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Regional Educational System as an Element of Regional Innovative System

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***Abstract*–The article deals with the specifics of the interaction of regional education system with the external environment presented by industry of the region, and cooperation within the system (by the example of universities and Academy of Sciences). The paper clarifies the role of regional education system in shaping a culture of innovation. It tests the idea of the multidimensional process of formation of this type of culture in the region. Changing the approach to the "science" and "education" from "passive" participants to "active" agents of the regional economy is a result of a process of understanding the external challenges facing the Russian economy. Development of regional education system has to depend on the requirements of the regional economy, and the need of producing of a specific resource of the region. This can significantly change the "map" of education and science in the region.**

Keywords— regional educational system, region innovation transfer

I. INTRODUCTION

Much attention is paid to the theory of the regional innovation system in modern economic papers devoted to the regional development. According to Cook [1], regional innovation system (hereinafter - RIS) is a "set of nodes in the innovation chain that includes directly generating knowledge of the company, as well as organizations, enterprises that use (apply) this knowledge, and a variety of structures that perform specialized mediation functions: support for infrastructure, financing of innovative projects, their market expertise and political support".

An analysis of RIS models showed that almost all of them are represented by an innovation chain, in which institutional relationships are presented sequentially. The first element of this chain consists of *generation, transformation and translation of knowledge*, and the final stage is the *implementation* of innovative products on the market. Thus, the main structural elements of RIS (as well as in the national innovation system, hereinafter NIS) are the state, business and educational institutions of the region as creators of intellectual human capital.

NIS deals with a set of universities and other higher education institutions, that is influenced by the state education policy, the historical development of the education and science, government policy regarding the interaction of universities and business community, etc. [2] Thus, there is a general vector of the development of the university infrastructure (with the whole variety of types and categories of state universities and other agents of the education system) on the national level.

Moreover, the structure of the national innovation system should focus increasingly on the production of innovations in the regions, if we understand NIS and RIS as structural non-linear models with a specific set and interrelation of institutions. The system of interrelated institutions in RIS could be understood as economic agents (enterprises, scientific organizations, universities, funds, investors, etc.) as well as social values, norms, legal system based on regional specifics.

It seems that the element "*generation, transformation, and translation of knowledge*" would be correct to name "*regional scientific and educational system*". Thus, we are talking about the subsystem in RIS that is specifically designed to encourage and enhance the creative abilities of an individual.

Including this element into a complex system consisting of a set of interacting components (subsystems), we apply a systematic approach to the study of RIS. In this case, we apply the principle of hierarchy of the system, i.e. when a part of the system can be recognized as a specific system, or when each component of the system can be considered as a system. Very often an element of "*knowledge generation*" is presented with separate sub-elements "education" and "fundamental science", and this approach is wrong.

The need to maintain consistency in the approach to the investigation of RIS is obvious. Its subelements are highly interconnected, and inefficiency of any of them leads to the dysfunctionality of the system itself. Ineffective approaches to the development of secondary education system have led to increasing "massification" for higher education and also led to decrease in quality of higher education. The decrease of the quality of school education has led to a loss of the quality of applicants and further reduction in the quality of higher education (according to the sociological research, 40% of university success depends on the quality of students [3]).

II. MATERIALS AND METHODS

The research has begun three years ago, and it was the result of the extensive and comprehensive research of the educational

system in Russia. When a regional university was identified in the educational system with its influence on the development of a region, it turned out that a regional university is an important factor of influence.

The line of regional universities with "successful stories" were taken, and their similar characteristics were highlighted. External and internal factors of influence were investigated.

III. Results and Discussion

A. Terminology

The term "regional scientific and educational system" means the totality and unification of educational, scientific and research-educational institutions of the region at all levels.

Its structure and model play an important role in the formation of the policy for "regional inequality". We consider it as the main factor in leveling shortcomings and enhancing the region's competitive advantages by generating and incrementing human capital, developing regional infrastructure, institutions of the regional innovation system (factors of *second nature*).

The main economic function of the regional research and education system is to support the regional talent fund and to provide regional labor markets for new jobs with high-quality human capital.

This economic system, with a favorable approach and its development, should lead to fundamental changes in the regional labor market and influence the problem of solving regional inequality (which will be discussed in our further research). The main goal of the system is education, but the specificity of the modern education paradigm is to teach not to translate knowledge but to learn the ability to generate knowledge.

Corporate training programs and corporate training courses are also proposed to be considered as a subsystem in the regional educational system. Let us not forget that the carrier of human capital is often characterized by mobility on their work path, i.e. they incline to change jobs. In the process of so-called "diffusion of knowledge", it happens when a carrier either shares their knowledge or adapts it to the new conditions and thus the society (not only the career carrier themselves) gets new knowledge, skill, ability.

B. Regional research-educational system and culture of innovation

The proposed and implemented reforms of the national education system seem to forget about the main postulate - the quality of the knowledge is determined by the social conditions of its emergence. So, if we are talking about the need to build an education system in a way then specialists have sufficient capacity for creative thinking, the ability, and - that is most importantly - the desire to participate in the creative process, then we should talk about the creation of relevant social and cultural environments.

What we have to consider primary for innovative creation? Social and cultural environment or technological changes in society? We must accept the long-established truth that there are so-called social and cultural environment forms "Culture of innovation". It contributes to the process of concentration of a certain critical mass of the qualitative human capital of society for the generation of a qualitative leap in the technological development of society.

R. Florida, in his book about the creative class [4], gives the results of Simonton's research on creativity. He discovered that "the creativity is developing most rapidly in those places and in those periods that are characterized by the following four characteristics - core activities, intellectual susceptibility, ethnic diversity and political openness".

Many examples of the development of creative zones with a successful history of the commercialization of science, such as Silicon Valley or 71 quarter in Singapore, proof the proposed theory. Universities offer - within the framework of existing concepts of regional innovation systems - not only the territory itself for hosting of high-tech or innovative companies. This territory is distinguished by corresponding social and cultural environments for the support and implementation of the "culture of innovation" including the above parameters.

It is interesting that in the situation with the Soviet Union and its scientific breakthroughs, there is no parameter of *political openness* (due to the political conditions). However, despite the huge losses (human, financial, infrastructural) as a result of the Second World War, the fourth part of the scientific discoveries and inventions of the period of 50-60 years of the XX century had fell in the USSR. Of course, this success was the result of a number of cumulative factors, which include:

- an intellectual breakthrough of the Russian Empire of the beginning of the XX century [5];

- the positive effects of the industrialization in the 30s [6];

- developed military industrial complex of the USSR and industrial espionage as a result of the opposition of the USSR, the USA and other countries.

Separately, it should be noted among the following favorable factors:

- development of engineering and technical education in the period of Soviet Russia and the USSR. The growing prestige of engineering specialties (which were historically considered to be elite professions both in the Russian Empire and in Soviet Russia) [7].

Partial data on the number of students in the USSR are given in Table I.

TABLE I. Quantity of Students in the USSR by Specialization (in % among Total Quantity)

Specialization	1960-1961	1970-1971	1980-1981	1985-1986	1986-1987
Engineering	40.3	43.6	4.8	2.9	1.9
Economics	9.1	1.8	2.2	2.8	3.8
Law	1.7	0.9	0.8	0.8	0.9

For comparison, we present the following table showing the decline of elitism in engineering and technical specialties beginning in the 1990s. [8, 9] At the same time, the percentage of students in economics and other humanitarian specialties was growing. This led to the *"massization"* of these specialties (and as a result, to the loss of the quality of education of these

specialties, *"inflation of specialties")* and oversaturation of labor markets, including regional ones.

TABLE II. QUANTITY OF GRADUATES OF STATE UNIVERSITIES BY SPECIALIZATION (IN % AMONG TOTAL QUANTITY)

Specialization	1990	2000	2005	2008
Economics and management	13.8	44.3	9.9	32.0
Engineering	36.4	22.6	2.2	21.6
Social science and law	12.2	17.7	6.0	16.8

TABLE III. QUANTITY OF GRADUATES OF NON-STATE UNIVERSITIES BY SPECIALIZATION (IN % AMONG TOTAL QUANTITY)

Specialization	1990	2000	2005	2008
Economics and management	22.4	25.8	44.4	47.7
Engineering	-	-	-	-
Cybernetic science	No data	No data	0.5	1.2
Social science and law	17.1	28.8	32.5	28.6

The attentive state support (financing, high wages, social benefits for scientists and teachers, inventors, etc.) contributed to the formation of the social and cultural environment as supporting areas for the culture of innovation.

Moreover, in the USSR there was a system of vocational guidance for young people with a developed infrastructure of numerous clubs and schools. Thanks to the established connection of industry and branch research institutes, the system of local innovation was actively promoted (until the so-called era of Taylorism when the creativity of the worker was restrained by the bureaucratic system).

Therefore, it is necessary to consider the social and cultural environment as a supportive environment for creating innovations. At the same time, social and cultural environments have a recursion: that is, they reproduce themselves with new qualitative elements accumulated in the previous cycle.

A university, or a regional network of universities, is not in itself capable of providing full-fledged social and cultural environments (although universities are doing their best on innovative projects, scientific developments, etc.) [10]. Also, it is difficult to assign this mission to enterprises engaged in corporate scientific developments with own laboratories and research centres. We have already mentioned the "rule of 40" (the success of the university depends on the quality of students or school graduates by 40 %). This means that only the holistic development of the regional science and education system is able to ensure the development of cultural and social environments.

C. Regional research and educational system: RAS and regional universities

Despite the existence of scenarios for the development of the territories of the Russian Federation and the development of regional human capital in the framework of the development of education and science, the question about the role of RAS departments in this scenario and the division of authority between the RAS and regional universities is opened.

The Federal Law "On the Russian Academy of Sciences, the reorganization of State Academy of Sciences and the introduction of amendments to certain legislative acts of the Russian Federation" No. 253-FZ dated September 27, 2013 points to the scientific and methodological guidance of the RAS on educational institutions of higher education, while the legislator reveals the mechanism of such interaction. In the Law, there is a reference to the obligation to send the relevant reports to the RAS only. There is the practice to create joint laboratories, basic departments and research centres.

The issue of interaction and integration of academic and university science is really difficult for the regions. In Soviet times, three intellectual clusters were responsible for the development of higher education and science: the USSR's Academy of Sciences with a high level of fundamental researches and state funding; industry science with its proximity to the industry; and higher education with its highly qualified teaching staff [11].

When the behaviour patterns of the economic agents of the Soviet economy existed, this system was quite effective [12]. When we revise the role and functions of institutional areas, the internationalization of higher education, science and industry, the university has begun to unlock university and industry science. Universities with "National Research" status should also carry out fundamental research (according to their western types).

The functions of the universities with "National Research" status are also to interact with the government sector in order to coordinate and develop directions for the development of high-tech sectors of the domestic economy. Thus, we have indirect reorganizing of the outdated tradition of the vertical institutional matrix of education and science management. Do the RAS functions have to go completely to this category of universities?

The practice of "successful" regions shows that the integration of academic and university science is one of the factors of the effective development of a regional innovation system influencing the synergistic effect [13]. Fundamental science, as is known, is not subject to the mechanisms of a market economy; it is primarily aimed at expanding scientific knowledge, while applied science is integrated into the market.

The symbiosis of the RAS with a fundamental science and the university with "industry" science plays the role of a cultural barrier for government itself and its attempts to make all scientific knowledge commercialized (when the demand for scientific knowledge will be determined solely by its good commercial perspective in a short time) [14].

In addition, historically RAS and branch research institutes were the centres of science. The system of higher education was primarily focused on the development of educational capital. The balance between scientific capital and educational capital seems to remain – universities are still more oriented to the educational process than to the scientific one. Firstly, the staff of universities is more focused on the educational process in view of the established traditions and work experience. Secondly, the increasing academic load and its bureaucratic maintenance do not allow teachers to engage in science.

The situation with the integration of the institutions of science and education in the regional innovation system raises another problem. The Soviet education system, of which we were all proud, is becoming a thing in the past. Education as a social good and science as a social institution have to meet external challenges. However, copying of Western models of universities, models and education systems are the so-called catching-up model, which basically has the reproduction of some institutional model [15].

This leads to the fact that the structure of the domestic university is not reformed, but it is adapted to some external standards. And this is a problem because science and education belong to the categories of public goods, and that means that the social conditions for the formation of educational and scientific capital affect the quality and specificity of these capitals, as we can see from analysing the "success stories" of various universities of the world [16].

In all cases, the transmission of new knowledge and expanding the scope of activities are effectively supported by reforms of the internal structure of scientific and educational institutions, which includes human resources with established traditions, relationships, accumulated experience, including historical one. Therefore, it is important to develop a clearer and more systematic mechanism for interaction between the Russian Academy of Sciences and regional institutions of higher education.

D. Regional research-educational system: interaction with business

Analysis of the scientific literature focused on the study of cooperation between the academic community and business shows the papers focused on the interaction between universities and business. This is easily explained by the fact that business is a consumer and the actual customer of the main good produced by the university – knowledge that is transmitted through the graduate.

In modern conditions, the competitiveness of the market subject depends on the ability to respond to the requirements of the knowledge economy. Knowledge, as is known, is a specific product. It has the ability to become obsolete quickly, hence the speed of its exchange between market participants is to be the main factor. Reducing the "market" distance between participants in the knowledge economy significantly increases the useful properties.

There is another reason forcing to develop the cooperation. According to Alexander Abramov, corresponding member of RAO, "one of the most serious problems of modern Russian society is that raising readiness for strenuous work and perception of learning as serious work fell out of the sphere of public and school attention" [11].

According to Andrei Klepach, Director of the Department for Macroeconomic Forecasting at the Ministry of Economic Development and Trade, the problem is not just a shortage of scientific, technical and working personnel. There is a problem of value, the problem of creative, skilled and intense hard work and readiness for it. And the prestige of labor and readiness for it are formed when a person learns [11].

A regional research and education system is a full-fledged element in the region's innovation chain. Therefore, it is necessary to take into account how the system contributes to the "value creation" process as a source of knowledge for creating a new product or service.

Tables IV and V contain the data on how business found scientific institutions of higher education as institutional sources.

TABLE IV. PROPORTION OF ORGANIZATIONS THAT RATED INDIVIDUAL SOURCES OF INFORMATION FOR TECHNOLOGICAL INNOVATION AS THE MAIN ONES

Technological innovations		
Mining, processing industry, oil and gas industry, electricity power industry		
	2013	2017
Science organizations of fundamental profile, %	0.9	1.0
Science organizations of industry profile, %	3.1	3.4
University, %	1.0	1.2
Communication, cyberactivity, other services		
Science organizations of fundamental profile, %	1.8	2.0
Science organizations of industry profile, %	3.6	3.8
University, %	1.7	1.7

TABLE V. MAIN SOURCES OF TECHNOLOGICAL INNOVATION FOR ORGANIZATIONS

Technological innovations		
Mining, processing industry, oil and gas industry, electricity power industry		
	2013	2017
Inner sources of firm, %	11.8	12.2
Customers, %	13.4	13.8
Internet, %	11,1	11,9
Conferences, %	3.9	4.1
Specific literature, %	5.3	5.3
Exhibitions, %	7,3	7,4
Communication, cyberactivity, other services		
Inner sources of firm, %	10.0	10.8
Customers, %	8.8	8.9
Internet, %	10.1	11.4
Conferences, %	5.2	6.0
Specific literature, %	5.8	6.5
Exhibitions, %	4.0	4.5

It is obvious from the above data that business structures have a certain degree of distrust to academic institutions and higher education institutions as sources of innovation.

However, such sources of information as scientific and technical literature, exhibitions, conferences, the Internet also include the transmission of knowledge (experience, skills) accumulated by the academic community.

Thus, the generated information field of the scientific and educational system is involved in informing the business community regarding the creation and production of innovative developments much more than just institutional sources [17].

Perhaps, low indicators of direct cooperation between academic institutions and the business community could be explained by such factors as:

- business distrust to the academic community (the problem of "theorists" and "practitioners");

- low professionalism of representatives of academic institutions involved in direct cooperation with practitioners from business structures who understand the challenges of the market;

- lack of domestic historical experience of cultural and professional interaction of academic institutions and institutions of higher education with the business community in the framework of the commercialization of science. A corridor for joint applied research in domestic practice existed with industry research institutes, and this is, apparently, a still continued trend noted in the table above.

Changing the approach from "passive" participants to "active" agents of the regional economy is a result of understanding the external challenges facing the domestic economy. The development of a regional scientific (research) and educational system should depend on the requirements of the regional economy and the need to produce *a specific resource* of the region. This could significantly change the regional map of education.

IV. CONCLUSION

It is possible that the "redundancy" of some of the unclaimed specialties will lead to a reduction of them. This means we can get a restructuring of the organization structure of higher education institutions in the region, and this would be done in an evolutionary way, not revolutionary.

However, the ratio of the specifics of the regional economy and its needs with the potential of the regional research – educational system is necessary in the framework of the formation of the human (intellectual) potential of the region.

This article did not pay attention to other levels of education in the regional system of science and education, but this would be somewhat beyond the format and idea of the article. Because, in our opinion, the effects and problems of interaction of the RAS or business structure under consideration are most clearly manifested at the level of higher education in the regional scientific and educational system.

The study of the role of other levels will be considered in further works. Also, we are interested in studying the Triple Helix model (university-state-business) precisely with expanding the active elements of this model to the element proposed in this article – namely, the regional research-educational system.

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