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Models For Formation Of The Medical And Pharmaceutical Clusters In Russian Federation.

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ABSTRACT

The aim of the work is to study the models of medical and pharmaceutical clusters in the modern Russian economy. Industry and organizational characteristics of high-tech clusters, the key specialization of which is medicine, pharmaceuticals and health care are considered. The paper presents the values of the localization coefficient of the enlarged economic activities and industrial production in regions of Russian Federation, on the territory of which medical and pharmaceutical clusters have been created. It is concluded that the key feature of considered regions in the conditions of knowledge economy is the tendency to the formation of multicluster on inter-sectoral or territorial basis.

Keywords: medical and pharmaceutical cluster, multiclusters, clustering models, localization of production

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INTRODUCTION

The risks of maintaining the technological backwardness of Russian industry are amplified by the dependence on energy exports and the presence of unresolved structural problems on the sectoral and spatial development (Kochetkov, Larionova and Vukovic, 2017). At the same time, the Russian economy has retained the potential for the implementation of the innovative development scenario (Kondratiev, 2015). In 2016 the Russian Federation took 43rd place in the ranking of "Global Innovation Index", rising by five positions compared to last year. In 2016, Russia ranked 12th in the integrated indicator of innovation growth calculated on the basis of national R&D expenditures, number of patents granted, level of higher education and other key indicators.

In modern Russian conditions, the formation of medical and pharmaceutical clusters remains a key area for new points of economic growth in high-tech industries (Ketels, Lindqvist and Sölvell, 2012). The problems of practical implementation of the cluster approach to the modernization of regional economic systems are actualized by the need for accelerated implementation of import substitution and increase in the high-tech production (Granberg, 2018).

Improving the efficiency of medical and pharmaceutical clusters solves the problems of infrastructure and investment support of innovative processes (Moser, 2016). The optimal solution of these problems is proposed based on existing industry complexes and individual large enterprises that are not included in the clusters (Volchkova and Minaev, 2014). The lack of development of economic and mathematical methods for identification and differentiation of clusters as the main form of Russian high-tech industry determined the purpose and objectives of this study.

DATA AND METHOD

Clusters differ from other forms of spatial concentration of production, such as territorial production complexes, as a high degree of localization of enterprises and organizational decentralization. At this stage of the study, a hypothesis was put forward about the possibility of using the Herfindal-Hirschman index (HHI), usually used to assess the level of monopolization of a certain industry, to simulate the processes of formation and development of innovative clusters (Kucenko, 2009). Herfindahl-Hirschman index is the sum of the squares of the market shares of each firm in the industry and is appropriately calculated according to the following formula:

$$HHI = S_1^2 + S_2^2 + \cdots + S_N^2, (1)$$

where *Si* is the percentage of the firm's market share in the industry.

It should be noted the high sensitivity of the Herfindahl-Hirschman index, which is responsive to changes in the market shares of each firm in the industry. Accordingly, the differentiation of clusters from territorial-industrial complexes on the basis of the values of the Herfindal-Hirschman Index is based on the share of enterprises with small and medium-sized shares in the market of goods, works and services in the structure of production. related to the studied type of economic activity (Kozlova and Makarov, 2014). Concentration ratio, which is the sum of the market shares of three or four largest firms belonging to a certain type of economic activity, deserves special attention for the identification of objective prerequisites for the formation of clusters at the sub-federal level. The concentration ratio (CR) is calculated according to the following formula:

$$CR_r = \frac{\sum_{i=1}^{r} S_i}{\sum_{i=1}^{n} S_i}, (2)$$

where *CRr* is the concentration factor of production;
Si is total market share;
r is the number of firms used to calculate *CR* (usually 3 or 4);
n is total number of analyzed firms belonging to a particular type of economic activity in the study area.

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ANALYSIS AND RESULTS

Consider the economic systems clusters, the key specialization of which is medicine, pharmaceuticals, health and social services. Table 1 presents the characteristics of these clusters.

Table 1 Characteristics of clusters, the key specialization of which is medicine, pharmaceuticals, health and social services

Cluster	Region of the Russian Federation	Number of participating organizations in 2016 (unit)	Number of employees in 2016 (pers.)	Year of creation
Altai biopharmaceutical cluster	Altai territory	11	2532	2008
Baikal pharmaceutical cluster	Irkutsk region	37	7188	2014
Biomedical cluster	Kemerovo region	49	21968	2012
Innovative territorial cluster "Pharmaceuticals, medical equipment and information technologies"	Tomsk region	52	12622	2013
Cluster " Medical industry, new chemistry and biotech»	Moscow	14	31044	2014
Moscow medical technologies cluster "South"	Moscow	19	5401	2015
Innovative territorial cluster "PHYSTECH XXI"	Moscow region	25	46075	2012
Innovative territorial cluster of medical and pharmaceutical technologies	Samara region	55	10806	2014
The Cluster of Biopharma	Belgorod region	22	2498	2014
Cluster of medical, pharmaceutical industry, radiation technologies	Saint-Petersburg	13	3626	2011
Cluster of medical and ecological instrument engineering and biotechnologies	Saint-Petersburg	39	7504	2010
Cluster of pharmaceutical, medical industry, radiation technologies	Leningrad region, St. Petersburg	12	13845	2014
Social cluster	Arkhangelsk region	18	946	2015
Pharmaceuticals, biotechnology and Biomedicine	Kaluga region	54	11259	2012
Pharmaceutical cluster	Ryazan region	10	4360	2014
Chemical and pharmaceutical cluster	Volgograd region	10	22452	2012

According to the data of the «Russian cluster observatory» from the considered clusters Cluster of Kaluga region "Pharmaceuticals, biotechnology and Biomedicine" is at a high level of organizational development, the Cluster of medical, pharmaceutical industry, radiation technologies of St. Petersburg is at the average level of organizational development. Other clusters presented in the table are at the initial level of organizational development. We will analyze the organizational parameters of the development of innovative clusters, the main specialization of which is medicine, pharmaceuticals, health and social services, presented in table 2.

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Table 2. Organizational aspects of the formation of innovative clusters, the key specialization of which is medicine, pharmaceuticals, health and social services

Cluster	Region of the Russian Federation	Average number of employees	HHI	CR_3	CR_4
Altai biopharmaceutical cluster	Altai territory	230,2	2812	0,83	0,88
Baikal pharmaceutical cluster	Irkutsk region	194,3	1492	0,55	0,61
Biomedical cluster	Kemerovo region	448,3	485	0,25	0,31
Innovative territorial cluster "Pharmaceuticals, medical equipment and information technologies"	Tomsk region	242,7	765	0,37	0,44
Cluster " Medical industry, new chemistry and biotech»	Moscow	2217,4	1840	0,66	0,80
Moscow medical technologies cluster "South"	Moscow	284,3	3580	0,82	0,86
Innovative territorial cluster "PHYSTECH XXI"	Moscow region	1843,0	1118	0,48	0,58
Innovative territorial cluster of medical and pharmaceutical technologies	Samara region	196,5	1323	0,56	0,60
The Cluster of Biopharma	Belgorod region	113,5	1344	0,58	0,64
Cluster of medical, pharmaceutical industry, radiation technologies	Saint-Petersburg	278,9	1655	0,66	0,74
Cluster of medical and ecological instrument engineering and biotechnologies	Saint-Petersburg	192,4	2376	0,73	0,79
Cluster of pharmaceutical, medical industry, radiation technologies	Leningrad region, St. Petersburg	1153,8	1990	0,66	0,76
Social cluster	Arkhangelsk region	52,6	3108	0,74	0,80
Pharmaceuticals, biotechnology and Biomedicine	Kaluga region	208,5	1036	0,46	0,57
Pharmaceutical cluster	Ryazan region	436,0	3882	0,86	0,90
Chemical and pharmaceutical cluster	Volgograd region	2245,2	4183	0,91	0,93

Calculated by the author

The systematization and generalization of cluster initiatives in the Russian regions, on the territory of which the considered clusters have been created, allowed to draw the following conclusions. Innovative clusters are characterized by the presence of clusters in the region, developing in the following related high-tech activities: nuclear and radiation technologies, biotechnology, new materials, microelectronics and instrumentation, chemical production. It should be noted that the considered regions are characterized by the formation of clusters with adjacent key specialization in the field of medical industry, pharmaceutical production and biotechnology.

This trend allows to identify medical and pharmaceutical clusters as a special kind of innovation clusters and consider them as a potential technological core of the formation of innovative multiclusters. The author singled out the Innovative territorial cluster "Pharmaceuticals, medical equipment and information technologies" located in the Tomsk region, integrating adjacent clusters of the medical industry, pharmaceuticals, information and communication technologies within the region. At the same time, Moscow city and the Moscow region, as well as St. Petersburg and Leningrad region, respectively, are characterized by the formation of potential multiclusters based on the inter-sectoral and territorial principle, combining high-tech industrial production, created within the territorial-industrial complexes and science towns. We should also note the Innovative cluster of information and biopharmaceutical technologies of the Novosibirsk region, the key specialization of which is information and communication technologies, while the creation of this cluster confirms the hypothesis about the potential of medical and pharmaceutical clusters for the formation of multicluster formations of an innovative type. We also note a similar model of intersectoral interaction between

clusters of Novosibirsk and Tomsk regions, the innovative core of which is medical, pharmaceutical and information technologies.

Based on the spatial location of medical and pharmaceutical clusters, the author identifies a potential Siberian innovative multicluster developing innovative technologies in the following areas: medical industry, biopharmaceutical technologies, information technologies. The composition of this multicluster formation includes the following clusters of subjects of the Siberian Federal district:

- Innovative cluster of information and biopharmaceutical technologies (Novosibirsk region);
- Innovative territorial cluster "Pharmaceuticals, medical equipment and information technologies" (Tomsk region);
- Innovative biopharmaceutical cluster (Altai region);
- Innovative biomedical cluster (Kemerovo region).

The calculation of the localization coefficient of industrial production is carried out for the economic systems of the Russian regions in which the innovative medical and pharmaceutical clusters operate. Among the enlarged types of production, were identified the types of economic activities, localization of which in the territory forms prerequisites for the development of innovative medical and pharmaceutical clusters. The obtained values of the localization coefficient of production are systematized in table 3.

Table 3. The values of the production localization coefficient (LC) in the context of the Russian regions and innovative medical and pharmaceutical clusters located on their territory

Clusters	Russian regions	Manufacturing industry in general	Chemical production	Manufacture of machinery, vehicles and equipment	Production of electrical equipment, electronic and optical equipment
Cluster "Medical industry of new chemistry and biotechnology", Moscow medical technologies cluster "South", Cluster "PHYSTECH XXI"	Moscow, Moscow region	1,16	1,84	1,1	1,11
Cluster of medical, pharmaceutical industry, radiation technologies	Saint-Petersburg, Leningrad region	1,19	1,03	1,77	1,72
Cluster of medical and ecological instrument engineering and biotechnologies	Altai territory	1,07	0,68	0,69	0,42
Altai biopharmaceutical cluster	Irkutsk region	0,8	0,7	1,11	0,51
Baikal pharmaceutical cluster	Kemerovo region	0,96	0,94	0,63	0,19
Biomedical cluster	Tomsk region	0,61	1,11	0,36	2,47
Cluster "Pharmaceuticals, medical equipment and information technologies"	Samara region	1,44	0,87	2,61	1,07

Cluster of medical and pharmaceutical technologies	Arkhangelsk region	1,03	0,06	2,66	0
Social cluster	Kaluga region	2,06	0,13	2,86	3,04
Cluster «Pharmaceuticals, biotechnology and Biomedicine»	Ryazan region	1,5	0,74	0,5	3,51
Pharmaceutical cluster	Volgograd region	1,54	1,63	0,3	0,12
Chemical and pharmaceutical cluster	Belgorod region	0,97	0,08	0,17	0,23

Calculated by the author

DISCUSSION

The obtained low quantitative values of the localization coefficient (LC) of such economic activity as production of electrical equipment, electronic and optical devices for a number of the considered regions are due to the orientation of clusters created in them to pharmaceutical production and biotechnology (Gubanova, Bessonova and Anoshina, 2017.).

The obtained low quantitative values of the localization coefficient (LC) of such economic activity as "chemical production, production of rubber and plastic products" for a number of the considered regions are due to the following factors:

- Social cluster of the Arkhangelsk region is not focused on medical and pharmaceutical production, but on the provision of social services, including the development of an individual approach to the development and production of technical means of rehabilitation and prosthetic and orthopedic products, and accordingly does not depend on the presence of large chemical industries in the region (Artobolevsky, 2007);
- Cluster in Kaluga region "Pharmaceuticals, biotechnology and Biomedicine" is new to the region of the cluster initiative implemented in the framework of effective cluster policies at the level of subject of the Russian Federation (Tkacheva and Afanasjeva, 2017.);
- Cluster of Biotechnology in Belgorod region is oriented not to the traditional medical-pharmaceutical production and biotechnology (Pozdnyakov, 2017), and relies on powerful agro-industrial complex (Larionova, Yalyalieva, Murzina and Napolskikh, 2016), the value of localization close-up view of economic activity "forestry and agriculture" is 4,05.

On the basis of the values of localization coefficient of the enlarged types of economic activity and branches of industrial production systematized in the table it is possible to draw a conclusion that the following features are characteristic for this type of innovative clusters:

- high value of the coefficient of localization of manufacturing industries as a whole (the maximum value of 2.06; the minimum value of 0.61; the mean value of 1.19);
- uneven distribution of localization values of industrial production of petroleum products and chemical production (maximum value of 1.84; minimum value of 0.06; average value of 0.82);
- uneven distribution of localization coefficient of industrial production of vehicles, machinery and equipment (maximum value of 2.86; the minimum value is 0.17; the average value of 1.23);
- uneven distribution of the localization coefficient of industrial production of electrical equipment, electronic and optical devices (maximum value of 3.51; minimum value of 0; average value of 1.2).

The organizational parameters of the choice of the strategy for the development of innovative clusters of medical and pharmaceutical technologies are presented in table 4.

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Table 4. Organizational parameters of the strategy choice for the development of innovative clusters of medical and pharmaceutical technologies

Organizational parameters for the development of innovative clusters	Range of quantitative values for assessing the level of organizational development		
	Low level	Medium level	High level
1. The number of organizations in clusters (ed.)	From 10 to 50	From 25 to 50	> 50
2. Average number of employees of the cluster organizations, total (people.	< 10 000	>10 000	> 10 000
3. Herfindahl-Hirschman Index HHI	>1800	<1800	<1000
4. CR3 concentration ratio	<0,95	<0,7	<0,50
5. CR4 concentration ratio	<0,95	<0,75	<0,60

Developed by the author

We also consider the industry parameters of the choice of strategy for the development of innovative medical and pharmaceutical clusters (table 5).

Table 5. Industry parameters of the strategy choice for the development of innovative medical and pharmaceutical clusters

Potential direction of clustering and innovative development of the economy	The threshold values of the coefficient of localization (LC)		
	Minimum value allowed	Sufficient value	High value
1. Production of petroleum products, chemical production	0,05	0,7	1
2. Production of electrical equipment, electronic and optical equipment	0	1	2
3. Manufacturing in general	0,5	1	1,5
4. Manufacture of machinery, vehicles and equipment	0,1	0,5	1,5

Developed by the author

CONCLUSION

Accordingly, for the considered innovative medical and pharmaceutical clusters, the value of the localization coefficient of manufacturing in General, as well as chemical production and industrial production of electrical equipment, electronic and optical devices are considered as the main criterion in assessing the potential of economic systems of the Russian regions to form innovative clusters and multiclusters (Napolskikh, 2016).

The final systematization of the results is presented in table 6 in the form of clustering strategies of the economic space of the Russian regions on the basis of the formation of innovative medical and pharmaceutical clusters. A special feature of this type of innovation clusters is the potential for the formation of multiclusters based on inter-sectoral integration (Innovative territorial cluster "Pharmaceuticals, medical equipment and information technologies of the Tomsk region") or territorial integration (allocated by the author of innovative production multiclusters of Moscow and Moscow region and, accordingly, the city of St. Petersburg and Leningrad region.

Table 6. Clustering strategies of economic systems in Russian regions based on the development of medical and pharmaceutical clusters

The value of the coefficient of localization of related economic activities	Level of organizational development of the cluster		
	Low level	Medium level	High level
High value	Innovative multicluster (cluster of high-tech products and new technologies as a point of innovative growth of agglomeration of clusters)	Innovative multicluster as a center of innovative transformation of the region's economic system	Innovative multicluster as the basis of scientific, technological and socio-economic development of the region
Sufficient value	Innovative multicluster (cluster of high-tech products and new technologies as an innovative core of a conglomerate of potential clusters)	Innovative multicluster (innovative cluster as the center of integration of the conglomerate of potential clusters)	Innovative multicluster (innovative cluster as a scientific and technological core and the center of integration of the conglomerate of potential clusters)
Minimum value allowed	Cluster of high-tech products and innovative technologies	Innovation cluster developing breakthrough technologies of the following technological structure	Innovative multicluster (innovation cluster as well as the center of integration of the conglomerate of potential clusters)

Developed by the author

The General directions of development of high-tech industries in the regions of Russia, the integration of which with innovative medical and pharmaceutical clusters creates the potential for the formation of innovative multiclusters, are also identified. These areas of development of high-tech industries in the regions of Russia include the following: nuclear and radiation technologies, biotechnology, new materials, microelectronics and instrumentation, chemical production.

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