words, the development of the sphere of science and education directly depending on the several factors (sufficient funding, employment of personnel, relevant administration, legal restrictions) qualifies for the integral coordination of agents from both the government and the business areas. Such approach includes the theory and methods of logistics as the science of coordinating of different resource flows and wide known achievements of innovation theory.
The world leaders among the countries that have the greatest value of R&D expenditure as a percentage of GDP are countries such as Israel, South Korea, Switzerland, Sweden, Japan, Austria and Denmark, whose indicators in recent years have exceeded 3-4% of GDP. As we can see in Fig. 7, even in the USA, where the world's largest investments in research and development are invested in the country's gross domestic product, these expenditures account for about 2.7% of GDP, in China about 2% - this can be explained by the large volumes of GDP in absolute amounts compared with the GDP of South Korea, Israel, Switzerland and a number of other countries, as well as a fairly high population of China and the United States. Russia has extremely low position in this list, investing only 1.1% of GDP in research and development.

Despite the direct dependence of innovation development on R&D financing, in many countries with developed innovative ecosystems, the scientific and educational policy is aimed at the gradual reduction of state financing, which ultimately forces universities to work with industry. Comparison of Fig. 1 and 2 shows that in countries with the largest share of R&D expenditures (for example, South Korea, Israel, Finland, etc.), much larger funds are attracted from industry, rather than from the state.

It is seen that business actors actively participate in financing research and development work in various countries. In countries such as Japan, South Korea, China, Germany, the United States, the share of business in financing R&D is several times higher than government funds and accounts for more than 60-70% of the total amount of financial support. The activity of business entities in financing innovative activities in these countries was achieved thanks to a favorable investment climate in the country, widespread use by governments of methods of financial stimulation of innovation activities, which reduced the burden on the state budget of these countries.
Many experts are sure that it is universities that must take responsibility for the formation of a new technological order both in terms of equipping the economy with qualified personnel and technological development. Attention should be paid both to improving the quality of the work of universities in the field of research, and everything related to the transfer of these results to the real economy.

As a new stage in the development of society endows knowledge with a great power in social life, the main creators of which are primarily universities, the university should implement a new function in modern conditions as integrators. By "integration function" is understood the organization of the processes of elements' interaction in a complex system in order to ensure its development. In a particular case, we consider information interaction, which is a process of co-production, exchange and transfer of knowledge. The University plays the role of a leading participant and an organizational mediator for the cooperation of the academic environment, business environment and power structures. The main goal of this cooperation is the unification of efforts to solve interdisciplinary problems in the educational and scientific spheres, as well as activities aimed at the introduction of innovations.

2 Experimental section

Russian scientists [12] already argued for the integration function of universities as a necessary phenomenon in the context of the rapid innovative development of society, thanks to which all innovative processes occur in the shortest possible time and are highly effective. Being an integrator, the high school provides its internal opportunities for organizational cooperation, as well as creates external organizational networks of information cooperation. Regarding the integration function, one should consider that not merely a lot of bilateral cooperation with various partner organizations, but, first of all, providing the opportunity for interaction between partner organizations on an intellectual university basis, which acts both as a participant and as an intermediary, as an interaction catalyst.

However, despite the fact that Groudzinski A.O, Strongin R.G. and Maximov G.A. have detected yet another such important role of higher schools as integrators in the modern economy, their work lacks the vision of a triple helix, which is the basis of any progressive innovation system.
Due to the university factor, tri-lateral networks are built in the triple helix model, which contribute to the fastest and most effective commercialization of new technologies in the innovation economy (Fig. 1).

**Fig. 3.** The Leydesdorff’s original triple Helix Model of University–Industry–Government Relations [13].

According to the Dutch scientist Leydesdorff, the innovations come about in the following way: the institutional spheres in the triple helix model partially overlap each other, people from different spheres meet, and new ideas are created. Thus, such a model becomes balanced. Institutional spheres fulfill their traditional roles, but they also acquire new functions (Fig.1). We, in turn, would like to show the cumulative role of the university factor in the process of interaction between the entrepreneurial, government and R&D spheres, since just at the borders of the intersection of the three spheres the integration function actively acts, managing and organizing the interrelations in the most efficient manner, generation of the maximum possible amount of new knowledge (Fig. 2).

**Fig. 4.** The sphere of active participation of universities’ integration function in innovation processes.
In according to Leydesdorff triple helix theory, each strand is related to the other two creating a new layer of communications, networks and organizations inside the model (Fig. 3). Due to his network of relationships, innovative strategies, and projects are generated adding surplus value by reforming and adapting infrastructure in process of achievement main goals.

Fig. 5. The overlay of communications and expectations at the network level guides the reconstruction of institutional arrangements in the accordance with the Leydesdorff’s theory [13].

In the triple helix the integration function of universities connects three dynamic and constantly developing actors (authorities – academia – business) of the innovation economy as a common thread (Fig. 4), so the locus is determined in the center of the model, like a nucleus, energizing all the drivers to build an overlay of communications, networks, and organizations among the helices. While the helices of institutional spheres are continuously developing and transforming new information, the integration function, not falling behind, is being modernized and adapted to new conditions, helping to interact actors at each level of their development. Universities in the process of implementing the integration function create based on digital technologies innovative schemes for the transfer of knowledge, new methods for calculating the attractiveness of common projects with the industry, increasing the return on investment, universities are responsible for management innovations during the integration process and monitor compliance with intellectual property rights.
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Fig. 6. The locus of integration function in triple-helix model.

Universities integration function could be interpreted as a flow of knowledge being created and relevantly supported by the efforts of universities. Thus, due to the integration function of universities, the most favorable supportive environment for the implementation of innovation activity as a whole arises. This favorable supportive environment represents innovation ecosystem, in which the participants of innovative process interacting with each other achieve a synergistic effect. Innovative ecosystems built on the collaboration are considered as successful innovative ecosystems. At the heart of a successful ecosystem is the network organizational structure [14]. One of the main tasks of any state now is to build an innovative ecosystem in its country. In order to make the mutual participation of the main actors in the innovation environment more effective, it is necessary to identify their mutual interests, which represent certain needs that can be successfully met due to participation in innovation activities, and develop an effective system for simulating this kind of activity. Incentives for the production of innovations become sustainable if actors can create unified communications networks on the basis of profile platforms and develop collaborations in the format of triple spirals. Triple helices endow systems with the property of self-adaptation to any external changes, allowing them to move forward on the basis of self-development, without the participation of the managing center.

3 Results and discussion sections

The Department of Advertising and Public Relations (APR), a part of the humanitarian institute of the Peter the Great St. Petersburg Polytechnic University, is a clear example of an educational structure that performs the function of an integrator.

In the process of fulfilling the integration function the department of the APR concluded, long-term cooperation agreements were with companies and agencies operating
in the St. Petersburg market for active interaction in the educational and scientific spheres, allowing to observe the balance of interests of partner organizations and trainee students.

This cooperation includes the passage of students in the Department of Internships in these organizations, the invitation of practicing speakers for conducting master classes, open lectures, practical classes, as well as joint conferences with academic staff and employees from partner companies. Particular importance is attached to the implementation of real projects in the field of advertising, marketing and PR at the request of companies within the framework of dispersed project practices.

The project activity at the Department of Advertising and Public Relations is realized in the process of preparing bachelors (in the third year of preparation) and masters (in the first and second year of preparation) within the framework of a dispersed practice with the aim of forming a portfolio of individual achievements of project participants and integrating future specialists into business environment.

At the department of "Advertising and public relations", the rules of the project activity (project dispersed practice) have been developed and approved, which allows to control the process of organization and management of projects.

It could be proved with certainty that after the students have passed the projected dispersed practice, the theoretical positions acquired during the lecture and seminar sessions, as well as in the process of independent work, are tested in practical studies at enterprises, in advertising, communication and marketing agencies. On the basis of the personal experience students can create the required professional skills and simulate the situation of work in the chosen specialty. Qualitative approach to the selection of projects determines the competitiveness of the future specialist in the labor market.

Thus, the Department of Advertising and Public Relations makes a significant contribution to the development of higher education and empowers graduates of the department with human capital that can create high added value in the future workplace.

4 Conclusions

All of the above confirms our hypothesis as nowadays the main aim is to move universities to an absolutely new level of interactions, responsibilities and creation new knowledge. In the following works, we plan to calculate the effectiveness of the integration function of the presented academic structure with business enterprises and thereby justify the importance of fulfilling the integration function for the economic system as a whole.

References

2. Synergy in the Knowledge Base of US Innovation Systems at National, State, and Regional Levels (TLevels)