The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

http://dx.doi.org/10.15405/epsbs.2017.11.15

6th icCSBs 2017
The Annual International Conference on Cognitive - Social, and Behavioural Sciences

DEVELOPMENT OF INNOVATIVE INDUSTRIAL CLUSTERS: PROBLEMS, TOOLS AND PROSPECTS

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Abstract

Innovative clusters are capable of producing innovative activities, using other (non-financial) factors of growth, namely, intellectual potential (equity) created in these territories that strengthen innovative activity in the territory of clusters in regions. The extent of influence of innovative development on regional economy is revealed through indicators of costs for technological innovations and the amount of shipped products. We discovered that the high ratio of correlation 0.91 shows a direct link between these indicators. This indicates the necessity of continuing to make investments in innovations that will entail growth of the shipped products. The products will be reflected in such indicators the gross regional product, value added, receipts in the budget and other indicators. Correlation and regression analysis also confirm the interrelationship of the researched factors which has practical applications for public authorities and local self-government in case of acceptance of management decisions.

Keywords: Cluster, development, region.

http://dx.doi.org/10.15405/epsbs.2017.11.15
Corresponding Author: Juliya Sergeevna Tsertseil
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

Cluster policies and programs are promoted by governments at national and regional levels, bringing more resources and legitimacy to cluster construction. These policies have been the focus of study by many academics. Philip McCann in his book (Gordon & McCann, 1999) addresses the problem of relations among participants of a cluster from the point of view of geographical access, innovative processes within industrial clusters, the possibility of decreasing transactional expenses and the ways for improving the structure cost. The book builds the classification on the basis of three key signs of a cluster: net accumulation, industrial complex, social entrepreneurial networks. The first type of a cluster is rare in modern economic environment and is based on the model proposed by Alfred Marshall in 1968. The second type of a cluster is described in works of classical economists like Weber (cited in Asheim &Cooke, 2006), and also in neoclassical theory. This type is used in the real production sector specifically in the extracting and processing industry. The third type of cluster is widely adopted in modern market economies (Verbeek, 1999).

Some authors investigate the problem of decreasing transactional expenses, as well as the process of creation involving value added cost in clusters and allocation of the main cluster initiatives in the region in general. In this case development of a cluster is based on the line of ascent: the first stage requires presence of key participants: universities and colleges, research institutes, federal development programs, and industrial resources. After the implementation of the first stage is complete, the second stage of the development of a cluster is established by professionals who are engaged in the production of semi-finished and finished products. The third stage is the highest level of development of a cluster and leads to allocation of special enterprises engaged in relative and supporting industries necessary for functioning of a cluster. (Roelandt &Hertog, 2000)

Some academics (Cooke, 2010) identify existing and developing clusters with innovative development of regions that is expressed in growth of the following indicators: gross regional product, gross regional product per capita.

Table 01 shows the theoretical (conceptual) approaches to determine the essence and content of the concept of the "innovative cluster".

Table 01. Theoretical (conceptual) approaches to determine the essence and content of the concept of the "innovative cluster".

Authors, (source)	Key sign of a cluster	Content
Alfred Marshall, (Robbins, 1968)	Geographical accessory (region) as the factor explaining concentration of economic activity.	Belonging of the participants of a cluster to one geographical territory occupied in the industry of the same name that allows increasing intensity of cooperation communications. The following factors exert impact on development of a cluster: - the developed "local" labour market; - key resources on an entrance from suppliers; - the know-how, their movement (exchange) and implementation are provided by participants of a cluster that leads to improvement of work performance, economic development of the territory in general.
Joseph A.	Economic development is considered	The concept "a cycle of economic development"

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Schumpeter, (Schumpeter, 1939)	within innovative development based on "long waves", developed by Kondratyev N. D.	contains the following elements: consumption, means and objects of the labor, work, cost, the prices, and costs performed within innovative development of the territories.
Jacob Schmookler, (Schmookler, 1966)	Entrepreneurial chain	Independent technological chains, the forming flows (movement) of resources
Frederic M. Scherer, (Scherer, 1982)	Entrepreneurial chain	Independent technological chains, the forming flows (movement) of resources. Their analysis was carried out with use of an indicator of "costs for research and experimental developments of Research and Development"
Michael Porter, (Porter, 2007)	Geographical accessory (region) of participants of a cluster. The industrial groups with criteria of clusters which are based on advanced production technologies and have national competitive advantages	In a cluster the author distinguishes direct production enterprises in this specific industry from participants, the entity of the supporting and related industries, suppliers, consumers, and also the serving institutes (state, scientific, educational, research, logistic and so on).
Paul Krugman, (Krugman, 1991)	Geographical accessory (region)	He marked out the principles of clustering of economy, being based on accessory on a geographical sign. At the same time he gave distinctions in opportunities of clustering of the territories occupied in industrial production and agricultural sector, considered distinctions in the cost level of this or that economic system (transport)
E.J. Feser, E.M. Bergman, (Feser & Bergman, 2010)	Key role in creation of a chain of values in the region. The cluster is merging on the basis of industrial enterprises and non-production organizations for which participation in a cluster is an additional competitive advantage due to the establishment of production relations, manpower and intangible assets created in the territory of a cluster.	Using the process approach, 23 clusters are determined by the principle "entrance exit". Allocation in similar industries, suppliers of the same name and consumers of resources in the entrance exit system. Participants of cooperation communications are selected not by cost criterion but according to non-material indicators (technologies having the same name of production and non-production nature)
Ben Thuriaux-Aleman, (Thuriaux, Eagar & Johansson, 2013)	Innovative cluster exist on 3 levels: meso - macro - microlevel	Interaction between industrial sector and research sector of economy, entering of the concept "critical mass". Focus at the macro level — specialization of national (regional) economy, the need for innovations and fixed improvement of "product" and "processes" for mega-clusters. Clusters of meso-level assume interaction of participants of a production chain at various stages of creation and movement of "product", assumes carrying out SWOT analysis.
Hessel Verbeek, (Verbeek, 1999)	Entrepreneurial chain	Possibility of creation of value added in a chain of values innovative clusters
Michael J. Enright (Enright, 2000)	Implementation of cluster approach is considered in the conditions of globalization of economic communications and presence in the local market of the MC countries (multinational corporations) capable to	The strategy of interaction between multinational corporations (MC) and local clusters in various directions: the state participation, the level of development of productive forces in the region, a possibility of implementation by partners (MC, a cluster) investments of a material and intangible nature,

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	influence the level of competitiveness of the entities and organization in the region	receipt of benefits and benefits as a result of implementation of cooperation communications.
Gordon L. Clark, Meric S. Gertler, Maryann P. Feldman (Gordon, 2003)	The cluster is under construction on the basis of geographical accessory, at the same time it takes into account: institutional approach (a role of transactional expenses in forming of trade flow), global approach (an equity modulation, in particular the intellectual equity)	Authors build the matrix by sectors, in each of which a certain type of a cluster depending on the chosen key signs is allocated: 1 group: - interaction in a cluster; - interaction between clusters; - isolated entities which are territorially present in one region. 2. group: - categories of suppliers (local, external, residents, nonresidents) 3 group: - export orientation: - import orientation.

2. Problem Statement

Nowadays the Russian Federation is implementing a program called the "Strategy of Innovative Development of the Russian Federation till 2010" that provides different Development programs of the innovative territorial clusters obtaining sources of financing (Vershinina, Goryainova, Zhdanova, & Maksimova, 2016) from various levels of the budget system of Russia: federal, regional, and local. Table 2 shows these sources of financing. The two pillars of the development of innovative industrial clusters in Russia are: territorial- industrial complexes (TIC) and the state support. This paper investigates one of the state tools of support for design and development of innovative territorial clusters: Special economic zones for industrial development.

Table 02. Structure of sources of financing a program implemented by innovative industrial clusters in years 2012-2017 in million roubles.

Specialization	Fed. budget	In % to the total amount of funds	Regional and local budgets	In % to the total amount of funds	Funds of non-budgetary sources	In % to the total amount of funds	Total amount of all sources
Nuclear and radiation technologies	116990	42	12227	4	147964	53	277181
Production of space crafts, shipbuilding	95079	48	26927	14	75473	38	197479
Pharmaceutics, biotechnologies and medical industry	47077	32	26385	18	75151	51	148613
New materials	23691	16	20479	14	104463	70	148613
Chemistry and petro chemistry	128693	27	74741	16	270121	57	473555
Information technologies and electronics	68208	30	51947	23	106967	47	227122
TOTAL	479738	33	212706	14	780139	53	1472583

(Source: Universal information and analytical portal of the state support of innovative business development. The Internet - resource: http://innovation.gov.ru)

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Table 03. Types of innovative industrial clusters in different branches of Russian economy

Name of territory	Nuclear technologies	Instrument making	Pharmaceutics and biotechnologies	Nanotechnologies	Petro chemistry	Information technologies and electronics
Altai Krai			+			
Archangelsk Oblast		+				
Kaluga Oblast			+			
Kemerovo Oblast					+	
Krasnoyarsk Krai	+					
Moscow				+		+
Moscow Oblast	+		+	+		
Republic of Mordovia						+
Nizhny Novgorod Oblast	+				+	
Novosibirsk Oblast			+			+
Perm Krai		+				
Republic of Bashkortostan					+	
Republic of Tatarstan					+	
Samara Oblast		+				
St Petersburg			+			+
Sverdlovsk Oblast				+		
Tomsk Oblast			+			+
Ulyanovsk Oblast	+	+				
Khabarovsk Krai		+				

(It is constituted by authors on the basis of the analysis of information posted on the official sites on the Internet.)

Table 04. The list of the supporting and related industries of the participating entities of innovative industrial clusters in the territory of the Russian Federation.

Industry type	Product	Allied industries and the supporting industries	The list of the involved supporting clusters depending on industry specifics
Nuclear industry	Isotopes of various elements, calcium, components of systems of regulation of protection of the reactor, containers for the fulfilled nuclear fuel, lithium, magnets,	Nuclear power plants, medical industry, construction, instrument making, electronics, power	Cluster (instrument making), cluster (pharmaceutics, biotechnologies,

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	nickel powders, the equipment dosimetric and radiometric, energy, lighting products, pipelines, semi-finished products from refractory metals, the medical industry (the surgical equipment)	engineering, chemical industry	medical industry), cluster (chemistry and petro-chemistry)
Instrument making	Means of land servicing of aviation equipment, the aviation equipment, system of electronic indication based on multi-color ELT, the input equipment and an information output, the process control system, development and production of microelectronic sensors of mechanical, geometrical, thermal and other sizes (pressure, acceleration, movement, an angle of rotation, temperature, level, an expense, etc.)	Mechanical engineering, instrument making, information technologies and electronics	Cluster information technologies and electronics
Pharmaceutics, biotechnologies, medical industry	Chemical and pharmaceutical products, biopharmaceutical products, food, medical equipment, test systems, sensors of immunes, medical diagnostic units; pharmacology: innovative antiviral and antibacterial medicines, active additives, blood substitutes, wound and anti-burn coverings, carrying out preclinical testing and screening of medicines	Food, medical, instrument making	Instrument making cluster
Nanomaterials	development and production of microelectronic products, electronic equipment and means of communication, information technologies, measuring instruments	Research and Development, medical industry, instrument making, oil and gas industry, telecommunications	Cluster of pharmaceutics and biotechnology, cluster, instrument making, petro-chemistry cluster
Petrochemistry	Isoprene, butyl, halobutyl, butadiene rubber, styrene, polystyrene, neonol, ethylene glycol, polyvinyl chloride, the caustic soda, adsorbents.	Defence industry, automotive industry, production of synthetic detergents, latex industry	Cluster of nanotechnologies, cluster of pharmaceutics and biotechnology, instrument making cluster

Table 05. A list of innovative industrial clusters working in collaboration with special economic zones for industrial-production purpose (SEZ I-PP).

Special zones for industrial development	**On the territory of**	**Clusters (branches)**	**Date of establishing, governing body**
SEZ I-PP«Lipetsk»	Lipetsk Oblast	Production cluster (metal products, machine, equipment, auto components) Cluster of production building materials	Established by the Order of the Government of Russia №782 on the 21-st of December, 2005 on the territory of Gryasinsky region of Lipetsk oblast.
SEZ I-PP «Alabuga»	Republic of Tatarstan	Petro chemistry cluster Cluster of automobile	Established by the Order of the Government of Russia №782 on the 21-st of December, 2005 on the territory of

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		manufacturing Construction cluster Agricultural cluster	Elabuga region of the Republic of Tatarstan
SEZ I-PP «Moglino»	Pskov Oblast	Cluster of production of machine elements Cluster of production electronics Cluster of production equipment for railways, urban engineering, agriculture, Construction cluster Logistics cluster	Established by the Order of the Government of Russia №729 on the 19-th of July, 2012 on the territory of Pskovsky region of Pskov Oblast.
SEZ I-PP «Tolyatti»	Samara Oblast	Cluster of automobile manufacturing	Established by the Order of the Government of Russia №621 on the 12-th of August, 2010 on the territory of municipal Stavropolsky region of Samara Oblast
SEZ I-PP «Kaluga»	Kaluga Oblast	Metalworking Mechanical engineering Food industry Timber industry complex Automobile manufacturing and production of auto components Chemical industry	Established by the Order of the Government of Russia №1450 on the 28-th of December, 2012 on the territory of Lyudinovsky region of Kaluga Oblast
SEZ I-PP «Titanium valley»	Sverdlovsk Oblast	-Production of titanium products; - production of components and equipment for metallurgy; - mechanical engineering; -aircraft industry; - medical device and materials; - equipment for oil and gas industry;	Special economic zone of industrial- production type “Titanium valley” was established by the Order of the Government of Russia №11032 on the 16-th of December, 2010 on the territory of Verchnesaldinsky municipal district of Sverdlovsk Oblast

(It is constituted by authors on the basis of the analysis of information posted on the official sites on the Internet.) Internet-source: http://www.russez.ru/oez/industrial)

The state supported innovative territorial clusters in order to achieve the following aims of the development of innovative industrial clusters for medium and long term period.

Table 06. The main indexes of the development of innovative industrial clusters in the years 2012-2017.

Indexes	2012	2013	2014	2015	2016	2017
The total number of employees in the organizations cluster participants (thousands of people)	914.0	906.0	913.5	926.6	947.7	968.2
The number of high productive working places, created for the first time or as a result of improvement existing working places (units)	29048	35219	39692	44587	51342	55143
The volume of investments by organizations cluster participants (billions of rubles)	292.5	402.9	530.9	655.8	809.9	946.1

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The total amount of investments for the development of a cluster including budget funds and money from extra budget (billions of rubles)	416.7	464.6	514.3	564.4	619.0	643.4
The volume of works and projects in scientific research and development done by organizations cluster participants (billions of rubles)	72.9	89.6	97.8	114.7	129.4	144.0

(Internet-source: http://www.russez.ru/oez/industrial)

Table 06 shows that the total amount of investment for the development of clusters across the period 2012-2017 is to increase for more than 50% or for 227bln roubles, the volume of investment costs is to increase 3 times and reach the 946.1bln of roubles. The number of employees in the organizations participants of a cluster is to increase for more than 54.2 thousands of people and the number of high productive working places for more than 26.1 thousands units.

3. Research Questions

In compliance with the theories of economics innovative development the large share of the costs for technological innovations guarantees in future high rates of profit performance due to the disposal of commodities, works and services at the enterprises – cluster participants.

Analysis of relationships between the amount of costs for technological innovations and amount of the shipped products in cluster.

This paper deals with the following issues:

- evaluation of expected development of innovative industrial clusters in Russia;
- evaluation of innovative activity of the territorial regions with innovative industrial clusters;
-analysis of efficient functioning of special economic zones as a means of support and development of innovative industrial clusters in Russia;
-analysis of the volume of costs for introduction and development of technological innovations on the territories of innovative industrial clusters in special economic zones of industrial- production type;
-analysis of relationships between the amount of costs for technological innovations on the territories of innovative industrial clusters and in special economic zones of industrial- production type and the volume of produced and shipped produce.

4. Purpose of the Study

The purpose of this article is to provide theoretical and methodological approaches for the development of innovative industrial clusters, evaluation their modern conditions, the factors of cluster influence and the practical recommendations for improvement their functioning aiming at strategic development of Russian territories. For our purpose we used the indicators posted on the official site: costs for technological innovations and the amount of the shipped products. Table 07 provides specified data. We consider that these indicators most objectively reflect the positive tendencies developed in economy.

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Table 07. Costs for technological innovations and amount of the shipped products, million roubles.

The territories with clusters	Costs for technological innovations	Amount of the shipped products	The territories with clusters	Costs for technological innovations	Amount of the shipped products
Moscow Oblast	134313.9	2 146 692.8	Nizhny Novgorod Region	55695.4	1 177 167.2
Kaluga Oblast	11604.9	468 991.1	Samara Oblast	61181.3	1 217 354.2
Moscow	190334.7	4 978 422.7	Sverdlovsk Oblast	39669.3	1 399 111.7
Leningrad Oblast	12639.3	712 617.7	Altai Krai	3318.9	297 914.7
St. Petersburg	67845.1	2 871 811.2	Krasnoyarsk Krai	60049.8	1 487 292.6
Arkhangelsk Oblast	1512.8	449 768.8	Kemerovo Oblast	3899,6	1 103 444.7
Republic of Mordovia	5196.1	124 567.8	Novosibirsk Oblast	5069.3	423 243.4
Republic of Tatarstan	53353.8	1 828 184.3	Tomsk Oblast	11634.6	344 917.3
Ulyanovsk Oblast	3615.0	248 994.5	Khabarovsk Krai	7587.3	273 490.1

(It is constituted by authors on the basis of the analysis of information posted on the official sites on the Internet.)

5. Research Methods

The methodological approach involves general scientific and specific methods. While preparing the theoretical part of this paper we applied methods of deduction, induction, and dialectical method of learning, retrospective analysis. We used the following empirical approach and methods; comparative method, group method, ranging, integral evaluation, statistical method, specifically vertical and horizontal analysis, correlation and regression methods, cluster approach, program aimed and systematic methods.

To determine the relationships between the values under consideration we introduced the concept of the sample empirical correlation moment to find out the sample correlation coefficient. An analytical form of relationship was designated where the alteration of the effective index (the share of amount of the shipped products) is stipulated by the influence of the factor (the amount of costs for technological innovations).

6. Findings

We calculated the coefficient of correlation to establish the connection between specified indicators. Table 08 shows the results of calculations obtained:

Table 08. Data of the statistical analysis.

Correlation matrix	y	x1
y	1	0,918991867
x1	0.918991867	1

(Source: it is constituted by authors)

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Thus, correlation coefficient is = 0.9189

This result testifies to high direct link and dependence of these indicators.

Then we carried out the regression analysis and its results are reflected in tables 09.10.

Table 09. Results of the regression analysis: regression statistics.

Regression statistics	
Multiple R	0.918991867
R-square	0.844546051
Rated R-square	0.834830179
Standard mistake	491828.3902
Observations	18

Table 10. Results of the correlation and regression analysis.

	Coefficients P-value	**Standard mistake**	**t-statistics**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95,0%**	**Upper 95,0%**
Y-crossing	320983.9756	149251.388	2.150626	0.047135	4585.167	637382.8	4585.167	637382.8
Variable X 1	21.65520988	2.322691967	9.323324	7.22E-08	16.73132	26.5791	16.73132	26.5791

(Source: it is constituted by authors)

The correlation and regression analysis calculated revealed a close direct link between the amount of costs for technological innovations (X) and the amount of shipped products. But the coefficient of determination equals 0.84 that means that we got 84% of confirmed adequacy of the carried-out calculations. You can see the turned-out equation of linear regression in fig. 1:

$$y = 21.655x + 320984$$

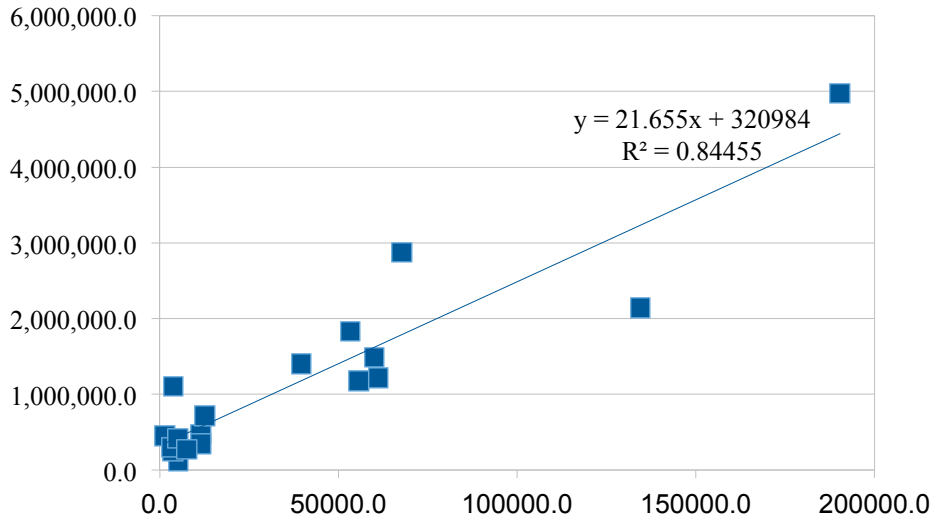

Figure 01. The regression analysis of communication of amount of the shipped products and costs for technological investments (it is constituted by authors).

The result of the calculations done proves that the increase in costs for technological investments had a positive effect on economic indicators of companies' activities in regions where innovative industrial clusters function.

We have also analysed indicators of costs for technological innovations and the volume of shipped

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produce in special economic zones of industrial production type and created the following model:

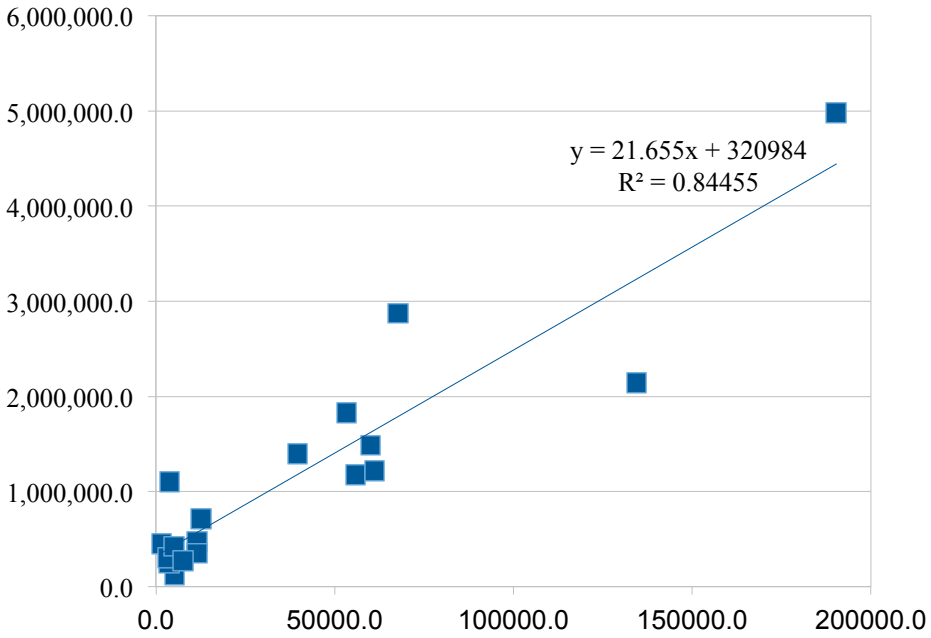

Figure 02. Correlation-regressive model of interconnection between costs for innovative technologies and the volume of shipped produce on the example of special economic zones of industrial- production type.

This model reflects X- costs for innovative technologies in 2015. Y- volume of shipped produce in 2015.

$y = 21.655x + 320984$

$R^2 = 0.8445$

This model has a high index of determination ratio which is the evidence of model quality. The model shows that the volume of costs for technological innovations has a positive effect on the volume of shipped produce as well as on economic indexes of the development of the region.

From a wider perspective the innovative products and technologies developed will contribute to the growth of the regional economy and will involve state and other institutions like universities, standard agencies, research institutes, centers for further training, professional organizations, as well as institutions delivering support in the field of education, training and information, research and technical aid. In comparison with market deals between consumers and producers located far from each other, we believe that one of the main advantages of special economic zones is close location of organizations-participants ant institutions, high level of production cooperation and frequency of deals between them enhance the level of coordination and trust between participants of the cluster.

7. Conclusion

On the basis of our research we think that the following measures of state support will help pilot clusters in the territory of Russia:

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- ensuring support for development programs of pilot clusters within state programs and federal target programs;
- provision of subsidies from the federal budget to budgets of subjects of the Russian Federation on joint financing of projects for development pilot clusters;
- provision of subsidies from the federal budget to budgets of subjects of the Russian Federation within the program of support of a small business and average enterprises;
- involvement of state institutes for implementation of actions provided within development programs of pilot clusters;
- motivation of companies to participate in joint work with the state in implementation programs for innovative development of pilot clusters;
- distribution of tax benefits in the territory of pilot clusters.
-

According to the Ministry of Economic Development of the Russian Federation the list of the actions which are selected for joint financing subsidies from the federal budget involves 74 events within 24 regional cluster projects. At the same time the greatest number of the applications (17) for federal subsidies were made by the Kama innovative territorial and production cluster of the Republic of Tatarstan.

According to the Ministry of Economic Development the priority project "Development of Innovative Clusters — Leaders of World-class Investment Appeal" is considered as the next stage in development of pilot innovative territorial clusters. Federal government will provide additional support in connection with the project for dynamically developing and world-class perspective clusters. It is supposed that approximately 5 territorial subjects of the Russian Federation where innovative territorial clusters are based will be chosen.

The main target indicators of project implementation are:

- growth of development per one worker for 20% at least in relation to the level of 2016;
- number of the high-productive workplaces created a new or as a result of upgrade of the available workplaces, the participation in organizing clusters – at least 100 thousand for 2016-2020.
- investment attraction at the expense of non-budgetary sources – over 300 billion roubles for the years 2016-2020;
- amount of works and projects in the sphere of the research and development which is carried out jointly by two and more participating organizations or one or more participating organization together with the foreign organizations at least 100 billion rubles for 2016-2020;
- the number of patents for inventions in the participating organizations of clusters will grow 3 times at least in relation to the level of 2016;
- number of the technological startups which received investments will be 300 for the years 2016-2020.

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- the amount of total proceeds from export of non-oil products by clusters and by the companies will double in relation to the level of 2016;
- growth of an average share of value added in revenue by organisations participating in clusters for 20% at least in relation to the level of 2016.

Thus the innovative industrial cluster is a system of geographically adjoining interconnected industrial enterprises and the organizations complementing each other on the basis of forming a single corporate management strategy and cooperation. The interaction between the innovative potential participants of a cluster will create the competitive advantages for increase which will be expressed in creation of additional economic value added and lead to growth of cost of the companies and their investment appeal.

Now innovative activities of the entities and organizations in the territory of regional clusters are performed within programs of innovative development with participation of the state in the following areas:

- reconstruction and upgrade of a property, plant and equipment (preferential direction of financing):
- carrying out research and experimental development;
- increase in a share of innovative products in a total amount of release.

Innovative industrial clusters are capable to produce innovative activities, using other (non-financial) factors of growth, namely, intellectual potential (equity) created in these territories that provide strengthening of innovative activity in the territory of clusters in regions.

We analysed data on innovative industrial clusters binding to their territory. The extent of influence of innovative development on region economy was revealed through indicators of costs for technological innovations and the amount of shipped products, the number of innovations. The high coefficient of correlation 0.91 shows high direct link between these indicators. With respect thereto it is necessary to continue to make investments in innovations that will entail growth of the shipped products to be reflected in such indicators as a gross regional product, value added, receipts in the budget and other indicators. We carried out correlation and regression analysis and they confirmed interrelation of the researched factors which have practical application for public authorities and local self-government in case of acceptance of management decisions.

There is strong evidence that state support of the development of innovative industrial clusters is efficient in special economic zones of industrial- production type.

Thus, it is possible to make a conclusion that allocation of innovative промышленный clusters promotes development of regions where they function. One more important point is the support of innovative clusters by the state at federal and regional levels. State support will help private sector in the conditions of financial crisis to increase the level of economic development of the territories and the country in general and independently.

http://dx.doi.org/10.15405/epsbs.2017.11.15
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Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

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