System of Criteria and Indicators for the Development of Resource-Based Multiclusters

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Annotation
The paper presents the system of criteria and indicators of development of resource-based multiclusters able to be used for the purposes of government control of performance efficiency of the territory on which they are located. The limitations of the paper are general adaptation mechanisms of a region economic system within the frames of innovation development that would significantly enrich the theoretical aspect of the study.

An indisputable advantage of the suggested system of the parameters for the purposes of governmental control of the resource-based multiclusters efficiency is its versatility, as it is adapted to any kind of regional economic system.

Key words: Governmental control, Economy clustering, Natural resource-based multicluster**,** Efficiency of governmental cluster policy.

1 Introduction

In the modern conditions of global economy, the competitiveness of the cluster residents is interpreted as a concentrated expression of the production, scientific, educational and technical advantages implemented in innovation technology, goods and services [1]. The multi-subject composition of the multicluster can be classified according to the subject composition of the "triple spiral" model, i.e., it appears possible to single out «state and municipalities», «science and education» and «business [2].

The aggregate social and economic effect produced through implementation of governmental cluster policy, which is achieved by applying structural modifications to the economy, can be used as the efficiency indicator [3].

The formation of resource-based multiclusters at the regional level is based not only on building an industry infrastructure but also on the formation of a network interaction structure between innovation businesses and the government. In this case, the methods used to assess the natural resource-based multiclusters can be applied to control the efficiency of the use of the state resources [4].

The practical importance of this approach lies mainly in the opportunities to formulate and implement large national-and regional-scale investment and innovation projects. Issues of government regulation of the cluster have been studied in works by [5, 6].

In this regard, studying theoretical approaches to improving government control of the formation of natural resource-based multiclusters at the regional level becomes an important scientific task.

2 Data and Method

Most international studies on the problem of efficiency of the resource-based multiclusters are devoted to comparative analysis of transaction costs of economic activity at the regional level. In the modern economy system the structure of transaction costs are determined by a wide range of technological and ecological factors [7, 8]. Minimization of transaction costs as a main function of government control allows us to consider costs of interactions between economic agents in the multicluster. An multicluster performance efficiency for economic agents can be defined as the ratio of the benefits of transaction costs reduction in multicluster and the institution's maintenance costs and/or institutional constraints loss:

$$\mathrm{ME} = \frac{TC_0 - TC_\mathrm{m}}{IMC + ICL}$$

Where:

ME = multicluster efficiency

TC = Transaction costs

IMC = Institution maintenance costs

ICL = Institutional constraints loss

Efficiency of informal institutions of control of the formation of resource-based multiclusters can be evaluated using the following formula:

$$\mathrm{UIE} = \frac{LGC}{IIC + ICL}$$

Where:

UIE = Informal institution efficiency

LGC = Losses associated with government control

IIC= Informal interactions costs

ICL = Informal constraints loss

If the informal institution is of a "grey" (illegal) nature, its efficiency can be evaluated using the following formula:

$$\mathrm{GIE} = \frac{CLA + LGC}{IIC + ICL + RIAL}$$

Where:

GIE = grey institution efficiency

CLA = Losses associated with activity legitimization

LGC = Losses associated with government control

IIC = Informal interaction costs

ICL = Losses associated with informal constraints

RIAL = Losses associated with risks of illegal activities

In the context of the network analysis of the of the formation of resource-based multiclusters at the regional level, it is expedient to use the instruments of the mathematical graph theory. Considering the development criteria of the resource-based multiclusters, we can single out such parameters as the density of the institutional environment and its innovation conductivity, which produce effect on the diffusion speed of the management and production innovations within the cluster. Let us make an assumption that any economical agent of the multicluster may be connected with other economical subjects through identifiable bilateral relations, both direct connections and indirect ones operating through intermediaries.

The multicluster density can be characterized as the ratio of the stable formal connections between the multicluster organizations and businesses to their total number. The multicluster density can be represented with the formula below:

$$d = \frac{\sum(sx_1, sx_2 \ldots sxn)}{n}$$

Where:

d = Multicluster density

sxi = Number of the stable formal connections between the ith muticluster agent with the other ones

n = Total number of the multicluster agents

Considering the multicluster density, it is required to single out the institutional environment integrity parameters related to the cluster. The multicluster integrity can be characterized as the ratio of the sum of the number of the indirect connections of each multicluster agent with the other ones to their total number:

$$i = \frac{\sum(ux_1, ux_2 \ldots uxn)}{n}$$

Where:

i = Multicluster integrity

uxi = Number of the multicluster agents connected with indirect non-formal connections with the ith cluster agent

n = Total number of the multicluster agents

The multicluster complementarity can be characterized as the average number of the primary communication channels between each multicluster agent and the other ones:

$$c = \frac{\sum(ax_1, ax_2 \ldots axn)}{n}$$

Where:

c= Multicluster complementarity

axi = Number of the primary communication channels between each multi cluster agent and the other ones

n = Total number of the multicluster agents

The multicluster conductivity is considered as the average length of the bilateral interaction chains between the cluster organizations and businesses which are not directly interconnected but build communication channels for innovation diffusion, technology transfer, as well as for informational and sociocultural interactions between the cluster agents. The multicluster conductivity can be represented with the formula below.

$$\varphi = \frac{\sum(Lx_1x_2, .. Lx_2x_1, \ldots Lxmxn)}{\sum xixj}$$

Where:

φ = Multicluster conductivity

xixj = Communication channel between the *i*th and the *j*th multicluster agents which are not directly interconnected

Lxixj = Aggregate length of the bilateral interaction chains between the multicluster agents building the communication channel.

3 Analysis and Results

To assess the impact of innovation on economic development of the regions of the Russian authors applied regression analysis. As a final indicator of innovative development of regional economic systems used the "share of innovative goods, works and services in their total volume". The analysis revealed that in the Russian regions is no direct correlation between the share of innovative products and factors, which in accordance with the theory of cluster should define an innovative vector of territory development. The results of the correlation analysis are presented in Table 1.

Using the territorial method to identify and assess the development of the resource-based multiclusters at the regional level allows assessing the synergetic effect produced by the interaction between primary sector and innovation businesses. A local resource sphere is created in the territory of this cluster, which is intended for providing innovation technologies, outside the region as well.

Table 1 The results of correlation analysis of innovative development of the Russian regions

Indicators of innovative development of the Russian regions	№ 1.1	№ 1.2	№ 1.3	№ 1.4	№ 2.1	№ 2.2	№ 2.3	№ 2.4	№ 3
1.1. The proportion of organizations implementing technological innovation	1,00								
1.2. The proportion of organizations implementing organizational innovation	0,69	1,00							
1.3. The proportion of organizations implementing marketing innovation	0,35	0,48	1,00						
1.4. The proportion of small innovative businesses, implementing technological innovation	0,22	0,12	0,26	1,00					
2.1. Number of advanced production technologies	0,27	0,27	0,26	0,21	1,00				
2.2. The number of used advanced production technologies	0,28	0,28	0,29	0,25	0,74	1,00			
2.3. The number of organizations engaged in research and development	0,28	0,22	0,24	0,19	0,88	0,74	1,00		
2.4. The number of issued patents for inventions and utility models	0,26	0,18	0,20	0,14	0,74	0,67	0,96	1,00	
3. The proportion of innovative goods, works and services in the total volume	**0,00**	**0,03**	**0,07**	**0,05**	**0,06**	**0,15**	**0,03**	**0,01**	**1,00**

Competitive advantage of multicluster are the result of the synthesis of competitiveness factors, formed at previous stages of regional economic development. The main factors of competitiveness at different evolution stages of territorial economic systems are presented in Table 2.

Table 2 The main factors of competitiveness at the evolution stages of territorial economic systems

the evolution stages of territorial economic systems	The main factors of competitiveness
Industrial agglomeration of industry	Transportation and logistics advantages, reducing uncertainty and transaction costs on the basis of geographical concentration, rapid response to competitors' innovations
Innovative industrial zones	Staffing and infrastructural benefits of innovative development, reducing uncertainty and transaction costs with the use of formal institutions and on the basis of an explicit contract with the participants of cooperation
Local innovation networks	Information benefits, reducing uncertainty and transaction costs with informal institutions, social capital formation, diffusion of management innovations
Multiclusters	Innovative advantages of joint activities in the network of scientific and technical cooperation, formation of the institutional environment of innovative development, a partnership with the government and the local community

The current Russian model for multicluster relations between the state, business and society is characterized under the three main segments of the institutional socio-economic interactions:

«White sphere». It combines the formal institutions of the legislative and administrative regulation within the framework of multicluster, which include: registration, licensing, arbitration proceedings, auctions, etc.

– «Gray sphere». It includes informal institutions, shadow rent from business, political "bargaining" with the regional management, etc.

– «Black sphere». It includes informal practices of corrupt interactions, interaction with the criminal world, raider grabs businesses, etc.

A variety of business and government in the formation and development of clusters is given space with two axes shown in Figure 1.

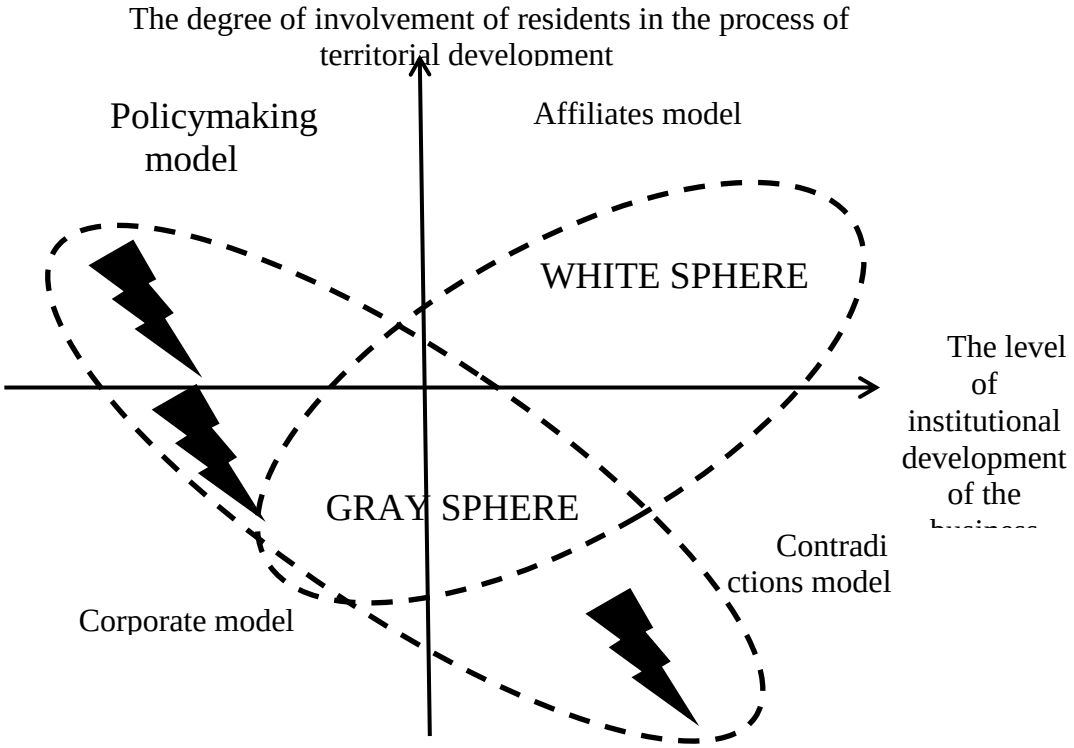

Fig. 1. Models and institutional spheres of interaction between business, government and society in the framework of multicluster

It was found out in the course of the research that l resource-based multiclusters do not only broaden and develop but, in time, they can also become narrower and disintegrate. This kind of dynamics and flexibility of resource-based multiclusters represents their distinctive feature and requires permanent governmental control. In time, efficient active clusters become objects of big governmental investments. The economic institutions uniting into a multicluster on the basis of vertical and horizontal integration build a unified distribution sphere innovation technologies and the essential condition for the efficient transformation from innovations to competitive advantages is establishing a network of stable connections between all the cluster agents.

Formation of resource-based multiclusters at the regional level may, on the whole, be regarded as a response to excessive transaction costs [9,10]. At this point, multicluster integration processes are characterized by aggregation and consolidation of enterprises. This implicitly proves the desire for diversification and economic control of enterprise risks associated with imperfect institutional environment and excessive transaction costs. Comprehensive mechanism for efficiency control of transaction costs which is used in economy to reduce them involves development of specification and protection of property rights, standardization of measurements, accounting and reporting, maintenance of monetary system, improvement of law enforcement effectiveness and efficiency, as well as implementation of measures aimed at eliminating unnecessary administrative burdens and infrastructure markets of various transactions.

The basic requirements of institutional changes to improving effectiveness of natural resource-based multiclusters include recognition of the critical role of the government control of

economic development; government's commitment to economic development; accounting of institutional transformation costs; review of efficiency of the current control.

4 Discussion

From the position of the institutional theory, the functioning sphere of the multicluster institutions represents an environment that is commonly called institutional. The study of the institutional environment of a territory as an evolving endogenous factor was initiated by the representatives of the school of economics of Washington University in the 1970s [11].

Douglass North uses the institutional environment term to define the institutional limits which exist at the macro level and determine the possible conditions of contractual agreements between individuals [12]. Oliver Williamson defines the institutional environment as an established system of the informal "rules of the game" which build the sociocultural context of economic activity [13].

In the context of this research, the institutional environment of natural resource-based multiclusters is interpreted as the aggregate of the institutional connections which surround and fill the regional economic system and produce their effect on it. On the other hand, the development degree of the governmental control mechanisms applied to the cluster policy efficiency at the regional level is determined by the activities of various groups of interests within the multicluster, while the effect they produce on the environment depends on the level of the institutional control of the interrelations inside those groups.

Thus, we can speak about a network aspect of functioning of the natural resource-based multiclusters which sets trajectories of interactions between economic entities. Network analysis for the purposes of government control of the formation of resource-based multiclusters at the regional level allows to:

· Identify the influence of informal relationships between economic agents within a multicluster on competitive ability and efficiency of a multicluster as a whole.

·Evaluate structural consequences for the economic system of a multicluster due to change in equilibrium of institutional environment of a territorial unit.

· Identify the optimal organizational structure of communication channels in the resource-based multiclusters at the regional level.

5 Conclusion

Studying the formation of resource-based multiclusters in the modern practices of the economic development allows determining the formation trends of an efficient governmental control system at the regional level. The research shows that the formation of the governmental control mechanisms is based on a general study of the transaction costs of economic activity. The resource-based multicluster have their potential both for generating fundamental and applied knowledge and for managing innovation projects. The efficiency parameters suggested by the author for the modern cluster policy implementation for the governmental control purposes, such as density, integrity, complementarity and conductivity of multicluster will allow controlling the development efficiency of the resource-based multiclusters. The paper offers the method for calculating performance efficiency of an cluster institution for economic agents, as well as efficiency of informal institutions. The article formulates recommendations for implementing control principles to improve government regulation of multiclusters.

The results proposed in the study can find application in the sphere of government control under conditions of the natural resource-driven economy. Thus, the proposed efficiency indicators of multicluster effectiveness were used by government authorities of the Republic of Mari El (Russia) while developing the programs for development of the region's economy. The

mechanisms for government regulation 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. It is planned to implement future research findings into the practice of public administration in Russia through long-term programs of collaboration between the Volga State University of Technology and government agencies of the Mari El Republic.

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