Methodological Aspects of Making the Dynamic Model for the Development of Institutional Environment of Innovative Multiclusters

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Abstract

The study of the development of institutional environment of innovative multiclusters allows identifying the stage of its life cycle and the direction of the development of clustering the economic system of the region. The purpose of this study is to research methodological approaches to improve the objectiveness of construction of the dynamic model of the innovative multiclusters. The approach to solving this problem is based on institutional methodology which offers innovative solutions within the frames of institutional environment of the local economic development policies. The models of cooperation between the economic agents of an innovative multicluster at various stages of development of its institutional environment, proposed by the author, allow monitoring the effectiveness of the regional cluster policy over the long term. The study shows that the structure of cooperation between economic agents in the framework of this model of formation and development of innovative multiclusters occurs due to the institutional aspects of the regional cluster policy. The classification of economic agents of an innovative multicluster, which are the main parties of the institutional environment modernization processes of the regional economic system, is provided.

Keywords: economic modeling, cluster policy, institutional environment, life cycle of cluster.
INTRODUCTION
The process of formation of innovative multiclusters at the sub-federal level is the consistent implementation of a set of interrelated steps to organize effective economic cooperation between the parties of the regional economic system. The analysis of the Russian practice of clustering regional economic systems revealed a number of trends and patterns of formation and development of innovative multiclusters.

The formation and development of integrated cluster formations at the sub-federal level is performed "from the top down" with active use of administrative resources; moreover, the processes of formation of the innovative multiclusters are implemented most effectively in the regions with traditionally prevailing high scientific and technical potential (Achenbach, 2012). The development of the clustering process is impossible without formation of the regional mechanisms and institutions of interaction among scientific and educational entities and the business community; meantime, the mandatory condition for development of the innovative multiclusters is the structural diversification of the regional economic system, based on formation of an effective institutional environment to generate and transfer innovative technologies (Boush, Kulikova and Shelkov, 2016). Here, in the process of development of an innovative multicluster, the increase in the number of the economic agents occurs, forming added value production chains (Kleiner, 2015).

DATA AND METHOD
The methodological advantages of the tools for the institutional direction of the economic thought make it possible to simulate the changes in the structure of the interactions among the economic agents of the innovative multicluster, depending on the dynamics of the innovation environment development. Based on the grouping of the economic agents, involved in the formation and development of the scientific and industrial clusters, the systematization of the main participants in the institutional relations within the internal environment of the innovative multicluster was performed. The classification of the economic agents of the innovative multicluster, involved in the formation and development of its institutional environment, is shown in the Table 1.
Table 1. The classification of the economic agents of the innovative multicluster (clarified and supplemented by the author on the basis of works of Y.A. Achenbach and G.B. Kleiner)

<table>
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<th>Type of the economic agents of the innovative multicluster</th>
<th>Characteristics of the main organizational forms of the economic activity</th>
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<td>Agents-provocateurs</td>
<td>Enterprises of the &quot;core&quot; of the multicluster, the regional development agencies, the associations of industrialists and entrepreneurs, the regional chambers of commerce</td>
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<td>Agents-facilitators</td>
<td>The suppliers of the specialized resources for the enterprises multicluster; logistics, engineering and other service organizations, providing the infrastructure support to the processes of formation and development of the multicluster, venture capital funds</td>
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<td>Agents-innovators</td>
<td>The scientific research and educational institutions, as well as the small innovative enterprises and the innovative infrastructure enterprises, based on them</td>
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<tr>
<td>Agents-imitators</td>
<td>The subjects of the innovative business, distributing and implementing new technologies on the basis of the license agreements; the centers for the commercialization of the innovations and transfer of the technology</td>
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<td>Agents-integrators</td>
<td>The independent enterprises of the innovation infrastructure, integrating the efforts of the innovative businesses (business-incubators, technology parks, industrial parks, venture), the structural units of the regional executive and local self-governing authorities, regulating the processes of the socio-economic development of the territory</td>
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Consequently, the solution to the problem of constructing the model for the clustering of the economic system in the region should be based on a study of the relationship of competition and cooperation, preconditioned by the processes of distribution of the internal resources of the multicluster of both material and immaterial nature.

4 types of institutionalization of the vector of the interactions of the cluster economic agents were identified based on the theory of mathematical graphs. Based on the
dialectical nature of the development of the cluster formations, it can be assumed that in the framework of the intracluster interactions the economic agents implement in relation to each other a strategy, either stimulating or restricting the development. Therefore, each pair of economic agents of the innovative multicluster, when considering it as the directed mathematical graph, can belong to one of three types of interactions, summarized in the Table 2.

Table 2. The types of institutionalization of the interaction among the economic agents of the multicluster (developed by the author based on the classification of G.D. Boush)

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<th>Vector of the interaction among the economic agents</th>
<th>Result of the interaction among the economic agents</th>
<th>Direction of the institutionalization of the type of interaction</th>
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<td>+ +</td>
<td>The mutually beneficial cooperation of the economic agents aimed at the development of the competitive advantages of each other and the innovative multicluster as a whole.</td>
<td>Broadcasting of the experience within the multicluster, its incorporation in the form of a tradition. Formation of the mechanisms for the internalization of the positive externalities of this type of interactions.</td>
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<td>+ -</td>
<td>The support is provided by one economic agent to the second one through the limitations of the own resources and opportunities for the economic growth.</td>
<td>Formation of the compensatory mechanisms, based on the distribution of the risks and benefits for the long term. Implementation within the cluster of the public-private partnership mechanisms.</td>
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<td>- -</td>
<td>The economic agents of the multicluster block each other's development, limiting the competitiveness of the cluster formation as a whole.</td>
<td>Implementation of the system of &quot;checks and balances&quot; in the framework of the internal environment of the multicluster. The establishment of the institutional platforms for the regulation of the economic interests.</td>
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**ANALYSIS AND RESULTS**

On the basis of this approach, it is possible to analyze the structural changes in the territorial network of the institutional relations with the participation of the innovative businesses, the scientific research and educational institutions and the public authorities, complementary and reinforcing the competitive advantages of each other as a result of the distribution of the positive externalities of the clustering processes within the adaptive model of interaction among the participants of the multicluster. The structural and institutional scheme of interactions among the economic agents within this model of the formation and development of the multiclusters is shown in the Figure 1.

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<th>Formation of the cluster initiative by the agents-provocateurs, the motivated participation of the regional authorities in the supporting of the initiative</th>
<th>Creation of the agents-integrators, involved in the regulation of the formation and development of the innovative multiclusters, by the regional authorities</th>
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<tr>
<td>Implementation of the cluster programs, combining the innovative business and the scientific-educational institutions (agents-innovators) within the framework of the joint infrastructure projects</td>
<td>Creation by the regional authorities of the specialized agents-facilitators, formation of the investment and venture capital funds for the purpose of the resource support of the cluster development processes</td>
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<td>The initiation of the cluster initiative within the territorial business community through the inclusion in the multicluster of the additional agents-innovators, agents-imitators and agents-facilitators</td>
<td>Coordination by the agents-integrators of the departmental target programs, the provision of a grant support, the provision of the guarantees and co-financing of the priority areas of the cluster development</td>
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<tr>
<td>Networking of the principal-agent relationship of the multicluster participants based on the co-generated and institutionally enshrined goals and objectives of the cluster development</td>
<td>The identification of the institutional environment of innovative multicluster and the territory of its localization, the formation of the unified mechanisms of the state support for the economic development</td>
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**Figure 1.** The structural-logical scheme of the formation and development of the innovative multiclusters (developed by the author)
From the point of view of the evolutionary direction of the economic thought, where the subject of the study is the historical background and conditions complicating the organizational forms of the economic systems, the innovative multicluster is the evolving institutional system, gradually transforming the socio-economic system of the territory of its localization. As part of the institutional dynamics of the interaction among the participants of the multicluster, four stages of the multicluster life cycle were identified: innovative, infrastructural, competitive, and transformational.

Let us consider the models of interaction among the economic agents of the innovative multicluster at the various stages of development of the institutional interaction environment in the form of the directed graph, consisting of a number of peaks – the economic agents of the multicluster). The models of interaction among the economic agents of the innovative multicluster at the various stages of development of its institutional environment are shown in the Figure 2.

**Figure 2.** The models of interaction among the economic agents of the innovative multicluster at the various stages of development of its institutional environment (developed by the author)
The author analyzed the institutional structure of the economic space of the Russian regions in order to analyze the stages of development of innovative multiclusters. The differentiation of the Russian regions, depending on the models of interaction among the economic agents of the innovative multicluster in 2015 are shown in the Figure 3.

**Figure 3.** Spatial distribution models of interaction among the economic agents of the innovative multicluster in Russian Federation in 2015 (developed by the author on the basis of statistical data of the Russian Cluster Observatory http://cluster.hse.ru/)

In the course of implementation of the cluster initiative, the gradual integration of the economic space takes place, moreover; the coordinating role in formation of the innovative cluster with each successive stage is gradually transferred from the agents-provocateurs to the agents-integrators, the regional development corporations and the managing companies of the clusters play.

**DISCUSSION**

The key essential feature of the innovative multiclusters is the complex two-level structure of the cluster-forming "core", acting as the central system-forming element of the inter-sectoral cluster formation and the independent cluster of the innovation type
at the same time. The two-level structure of the multicluster core determines the nature of the processes of the integration of the economic agents into the multi-cluster formation (Larionova, Zagaynova and Tarasov, 2015).

The solution to the problem of construction of the dynamic model of the innovative multicluster assumes its consideration as the network organizational structure with the specific elements of the hierarchy and the institutionalization of the interactions (Matafonova, 2016). The previously considered essential features of the innovative multiclusters allow the consideration of the network relationship formed within its framework as relatively homogeneous, equal and mutually beneficial (Porter and Ketels, 2015).

However, the complex economic structure of the multicluster formation presupposes the existence of two overlapping levels of the network interactions. The first (cluster) level includes the network interconnections, formed within the individual industry segments of the multicluster based on the implementation of the related activities and processes by the economic agents (Hopf and Tularam, 2014). The second (multicluster) level of the network interactions is represented by the economic relations arising among the diverse economic subjects, belonging to different segments of the multicluster (Dzhindzhelia, Popkova and Shakhovskaya, 2015).

The specific nature of the hierarchization and institutionalization within the network structure of the multicluster lies in the leading role of the cluster-forming components: the core of the multicluster formation (the innovation cluster as it is) and the organizations, being the formal/informal leaders within the industry segments of the multicluster and influencing the development of the segment as a whole. The unity and the interrelation of the segments of the innovative multicluster are ensured by the flows of the resources of various types, optimally distributed within the multicluster formation among the industry segments (Kim et al., 2014).

**CONCLUSION**

The features of the processes of integration of the economic agents are also determined by the presence of the structural intercomponental contradictions and the contradictions caused by the presence of the competition among the economic agents of the multicluster. The main factors of the formation of the set of contradictions among the multicluster agents are: the distribution of the organizational and institutional functions within the domestic environment of the multicluster; the contradictions among the industry segments, the multi-level nature of the set of sectoral interests and strategic goals of the territorial development.
The construction of the dynamic model of development of the institutional environment for each territorial unit can improve the effectiveness of the interactions among the agents-innovators, generating the ideas, the susceptibility of the agents-imitators, distributing and implementing the new technologies, and to extend the participation of the agents-facilitators in the innovative projects, providing the financial and other resources. The flexible network structure of the principal-agent interactions of the economic agents-integrators with the subjects of the innovative business contributes to the effective transformation of the results of basic scientific research into the industrial and managerial innovations, and the innovation into the competitive socio-economic advantages of the territory.

The results proposed in the study can find application in the sphere of government policy of development the knowledge-driven economy. Thus, the proposed models were used by government authorities of the Republic of Mari El (Russia) while developing the programs for innovation development of the region’s economy. The structural-logical scheme of the formation and development of the innovative multiclusters considered in this article were used by the city administration of Yoshkar-Ola in the process of formation of a local natural resource-based innovation cluster in frames of collaboration between the Volga State University of Technology and government agencies of the Mari El Republic.

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REFERENCES


