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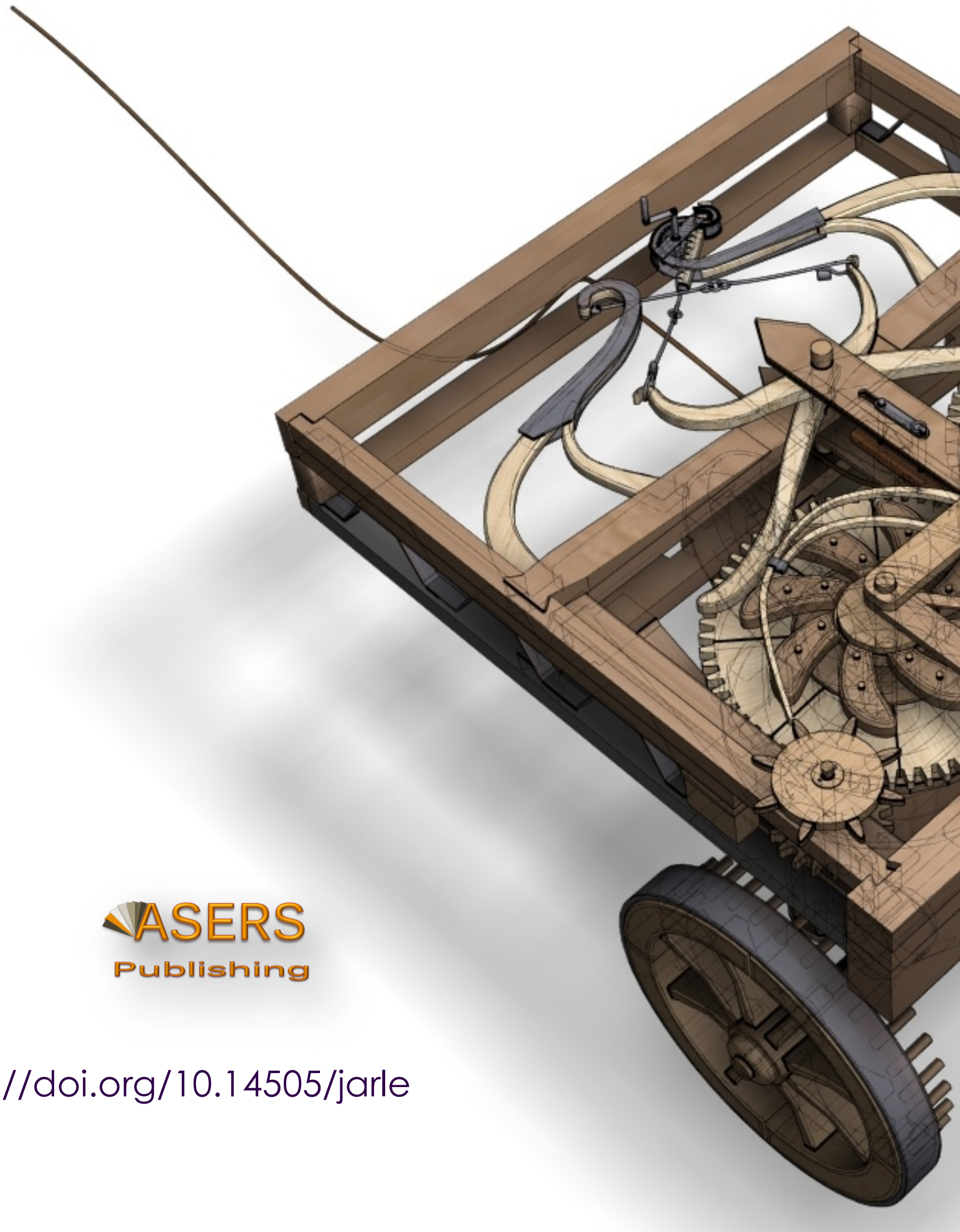

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Composite Cluster as a Factor of Aerospace Brach Development in Perm Krai

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Abstract:

In today's economy competition is getting severe not only on between companies, but also on the level of territories. This is why clusters in both developed countries and in Russia are becoming the new way of getting competitive advantages through creation of new highly qualified labour options, through innovative entrepreneurship development and closer cooperation of capital and science. The authors of this article carry out the analysis of the already existing clusters from the standpoint of their efficiency and applying the methodology of the European Cluster Observatory as well as several other approaches developed by Russian researchers. As of today the map of clusters for Russian Federation shows a very insignificant number of clusters in the field of new materials and technologies. Thus, this article suggests a structure for an aerospace composite cluster for Perm Krai. This region already has several innovation clusters, and this is why there is already a certain organizational and intellectual potential for this new cluster. During spring 2016 the government of Perm Krai was discussing the decision on this new structural unit – a composite cluster, however, detailed research on its potential structure has not been carried out. Basing on the available demand of the local market and evaluation of the parameters of the already successful industrial and innovation clusters in Russia we suggest here the strategic guidelines for the discussed cluster development until 2020.

Keywords: competitiveness; industrial cluster; composite cluster; aerospace industry.

JEL Classification: L52; O32.

Introduction

Contemporary global economy demands the availability of competitive advantages from not only enterprises and corporations, but also from regions and countries. According to M. Porter, there is no such country in the world that can be competitive in all branchers/sector, neither in their majority (Porter 2005, 256). Formation of these advantages is based mostly on new technologies, new products and commodities, and also new system of cooperation/interaction organization. The cluster system of organization in this regard is among the most competitive today. Synergy effects which always arise in any cluster strengthen the competitive forces of companies inside this cluster, and also competitive forces of the territories on which this cluster is located. The major cause of these new forces is that several newer advantages arise from the interaction of companies inside a cluster: preferences from innovative activity; lower expenditures (on assets' relocation and also on technology transfer) and also enhanced business communications between cluster participants. All of this increases the efficiency of their performance and at the same time reduces their risks.

In European countries, attention to cluster organization in the economy became more focused after 1999, and as of today in the majority of the EU country members cluster approach is already an integral part of state innovative policy (Oxford Research Cluster policy in Europe 2008). European Cluster Memorandum (2008, 7) assign to cluster organization one of the leading roles in regional policy, firstly, being the driver of innovations, secondly, the source of competitive development which can unlock the regional potential, and thirdly, the instrument for efficient interaction of enterprises, public bodies, universities and other institutions.

In Russian economy clusters became legally institutionalized in 2005 and as of today their quantity already almost reached one hundred (as of June 2016 there existed 98 clusters and in several regions of Russia decision on the creation of new ones have been approved, new ones are thus in the process of establishment) (Russian Cluster Observatory data). Among those there 25 pilot innovation clusters grouped into 6 branches: information technologies and electronics; pharmaceuticals and biotechnologies; chemistry and petrochemistry; aerospace and ship-building; nuclear technologies and advanced materials (Kutsenko 2015). These pilot clusters have existed since 2012 and it is this very group of clusters that has the largest potential for further development, since all of them are able to combine the effects from new developing branches and technologies along with new means of organization.

The mechanism of clusters' functioning in Russian Federation differs from European ways of cluster development a lot, however, the key guidelines in cluster development are essentially the same (Innovation Clusters in Europe 2008). At this, European clusters have been actively engaging businesses and universities into the system of their management, while Russian clusters are more oriented on state support, and cluster's nucleus is usually a large state-owned industrial enterprise.

1. Industrial Cluster: Methodology of our Analysis

In economic science the very concept of cluster has been elaborated extensively as early as 1980s in the US due to strengthening competitive position of Japan because of which America lost a significant share of its markets, and this has made actual the problem and the notion of international competitiveness. M.Porter defining cluster as such described it as a group of geographically neighbouring interrelated companies… acting in a particular field and described by common activity, so that they complement each other (Porter 2005, 258). In global practice Porter's model is considered to be one of the most grounded and popular ones for managing the competitiveness of a particular region (Porter 2008). Very close ideas also belonged to Raines (2000), Feser (1999), Bergman (1999), Sweeney (2000), Martin (2003), Brenner (2001).

European and American countries have been actively developing their national cluster programs, and for Russia they have partially served (in part of their results) as a guideline for territorial cluster policy development.

According to the methodology developed by Russian Ministry for Economic Development (as of 26.12.2008, N 20615-ак/д19) there are five types of clusters which can be grouped by size, capacity and development stage. In the world practice cluster can include as their members both small and medium-sized firms, some of them consist of small firms only, actually, while others, on the contrary, have only large-size members. A range of well known clusters have been created around big research universities. In Russian Federation in most of the clusters the nucleus is formed by mid-size and large enterprises.

Today's situation with Russian cluster policy is that a region which is planning to develop an industrial cluster usually has several appropriate structures which may belong to completely different industries and sectors. This enables, on one hand, using the advantages from geographical concentration of enterprises, and on the other, this also make it possible to shift the territorial borders to the appropriate and convenient size (Dezhina 2013; Zagorskii, Tishchenko 2009; Deputatova 2016).

Cluster model also means integration of mutual interests of producers, research organizations and public bodies of various levels. Concerning the power of influence of each particular stakeholder on cluster performance theory and practice do not really match (Zhdanova 2008). Majority of authors agree that regional public bodies participating to some extent in a cluster network try to solve their strategic problems, concerning mostly the territorial industrial policy (Dezhina 2013; Trofimova 2011; Glukhova 2012; Fedorovich Trifonov 2012). While industrial enterprises and research organization try to solve their own strategic issues, related to technology transfer, science-intensive R&D and numerous HR issues. All of this makes it possible for an industrial cluster to solve a wide range of large-scale problems, such as foresight in science and technologies, innovations' transfers etc. Most of these issues are rather hard to handle outside cluster.

The system of organizations' interaction within a cluster can be approached from different standpoints. Since innovative production is usually more oriented on the stage of a life cycle, this defines the structure of an industrial cluster as a set of several loops (Zhdanova 2008, 22).

The first loop is the nucleus of a cluster which consists of the leading industrial enterprises. The second loop includes the supporting enterprises and companies providing the nucleus with raw materials, equipment, software etc, this loop also includes the most important consumers (clients).

The third loop consists of infrastructural organizations: education and research institutions, institutes of commerce, financial units and centers of technology transfer. The responsibility for managing the cluster development strategy and coordination of interaction between its participants belong to the managing company of a cluster which is an independent economic unit. While the board (or the coordination council) of this managing company must consist of the representatives from all enterprises included into the cluster's nucleus. However management directly is to be carried out by an independent director who would be able to take into account the interests of all cluster participants and would act keeping in mind the interests of cluster development and regional industrial priorities (Isupov, Tiukavkin 2013, 29).

Companies belonging to all these loops have very different statuses within the regional system and are also different in terms of economic scale. Therefore, the width and inclusiveness of cluster network very much determines the scale and the impact capabilities of a formed cluster.

Cluster's nucleus is formed by the initiator of the cluster idea and the following system as such. This initiator is the key stakeholder, normally it is located on the territory chosen for this cluster and determines its key features: sectoral preferences, scale and directions of activities, variety of products and services and also the geography of further cooperation depending on the interests.

Cluster's aims reached are usually assessed by the effects and impacts it has. Such assessment of results is possible applying a system of indicators which normally includes the growth of income rate, the decrease of expenditures, volumes of investments, employment generation, reduction of production cycle, quantity of joint project implemented, growth of contribution to local budgets, growth of average salary in the region etc. (Zagorskii, Tishchenko 2009, 26; Trofimova 2011, 21). This system of indicators can be common for all organizations and enterprises in a cluster, however, it would be more efficient to adjust it according to the type of interaction between organization in a cluster. In types of interaction for our case we opt to follow (Kutsenko 2015, 43), where all indicators are distributed between three levels. Indicators of the first order explain the implementation of joint projects, creation of new vacancies for highly qualified labour force and overall increase of investments. Indicators of the second order include the growth of contribution to budget, growth of production volumes and also decrease of expenditures. And finally, the third order indicators cover the reduction of a production cycle, increased financing of various projects, growth in R&D volumes and also growth in average salary of cluster's employees.

All of the mentioned above indicators would be used further in our analysis of Russian clusters.

2. The Branch of Composites: Analysis of Development

Advanced composite materials available today can be called the third generation of polymers. Taking into account the today's technologies we can divide all composites into three groups: fiberglass, carbon fibers and organic plastic composites. The most prominent advantages of composites (especially when compared to various metals) is their light weight which can be extremely important when it comes to transporting and installation. Other important features also include their high strength, durability, no corrosion and robustness to reactive chemicals. There also a few disadvantages of using composites which are important to be mentioned here, these are high costs of production, hygroscopic properties and high labour intensity of their disposal.

Composites can be and are applied in numerous branches and sector – from aircraft engineering and ship-building to biotechnologies, medicine and design. Composites are also actively used in construction, energy sector, petrochemistry and engine building as well as in infrastructure of the utilities sector, in development of agricultural equipment and automobiles, road construction and even in production of household items.

According to some expert estimations (Kablov 2015, 36), in 2015 the volume of the world market of composite materials was about 80-90 bln USD, or equivalent to 10-12 mln tonnes a year. Their share in the airspace sector was around 15%, while ship-building took around 2-3% only (Isaeva 2015). Production of composites and their products is growing for about 5-8% each year worldwide. The leader in composites production is China, its share is about 28%. The second place belongs to the USA with 22%, and third goes the EU with 14%. All other countries account for about 36%. In this latter group Russia has a very modest share of around 1% only but still, the growth of Russian composite materials production is rather prominent, about 35% a year. Still, generally speaking, in the world carbon materials have a very insignificant share of consumption if compared to other materials.

Most of this consumption falls on civil economic sectors. Among them, first of all, we need to mention construction & building, including construction of roads and transport infrastructure (18% of the world volume), energy sector and electronics (around 21%), transport machine-building (15%), communal services and utilities (12%) and also wind energy (slightly over 11%). According to the estimates in (Wind Turbine Composite Materials Market 2015), the key driver of composites consumption growth is the construction sector along with transport and communal infrastructure.

Development of the composites' market is one of strategic priorities for Russian economy. In Russia today composites are mostly consumed by such sectors as constructions, transport, agricultural and general machine-building, chemistry and petrochemistry, energy sector and aviation.

The Ministry of Industry and Trade of Russian Federation has developed three variants of composites market development till 2020. Each of these variants assumes production development for 7 branches, but with different structure of composite materials' consumption.

The first of these variants is an inertial one, under it the market volume in 2020 would reach 30 bln rubles, and the key sectors (with the total share of 64%) would be aviaconstruction, ship-building and aerospace.

The second variant can be considered as the base one, under it the market volume would reach 120 bln rubles, and the key branches to use composite materials would be also constructions sector, transport infrastructure and transport machine-building. The share of each sector would vary from 15% to 19%.

The third variant is the targeted one. It assumes the market volume (in the same 2020) would reach 223 bln rubles, with more or less equal shares for all seven branches, however, the focus would be on transport infrastructure development, and thus, its share would be around 22%.

In order to achieve these indicators production capacities must be increased fourfold (for the base variant) and twelvefold (for the targeted variant). The state development programme which defines these aims and indicators, also includes a special subprogramme 'Development of composite materials and goods production'. It describes the conditions for sectoral programmes' development aimed at composites wider use along with the system of normative and technical documents concerning the key features of composite materials and products. All these issues are vital for further development of large and medium-sized enterprises involved in composites production.

Part of the indicators mentioned in this roadmap has already been implemented. Russia already has seven composite clusters which are present on the cluster map of Russia, elaborated by Russian Cluster Observatory (visit http://map.cluster.hse.ru) of the Institute for Statistical Studies and Economics of Knowledge. One more cluster is already announced as launched one - Tatar composite cluster 'Tatneft-Alabuga', but in fact, it is still at the stage of design and documenting.

If we turn to national methodologies of regional clusters' assessment, we can see that most of them are based either on calculation of production ratios, or on relative indicators, similar to the methodology of the European Cluster Observatory (Rastvortseva, Cherepovskaia 2013).

The authors have carried out the analysis of the already operating composite clusters on the territory of Russian Federation, and however they tend to trust more the latter of the methodologies, it would be hard to apply it in case of Russia in full due to data unavailability for part of necessary calculations. Russian Cluster Observatory disregarded as such the time of these clusters' launch and labelled them as 'beginners', since the analysis of their performance clearly shows that none of them has enough features or indicators to be assigned at a higher level than that. Clusters are being assessed according to the following criteria:

- Features of establishment – the year, number of initial participants, number of employees;
- The status of cluster – number of industrial enterprises participating in a cluster; number of universities and research centers involved;
- The width of partner network – number of Russian and foreign partners;
- Number of implemented and in process of implementation joint projects between cluster's participants.

Most of these clusters were launched during 2014-2015, but for one cluster in Dubno, which was established earlier and initially was aimed at nanotechnologies development and nuclear physics studies. The composite direction was added later. This also explains their large number of participants and employees (more numbers has only Moscow cluster).

By the cluster status the leaders are also the same, but by the width of partner network the highest rank got Smolensk cluster, followed by the association 'AKOTECH'.

The widest variety of products and services have Lipetsk (7), Smolensk (9) and Moscow (10) clusters. Comparing their proposition is rather difficult to implement due to gaps in actual data. According to the data on the already implemented projects, the leader is Smolensk cluster, which has 7 projects either at the final stage, or at the stage of ongoing development. All other clusters, but for Dubno and AKOTECH (both have only 1 project) did not announce any ongoing projects as such. Thus, if we apply the integral assessment of these clusters' performance results using their open data, then Smolensk cluster can be announced the leader. It definitely demonstrated high performance and strategic orientation. Then follows AKOTECH association. Clusters located in Moscow region have the most of resource opportunities, however, their final results are significantly lower.

Analysis of the composite clusters' performance also shows that calculations of performance efficiency indicators is hardly possible due to lack of detailed reporting data, and this partially proves that Russian producers of composites have rather low competitiveness. And this means that other territories have the chance to develop at this comparatively free market.

3. Prospects for Composite Cluster Formation in Perm Krai

Already functioning clusters in Perm Krai are closely connected to military industrial sector, and this is mostly preconditioned by the very history of industrial development of this region. The planned composite cluster would be also partially integrated into this complex.

Both Perm clusters – Technopolis 'Novyi Zvezdnyi' and 'Fotonika' – are attributed to innovative territorial clusters. 'Novyi Zvezdnyi' cluster is specializing in missile and aviation engine-building as well as in high-tech machine-building for the energy sector. The nucleus of this sector is formed by two enterprises: 'Proton-PM' and 'ODK-Permskie motory'. Russian Cluster Observatory assigned this cluster as 'medium-level status', and this means good performance results of the cluster in the previous period. At the same time, production of aerospace cluster today is indeed below the world level. Low innovativeness in the field, lack of new technologies and new types of products, underdeveloped cooperation in the production field – all hinder the development of competitive advantages at the level of separate enterprises.

Organization of structural units, oriented on new technologies, must help solving the indicated problems.

The key aim of the composite cluster creation is implementation of the most promising composite materials in avia, missile and space industries of Perm Krai in order to increase their competitiveness.

The authors of this text suggest the following structure for this cluster in Perm Krai (see Figure 1).

Figure 1. The structure of aerospace composite cluster in Perm Krai

The presented here list of cluster participants demonstrates that many organizations are already in cooperation on very similar issues, and this would ease communication in the process of cluster establishment and during the formation of environment for data exchange based on the principles of open innovations. Moreover, this rather free communication itself creates certain space for intercluster cooperation, and as European cluster experience shows, this enhances cluster performance.

Innovative activity development can be also enhanced by the fact that cluster nucleus should include not one or two large enterprises, but several interrelated but still independent companies. In such a case cluster would never turn into some sort of production lobby. Besides, cluster essentially is an open structure which simply must be developed all the time, mostly by means of new participants inclusion from small and medium businesses. For these companies the potential new field of activity is first of technology transfer, R&D and auxiliary infrastructure development.

The design of this cluster which the authors suggest to name according to the subbranch – 'Aviacomposit' – includes not only the structure but also the key parameters which allow setting the target indicators for the cluster development programme. Setting parameter estimates is always a complicated part of any system design since these parameters have to be based on interpretation of situation and on the consequent choice of assessment methodology (-ies). In our case while calculating the target parameters we suggest to apply benchmarking, that is the comparison with best practices of similar companies and organizations. Preliminary analysis shows that on the one hand, Smolensk cluster may be a good example here as a composite cluster with the most outstanding performance indicators. But on the other hand, we still need to analyze the performance of some other clusters which also demonstrate quite good results.

Clusters selected for this analysis are related to all three levels of organizational development. We have selected only those clusters which are industrial ones and/or are using the most advanced production technologies. Moreover, from our analysis we have excluded those clusters which exist only on paper, meaning those which do not have any significant results. One more peculiar feature of our data is that part of these clusters can be called industrial, and part – pilot ones. Thus, they have rather different planning horizons. However, their indicators under the framework of cluster development programme are rather similar, thus we use this data for comparison purposes.

Consolidated data on the selected clusters broken down into current and planned indicators is presented in Table 1. The indicators of investments and labour productivity are calculated by the authors, using the information from programmes and reports of the clusters under study. Thus, all indicators of the first order (according to the methodology suggested by the authors which includes three orders of indicators) are being analyzed. The indicators of the second and third orders have some limitations in terms of reporting information availability for both clusters' data themselves and general statistics too. For example, the Ministry of Economic Development data for 2014 shows that spending on R&D for the item 'new and advanced materials' had the growth of nearly 77% for 5 years, however, this item covers not only composite materials actually (Dezhina 2013, 53). Similar situation with data availability and accountability is observed for several other indicators. Part of planned indicators for the same reasons is not presented in the table as such.

Table 1. Analysis of efficiency indicators for the leading clusters of Russian Federation

Cluster's name (key field of operations)	Number of employees	Investment volumes, mln RUB	Revenues, bln RUB	Labour productivity, mln RUB per person	Number of highly qualified workplaces	Average monthly salary, ths RUB
High level						
Kamsk innovation territorial-production cluster, Kazan (automobiles, parts and automotive components)	151,561	11,639.5 (2014-2020)	983.5 (2016 data)	2.57	Not disclosed	Not disclosed
Consortsium «Science-education-production cluster 'Ulyanovsk-avia', Ulianovsk (aircraft engineering and construction)	30,028	33.4 (2012-2016)	250.0 (2018 forecast)	2. 53	22,200 (2018 forecast)	50.0 (2020 forecast)
Medium level						
Ship-building innovation cluster of Arkhangelsk region, Arkhangelsk (ship-building)	50,417	6,599.6 (2014-2017)	180.1 (2020 forecast)	3.57	19,500 (2020 forecast)	95.0 (2020 forecast)
Innovation cluster 'Zelenograd', Moscow (microelectronics and equipment development)	7,772	8,222.9 (2015-2018)	46.4 (2017 forecast)	2.58	18,000 (2017 forecast)	Not disclosed
Technopolis 'Novyi zvezdnyi', Perm (aerospace)	34,696	4,358.8 (2014-2017)	90.0 (2020 forecast)	4.00	15,500 (2020 forecast)	Not disclosed

Industrial cluster for machine-tool manufacturing 'Lipetskmash' (production of machines and equipment)	8,732	10,200.0 (2014-2020)	15.0 (2020 forecast)	2.40	6,226 (2020 forecast)	51.0 (2020 forecast.)
Initial level						
Smolensk composite cluster, Smolensk (energy sector equipment and construction materials)	2,374	2,200.0 (2016-2020)	3.9 (2020 forecast)	1.64	Not disclosed	Not disclosed
'AKOTECH', Obninsk (aircraft and aerospace engineering)	5,622	232.2 (2015-2020)	16.1 (2020 forecast)	2.86	3,627 (2020 forecast)	Not disclosed

Source: Compiled by the authors using the information from the programmes of the selected clusters posted on their official web-sites and also information of the Russian Cluster Observatory

Despite the differences in planning horizons, in belonging to a particular sector and in organizational level of the objects analyzed, we can still outline the threshold values of the indicators and on their bases we can formulate our recommendations for the cluster in the process of establishment.

Cluster development strategy till 2020 must include the following target objectives:

- Investment volume – the minimum of 45 mln. RUB. The volume of investments is significantly lower than other financial flows in the actively developing clusters due to the fact that the cluster nucleus got some investments under its previous project and already has the necessary capacities;
- The number of employees – minimum of 30 ths people, among them, no less than 60% should be highly qualified employees, that is around 22 ths people. The coefficient of 0.6 stands for the average value of this indicators for the clusters of higher and medium development levels;
- Labour productivitiy – not lower than 2.5 mln RUB per one employed person. This value can be treated as the lower threshold for the clusters of the medium and higher development levels;
- Average salary – minimum of 51 ths. RUB. Considering that the average salary in Perm Krai overall as of June 2016 was 31,992 RUB (http://permstat.gks.ru), thus the expected salary rate taking into account the expected inflation rate (according to the data of the Ministry of Economic Development) will either keep its today's value, or will be higher. This is actually quite comparable to the similar parameters of Saxon cluster 'Silicon-Saxony' (Germany, semiconductors' production and information technologies), it has it planned for the year 2017 to have income in the amount equivalent to 132 bln. RUB and labour productivity per worker – around 4,725 ml. RUB (http://map.cluster.hse.ru).

Conclusions

Considering the opportunities for clusters' development in Russia's economic space, we need to note that we agree here with many Russian researchers who wrote that domestics cluster structures, especially in the field of innovations and high-tech products, have not yet reached the level which would guarantee high competitive position for the companies which joined them and overall for the territories on which these clusters are located. Composite clusters in Russian Federation have been actively developing during the last five years, but we still cannot observe real competition at this market. For Russian companies and clusters working in the field Western experience can be used as a strategic guideline since in many developed countries local public authorities use clusters for 'new economy' promotion (Muro and Katz 2011) and thus, cluster development is often an integral unit in territorial development programmes. For example, in 2014 the government of Canada, aiming at support and promotion of a composite cluster, launched the programme of business development, ACOA. This programme covered over USD 0.5 mln., apart from investments by industrial companies.

At the same time, regional programmes on technological development of composite materials subsector in the regions must have a certain 'roadmap' and work according to it, as of today they are still at the stage of rather low intensity of performance. This is why the new cluster for Perm Krai presented here has many prospects for further development considering that it already has organization of various types included in its structure (which are necessary for efficient performance of the cluster) and also because there exist the market demand for this type of product as such. The already developed structure of the cluster along with the indicators of its development can be applied to other, similar clusters, also operating in the field of various advanced materials and the like. Aside from the presented here indicators, the tactical programme on cluster further development must also include actions and measures on information support of cluster operations, namely, for local media and social networks, which are often a blindspot for already operating clusters in Russia.

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