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Evaluation and Prospects of the Cluster Model of Industrial Development

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The contradictions of Russian industrial development are caused the increasing attention to the new forms of economic and organizational principles of sector's administration. In that same context the actuality of industrial clustering is growing up. The main goal of the research is overall evaluating the effectiveness of the clustering process of Russian industry, in consideration of regional and industry characteristics.The results show that the clustering process has been actively developing in the national industrial sector, which focused on cooperating of small, medium and large enterprises to implement particular R&D and manufacturing chains. To a certain extent the goal of achieving synergy effects which realize by increasing of economic efficiency and effectiveness of each company or organization due to their high degree of concentration and cooperation, geographical and sectoral variability, innovative activity of organizations which belong to clusters.

Key words: Industry, Clusters, Production innovativeness, Industrial policy.

The transformation processes in the social economic development of modern society are becoming a significant challenge for the national economy's industrial sector. It requires new organizational and economic forms of industrial progress, which are sufficient for market requirements and strategic priorities of social development and the requirements of competitiveness as well.

The views of competitiveness in the scientific community have been historically developing from the cost-savings principle through the resources provision to knowledge and intellectual potential of society (Astakhov & Dobrova, 2012).

The effective utilization of limited resources and intellectual capacity is currently associated with clustering development. The introduction and popularization of the definition «cluster» usually relates to Porter's interpretation of geographically concentrated group of related industrial facilities and associated non-profit organizations and institutions in particular areas, which will not only compete, but complement each other (Porter, 2010).

Then cluster have been actively considered as a structural economic competitiveness institute (Gasanov & Kanov,

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2013), and as a form of management of industrial enterprises (Zhdanova, 2008)

Nowadays, it increasingly emphasizes that the cluster structure is different from such features which are typical for network companies. There are allocated self-organizing principle, stable and flexible relationship, the effective specialization of production activities, distribution of outsourcing cooperation, the organisation of the public economic interests, goals, corporate culture (Izmailova, 2013; Degtyareev, 2009; Ivanova, 2012).

According to the new institutional theory, cluster is a hybrid form of institutional relations (Golovanova & Avdasheva, 2010). The most common is that the institutions of business, government and science are considered as the main actors of cluster (Dronova, 2013).

The doctrine of "open innovation" is kindled scientific interest when the research and development activities are actively involved to create a sustainable business model (Avdushkin, 2013).

By the way it is emphasized that the inter-organizational network is a specific contractual arrangements between the formally independent market participants in order to optimum employment of resources, especially knowledge in explicit and implicit forms (Zhokov & Pospelova, 2015). It draws attention to the principles of cluster implementation in cooperation and specialization.

The exact figure of clusters in the Russian economy is yet to be determined. So that such form of industrial integration, despite of having significant number of fundamental research is still lacking a clear list of criteria on the basis of which a specific manufacturing agglomeration can be categorized as clusters (Rastvortseva & Cherepovskaya, 2013). At the same time the extent of spread of this phenomenon in the economic complex of Russia can be evaluated by indirect way.

Thus, within the framework of the Working Group which is responsible for development of public-private partnerships in innovation sphere of Government Commission on High Technology and Innovation competitive selection of innovative programs for the development of territorial clusters was held in the early 2012. There was the total number of 94 applications from different federal subject. However, during the expert evaluation from the representatives of government, scientific, educational organizations and leading companies, only 25 were selected as innovative regional clusters (IRC). This list was approved by the Government of the Russian Federation, where the innovative regional cluster is a set of enterprises and organizations which are allocated in a limited area (cluster members), which are characterized by the presence of (13) :

- Bringing together the members of R&D and manufacturing chain in one or more sectors (main economic industries);
- Mechanism of coordination and cooperation of cluster members;
- A synergistic effect in terms of improving economic efficiency and effectiveness of each company or organization due to their high degree of concentration and cooperation.

In general, the classification of the cluster's types can be performed on several criteria (Mirolubova, Karlina & Kovaleva, 2013; Kutsenko, 2009; Bareev, 2012): regional, national, transnational, symmetric, asymmetric, export-oriented, etc.

METHOD

The basic methods of statistical analysis are to group data by criteria areas, industries, number of organizations, innovative production, number of jobs and the productivity of workers.

RESULTS

The analysis of the distribution of innovative regional clusters according to the federal districts of Russia

The Table 1 presents information about the distribution of innovative regional clusters of federal subjects of Russia in 2013. It shows that from 25 innovative clusters just 18 were allocated in the European part of Russia, and only 7 were on the Asian side. But anyway, the great majority of clusters were located in the areas which characterized by traditionally high levels of innovation activity: 9 clusters were on the territory of the Volga Federal District; 6 clusters were on the territory of the Central Federal District (5 clusters were on the territory of Moscow and Moscow

region); five clusters - in the Siberian Federal District

There were about 70 percent of the clusters which have applied for participation in the competition in these three federal districts. The minimum number îf applications have been submitted from the North-Caucasian and the Far Eastern Federal Districts - 1 and 2, respectively, and the Central Federal District got 26 applications. The Volga district got 22 applications. The Siberian district got 18 applications. The total number of clusters from the Siberian Federal District which have applied for participation in the competition, just 39% passed the competitive selection and got the status of innovative regional clusters (IRC). In the Volga Federal District - 41%, and in the Central - only 23%

The distribution of experimental innovative regional clusters of industry areas

In total, 49 clusters of regions took part in the competition. The largest number of applications were received from the Moscow region and St. Petersburg, Voronezh, Novosibirsk, Kemerovo, Rostov and Sverdlovsk regions, the Republic of Bashkortostan, it allows to draw the conclusions about the level of development of these integration formations in the Russian economy

The Table 2 provides the information on the distribution of experimental innovative regional clusters of industry areas in 2013.

The chart shows that in accordance to industry-specific cluster formations in the framework of the competition were formed six industrial areas, «Nuclear and Radiation Technology»; «Manufacture of aircraft and spacecraft, shipbuilding»; «Pharmaceutical, biotechnology and medical industry»; «New materials»; «Chemistry and petro chemistry»; «Information Technologies and Electronics». The largest number of clusters that have passed the competitive selection refer to such industry areas as «Information Technologies and Electronics» and «Pharmaceutical, biotechnology and medical industry» - 7 and 6, respectively.

By the way these two clusters – «Innovation Cluster of information and biopharmaceutical technologies of Novosibirsk Region» and «Pharmaceuticals, medical technology and information technology of Tomsk region» had a mixed - interdisciplinary character. The clusters of Tatarstan and Bashkortostan republics, Arkhangelsk, Kemerovo and Nizhny Novgorod regions, the Khabarovsk Territory are characterized by the leading role of large-scale industrial production. The development of these clusters favors the accelerated transfer of innovations in direct production, and the creation of value added tax for the new small and medium enterprises

In contrast, the clusters of Pushchino, Troitsk and Dimitrovgrad, «Fiztech-XXI» the main priority is to use the potential of leading scientific and educational organizations within their territories. It considers an intensification of the process of attracting foreign advanced

Table 1. The distribution of innovative regional clusters by the federal districts in 2013 *

Federal district	Number of clusters that have applied for the competition	Number of clusters included in the list and received the status of IRC	The cluster‘s percentage received status IRC, %
		The European Part of Russia	
Central	26	6	23
North-Western	11	3 (5 – without cluster‘s unification)	45 (without cluster‘s unification)
Southern	8	-	-
Volga district	22	9	41
North-Caucasian	1	-	-
		The Asian Part of Russia	
Ural district	6	1	17
Siberian district	18	5 (7 – without cluster‘s unification)	39 (without cluster‘s unification)
Far Eastern District	2	1	50

* The chart is based on (Gokhberg & Shadrina, 2013)

manufacturing lines and their deployment on the basis of existing scientific and human capacity and the development of small and medium-sized innovative entrepreneurship in the process of commercialization of innovations.

The analysis of the participants of innovative regional clusters by federal districts

There is a diagram which shows the information about number of participants of innovative regional clusters according to the federal districts in 2013 on the Figure 1. The diagram shows that the great number of participants of innovative regional clusters are in the regions which are leaders in the number of innovative regional clusters - Volga (122), Central (107) and Siberian (102) federal districts. By the way the number of organizations-participators in innovative regional clusters in other federal districts is much lower - from 49 organizations in clusters of Northwestern Federal District - up to 6 companies in a single cluster, the Far Eastern Federal District

In the most cases, the cluster formations, which have submitted applications for participation in the competition, were located within the borders of one subject of the Russian Federation. It happened because of the widespread practice of active involvement of regional authorities to support priority development areas, which have already characterized by existing cooperative relations within a particular subject of the

Table 2. The distribution of experimental innovative regional clusters of industry areas in 2013. *

Business sector	Cluster
Nuclear and radiation technology	«Dubna» (Moscow region)
	«Sarovskiy» innovation (Nizhny Novgorod region)
	«Closed city» Zheleznogorsk (Krasnoyarsk region)
	The Nuclear (Ulyanovsk region)
Manufacture of aircraft and spacecraft, shipbuilding	The Aerospace (Samara region)
	Technopolis «Noviy Zvezdniy» (Perm Region)
	Aircraft and Shipbuilding (Khabarovsk region)
	«Ulyanovsk -avio» (Ulyanovsk region)
	Shipbuilding (Arkhangelsk region.)
Pharmaceutical, biotechnology and medical industries	Pharmaceutical and Medical Industry (St. Petersburg) **
	Pharmaceuticals and medical equipment (the Tomsk region) ***
	Biopharmaceutical (Novosibirsk region) ****
	Pharmaceutical, biotechnology and biomedicine (Kaluga region)
	Biotechnology (Moscow region).
	Biopharmaceutical (Altai Territory)
«New Material»	«Fiztech XXI» (Moscow region).
	«Troitsk» (Moscow)
	Titanic (Sverdlovsk region.)
Chemistry and petrochemistry	Automotive and petrochemicals (Nizhny Novgorod region).
	«Kama» (Tatarstan)
	Petrochemical (Bashkortostan)
	Complex processing of coal (the Kemerovo region).
Information technology and electronics	«Zelenograd» (Moscow)
	IRC «SibAcademSoft» (Novosibirsk region) ****
	IC and Electronics (Tomsk region) ***
	IT-cluster (St. Petersburg) *****
	Radiation Technologies (St. Petersburg) **
	Efficient lighting (Mordovia)

* The chart is based on (Gokhberg & Shadrina, 2013)
** Clustered medical, pharmaceuticals, radiation technologies St. Petersburg
*** Clustered "Pharmaceuticals, medical technology and information technology Tomsk Oblast"
**** Combined in innovative biopharmaceutical cluster of information and technologies of the Novosibirsk Region
***** Clustered "The development of information technology, electronics, instrumentation, communications, and information and telecommunications St. Petersburg"

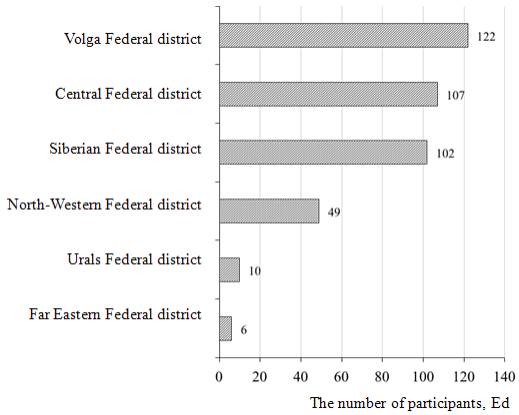

Fig. 1. The number of participants of innovative regional clusters according to the federal districts in 2013; the number of organizations (figure is based on: Innovative regional clusters // Innovations in Russia. – URL: http://innovation.gov.ru/taxonomy/term/545)

Federation in the recent years. In addition to the above, the clusters which have passed the competitive selection, are characterized by different forms of territorial organization, and the proportions between scientific, technological and industrial components as well. For example, in terms of territorial structure, there are clusters which operate within the boundaries practically coincide with municipal boundaries (Sarov city, Zheleznogorsk city). By the way, there are clusters, which combine the industrial enterprises, scientific and educational organizations, which operate in agglomerations (Moscow, Moscow region, St. Petersburg, Novosibirsk and Tomsk regions). In addition, there are clusters which members are located around the region (Republic of Mordovia, Sverdlovsk region).

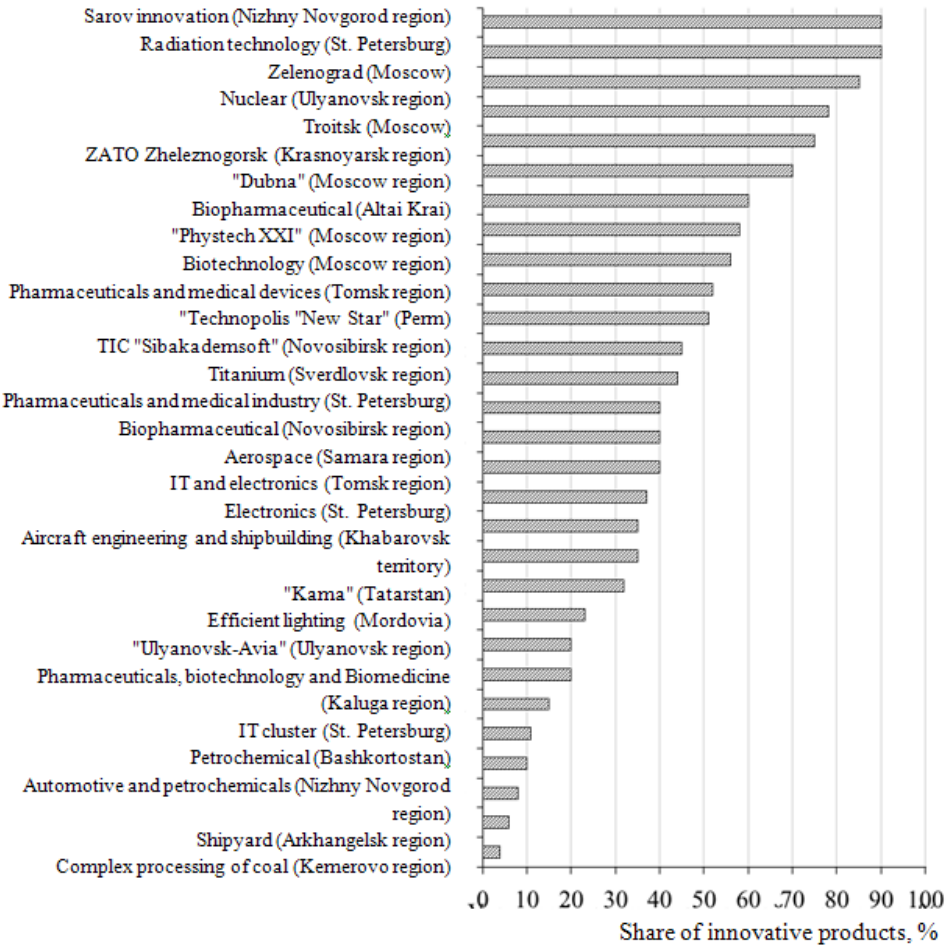

Fig. 2. The share of innovative goods, works and services to the output, which were made by participants of the experimental innovative regional clusters in 2012,% (figure is based on (Gokhberg & Shadrina, 2013))

At the same time almost all members which passed the competitive selection of clusters are located in areas with a high concentration of scientific, technical and industrial activity. Among them, for example, the number of science cities, special economic zones and closed administrative-territorial entities, including Zelenograd, Dubna, Pushchino, Obninsk, Troitsk, Sarov, Zheleznogorsk, Dimitrovgrad; agglomeration of Moscow, St. Petersburg, Novosibirsk, Nizhny Novgorod, Samara, Tomsk, Perm, Ulyanovsk, Nizhnekamsk; the territory as part of the Khabarovsk and Altai territories, the Arkhangelsk Region, the Republic of Mordovia and Bashkortostan.

To evaluate the current level of innovative activity of the participants of innovative regional clusters, which passed the competitive selection the share of innovative goods, works and services to the output was used. There is a diagram on the Figure 2 which shows the estimated value of this indicator of the participating organizations experimental innovative regional clusters in 2012.

The maximum value of this indicator recorded in clusters which are attributable to the sector «Nuclear and Radiation Technology» (over 60%). Relatively the high rates are in clusters of industries such as «New Materials» and «Life Sciences and medical industry» (40%). And the lowest rates are in clusters of industry «Chemistry and petrochemistry».

In particular, the diagram on Figure 2 shows that in such clusters as innovative Sarov

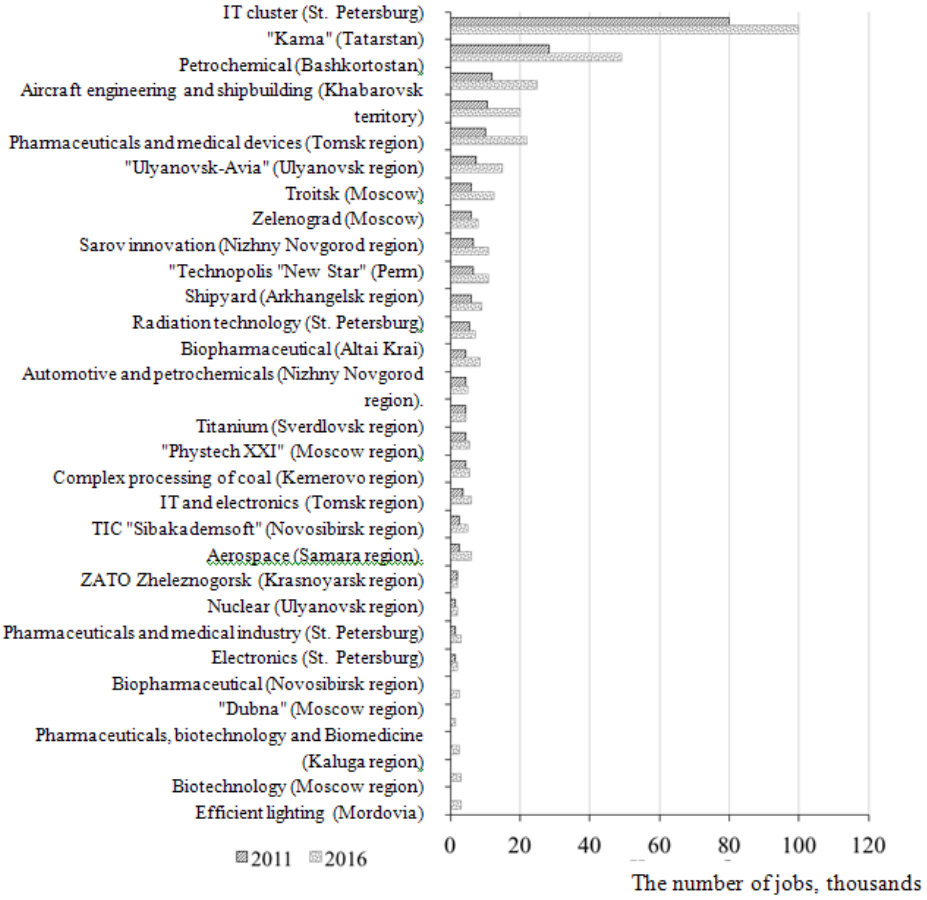

Fig. 3. The number of job positions of the members of the experimental innovative regional clusters with salary twice as high as average rate in the region of the cluster, thousand. Job positions (figure is based on (Gokhberg & Shadrina, 2013))

(Nizhniy Novgorod region.), Radiation Technology (St. Petersburg), «Zelenograd» (Moscow), nuclear (Ulyanovsk region.) «Troitsk» (Moscow), but Zheleznogorsk (Krasnoyarsk Territory), the share of innovative goods, works and services to the output was at the level of 70-90%. The share of innovative products in the clusters «Dubna» (Moscow reg.) Biopharmaceuticals (Altai region), «Fiztech XXI» (Moscow reg.), Biotechnology (Moscow reg.), Pharmaceuticals and Medical Appliances (Tomsk region.), Technopolis «New Star» (Perm Territory), CTI «SibAcademSoft» (Novosibirsk region.), titanium (Sverdlovsk region.), Pharmaceutical and Medical Industry (St. Petersburg) Biopharmaceuticals (Novosibirsk region.) was at the level of 40-60%.

The share of innovative products in the Aerospace cluster (Samara reg.), IT and Electronics (Tomsk region) Radio electronics (St. Petersburg), aerospace and shipbuilding (Khabarovsk Territory), «Kama» (Tatarstan), effective lighting (Mordovia) «Ulyanovsk-Avia» (Ulyanovsk region.) was at the level of 20-40%. The share of innovative products in clusters Pharmaceuticals, biotechnology and biomedicine (Kaluga reg.), the IT cluster (St. Petersburg), Petrochemical (Bashkortostan), Automotive and Chemicals (Nizhny Novgorod region.), Shipbuilding (Arkhangelsk region.) Complex processing of coal (Kemerovo region.) was at the level of 5-20%. Another important indicator of the innovative organizations activity of regional clusters is to create high-performance workplaces. Graph on Figure 3 shows the number of job positions in the members of the experimental innovative regional clusters with a salary twice as high as average rate

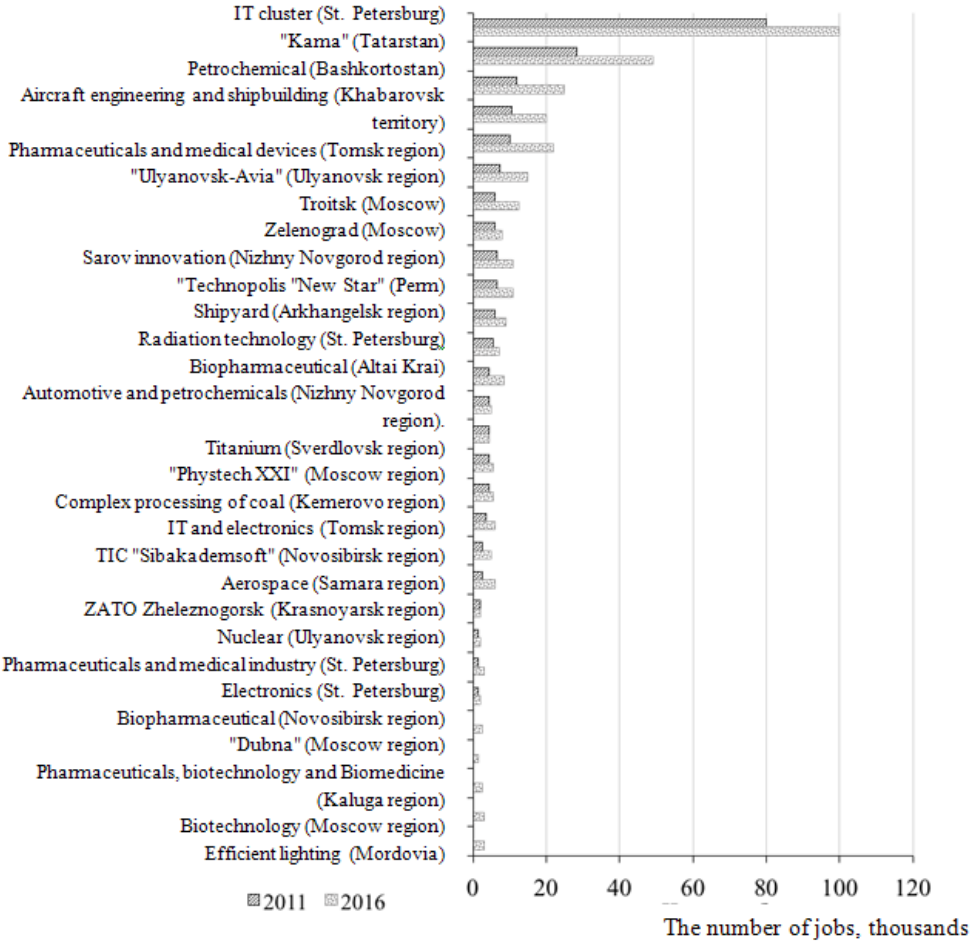

Fig. 4. The volume of output per worker in the organization - participants of innovative experimental regional clusters, thousands. rub./person. per year (graph is based on (Gokhberg & Shadrina, 2013))

in the region of the cluster. In general, in the cluster members organizations the number of jobs with a salary twice as high as average rate in the region of the cluster was 179.6 thousand. And this figure should increase by 84.7% - to 331.7 thousand by 2016.

In general, the chart shows that the IT cluster (St. Petersburg), the number of job positions with a salary twice as high as average rate was 80 thousand in the region based cluster in 2011. And their number should be increased to one hundred thousand by 2016. In the cluster «Kama» (Tatarstan) - in 2011 - about thirty thousand jobs with a salary twice as high as average rate the region based cluster, and they will plan to increase up to 50 thousand by 2016. The number of jobs with a salary twice as high as average rate in the region-based cluster was ranged from 10 to 15 thousand in 2011 in such clusters as the Aircraft and Shipbuilding (Khabarovsk Territory), Pharmaceutical and Medical Industry (St. Petersburg), «Ulyanovsk-Avia» (Ulyanovsk region.)., and they will increase it up to 20-50 thousand. The rest of clusters that have passed the competitive selection the number of jobs with a salary twice as high as average rate of its region-based cluster, was less than 10 thousand, and in total - about 80 thousand. At the same time it is planned to double such jobs for the most part of the clusters which were presented in 2016 and then the total number should exceed 140-150 thousand.

By the way, the development of innovative regional clusters which include the modernization of the industrial and technological base, commercialization of new products and the expanding of cooperation, should lead to the productivity increasing. There is a diagram on Figure 4 which illustrates the performance of volume output per worker in the organizations-participates of the experimental innovative regional clusters.

So, in the petrochemical (Bashkortostan), «Kama» (Tatarstan) and biopharmaceutical (Altai Territory) clusters the volume of production output per worker was at the level of 4.5-7.5 mln in 2011. rubles per person per year, and it should be grown to 6-10 mln. rubles per person per year by 2016. In clusters «Fiztech XXI» (Moscow region)., Pharmaceutical, biotechnology and biomedicine (Kaluga reg.), Automotive and Chemicals (Nizhny Novgorod region.), Titanium (Sverdlovsk region.), Pharmaceutical and Medical Industry (St. Petersburg), Integrated processing of coal (the Kemerovo region)., CTI «SibAcademSoft» (Novosibirsk region)., aerospace and shipbuilding (Khabarovsk Territory) the volume of production output per worker was at the level of 2-3.5 mln. rubles per person year in 2011, and it should be increased to 4-5.5 mln. rubles per person per year by 2016.

In clusters Technopolis «New Star» (Perm Territory), Sarov Innovation (Nizhny Novgorod region.), «Dubna» (Moscow region), «Ulyanovsk-Avia» (Ulyanovsk region.), Zheleznogorsk (Krasnoyarsk Territory) Biopharmaceutical (Novosibirsk region.) Shipbuilding (Arkhangelsk region). «Zelenograd» (Moscow), IT and Electronics (Tomsk region) the volume production output per worker in 2011 was at the level of 1-2 mln. rubles per year, and it should be increased to 1.5-3.5 mln. rubles per person per year by 2016. Clusters Biotechnology (Moscow reg.), «Trinity» (Moscow), Radio electronics (St. Petersburg), nuclear (Ulyanovsk region), Aerospace (Samara region), Pharmaceuticals and Medical Appliances (Tomsk region), Effective lighting (Mordovia) Radiation Technologies (St. Petersburg), the IT cluster (St. Petersburg) the volume of production output per worker in 2011 was at the level of 0.5-1 mln. rubles per person per year, it should be increased to 0.7-2 mln. rubles per person per year and by 2016. Generally, almost half of the average volume of the cluster production output per worker in the period from 2011 to 2013 should be increased by half

DISCUSSION

Thus, it becomes evident that the clustering process has been actively developing in the national industrial sector in the recent year, which focused on cooperating of small, medium and large enterprises to implement particular R&D and manufacturing chains for achieving certain synergy effects which asset in improving economic efficiency and effectiveness of each company or organization due to their high degree of concentration and cooperation. This is obviously demonstrated by the number of participants as an indicator of the competitive selection, which was

held during the Working Group Activity on the development of public-private partnerships in the innovation sector with the Government Commission on High Technology and Innovation as the geographical and sectoral clusters of variability, as well as indicators of innovation activity of organizations within into clusters.

The development of industrial cluster organization meets the basic requirements of social-economic development and modernization of the national economy, economic security and stability of the national economic system (Edelev & Lyapuntsova, 2014; Borodin, Tatuev, Shash, Lyapuntsova & Rokotyanskaya, 2015; Tatuev & Tatuev, 2015; Rokotyanskaya, 2013).

Therefore, in our opinion, it is advisable in the question of industrial policy to strengthen support for the process of creating vertical industrial clusters uniting similar in principle sectoral industrial production as the core, and vertically integrated with their peripheral businesses. This organizational and economic space of the state can and should play a key functional role in reproduction processes through the mechanism of public-private partnerships.

CONCLUSION

The development of the industrial cluster organization meets the basic requirements of social-economic development and modernization of the national economy, economic security and stability of the national economic system as well. Therefore, it is advisable to strengthen support for the process of creating vertical industrial clusters cooperating similar industrial production in the question of the industrial policy branches and the interlinked economic activities enterprises. In such business concept the government must play lead functional role in economic reproduction process through public-private partnerships mechanism. This organizational and economic space of the state will have to play a key functional role in reproduction processes through the mechanism of public-private partnerships.

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