

Education Clusters in Fostering Innovation Security: Experience of Rostov and Kaliningrad Regions in Western Russia

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Abstract-The article is devoted to the urgent problems of innovation development and innovation security of border regions, focusing on the regions of Western Russia. The purpose of the paper is to trace the interrelations between economic, innovation and educational clustering in the situation of geo-economic turbulence and instability. These inter-organizational interactions are viewed to be one of the factors to increase regional innovation security. The research objective is to highlight the integrative role of the education system for the innovation economy of the regions. The comparative analysis of the experience of the self-sustained South-West (Rostov) region and the deeply integrated into European space North-West (Kaliningrad) one enables the researchers to identify the main factors of reaching innovation security via self-organizing cluster mechanisms. The results and the findings of the study (including the positive clustering experience) are to be used in the decision-making within regional governance.

Keywords-education clusters, innovation clusters, regional innovation security, Western Russia

I. INTRODUCTION

The recent situation of geo-economic turbulence caused the high risks for the innovation development in border regions. Being deeply included into the international division of labor, border regions are suffering from the lack of interaction with neighbor territories. This situation, especially urgent in the 'Russia-West' system, is realistic for both general economic interrelation and innovation-technological one. That is why the innovation security of border region in the conditions of geo-economic changes is the problem of significant relevance, as it is for the Western border regions of the modern Russia.

The issue of innovation security is in the focus of the numerous studies. Its interdependence with the structure of innovation system of a region and the specialties of innovation development are viewed by T. A. Achkasova, B. T. Asheim, V. L. Baburin, M. P. Feldman, M. S., Gertler, V. V. Ivchenko, I. V. Pilipenko, A. N. Pilyasov, Yu. Yu. Rosich,

S. P. Zemtsov, N. V. Zubarevich and other. The specific features of innovation security in Russian regions, including tacit knowledge, existing institutions and the role of human capital, is studied by A. V. Bagryakov, I. M. Golova, A. A. Kuklin, A. A. Mikhaylova, A. L. Myzin, N. L. Nikulina, A. I. Tatarkin, K. Y. Voloshenko and other researchers, the most of them belong to the Ural school of economic and innovation security studies [1], and to the Baltic one [2, 3]. On the one hand, these studies provided the pattern of evaluation and indexation of innovation security that includes indicators related to the regional education system such as the number of graduates and PhDs of higher education Institutions (HEIs) or the percent of highly-qualified personnel. On the other hand, such indicators mostly give the general quantitative evaluation without taking into account qualitative and structural interconnections between education, innovation and economic production systems of a region, including structural entities in the each of these spheres. The latter mostly relates to the clusters and proto-clustering structures that tend to synchronize producing, scientific and studying processes and integrate business and education structures.

The phenomenon of educational cluster is in the center of interest for the growing number of researches. The possibility of clustering in the educational sphere and its specifics comparatively to the production sphere became obvious for M. Porter being the author of economic cluster concept [4], as well as for his successors such as A. Artiganave, M. T. P. Gi, J. Kelly, N. Ketelhohn, M. Krasniqi, and L. Zhang viewing the experience of Massachusetts Higher Education and Knowledge Cluster [5]. Some studies in this sphere were inspired by the cases of educational clusters developing in the USA and European countries, especially in France where education system plays the integrative role for each regional society [6]. The main interest of Russian researchers in this sphere is to construct the theoretical and methodological concept of regional educational cluster [7, 8, 9], as well as to find out the possibilities to implement foreign experience adapting to the

Russian regional specifics [6, 9]. Such studies are focusing on both economic and social regional development, as well as on the ways to organize innovation activity in HEIs, but mostly revise educational clusters as they are, without their relation to other market sectors. That is why there is a need in complex research designed to trace the processes of mutual clustering.

II. CHALLENGES AND THREATS TO REGIONAL INNOVATION SECURITY IN THE SYSTEM OF GEO-ECONOMIC TURBULENCE

A. *Regional Innovation Development: Factors of Insecurity*

Innovation security, viewed to be the structural component of the general economic security, has its own specifics and is much more sensitive to internal and external instability in both production sphere and scientific-technological one. This feature is uncovered in the turbulent situations. When border regions lose their previous markets, partners or subcontractors that belong to the lower links of the added value chain, they are more likely to redistribute the market flows to internal national demand or to change the main vector of international partnership and subcontracting. This statement is proved by the recent practice of the most of Russian border regions, turned their international activity from the West to the East. One of the most significant examples is Rostov region. In the period after the negative shift in international relations this region not only maintained its leading positions in the production in the profile industries (the share of agriculture in the GRP raised from 10,6% in 2013 to 13,6% in 2015, and the share of manufacturing raised from 17,5% to 17,9%, and the share of building industry – from 8,4% to 9,2% respectively, while the GRP performed the increase from 917.688,1 to 1.171.784,1 mln. RUR during this period [10]), but also tries to maintain its role of export-oriented region.

But in the case of innovation activity the critical mass of internal potential is often not enough for the competitive development. Also the high links of added value chain are represented not in every region, so that they not always can be effectively substituted by the participation of new partners from other countries or other regions of the same country. The transactional costs to find the new partner in the sphere of innovation are much greater than in non-innovative production and trade. That is why in the situation of geo-economic turbulence the main factors of innovation insecurity associated with the internal self-insufficiency are: the lack of internal regional organizational potential and human resources for innovative activity and development, the lack of the license agreements to use exported high technologies in regional production, the lack of hi-tech equipment and soft and, finally, the gaps emerging in the added value chain when the stages of the innovation production process are not still available. Another group of factors is related to market issues such as lack of demand at the local market of innovations and innovative production, the unavailability of previous external markets, as well as

disconnection between the regional labor, capital, information, technologies and innovation production markets.

B. *Self-Organizing Mechanisms of Overcoming Innovation Insecurity*

The ability to overcome or, at least, minimize the negative factors of innovation insecurity depends on both quantitative regional potential in the research and development, productive and marketing spheres, and the qualitative synergy of restructuring and self-organizing. This processes are associated with the creation of the new level of regional economic system and represented by the cooperation of enterprises into regional innovation clusters maintaining internal market competition that stimulate their development. Being in its nature self-organizing process, clustering is sensitive to the initial conditions [11]. As a result, the first integrative possibilities that give the impetus to cooperation, determine the future structures and their ability to be competitive at local, national and global innovation market.

Clustering trends take place mostly in the regions and economic sectors where the organizing role of the state policy and government is not stronger then the crisis trends and risks. The direct governmental support becomes the platform for integration, the lack of the markets compensated by the state order for innovation, and the lack of technologies covered by state investments and conversion from the military sphere to civil one. It takes place in the most strategically important direction of the national innovation development, but the state target programs of support do not cover all the internal need in maintaining innovation security in regional practice. That is why regional societies are seeking for other integrative platforms to become the cores of clustering for innovative enterprises. Educational bodies become one of the most important links in this chain in Russian border regions [12], as they have internal potential for both educational development of human resources and scientific activities which can be transformed into innovation generation. On the one hand, educational sphere can represent a separate cluster (or a series of clusters crystallized at the basis of big regional HEIs), on the other – it creates the conditions for innovation clustering which is external to the educational structures as they are but there takes place mutual clustering.

III. EDUCATIONAL SYSTEM BECOMES THE PLATFORM FOR INNOVATION AND ECONOMIC SELF-ORGANISATION

A. *Experience of Educational-Innovation Clustering in Rostov Region*

Rostov region has been tending to clustering since 1990s. Three generations of clusters have appeared in this region to the moment [12]. During the self-organizing of the first one (represented mainly by the profile agricultural productions) and the local governmental attempts to form clusters of the second generations (in the sphere of machinery), regional

educational organizations tended to form proto-cluster entities. During the 2000s in the conditions of internal instability and education reforms the exchange of human resources intensified in the regional educational system, as well as the need for restructuring, optimization and enlargement of HEIs became the obvious direction of the regional educational management. It embodied in the formation of South Federal University that joined previously existed Rostov State University, Rostov State Academy of Architecture, Rostov State Pedagogical University and Taganrog State Radio-technical Institute. Also the processes of integration and enlargement were initiated by Don State Technic University that finally joined with Rostov State Building University. Along with such merger the internal diversification takes place. It is embodied in developing new programs and courses (especially developing master programs that meet the needs of the current Russian education system), creating new departments, centers and other internal structures, related to both internal education and research processes and external environment (mainly concentrated in the Rostov agglomeration). All these trends indicate that proto-cluster entities form real education cluster during the last decade. Also it can be viewed as two clusters with South Federal University and Don State Technic University being their cores.

But at the turn of 2014 and 2015 new processes were initiated by the local business community and regional administration; they used the educational cluster as the organizational platform for the further development of innovation clusters. It is notable that the two previous generations of Rostov clusters were rather productive then innovation ones. The need for innovations in the region was caused by the need in import substitution, as the high-technological products in some spheres of machinery, maritime industries, biochemistry and others became not available due to the new geo-economic conditions. Also the food industry of the region was reoriented to the internal demand and needed technologies to substitute previously imported goods. In this situation 6 innovation clusters self-organized. The two of them initially appeared with the integrative role of Don State Technic University (the cluster of telecommunication and hi-tech) and South Federal University (the cluster “Southern Constellation”/ “Yuzhnoye Sozvezdie” specialized in high-technological machinery) using the system of preparing human resources, as well as the science and research base and technical, soft resources and databases of these HEIs. Appearing within the same wave of self-organizing, Azov cluster of industrial equipment and Taganrog cluster of echolocation equipment “Matitime Systems” also integrated the departments of these HEIs into their structure, followed by the biotechnological cluster “Amilco” and agricultural cluster “Don Milk Products” that started collaboration with Rostov subsidiaries of Moscow HEIs specialized in their professional sphere.

The experience of the last two clusters mentioned show that while the biggest educational centers are able to cover the high innovation producing risks, the smaller ones are also

able to be integrated into innovation clusters strengthening them. At the present time the educational environment of the Rostov region includes 37 organizations (30 state ones and 7 private), including 25 subsidiaries; with the total 137.152 students studying [13]. It means that the positive experience of innovation-educational clustering can be further transmitted to other productive sectors where there appears the need for innovations and high-qualified human resources.

B. Integration Potential of Education System in Kaliningrad Region

Kaliningrad region in less extent became the area for educational clustering. Only proto-cluster structures are forming in this sphere. Thus, the review of the regional potential is important to identify the possible influence on innovation clustering. According to the Monitoring on the effectiveness of higher education institutions (HEIs) conducted by the Ministry of Science and Higher Education of the Russian Federation, there are nine higher education institutions in the Kaliningrad region, including five private institutions [13]. Most HEIs are branches of universities located in Moscow and St. Petersburg – three per each. A total number of 23,808 students are being enrolled in higher education with 37.4% receiving public scholarships. The distribution of students is uneven between private and public HEIs with significant dominance of the latter – 80.7%. This is partly due to the highly focused area of studies provided by private institutions. For instance, six out of nine HEIs teach only social sciences. The branch of St. Petersburg State Agrarian University offers agricultural sciences in addition to social sciences. The cumulative share of these seven universities is 17.3%.

The knowledge and innovation capital of the Kaliningrad region is largely based on the two major universities – the Immanuel Kant Baltic Federal University (IKBFU) of the Ministry of Science and Higher Education and the Kaliningrad State Technical University (KSTU) of the Federal Fishery Agency. These universities are fully comprehensive, covering all scientific areas apart from military studies (Tab. 1).

The two core universities are responsible for 82.9% of all R&D expenditure carried out by the regional education cluster, with a significant lead by the IKBFU – 60.8% or 168.6 million rubles. Despite being the largest, IKBFU has the highest volume of modernization – 53.4% of the total cost of machinery and equipment is of less than five years. Research facilities are centered in numerous laboratories, science park “Fabrika”, business incubator (incl. nine university spin-offs), and a center for collective use. High technological capacity is due to the state “Development program” of Federal universities that ensured financial support of IKBFU at the expense of the federal budget at the volume of 1 billion rubles per annum in 2011-2013 [14]. IKBFU is one of the ten federal universities that are established to intensify linkages between HEIs, the economy, and the public of federal districts. Federal universities accumulate human capital in federal districts based on the

creation and implementation of innovations and new solutions, as well as ensure regional growth by bringing the

results of intellectual activity to practical application [15].

TABLE 1 CORE OF EDUCATION CLUSTERS IN THE KALININGRAD REGION [14]

Filed of science	Students at IKBFU*	Students at KSTU*
Engineering	799	2922
Social Sciences	2078	1157
Mathematical and natural sciences	1054	97
Humanitarian sciences	1116	-
Health and Medical Sciences	657	-
Education and Pedagogical Sciences	572	-
Agricultural Sciences	370	-
Art and Culture	159	-
Military science	-	-

Note: * Number of students in full-time equivalent

Of the 1414 faculty staff employed in the nine HEIs of the Kaliningrad region, 145 are researchers. The share of researchers centered in IKBFU is 95.2%. This factor reflects a significant disproportion and demonstrates a lack of attention to research functions on behalf of eight other universities. Starting from 2015 IKBFU is the member of the “5-100” international competitiveness project of the Russian Ministry of Education and Science. Unlike the “Development program” that predominantly focused on facilities and equipment, the new project is focused on human development, including international recruiting.

Since 2014 the cooperation of key regional universities and regional authorities has intensified noticeably. The identity of the innovation system is largely determined by the identity of the region and vice versa, thus, representatives of academia and public authorities should work in close cooperation to solve the development issues. One of the leading ideas adopted during the common strategic sessions held in “Fabrika” Science park is the “Living Lab” development framework. The traditional network of academia, business and public authorities is to be extended by the inclusion of society and the environment, leading to a “quintuple helix” institutional architecture. The compact size of the region and the uniqueness of its geographical location make it possible to consider it as a platform for developing best practices in health care management, strategic development and other processes affecting the interests of all stakeholders, followed by the broadcast of these practices nationally and internationally.

The development of the biomedical cluster in the Kaliningrad region is at the center of this intersection of interests. The prioritization of this particular direction could make the greatest contribution to the transformation of key environmental parameters, both directly through the further deployment of infrastructure projects (construction of an oncology center, the second stage of the “Fabrika” Science park with a genomic center and a biobank), and indirectly, affecting the quality of life of the population of the Kaliningrad region.

Engineering is another priority area at the intersection of many interests, including the development of engineering education and strengthening the position of the Kaliningrad region in the field of industrial engineering. In 2017 the Baltic Engineering Center for Mechanical Engineering was established at the IKBFU grounds; in 2018 the engineering center of the ABB company is placed in “Fabrika” Science park. Corresponding educational programs for personnel training are developed by the inter-university consortium with the involvement of specialists from the leading scientific and educational centers of Russia (Tomsk, St. Petersburg).

Maritime cluster is a particular sector that is announced as priority involvement area of core regional HEIs. Research in the field of coastal and marine geography, physics and biology of the sea and ocean constitute the potential that is to be developed with the involvement of the Institute of Oceanology of the Russian Academy of Sciences, and the World Ocean Museum.

IV. SUMMARY

The study has shown that the main reason to use HEIs for integration is the ability to receive additional organizational, informational and research resources, that was followed by the purpose to create the full cycle of preparing new specialists and improve the quality of human resources. At the present time the education-innovation-productive clusters appeared in Rostov region need further internal integration and synchronization between the stages of the full innovation live cycle. In comparison with Kaliningrad region, the strength of Rostov region is not only its high internal potential but also the fact that the educational system itself has been forming strong cluster during the last two decades along with general economic clustering in productive sector. It became the resource for mutual innovation clustering triggered by the initial conditions of geo-economic shift and the need for import substitution that was efficiently covered by the new clusters in a short-term, having the potential for strategic development in the long-term. Kaliningrad region probably will perform the similar trends in the nearest future

due to the interrelation processes started, so the complex support to its educational system is currently needed.

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