Machine-Building for Fuel and Energy Complex: Perspective Forms of Interaction

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Abstract. The article is devoted to the study of the existing forms of cooperation between the authorities, business and science in the fuel and energy complex and the machine-building industry at the regional level. The possibilities of applying the concept of the "triple helix" and its multi-helix modifications for the implementation of the import substitution program for high-tech products have been considered.

Introduction

International approaches to the solution of territorial formations problems caused by raising regions’ role and empowerment due to institutional and resource self-sufficiency are based on the sustainable development paradigm, aimed at population living standards improving under the positive dynamics of interrelated economic, social, environmental, etc. indicators.

The spread of information technologies has complicated the spatial organization of economic systems and brought to the foreground, horizontal and network type of cooperation that is more flexible than hierarchical interaction with the traditional administrative approach, and more open and focused on collaboration, cooperation and integration than the "individualized" competitive market economy [1]. Unlike the competition, inevitably leading to concurrent use of resources, mutually exclusive goals achievement and, therefore, their wasteful spending, the cooperation involves harmonization of efforts [2]. The increasing role of cooperation institutions is a natural outcome of technological, cultural and institutional evolution.

In connection with the communication opportunities development with relatively low costs, which previously would require a larger effort on the part of market actors [3], the structure is being changed. The alteration of the society role, the increase in the rate of consumer expectations and preferences changes, the consumer and domestic demand formation, stimulating new developments and implementations, impact the economic environment and the proliferation of new goods and values.

The article is aimed at the investigation of government, business and science cooperation in innovation economy sectors at the regional level.
As the methodological base of economic systems and models comprehensive analysis conducting that has sufficient empirical basis to describe the dynamics of many national institutional arrangements, their relationships in the face of uncertainty with other factors, political and social development and the "traps" of the interaction, the chosen concept of the "triple helix", by H. Etzkowitz and L. Leydesdorff and its multi-helix modifications (expanded models of innovation processes), key features of which are: the ability to compromise between the differentiation and integration of components, field to the participants' interactions and relationships changing, the strengthening effect in the context of communication theory [4].

**Discussion of the problem**

The concept of the triple partnership between the universities (science), business and government set by the triple helix model, introduced in the middle of 1990-ies – in the form of a synthesis of institutional attitudes of sociologists and biological analogy. G. Etzkowitz and L. Leydesdorff presented the interaction of government, business and the state in the form of hybrid social structures, like DNA molecules, which is characterized by the coupling of spiral structures, and increased adaptability to changes in the external environment. In the 2000-ies this model was actively implemented in the economic practice of developed countries as a methodological basis for the formation and organization of regional innovation systems. On its basis there were being created clusters, industrial parks, centers of competence and others.

It is clear that such experience in its pure form may not be transferred to Russian ground. The nature of Russian integration processes are mixed, due to a number of reasons: institutional and regulatory instability, the contradictory goals and conflicts of economic agents, unequal access to production factors, weak management mechanisms, the threat of markets monopolization, poor property rights protection, the relatively low level of business culture.

In this regard, Russia’s peculiarities require economic imbalances removal, the institutional environment improvement and regional development management system reform, namely the formation of common priorities; scientific or business environment economic agents identification and promotion in local communities; commercialization and diffusion of innovation processes maintenance; implementation of mechanisms of coordination and control over activities and change functions and areas of participants responsibility.

Considering the region as the central element in the transformation [5], the authors set a task to identify key hierarchical levels of regional "pyramid of innovations":

- innovation environment;
- innovation processes;
- mechanisms for the societal needs implementation;
- innovative activity and measures for its promotion (credits as one of the institutional determinants of consumer demand, tax and customs benefits, insurance and intellectual property protection tools);
- results and economic consequences of innovation for the subsequent filling with mathematical tools that allow to quantify and to identify "weak links", and the proposals for structural change, adapted to different formats of interaction in three main "blocks": the state, science and education, business and society - united on the basis of the strategic objectives of the industry and the traditional linkages, financing, degree of mutual influence and other factors (including life-cycle stage).

Such enterprises can take many forms and include the scientific and educational institutions, financial and government institutions, system integrators, manufacturers and/or suppliers of technologies, equipment, raw materials, manufacturers of finished products serving the production and so on. Table 1 shows examples of the most common contractual forms.
Table 1- The most common contractual forms of government, business and science cooperation in innovation sphere

| No. | Form of interaction | Features of interaction |
|-----|---------------------|--------------------------|
| 1   | Concession agreement | Under the concession agreement one party (concessionaire) undertakes, at its own expense create and (or) to reconstruct defined by this agreement, the property (real estate or immovable property and movable property technologically interconnected and intended for the implementation of activities under the concession agreement) (hereinafter the object of the concession agreement), the right of ownership to which belongs or will belong to other party (Concedent), to exercise activity with using (operation) of object of concession agreement, the concessionaire shall provide the concessionaire for a period specified in this agreement, rights of possession and usings object of concession agreement for the implementation of these activities. |
| 2   | The agreement on public-private partnership (PPP) | Under the agreement the private partner undertakes to create a fully or partially at the expense of own or borrowed funds is the subject of the agreement is immovable property or immovable property and movable property technologically interconnected and intended for the implementation of activities under the agreement to provide operation and (or) maintenance of such property, and the public partner agrees to provide the private partner the right of possession and use them for implementation of the agreement activities to ensure the right of ownership of the private partner the object of the agreement, subject to the requirements of the present Federal law and the agreement. Under the agreement, the parties also undertake to perform other obligations that arise from defining the form of public-private partnerships, a form of public-private partnership elements of the agreement. |
| 3   | Special investment contracts (Spic) | Special investment contracts (SPIC) are introduced by the Federal law "On industrial policy in the Russian Federation". The industry development fund acts as the operator at the conclusion of the ACNP. A special investment contract is an agreement between the investor and the Russian Federation (or its subject), which records the obligation of the investor (to master the production of industrial products within the scheduled time) and of the Russian Federation or its subject (to guarantee the stability of tax and regulatory conditions and to provide incentives and support). The validity of Spic is equal to the term of the project to operating profit plus 5 years but not more than 10 years. |
| 4   | Grants, budget investments, budget credits, state job | Various forms of (paid and free) budget financing of scientific research, to implement medium-term projects projects of the Federal program |

Forms of government, business and scientific-educational institutions cooperation can be simple or complex. Structural elements in such alliances can be a commercial affiliation program, the production of goods under license, the joint research and development, joint procurement, investment projects, enterprises, unions and associations, clusters, markets, industries, regions, etc., the composition of participants and their roles (and thus strategies) are constantly changing, which reduces the importance of rigid designation boundaries for these communities for a long period, highlighting the following problems:
- choice and analysis of the environment, which most closely is associated with the strategic objectives achievement;
- relationships definition;
- interaction processes "contact points" control.

Such forms are difficult to compare, to develop the criteria of effectiveness and efficiency.

A serious problem for the regional innovation systems development is a vertical system of cooperation between the state and scientific organizations, inherited from the Soviet Union. In the period of market transformations these problems were added by a mismatch between supply and demand on the scientific product division, base for researching and professional training, lack of science and technology policies coordination, the distribution between a number of weakly coordinating ministries and agencies, uneven financial flows and so on do not contribute to the true priorities and socio-economic sustainability. All this leads to the fact that the regional innovation system forming is extremely slow, contradictory and spontaneously.

Historically, the closest links have formed with the research structures assigned to certain departments, primarily belonging to the commodity sector of the economy, which is the one the state gives sustainable preference to. At the same time, Russian major business does not show sufficient level of activity and merging with the state leads to lobbying of local interests and reduces the overall efficiency, despite high incomes and international markets competitiveness.

Table 2 shows the structure of the agreements of the largest Russian company in the oil and gas sector, that is PJSC Gazprom.

| No. | The types of agreement                                                                 | The number of regions |
|-----|---------------------------------------------------------------------------------------|-----------------------|
| 1   | Cooperation agreements (long- and short-term)                                          | 61                    |
| 2   | The agreement on wider use of natural gas as motor fuel                                 | 61                    |
| 3   | The program "Gazprom - to children"                                                    | 61                    |
| 4   | Road map of the project "Expanding the use of high-tech products of regional science-intensive organizations, including import substitution, in the interests of "Gazprom" | 43                    |
| 5   | Memorandum of cooperation in the sphere of the regional educational and industrial center organizing and functioning | 2                     |
| 6   | The agreement on scientific and technical cooperation and partnership (2016-2020)       | 2                     |

The data given in the table eloquently testify the weak commitment of the company to participate in the regional innovative projects. Of the 61 region with which PJSC Gazprom signed a variety of cooperation agreements, only in 2 regions (Tomsk and Omsk regions) there are signed a Memorandum of cooperation in the sphere of the regional educational and industrial center organizing and functioning and an Agreement on scientific-technical cooperation and partnership, aimed directly at the regional innovation systems development. Intermediate between cooperation agreements aimed at maintaining the investment and income in the region, and agreements aimed at regional innovative development are roadmaps, or the projects aimed at expanding the use of high-tech products of regional science-intensive organizations in the interests of "Gazprom. They contain the plan and the stages of development of high-tech industries in the regions, local producers are involved, the examination and certification of products. In some regions, the roadmaps are involved in scientific and educational organizations. However, their number is not large, only 10.
In general, assessing the degree of the basic entities (components of the triple helix) interaction development, it should be recognized that the interaction between the scientific and the business environment appears to be the most problematic. This is caused by a number of objective and subjective factors, among which the most important is the applied sciences backwardness.

To evaluate the relationship between business and other elements (state and society) as well is quite difficult, but as the overall institutional environment has not yet formed adequately, and is not favourable, we can say that the existing format of the relationships is qualitatively different from the one that adopted in foreign countries.

A significant place in the socio-economic development of constituent entities of the Russian Federation is given to the arrangement of the clusters, since they allow to move away from the previously dominant approach in the orientation exclusively on high-tech industry, to stimulate research and development to accelerate the processes of creation and diffusion of innovations through the formation of stable ties between science, business and local authorities. These relations have a decisive influence on the frequency and speed of propagation of innovation and competitiveness.

For qualitative and quantitative assessment of innovation activity the authors developed a list indicating any trends in the structural indicators, distributed in three groups: an innovative component for economic growth; the investment component for the development in the long term; component of sustainable development, ensuring the growth of competitiveness and quality of life. Through econometric modelling the peculiarities of the development of the national industry structure for different public organizations historical periods that have allowed to develop additional indicators and to offer methods of measurement in order to assess the effectiveness of ongoing reforms in the country.

Recommendations for systematic upgrading of aspects of the socio-economic system developed by the authors based on the functional economic and mathematical models and lay the foundations for a unified approach ("designer") in the formation of resilient regions, regardless of geographical, social etc. differences.

In the study of the establishment and functioning of national innovation systems and approaches are of interest: the global experience, developed on the basis of various factors and the concept of "triple helix" of national forms of interaction of elements that contribute to the development of both fundamental and applied research of an interdisciplinary nature, the emergence of start-ups, variety of entrepreneurial universities and science parks.

A deep analysis of the "Euro-Atlantic", "Asian", "alternative" and other models can be the basis for the development of Russian regional ecosystems, taking into account local specificity and "smart specialization" in order of greatest contribution to socio-economic development.

By now there have been received a number of conceptual and applied results of the "triple helix" model research that take into account both the global and Russian economic realities, and historical retrospectives, which is the base for the current state and a number of inherited elements of economic activity.

The conceptual results, clarifying a number of provisions required to adapt the model of "triple helix" to domestic conditions [6] are as follows:

- the analysis of the empirical base of the model identifying the structural units, their substantive content, the development schemes of their cooperation in the area of cross-section;
- the study the possibility of initiating the process of interaction of any party structure in the model;
- the allocation of favourable conditions for development in the triple interaction.

In general, identified through econometric modelling features of development of economy of our country in different public organizations historical periods, and fragments [7] have received a possible economic interpretation of the role and structural proportions of the industry in socio-economic development and inconsistencies of modern economic policy that creates the real basis for further use of existing indicators and suggestions and development of additional ones for methods of measurement to assess the effectiveness of ongoing reforms in the country.
Full ecosystem restructuring in the Russian context will require the overcoming of existing gaps in three dimensions: 1) level of education and science – to form innovative generation (“people with imagination”); 2) at the enterprise level – in order to build the relationship between the development of fundamental and applied research of an interdisciplinary nature and implementation of developments in production, contributing to the achievement of a balance between international innovations and home traditions; 3) at the level of society – to create consumer confidence and domestic demand, stimulating new developments and implementations.

Conclusion
The result of set in this article the problems of application of the triple helix model and its modifications in the Russian context can be formulated as following: a priority approach should be a refusal of domination by any one side in favor of transformation of the state control ways and methods, higher adaptability of the regional authorities and stimulating all types of events, aimed at a variety of economic agents.

The implementation of the principles of the "triple helix" element of the "state" can be realized as following:
- on the federal level there are the functions of determination of priorities of innovation activities and creation of institutional preconditions for its development; management and financing of innovation activities (including such forms as the state order, tender or grant); the development of innovative policies and methods, models and tools for its implementation, including the development of virtual networks; the establishment of mechanisms of commercialization of knowledge and the organization of international cooperation in this field;
- at the regional level there are the creation of an appropriate infrastructure; establishment of integrated service centers with the participation of all stakeholders, with sufficient generation capacity development on the basis of key regional competencies, providing information, consulting, investment, branding support, technology transfer, strategic and operational management of innovation chains design.

Summing up, it should be emphasized:
- founded in the model of "triple helix" network format on the basis of the principle of consent and cooperation contributes to the integral effect of continuous updates;
- for Russia, foreign experience of the concept introduction can contribute to identifying and selecting the most promising forms of multilateral regional cooperation in matters of disclosure implicit opportunities for the development of new comparative advantages of regions, use of innovation, adapted to the conditions of the regions, development of the internal market and closer interregional cooperation [8].
- organization mechanisms of the innovation management need to be based on the network interaction innovation-based factors with the goal of transformation costs in a much larger-scale socio-economic impact at the level of individual enterprises and at the level of industries, regions, and states;
- social activity is another resource of competitiveness improvement;
- in conditions of intensified competition and changing patterns of consumer behavior, the key parameter is the rate of the innovation cycle reproduction;
- in any space can be formed in a special "ecological environment", which includes mutual expectations and requirements of the elements and permits adaptation of the old forms of economic entities to new conditions at the micro-, meso-, macro levels.

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