THE INNOVATIVE INDUSTRIAL CLUSTER CONCEPT OF REGIONAL MANAGEMENT FOR SUSTAINABLE DEVELOPMENT OF SOCIOECONOMIC SYSTEMS

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Abstract

The focus on the relationship between sustainable development, regionalism and clusterisation of economy formed a scientific interest of the present paper. Based on a questionnaire filled in by a sample of managers from 3 cluster-oriented regions of Russia, the perception of business strengths and weaknesses and the assessment of the external environment were investigated and paralleled with the main causes for the success of clusters or underutilization of the clusters integrated benefits.

The efficiency of a region's cluster-type development was linked to optimization of resources potential and national industrial complex enlargement, growth of market infrastructure, recruiting qualified personnel, attracting small and medium-size innovative businesses, and collaborative engagement of all entities participating in the strategic alliance within a cluster. The purpose of this research was to identify key factors of successful clustering of an economy based on experience of foreign clusters and leading clusters of the Russian economy, and to stimulate the influence of innovative clusters on regional social-economic development in Russia.

The research methodology is based on the cluster concept of regional management and numerous case-studies that describe the cases of high-tech clusters nationally and internationally.

Conclusions of the study give a plausible picture of the level of development, interrelated with the quality of business strategies in the measured regions, and ask for a comparative analysis of more Russian regions.

The present study contributes to the government body of regional management to approach sustainable development of social-economic systems and increasing entrepreneurial activity in the regions of the Russian Federation.

Keywords: *cluster efficiency, cluster strategy, economic competitiveness, innovation economy, innovative industrial cluster, national innovation systems, regional development, clustering success factors*

Introduction

The purpose of this research was to study best practices of cluster formation in Russia and foreign countries, in order to validate preconditions for development of highly effective territorial clusters. In the paper, we determine the key factors that create conditions for operation of a cluster in a sustainable way, and we outline different characteristics of economic clustering, especially its innovative focus.

The hypothesis of this research is to propose clustering in a regional economy as a mechanism of enhancing well-being and competitiveness in a region under globalization of social and economic processes.

The findings of this study contribute for the deployment by the government body of regional management to approach sustainable development of social-economic systems and increasing entrepreneurial activity in the regions of the Russian Federation.

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The Concepts of Clustering of National Economies

The realities of contemporary economy set new priorities for Russia. With the commodity markets globalization, the cluster development concept for the Russian economy is gaining in importance, with its main priority being to foster intensive economic growth through innovative development and diversification of business activities in the regions.

Clusters have multiple purposes: innovative modernization of production; activation of investment practices; development of enterprise infrastructure; creation of trend-setting, progressive human capital assets; generation of employment; raising living standards in the region and others.

Innovative cluster is a management mechanism that enables the creation of effective business models with a defined specialization based on interaction of every participant involved in value chain creation, starting with scientific research, proceeding with marketing and consumption of the innovative products.

Clusters and clustering processes keep interest of academics, regional policymakers and business people during the last 30—35 years (Asheim et al., 2006; Porter, 2000). In the literature, clusters are presented in many types, sizes and origins, and there is a wide array of cluster definitions, and ways to maintain it with innovative focus and sustainability (Martin & Sunley, 2003). However, the uncertainty surrounding the debate, calls for conceptual discussions.

The role of clusters in development and enhancement of innovative activities has been studied by many foreign researchers, such as Best (2001), Porter (1998, 2000, 2003), Castells and Hall (1994), Enright (2000), Boja (2011), Breschi & Malerba (2005), Shakya (2009) and others. Foreign and national cluster development practices were analysed by the Russian authors Porvatkina (2011), Kutsenko (2015), Britsko (2013), Maslikhina (2016), Yashin et al. (2017), Panarina (2016, 2017) and others. Nevertheless, the results of their research do not provide a clear view on key factors of industrial clustering in specific regions and do not outline different characteristics of economic clustering especially with its innovative focus.

The present research is based on the cluster concept of regional development by Porter (1998) who viewed competitiveness of a country from the perspective of international competitiveness of clusters (union of enterprises from different sectors). According to M. Porter, in the modern economy, especially in the context of globalization, traditional division of the national economy into sectors and industries is losing its relevance. Clusters (networks of interactions between enterprises and organizations) are taking leading positions (Porter, 1998). Porter's (1998, 2000) work on clusters has proved especially influential and inspired policymakers over the world to use his model as a tool for promoting regional competitiveness, innovation and growth. Porter (2000, p. 15) defined a cluster as a "geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g. universities, standards agencies, trade associations) in a particular field that compete but also cooperate".

Innovative clusters are seen as a driver of national economic growth at the works of Bathelt (2005), Martin and Sunley (2003). Other contributions include Malmberg and Power (2006, p. 57), who have pointed towards some generic criteria for cluster formation: "There should be a spatial agglomeration of similar and related economic activity; these activities should be interlinked by relations and interactions of local collaboration and competition; there should be some form of self-awareness among the cluster participants and some joint policy action". Yeung el al. (2005) focuses on the origin of the cluster and separate between an endogenous or self-organized cluster and an intentional cluster. The origin of the first one is closely linked to classical agglomeration and cluster effects (knowledge spill overs, collective learning, rivalry, complementarity, proximity, etc.), while an intentional cluster is closely linked to policy strategies and government support. Such an idea of policy-driven clusters is further

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developed by Richardson (2010, p. 59), who defines this as clusters that "...owe their origin to the direct action and strong commitment of governmental actors who set the conditions for the clusters creation either in response to an industrial crisis, or to promote regional growth".

Following the academic recommendations many regional policymakers around the world have tried to replicate successful regional clusters by designing, promoting and creating clusters, however some of them failed due to lacking an industrial foundation (Martin & Sunley, 2003). Fløysand et al. (2012) developed the concept of working clusters (a critical mass of knowledge, expertise and resources that create agglomeration economies), latent clusters (a co-location of firms that forms a critical mass, but that have not developed the level of interaction necessary to benefit from co-location) and potential clusters (clusters with only some of the elements necessary for a working cluster) and illustrated industry-driven clusters at various levels of development.

In the era of economy's digital transformation, development strategies of innovative industrial clusters should be based on endogenous models developed in works by Clausen and Rasmussen (2013), Cooke (2001), Delgado et al. (2014, 2016), Dunning and Narula (2005), Frej and Gause (2001), Kuznetsova and Roud (2014), Woodward (2012), etc. Technological factors are driving factors of cluster development in empirical research by Clausen and Rasmussen (2013) who proved that intentional technological changes are the core factors of economic growth, and that technology development level lies in direct proportion to invested resources. Investments add value to technologies, and technologies add value to investments, and this spurs economic growth. Endogenous models explain growth as based on inter-sectoral exchange of technologies and organizational innovations. National and regional economies advance, when companies from one sector set examples for companies from other sectors, and diffusion of best practices promotes sustainable growth.

For the purpose of determining factors and preconditions for highly effective clusters that spur regional growth, analysis of best foreign practices in cluster development is to be of our academic interest.

Case Analysis of Cluster Initiatives Development in Advanced Economies

According to expert opinion, in advanced economies, the contribution of clusters to GDP (Gross Domestic Product) is about 50%. In 2018 USA had 380 clusters, Great Britain – 168, the Netherlands – 20, Germany – 32, Denmark – 34, France – 96, Italy – 206, Finland – 9, India – 106. The production sector in Scandinavian countries for the most part consists of clusters structure (Porvatkina, 2011).

International experience in clustering shows that most of the clusters in advanced economies are formed on regional levels. Among distinct characteristics of clusters are their unique internal environment, infrastructure and regional macro system level, and also their capacity to utilize competitive advantages in the regions by means of participants' integration (Nahar & Inder, 2002; Moreno et al., 2005).

Worldwide recognized clusters are "Silicon Valley" (USA), London technical cluster (Great Britain), Information technologies, electronics, biology and pharmacology cluster "Sophia Antipolis" (France), Special economic zone (SEZ) "Technopolis Moscow - Zelenograd" (Russia) that is a key driver of new industrial Moscow and is dedicated to the development of innovative ecosystem of the city by creating favourable conditions for localization of high-tech companies.

It is to be noted that among bench-marking countries there can observed a certain specialization depending on regional conditions and competitive advantages. Thus, in Great Britain the most frequent clusters are bio-technical and agro-industrial, car assembly, financial services, tourism, and furniture clusters. Consumer goods manufacturing clusters are most

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frequent in Italy. French clusters produce electronics, consumer goods, plastic, and food. The priority industries of SEZ Zelenograd - Moscow in Russia are Microelectronics, Optics and Electronic Equipment; Medtech, Medical Devices, and Life Science; Energy Efficiency; Advanced Materials, Surfaces and Nanotech; ICT. Advanced manufacturing creates the key hubs of Moscow's innovative ecosystem dedicated to localization of hi-tech companies and research facilities. In USA biotechnology, pharmacology, aerospace engineering, computer and information technologies, and telecommunication services clusters are most significant (Kocker & Muller, 2015). Besides, innovation-oriented cluster development is a common tendency that can be observed in all countries.

Special attention should be given to practices of such countries as USA, Canada, China, Finland and Germany, as they are considered to be leaders in cluster development. USA was the pioneer in implementing the cluster approach. In the present work we study the development of pharmaceutical and aerospace clusters in the USA in detail.

Pharmaceutical, bio-technical and bio-medicine clusters are built close to universities and research laboratories of the corresponding specialization, and, as a rule, form industrial parks (Shapira, 2008). One of the main parks in pharmaceutics and biotechnology is "Triangle Park" in North Carolina, created in 1959. The cluster encompasses around 200 enterprises with over fifty thousand people on staff (Rykhtik, 2011), 4 universities, specializing in bio-medical engineering and molecular bio-technology; venture companies that invest millions of dollars in large and small enterprises, and the startups located in the park. Around 80 companies in the park are operating in pharmaceutical and bio-technological spheres with the total number of personnel exceeding ten thousand. Not only enterprises, but also large scientific and research institutes are located in Technopark, such as National Institute of Environmental Health Sciences (NIEHS), Research Triangle Institute (RTI), National Institute of Statistical Science (NISS), Inter-university Research Center, Statistics and Mathematics Institute, National Humanities Center and others. Some of the companies that the park houses are IBM, BASF Crop Protection, Bayer Crop Science, Monsanto Corporation, Nufarm Americas, and Syngenta.

Innovative approach, developed infrastructure, active interconnection of participants due to concentration of organizations on the same territory attract American and foreign investors. 80% of jobs are created by multinational companies. In 2016-2017 international companies invested 460 million dollars in the development of the park and created more than 2600 jobs (Panarina, 2017). Success of the park is largely determined by intensive collaboration of the state, businesses and universities. Among other specific features of the park are multiple recreation areas with natural landscapes, high-quality living facilities for employees, developed infrastructure, and convenient location of universities. All of this not only attracts employees, but also increases their loyalty.

A specific feature of development and operation of aerospace clusters in USA is that its participants are not concentrated in one geographic region. Two regions can be singled out in USA that specializes in aerospace engineering: 1. Cluster of Seattle, Tacoma and Olympia in the State of Washington (Northwest of USA); and 2. Cluster of Phoenix in the State of Arizona (Southern border of USA).

The first and world's largest aerospace cluster is located in the State of Washington with its history going back to 1916 in the city of Seattle. Currently around 132.5 thousand employees from 1350 organizations are engaged in aviation industry in Seattle. The most famous company is Boeing. Also, a large number of high-tech enterprises are involved in aerospace industry, among them we can name such as "Aerospace Industrial" (search and navigation equipment), "Aaco Avionics" (special electronic equipment and devices), "FLAerospace" (navigation devices) and others. Companies within the cluster not only contribute to the aerospace industry in the USA, but also hold a unique position in the creation chain of world aerospace products. The following universities are central to clusters – University of Washington (Seattle), that

specializes in researching new aerospace technologies and Washington State University (Pullman), that designs new engineering programs.

In the second region with the centre in Phoenix, the aerospace sector is represented by more than 1200 companies that include "Lockheed Martin Corp." (wide range of products for aviation space sector), "Honeywell International Inc." (various equipment and devices), "Space Manufacturing Inc." (navigation equipment) and others. Export revenue of aerospace companies increased by 22% in the period from 2015 to 2018 and reached 3.5 billion dollars. According to American researchers, due to the companies of the State of Arizona USA, they became the third-largest supplier of aerospace products in the world (Lindqvist et al., 2013).

Canada is one of the demonstrative examples of innovative clusters. Geographical, economic and political closeness of the country to USA largely determines specifics of cluster organization in the country. Today Canada has about 50 technological clusters of various size and development stages. The Science and Research Council and the Canada Institute for Scientific and Technical Information play important roles in the development of cluster structures. The Science and Research Council points out the following preconditions for creation of effective clusters: interest on the part of the local population; presence of a university or a research centre in the area; availability of principal technology for development of a cluster; developed information infrastructure; human resources; investments, including venture capital investments. Clusters in Canada are formed either on the basis of an already existing regional industrial infrastructure, or by establishing a research centre that will be the centre of a future cluster.

Aero Montreal aerospace cluster (Quebec, Canada), founded in 2006, contributes significantly to the Canadian economy. The cluster serves as a research centre and was built around an aerospace technology centre. The cluster includes world-class manufacturers, universities, scientific centres and suppliers of different elements of value chain creation. It is formed by 204 companies and 190 small and medium enterprises with 41750 employees. Its unique feature is that all enterprises involved in construction of aircraft components are located in one area. Its sales volume is 13.8 billion dollars, 80% of which are from export sales. The cluster creates 55% of the jobs in Canadian industry. The aerospace cluster contributes to GNP (Growth National Product) about 1.85% more than other national sectors (Lenchuk & Vlaskin, 2010).

The cluster policy of China is focused on improvement of already existing manufacturing clusters and their transformation into innovative ones by means of collaborative creation of radically new products. Clusters are initiated by the state through grants and investments.
One of the successful clusters in China is high-tech Zhanjiang cluster (Geng & Hengxin, 2009), which was founded as per special resolution of the PRC (the People's Republic of China) Government in 1992. The cluster was formed in the economic development area of Pudong. The state was actively involved in the creation of the cluster. In 1999 its principal direction of activity became biopharmaceutics, computer software and integrated circuits. The park houses 11 state manufacturing facilities, 5380 residents, and 108 research institutions. About 120000 people are employed in the park, with about 60000 of them being engineers and technical specialists (Geng & Hengxin, 2009). Throughout its operating history, there have been submitted 9142 patent applications and 2205 patents have been received. By 2018, the cumulative production value reached 6.54 billion dollars, with export revenue being 2.9 billion dollars.

Finland´s economy is also an interesting example of cluster development. Clusters are created in promisingly developing industries, where there is a necessary potential for development. The wood industry cluster is considered the "strongest" in Finland. It incorporates logging, woodworking, pulp and paper sectors, related engineering and machine manufacturing sectors, and also educational institutions and specialized research centres. The main products of woodworking and pulp and paper sectors are paper, cardboard, sawn wood, pulp, plywood,

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wood board, and joinery. The wood industry cluster contribution to GNP is 5%. At the end of 2018 it accounts for about 20% of industrial output and about 20% of the export revenue of Finland. About fifty thousand people are employed in the wood industry cluster. Companies of the wood industry cluster are actively engaged in innovative development, investing about two thirds of cumulative investments in research and development of engineering. The state also assists in financing various innovative projects related to creating new technologies and materials.

Analysis of the first clusters in Germany indicates that the clusters developed "from the bottom". They were mainly initiated by local authorities. Many regional clusters started and developed with no involvement from the state, which is explained by the federal structure of the country. Only in 2003 did German authorities begin giving high priority to high-tech projects. Today the clusters in Germany are created based on "triple helix" concept, *i.e.* collaboration of government, science and business. In addition to that, Germany promotes exchange of knowledge and innovations between key economic sectors to enable its full-scale development (Chemical parks and sites in Germany, and online resources). Since the 1980s Germany has been specializing in the chemical industry. Clusters in the country not only have close technological connections, but also have collaboration agreements between residents, which implies the creation of associations. Associations of chemical manufacturers are created in several federal states of Germany. In the North Rhine Westphalia region, there are two chemical clusters – in Ruhr region as part of the Ruhr coal field and chemical parks of the Rhine region. One of the largest European chemical unions - ChemSite association, was created in 1997 in the Ruhr region. It represents a good example of collaboration between government, science and business. It comprises 11 chemical parks, located in the densely populated region of Germany with developed infrastructure, including highways, water routes and railroads; and about 400 large and small member companies including start-ups, universities, research centres and Ruhr region authorities and public members.   Enterprises – cluster residents and also end product consumers are located close to each other. Cluster parks specialize in manufacturing of semi-finished products, ethylene, phenol, alkaloid, solvents, polyester, coal, tar, bitumen, aromatic hydrocarbons, methanol, ammonia, and industrial gases. The cluster has a high human potential with the number of employees being one hundred thousand people.

The second association ChemCologne consists of large enterprises with over 1000 employees each. Altogether the association is comprised of 150 organizations with over seventy thousand people on staff. Activity of enterprises within the association is characterized by high innovative activity and high capital intensity. The centre of this cluster is formed by chemical park in Leverkusen, chemical park Knapsack, petroleum refinery Shell, that are located close to transport junctions, pipelines and also energy providers. In addition to that, the cluster encompasses enterprises from other sectors, machinery manufacturing, logistic and marketing companies.

Analysis of foreign practices in cluster-type development by Britsko (2013), Ketels (2004, 2013, in press), Lenchuk and Vlaskin (2010), Liberati et al. (2016), Kocker and Muller (2015), Moreno et al. (2005), Sölvell and Williams (2013) allows one to determine preconditions for creation and effective operation of clusters (Table 1).

Table 1
Preconditions for Creation and Development of Clusters in Foreign Countries

Country	Preconditions
USA	• proximity to universities or research centres; • developed infrastructure; • attracting investments, including venture capital investments; • high human capacity; • developed network of supporting organisations
Canada	• the interest of the local population in the creation of a cluster; • location on university or research centre grounds; • available technology for the development of a cluster; • developed information infrastructure; • high capacity of local human capital; • attracting investments, including venture capital investments; • enhanced geographical localisation of cluster participants
Finland	• promisingly developing industries base; • economic and human potential of an industry; • developed infrastructure; • network of supporting organisations
Germany	• the convenient location of universities and research centres; • human potential in the region; • developed infrastructure; • presence of supporting organisations in the region (financial, logistics, information, etc.); • regional government policy supporting cluster development

Source: author's elaboration of the data systematisation

Systematisation of preconditions suggests similarity of criteria for successful cluster-type development of regions. First of all, effectiveness of foreign cluster structures is linked to developed business infrastructure, innovation-oriented entrepreneurial activities, long-term interaction with research centres and universities, highly qualified personnel and investments in new technologies and products. Efficiency of a cluster structure is based on effective interaction between all levels (participants) within the cluster. Establishment, implementation and improvement of this interconnection mechanism is a process managed by both members of a cluster and state non-commercial organizations.

Analysis of Trends and Factors of Cluster Development in Russian Regions

In Russia clusters are located in the following regions: Moscow special economic zone (Technopolis Moscow – Zelenograd), Saint-Petersburg (Saint Petersburg Cluster of information technologies and info-telecommunications; Saint Petersburg Cluster of medical, pharmaceutical industries and radiation technologies), the Republic of Tatarstan (Kama Innovative Territorial Industrial Cluster), Nizhny Novgorod region (Industrial Innovative Cluster of motor vehicle construction and petrochemical production), Perm region (Rocket Engine Construction Cluster Technopolis "Noviy Zvezdniy"), Samara region (Samara aerospace innovative territorial cluster), the Republic of Bashkortostan (Petrochemical Regional Innovative Cluster), Ulyanovsk region, etc.

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We have analysed the competitive advantages of some innovative territorial clusters in Russia in more detail by the works of Bek et al. (2013), Ivanov et al. (2009), Kuznetsova and Roud (2014), Kutsenko (2015), Maslikhina (2016), Panarina (2016, 2017, in press), Romanova and Lavrikova (2008), Sandler and Kuznetsov (2015), Yashin et al. (2017), Volkonitskaia (2015) and others.

One of the successful examples of cluster-based concept is the rocket engine construction cluster Technopolis "Noviy Zvezdniy" in the Perm region, which encompasses research and production potential of companies engaged in rocket and aviation engine construction, and manufacturing of high-tech products of power engineering industry in Perm region. Leading regional science and education institutions play a key role in the cluster – Perm National Research Polytechnical University, Perm State National Research University, and the Perm Scientific Centre of Russian Academy of Sciences. For the purposes of forming innovative cooperation and giving cluster members access to innovative ideas and technologies, the core companies of the cluster interact with external organizations – with over 1500 medium and small businesses. One of the unique characteristics of this cluster is historical cooperative relationships between companies: JSC Proton-PM, JSC UEC - Perm Engines, JSC UEC Aviadvigatel, JSC NPO Iskra, JSC PZ Mashinostroitel, JSC Perm scientific and instrument engineering company. Each company is a leader in its own segment of machine-building industry. For example, JSC Proton-PM holds a monopoly on the manufacture of the RD-276 engine that has some of the best indicators in the world market of launch vehicles for value of inserting 1 kg payload into orbit and launch safety (safety factor – 0,998). The missile-carrying aircraft Proton successfully competes in the world market of vehicles launching payloads into outer space. The Turbojet engine PS-90A manufactured by JSC Perm Engines provides an opportunity to improve the cost-effectiveness of new generation aircraft by almost two times and to ensure their compliance with world ecology standards. Interaction of separate cluster participants is carried out within the framework of the national Technological platform 'Minor Distributed Energy' and in cooperation with the JSC Russian Corporation of Nanotechnologies and Venture Fund Skolkovo (Moscow). However, a negative factor should be pointed out — the cluster does not have a designated organization to manage and coordinate development of the cluster, its strategic core, and the need for establishing such an organization is recognized by all members.

The Samara aerospace innovative territorial cluster enjoys scientific, educational and production-technological chains that were established in the soviet time economy and today determine specialisation of economy in the region. The cluster specializes in development of missile-carrying aircraft, space vehicles, airplanes, gas turbine and rocket engines, accessories and components, and electronic equipment. The cluster is made of three sub-clusters: 1) space and missile; 2) aircraft manufacturing; and 3) engine technology. Besides, the cluster includes higher education establishments that train specialists and carry out research for all the sub-clusters – Samara State Aero-space University and Samara State Technical University. Cluster participants possess a significant potential in research and development, and production and technology. So, more than 40% of personnel are engaged in research and development. Enterprises forming the core of the cluster are recognized as leaders of this market in Russia. For example, JSC SRC Progress is the head organization in Russia that develops missile-carrying vehicles of medium class and Earth remote- sensing space vehicles. JSC "Kuznetsov" is the largest engineering and development complex for creation of rocket and gas turbine engines in Russia. JSC 'Aviator – aviation plant' is a part of Russian Machines holding, and produces, repairs and does maintenance of TU-154 and AN-140 airplanes, and supplies components for aviation machinery. Established development institutes and a network of infrastructural organizations actively operate on the territory of the cluster to support and promote innovative solutions.

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Products manufactured by Kama innovative territorial industrial cluster of the Republic of Tatarstan are supplied to both internal Russian and world markets. About 40% of all synthetic rubber in Russia, every third Russian truck and every third tire are manufactured in the cluster. The cluster enjoys a powerful innovative potential. Participating leading scientific-research and educational organizations supply the cluster with qualified personnel, ground-breaking innovative solutions in chemistry, petrochemistry and automobile production, and effectively transfer technologies into production via innovative infrastructure facilities. Development of this cluster should lead to creation of an innovative economic centre on the territory of the Republic of Tatarstan that will encompass high-tech industrial sectors to the economic complexes, networks of logistic info-communicative centres and comfortable living conditions for republic residents (Panarina, 2017).

Petrochemical territorial cluster of Bashkortostan Republic unites petrochemical companies that hold leading positions in the national market. The cluster enjoys enhanced innovative activity of participants. The cluster development program makes provisions for the planned investment of about 165 billion roubles, with almost 160 billion roubles coming from private investors. The cluster includes 11 research and development and five educational organizations, specializing in petrochemistry. The development of the petrochemical cluster targets at strengthening its competitive position in the internal and external markets. All cluster development activities can be conventionally attributed to one of the two directions: 1) production, with the focus to improve production and establish a developed manufacturing infrastructure; and 2) social, with the focus on creating comfortable environment for living and development of employees and their family members residing on the territory of the cluster. With that, the main activities on developing manufacturing infrastructure are concentrated on activating small and medium innovative businesses around large enterprises of the cluster.

The strategic aim of Pharmaceutics, Biotechnologies and Biomedicine cluster of Kaluga region is to become one of the top three manufacturers of innovative pharmaceutical products in Russia. That is why the cluster maintains a high rate of economic development. Thus, the number of employees in pharmaceutical enterprises increased by more than 600 people within a year and reached 12400 people in 2019. During the period of 2016-2019, the range of finished pharmaceutical products almost doubled in quantity. At the moment, more than 15 articles are in the registration stage, and over ten pharmaceutical products are in the process of the development (different stages of clinical and pre-clinical trials). During the years 2016-2019 volume of manufactured products almost doubled and amounted to 21 billion roubles in 2019. The members of the cluster devote special attention to development and market launch of new products, and first of all, to the manufacturing of import-substituting products. For the purposes of creating the full chain of product development within one cluster, the Centre of pre-clinical trials was established according to GLP (Good laboratory practice) standards. One of the advantages of this cluster is its highly innovative activity. The cluster encompasses about 38 small innovative and special purpose companies. More than 70% of products produced by participating companies are innovative.

The information above enables us to describe main factors of creation and development of effective clusters in Russian regions, they were systematised in Table 2.

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Table 2

Preconditions for Forming the Innovative Territorial Clusters in Russia

Clusters	Preconditions
Innovative territorial cluster of rocket engine construction Technopolis "Noviy Zvezdniy", Perm region	• developed manufacturing and technological capacity of the region; • presence of qualified human potential; • development and application of innovative technologies; • steadfast stand on internal and external markets; • enhanced geographic localization of the participants; • available natural resources necessary for further development of existing and new participants; • the interest of regional authorities in innovative development of the cluster
Samara territorial aerospace innovative cluster	• enhanced geographic localisation of major production sites; • availability of powerful science and educational potential; • high level of cooperation between the cluster members; • available legislative and regulative framework and innovative infrastructure with exhaustive provisions for government support of innovations
Kama innovative territorial industrial cluster, Republic of Tatarstan	• beneficial economic and geographic position; • developed connections in the 'government-science-business' system; • enhanced geographic localisation of its members (largest enterprises are located within a 30-kilometre radius); • elaborated mechanisms for developing scientific infrastructure and international scientific connections, and also approaches for engaging educational organisations within the cluster into personnel training and development; • in-depth developed actions for improving transport, energy, engineering and social infrastructures
Petrochemical territorial cluster, Bashkortostan Republic	• location in one of the key petrochemical industry agglomerations in Russia; • considerable potential for developing contemporary petrochemical production; • high investment activity of cluster members
Pharmaceutics, Biotechnologies and Biomedicine cluster, Kaluga region	• enhanced innovative activity; • highly competent cluster management team; • the effective business model of members' interaction; • balanced high-tech chain for development and market launch of finished pharmaceutical and biomedical products; • developed a system of networking collaboration for achieving synergy in world level researches and personnel training; • beneficial geographic location in proximity to a large consumer market; • a high rate of social economic and innovative development of the region, favourable investment climate; • developed system of benefits and preferences for research and innovative companies in the region.

Source: author's elaboration of the data systematisation

Analysis of clusters in several regions in Russia enables us to define some general characteristics that determine the competitiveness of these clusters in the market.

1. Long-standing business activity history of cluster members. Throughout the years of their presence in the market, manufacturers have managed to build up production and financial potential, decrease losses and develop partnership connections.

2. Powerful academic potential of the territories on which clusters are based. In the studied regions, the number of academic establishments considerably exceeds the average Russian figures. Close connections with manufacturers enable the fast market launch of innovative

solutions in the form of finished products and contribute to solving the problem of human resources, which positively affects competitiveness.

3. Principles of specialisation and labour division are in widespread use. All clusters demonstrate a high level of specialisation between members.

4. Available supporting infrastructures in regions – industrial parks, techno-parks, special economic areas, etc.

5. The formation of clusters from groups of heterogeneous companies and organisations, interested in pooling together their resources with the purpose to jointly resist market fluctuations and to improve their chances for state support.

The above-listed characteristics of Russian clusters partly coincide with general factors of successful clustering in advanced countries. Alongside that, Russian clusters possess a considerable innovative growth potential, that has not been fully discovered yet.

Research Problem

The relevance of the cluster concept of regional management is increasing due to strengthening of geographic competitiveness and the need to improve business models of innovative growth, in order to be able to keep up with the accelerated rate of scientific and technological advances and to ensure sustainable growth of social and economic systems.

Contemporary economic policy of Russia views clusters as an innovative tool for developing regions, which is based on the balance between business freedom and state interests in social and economic growth of territories and the country in general. Territorial clusters are considered effective tools for achieving sustainable economic growth in a region. Their successful development is a decisive condition for creating a new business model with the priority in innovative upgrade.

Research Methodology

The investigation continued with the survey of 68 businesses involved in three regions of economy clusterisation distributed around Russia. The initial interview with the head of the Regional Development Agency (Moscow) was held to determine the major factors for possible weaknesses and strengths for clusters' formation and functioning and the basic assessment of the external environment to complete the portrait of the region's level of development with the main indicators used in policymaking to measure progress.

The structure of the discussion comprised three sections. The first section addressed the degree of economic development in the major economic regions and the skewness of wealth distribution, analysing the causes for business performance and identifying which indicators are used to measure sustainability. The second section focused on dominant sectors of industry in the Moscow economic zone (Russia´s capital) and its impact upon the region's evolution in the past and as future perspectives. Finally, the third section was dedicated to SMEs and their absorptive capacity to integrate to the clusters structure.

For the following up analysis with managers we have chosen territories with the most potential for economic development via innovative activities – Technopolis "Noviy Zvezdniy" (Perm region), Samara region aerospace innovative cluster and Pharmaceutics, Biotechnologies and Biomedicine cluster (Kaluga region). All these clusters allocate their spheres of specialisation. A smart specialisation strategy creates competitive advantages on the international level, first of all, due to innovative development of mentioned regions, improvement of sectoral management and engagement of a wide range of interested parties in clustering.

By analysing the operations, the international and inter-sectoral activities, and the long-term sustainability of the presented above clusters in Russia, half-structured in-depth interviews were conducted with 50 cluster managers in 2019.

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In this qualitative study, we focused on the following questions related to the benefits of the local environment, added value, cluster management, international activities, and the plans of these clusters.

- *Can the region's clusters rely on the local environmental benefits?*

Most of the clusters included in this analysis rely on local advantages. They try to involve local business actors, research and educational institutes, and local governments to embed themselves into the surrounding economic and social environments. Only three cluster managers stated that local relations do not influence their activities, as they are geographically independent and are carried out at a national or international level.

- *What added value does a cluster provide its members, and how is this value strengthened by cluster management?*

As Figure 1 shows, according to the region's cluster managers, the major added value of clusters is generating common research and development projects and providing project funds. Furthermore, the managers also appreciate that clusters generate knowledge transfers between members, increase competitiveness, and help members reach international markets and co-operations. Moreover, according to cluster managers, the two most important advantages for cluster participants are the option to co-operate and easier access to tendering resources.

Figure 1
Added Value of the Cluster for their Members
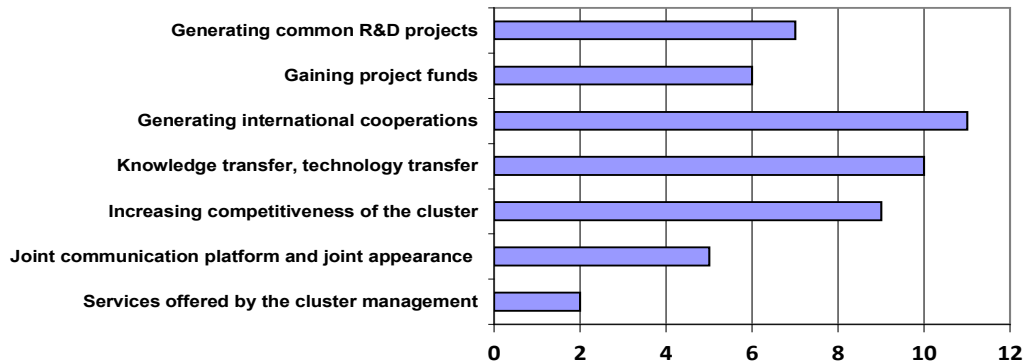
Note: by the number of opinions among the 50 cluster managers, 2019

- *How typical are inter-sectoral and international co-operations among regional clusters?*

The potential for inter-sectoral or international co-operation is utilised by the clusters in this region. Three of the clusters involved in this analysis perform inter-sectoral activities and they have made serious efforts to understand international relations, primarily by following European models initiating the promotion of a cluster and its international relations. The clusters have foreign relations due to cluster members.

- *How do the clusters view their future operations and objectives regarding their financing and sustainability*?

Considering the cluster organisations' changes and development, they have clear, well-defined visions of the future. They plan common research and development and innovation projects and have set a goal of becoming internationalised. The clusters aim to optimise inter-

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sectoral and inter-cluster co-operation to improve their competitiveness. About cluster financing, fifteen cluster managers said that, without project funds, the operation of their clusters would not be sustainable. However, most of the interviewees believe that membership fees, revenues from services, and other activities would finance their clusters' operation. However, without external resources, these clusters would be at risk of failing to develop because they cannot achieve self-sufficiency through their activity and, thus, require external help from both a financial and a professional point of view. Some interviewees indicated that cluster maintenance does not depend on direct project resources but on the economic environment and the positive effects of other forms of support. They considered an international presence, networking activities, and a common communication platform to be the most important tools. Still, their jobs would be significantly helped by the provision of infrastructure, low-interest loans, and operative mentoring activity, too. The clusters' financial statuses are not sufficiently stable, and the major difficulty that the managers face is the creation of financial background and the maintenance of the constant activities of cluster members. As the generating effect of project sources in the creation of clusters is indisputable, the cluster managers believed that external financial and non-financial support should be provided to achieve successful operations and development. As the new trends indicate, one of the most important directions and goals is to reach international markets and to enhance international and inter-sectoral relations.

- *Expectations of various interest groups from implementing cluster strategies*

One of the key factors of a successful cluster is the presence of various interest groups (stakeholders) in the formation of a cluster. It is worth mentioning, that effect, produced by the functioning of a cluster, can present different values for various cluster participants. Determining interests of stakeholders (business and academic representatives, investors, partners, regional and federal authorities) helps to understand incentive factors and expectations from the cluster development of a region. Expectations of various interest groups from implementing cluster strategies are presented in the form of Table 3.

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Table 3

Interest of Stakeholders in Cluster Strategy of Regional Development

Stakeholders	Reason of interest in cluster development
Business representatives	Decrease of transaction costs (due to stability of relations); easier access to qualified workforce (direct dialogue with educational establishments); improving investment attractiveness of a business (due to the reduction of business risks and high capital productivity ratio); mitigation of risks at entry into new markets and of potential losses; collaborative development of infrastructure; deeper business specialisation (opportunities to create a unique production chain); cost allocation to development and implementation of innovations; lobbying business interests; growth of a company's and its product competitiveness as compared with external competitors; increasing life cycle of a business by diversifying activities, etc.
Academic sector representatives	An opportunity to commercialise its own innovations (transform innovations in cluster products); access to commercial sources of financing research and development; growth of research and development base and infrastructure; employment for graduates of educational establishments
Investors	Receiving high earning power of invested assets; mitigation of risks; guaranteed repayment of capital due to business stability and competitiveness
Partners	Mitigation of business risks; long-term sustainable and mutually beneficial partnership; reduction of transaction costs
Regional authorities	Attracting investments into region; competitive growth of a region; sustainable growth of regional economy based on steady business development; increase of taxable base; provision of workplaces and reduction of out-migration; improvement of human capital quality and living standards
Federal authorities	Implementing an innovative model of national economic development; an increase of innovative potential; enhanced country competitiveness in the world markets; complex development of regions; diversification of the national economy

Source: author's elaboration of the data systematization

It is necessary to determine the expected effects on various stakeholders when taking mutually beneficial decisions and considering each other's interests will ensure the growth's synergy. A special role in intensifying cluster-type development of regional economies belongs to interested regional and federal authorities. In the era of information, companies operate based on integrated business processes. The state should enable continuous interaction between all members of innovative-technological economic growth complexity, and also develop appropriate infrastructure.

Research Results

Due to complex influence of an innovative industrial cluster on a regional economic system, in Figure 2, it makes sense to present its effect as a model based on the interpretation of an innovative industrial cluster influence on a regional economic system by in-depth interviews with 50 cluster managers of three regional clusters distributed around Russia.

Figure 2
Model of an Innovative Industrial Cluster Influence on a Regional Economy

Creation of cost advantages	Activation of innovative activity	Attracting investments
Increase of the occupational level	**MICRO-EFFECTS OF CLUSTERING**	Increase of tax liabilities
Personnel competency development	Creation of new businesses	Production volume increase

Competitiveness growth and regional image improvement	Development of regional investment attractiveness	Increase of budget costs for social and economic development of a region
Improved quality of human capital	**MACRO-EFFECTS OF CLUSTERING** Reaching goals of the social and economic wellbeing in the region	Increased export of regional competitive products
Overcoming economic decay	Diversification and sustainability of the regional economy	Sustainable GNP growth

By analogy with macro- and micro-environment of organisations, cluster participants produce micro-effects as they carry out their business activities, which in their turn lead to macro-changes in the regional economy. Innovative industrial clusters produce a multilateral impact on the regional economy. In particular, the creation of a new business and related increase of occupational level (micro-effect of clusterisation) lead to diversification of the economy and increase the probability of overcoming economic decay (macro-effect). The drive to reduce costs (micro-effect) ensures a competitive cost advantage, which directly affects price competitiveness and increases product demand. Due to the close relationship between manufacturers and academic establishments, three goals are achieved – personnel training, regular skills enhancement (micro-effect), and spur of innovativeness and increased export of competitive products (macro-effect). Besides, engagement of academic establishments into clusters positively affects the quality of human capital in the region (macro-effect). Clusters stimulate the increase of production volume to ensure sustainable GNP growth (macro-effect). With the development of clusters, tax liabilities grow, which expands regional budget capacities to finance territorial social and economic development projects (macro-effect). Inflow of investments into a cluster project together with production volume growth and high capital productivity ratio promote higher investment attractiveness and a more favourable image of a region in general (macro-effect). The suggested conceptual model of clusters' influence on regional economies maps micro-effects that result from the operation of a cluster, and lead to macro-changes in the regional economy.

The key purpose for implementing the cluster concept of economic development is to achieve territorial social and economic well-being, which is represented by such macro-effects as higher competitiveness of regional products, enhanced attractiveness of investment, deficit-free budget, improved human capital quality, sustainable growth of Gross National Product

(GNP) and other components. Clustering of regional economies, as is evident in Russian and foreign practices, is a compound process with a perspective for sustainable growth of social and economic systems.

As illustrated above, systematised factors and preconditions of clustering in Russia and foreign countries prove the similarity of criteria for successful cluster-type development in regions. First of all, the effectiveness of clusters is based on developed business infrastructure, the company focus on innovations, long-term connections with scientific centres and universities, highly qualified personnel and investments in new technologies and products. Alongside that, the developed structure of connections between all cluster representatives is a binding element, *i.e.* a cluster is capable of meeting its targets, with the most important ones being production expansion, development of export, innovative and human potentials, only when effective and mutually beneficial relationships of integration and connections of all clusters elements are in place. Creation, implementation and improvement of such a mechanism should be a managed process, developing under the guidance of a specialised non-commercial organisation interested in and responsible for the implementation of cluster projects.

To conclude the analysis of territorial cluster policy, it is worth listing the most significant factors to consider promoting successful clustering of the Russian economy:

1. Optimum development of state financial motivation system – preferential taxation, financing, subsidizing, grants, and state orders. Large-scale state support.
2. Developed supporting infrastructure, including financial, manufacturing and managerial. Extensive application of cluster infrastructural elements – incubators, accelerators, co-working, techno-parks, competitiveness poles, outsourcing, start-ups, etc.
3. In-depth development of academic sector; close and active relationship between universities, research centres and manufacturing companies.
4. Development of venture organizations.
5. Reliance on existing competitive technological potential of local manufacturing enterprises and scientific organizations.
6. Existence of leading enterprises that are able to be in charge of innovative processes and to consolidate other organizations around them in the period of cluster formation.
7. Available highly qualified world-class specialists.
8. Presence of small businesses in a cluster.
9. Available network for information exchange between small and medium-size innovative enterprises, educational and research establishments.
10. Establishment of screening procedures for companies entering clusters.
11. Interest of local community in forming a cluster.
12. Active state support for development of clusters. Government should ensure interaction between all participants of innovative and technological economy growth process, and by doing so guarantee sustainable growth of regions and of national competitiveness.

The obtained results have a theoretical and applied relevance for further research in relation to developing management mechanisms for innovative type clusters. Based on the above results, it is worth emphasizing that clusters should be viewed as a target for strengthening competitive positions of territories and the economy as a whole.

Conclusions and Recommendations

In this analysis the focus was made on the relationship between sustainable development, regionalism and clusterisation of the Russian economy, along with modelling of an innovative industrial cluster influence on a regional economy and investigating the best foreign and national practices in implementing and developing industrial cluster policies.

As presented above, the clusters have become geographic hubs of interconnected companies, start-ups, specialised suppliers, service providers, and associated institutions and government agencies in a particular field with innovative value for a nation or region. Clusters arise because they increase the productivity with which companies can compete. The development and upgrading of clusters is an important agenda for governments, companies, and other institutions. Local and state government, investors, start-ups, academic institutions are all intertwined together to be able to bring synergy effect in innovation growth and sustainable development, and trigger economic activity.

In Russia the cluster development initiatives started to be considered as an important new direction in economic policy, as it effects in macroeconomic stabilization, market opening, and production of more innovative products. Based on the above results, it is worth emphasizing that clusters should be viewed as a target for strengthening competitive positions of territories and the economy as a whole. The call for further research of theoretical and applied relevance in relation to developing management mechanisms for innovative type clusters in regional context of Russia is actual and has the author´s interest.

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