European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com

e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2020.04.39

PEDTR 2019

18th International Scientific Conference "Problems of Enterprise Development: Theory and Practice"

NETWORK MODEL OF THE REGIONAL INNOVATION SYSTEM BASED ON INDUSTRIAL COMPLEX CLUSTERING

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Abstract

Innovation clusters created in the industrial complex represent a special system of relationships not only between the enterprises included in the cluster, but also with support organizations, enterprises of related industries, research sphere, universities, customers and other counterparties. A network model for the implementation of completed cycle innovation processes is built as part of an innovation cluster. In this paper the authors propose a network model of a regional innovation system based on regional industrial complex clustering, which provides additional opportunities for the development of innovation processes by creating a new supporting infrastructure, improving innovation activity development processes and intensifying industry functioning through the use of primarily new digital technologies and development of dual-use technologies. This paper studies the specifics of innovation clusters, which represents a special form of the regional innovation system (RIS), which in turn includes the institutional component as scientific, state, economic institutions and industrial business that will provide for future successful development of the cluster-network initiative when organizing innovation activities. The authors clarify and supplement the theoretical issues of integration and networkization of the activity of industrial clusters by refining and supplementing theoretical issues related to the formation of cluster-network models of the regional industrial complex; by proposing the formation of potential clusters through changes in the profile of existing objects of the regional innovation system taking into account cluster-network structures and priority innovation projects implemented within clusters; by proposing a model of the cluster-network architecture of the industrial sector innovation system.

Keywords: Integration, innovation activity, industrial complex, cluster-network initiative, activity intensification, innovation activity.

https://doi.org/10.15405/epsbs.2020.04.39
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1. Introduction

The cluster-network model of the regional innovation system based on regional industrial complex clustering and integration of information and communication processes and technologies for the functioning of the regional industrial complex determines the development trends of leading high-tech industrial enterprises of the Russian Federation (Aliev, 2016).

The development of a cluster-network innovation system contributes to the acquisition, creation and accumulation of information used to generate new data on markets for innovative products, commercialization of innovations, and the formation of the optimal information logistics between cluster members.

The strategy for the creation of an innovation system of the regional industrial complex when implementing the cluster-network policy is pursued by regional authorities that regulate the activities aimed at RIS development, as well as by private business, which forms innovation development trends. The formation and development of the regional innovation system is the fulfilment of conditions for the integration of science, the state, and industrial business enterprises (triple helix) (Ermakova, Belotserkovskaya, & Ivanchenko, 2014).

An effective model for the formation of relationships between the enterprises of the regional industrial complex and the scientific sphere is regional space clustering and, above all, the creation of innovation industrial clusters (Mokina, 2018).

Currently, according to Order of the Chairman of the Government of the Russian Federation dated August 28, 2012 No. DM-P8-5060 41 territorial clusters have been created in the national innovation system of Russia, of which 25 are innovation high-tech clusters.

The cluster-network model of the regional innovation system based on clustering of the regional industrial complex represents a special economic zone created jointly with the state, science and business for the development of innovation activities by uniting industrial sector participants within a certain territory having resource, economic, technological, staff, financial and informational support for its functioning, a developed institutional environment.

When creating this zone, clusters are fully entitled participants in the market of innovative products (services), thereby increasing the overall level of socio-economic development of the region, its innovation activity.

2. Problem Statement

At the present stage of innovative development of the industrial complex of Russia the urgent issue is the creation of innovation cluster-network industrial structures that create new incentives for the development of innovative processes: creation of high-tech digital technologies, increasing the intensification and efficiency of functioning (Alisov & Khorev, 2000).

In the cluster-network model of organizing the innovation system of the regional industrial complex it is advisable to create a corporate information system for the control of technological processes within the cluster, which also increases its efficiency. This system is formed to make the processes within the cluster

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information-based, as well as to create mechanisms for the interaction of this cluster with the external environment - networking of its activities.

Measures to stimulate the activity of the industrial cluster include provision of its participants with access to the innovation and technological infrastructure of the region - business incubators, technology parks, technopolises and other innovative structures - as well as the availability of research laboratories and scientific bases, electronic libraries, etc.

Insufficient information on the creation of cluster-network models of the organization of the innovation system of the regional industrial complex, its place and role in the regional innovation system, as well as the level of impact on the efficiency and intensity of innovative activities of industrial enterprises determine the relevance, goals and objectives of this study.

Brief review of literature and opinions of the authors on the subject under study. Studies of foreign and domestic scientists on the theory of concepts of clusters creation and the cluster policy (A. Marshall, M. Porter, etc.) provided an opportunity to "form and record the features of the theory and methodology of research, formation, allocation and evaluation of industrial clusters" (Porter, 2003; Ratner, 2010).

The idea of a cluster belongs to scientist, classicist of economics Marshall (1890s), who determined that “success in economic development depends on the creation and development of localized concentrations of industries and their specialization” (Marshall, 1993, p. 256). By localization he meant territorial isolation, and by specialization — the availability of unique resources, proximity to markets, and a “historical incident” - current industrial localization (Chiaroni, Chiesa, & Frattini, 2010). Marshall (1993) noted that regional agglomeration and industrial specialization contribute to the growth of the technological potential of the market (Anisimova, Tyukavkin, & Chirkunova, 2019). Further on the concept of technological localization of Marshall was considered by researchers (Steinle & Schiele, 2002) and others (Ratner, 2010; Shorov, 2012).

The main creator of the concept of clusters is Porter. Porter (2003) introduced the concept of a cluster and examined the nature of its creation, developed a 4-factor diamond model, which consists in the formation of clustering processes and territorial concentration of competitors in the industrial sphere, intensification of interaction between them. Porter (2003) introduced the concept that the cluster approach is a new management technology that provides an opportunity to significantly increase the competitiveness of the industry, the region and the state as a whole. In 1990 Porter (2003) developed a definition of a cluster, which is understood as “...geographically concentrated groups of interconnected companies, specialized suppliers, service providers, firms in related industries, as well as related to their work organizations (e.g., universities, standards agencies, trade associations) in certain areas, competing, but leading the joint work” (Porter, 2003, p. 126).

Marshall (1993) in his works summarizes the essence of clusters and gives his own definition: “Clusters are integrated companies that are geographically closely located and, in some cases, belong to the same industry” (Marshall, 1993). He also notes the advantages of clusters: “Those enterprises that cluster together create their own additional benefits by increasing the quality of the workforce, research and changes in technology” (Ratner, 2010).

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Wolfgang Price expands the goals of cluster structures formation: “Creating clusters and cluster models of enterprises is a way to implement trust between the state and business, transforming individual companies into an entrepreneurial association”.

According to the authors, a cluster is a group of geographically localized, interconnected enterprises, counterparties of research and education sectors, innovation centres and network structures for organizing technological processes that complement and enhance the competitive advantages of each other and the cluster as a whole. The authors also note that there are two approaches to creating clusters: “organization of a cluster from the bottom” - a cluster is formed through the initiative of business; “organization of a cluster from the top” - the cluster is formed through the initiative of the state.

Theoretical and methodological provisions on the formation and development of clustering processes in the innovation system and industrial integration in industry are investigated in the works of Abalkin (2000), Ermakova et al. (2014), Mokina (2018), etc.

Aliev (2016) in his works notes that clustering of industrial enterprises depends on the efficiency of networking and information management, which is a production resource.

In the works of Shorov (2012) the cluster-network integration of industrial enterprises based on information technology is associated with the introduction of modern management systems in industry, in order to increase its effectiveness.

Ratner (2010) in his work focuses on the implementation of innovative projects using information and communication networks as an integrating factor.

3. Research Questions

The scientific significance lies in the development of theoretical principles and the proposal of practical recommendations on the formation of cluster-network models of the organization of the innovation system of the regional industrial complex, which consists in:

- Refining and supplementing theoretical issues of the formation of cluster-network models of the regional industrial complex, the study of activity integration and networkization processes;
- Increasing the efficiency of the existing innovation system in the regional industrial sector; the authors propose to identify potential clusters and change the profile of existing objects of the regional innovation system taking into account the cluster-network structures of the region and priority innovation projects implemented within clusters;
- A model of the cluster-network architecture of the industrial sector innovation system based on the system outline and "poles" of the regional industrial growth, which concentrate its economic potential, was proposed;
- A methodological approach to the evaluation of innovation activities and cluster-network innovation system of the regional industrial sector was proposed, tried and tested.

4. Purpose of the Study

In the work it is required to supplement and refine the theoretical issues of the formation of cluster-network models for the development of innovative activities of the regional industrial complex, to offer

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practical recommendations on the implementation of these models in the regional innovation system and the activities of industrial enterprises for the development of innovative processes.

5. Research Methods

The theoretical and methodological base of the research is represented by works of foreign and domestic scientists in the area of formation of cluster-network models for the organization of the innovation system of the industrial complex, as well as regulatory and legislative acts of the Russian Federation, materials of the statistics service, periodicals and works of scientific conferences related to clustering and networkization of industrial sectors. The methodological basis of the study represents methods of general scientific, economic and statistical analysis, a systematic approach, etc.

6. Findings

Based on the studies of the regional innovation system carried out by the authors, a hypothesis for the creation of a cluster-network model of the regional innovation system based on the innovation cluster is proposed. The basis of the hypothesis is the provision that it is necessary to take into account the innovation activity of the entire regional industrial complex, as well as the interests of stakeholders and user organizations that use innovation system objects, when forming a regional innovation system.

The idea of clusters creation and their main advantage is to develop parameters of competitiveness and efficiency of the activities of participating enterprises, and the idea of network structures creation is to form partnerships of participants with different functional activities, with their specific, but substantially limited resources (Ratner, 2010). Such a double partnership (integration plus networkization) helps to obtain a synergistic effect through a voluntary and collective contribution, as well as self-restraint expressing the interests of all participants, while preserving and isolating their unique differences and resources. It follows that the cluster-network innovation environment of the region is a dynamic structure, in which elements are formed and used taking into account changing conditions of competition.

Using modern technologies for networks building, this cluster is increasingly diffusing beyond the boundaries of individual enterprises transferring its structure to “virtual corporations”, which represent a temporarily used network of independent enterprises connected by information technologies for more efficient market development (Chiaroni, Chiesa, & Frattini, 2010).

The increase the efficiency of the existing innovation system in the regional industrial sector, the authors propose to identify potential clusters and change the profile of existing objects of the regional innovation system taking into account the cluster-network structures of the region and priority innovation projects implemented within clusters (Figure 01).

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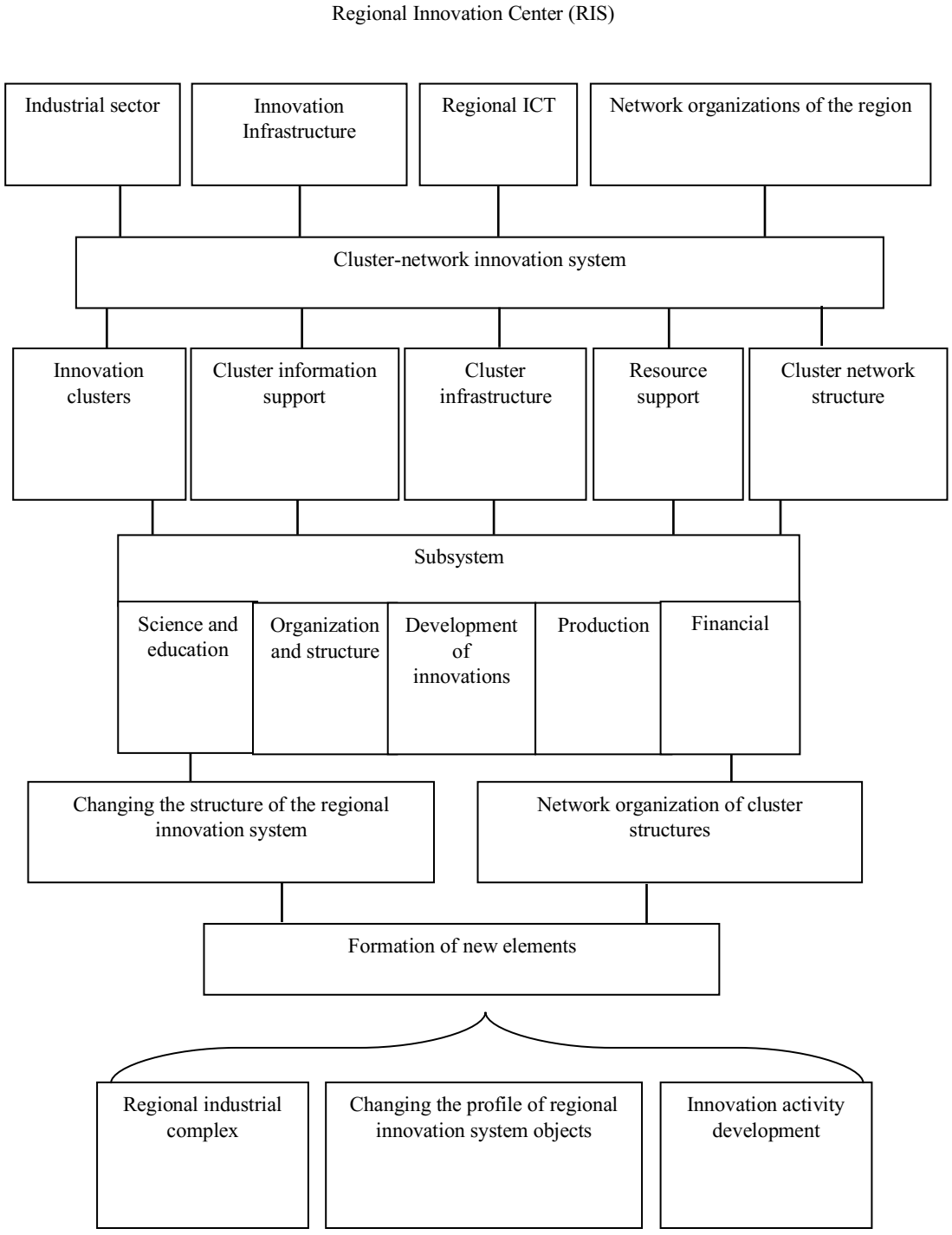

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Figure 01. Cluster-network construction of a regional innovation system (industrial complex of the region

For the cluster-network formation of the regional innovation system of the industrial sector the authors propose a model of cluster architecture, based on the system outline and the "poles" of regional industrial growth, which concentrate its economic potential (Figure 02).

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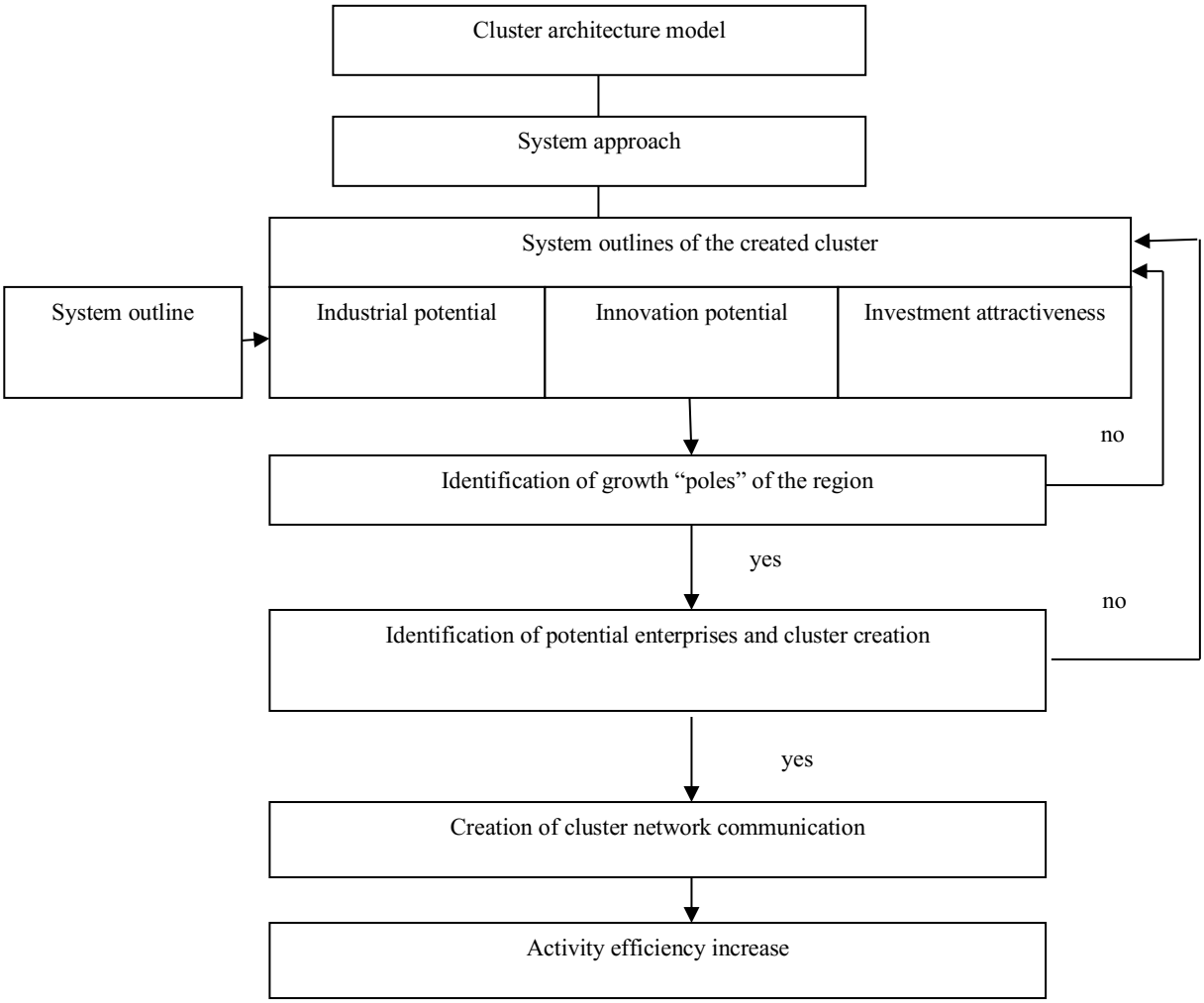

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Figure 02. Cluster architecture model based on the formation of a system outline and "poles" of the regional industrial growth

The system outline characterizes the degree of the current state of cluster subsystems, development indicators, determines deviations from the required parameters and the direction of the policy of the region's innovative activity development.

"Poles" of growth or centres of innovation activity are determined by the fact that each region has its own specificity and specialization of activity. The formation of clusters taking into account "poles" of growth presents an opportunity to consolidate resources and production capacities in the main and successfully developed areas of business, while forming innovative points for the development of the region (Terwiesch & Xu, 2008).

According to the authors, the created cluster-network innovation system of the region represents a new stage in the evolution of clusters, since the systemic implementation of newly created innovative projects cannot be carried out without network structures.

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Based on the proposed methodological approach the authors evaluated the cluster-network innovation system of the regional industrial sector and found the indicators that the influence of clusters and networkization on innovation and the development of RIS.

The authors propose five particular indicators in the evaluation methodology that reflect the development of industrial sector innovation activities:

- Internal expenditures of industrial enterprises of the region for R&D, % of GRP.
- The share of innovative products in total sales of industrial products, %.
- The number of industrial enterprises that carried out technological innovations in their total number, %.
- Indicators of regional industrial sector clustering based on the Herfindahl index, % of the total number of regional enterprises:

$$Hi = \sum Ki^2, \quad (1)$$

where Ki is the share of innovative technologies in the i-th enterprise of the cluster.

- Networkization indicators of the industrial sector of the region evaluated using agglomeration effects. The power of the agglomeration effect is determined by the formula, % of the total number of enterprises:

$$Yi = (Gx - Hi) / (1 - Hi), \quad (2)$$

where Gx is the index of the territorial concentration of industry calculated according to the Marell – Sedillot formula.

The evaluation was carried out at the enterprises of the industrial sector of the Samara region (Table 01).

The evaluation of the innovation activity in the industrial sector allows us to conclude that the results of the development of innovation activity in the Samara region have insignificant indicators.

Table 01. Indicators characterizing the level of development of the innovation activity in the industrial sector of the Samara region

Indicators	2015	2016	2017	2018
1. Internal expenditures of industrial enterprises of the region for R&D, % of GRP.	1.11	1.12	1.15	1.19
2. Indicators reflecting the share of innovative products in total sales of industrial products, %.	8.1	8.4	8.5	8.8
3. The specific number of industrial enterprises that carried out technological innovations in their total number, %.	2.1	2.3	2.7	2.9
4. Indicators of regional industry clustering, %	0.31	0.38	0.32	0.42
5. Indicators of regional industry networkization, %	0.08	0.09	0.10	0.10

Source: authors based on (AIRR, 2018).

7. Conclusion

- Theoretical issues of the formation of cluster-network models of the regional industrial complex, activity integration and networkization processes were investigated, refined and supplemented;

▪ A system for the identification of potential clusters in the region, as well as changing the profile of existing objects of the regional innovation system taking into account cluster-network structures and priority innovative projects implemented within clusters was proposed;

▪ A model of the cluster-network architecture of the industrial sector innovation system based on the system outline and the "poles" of regional industrial growth, which concentrate its economic potential, was proposed;

▪ A methodological approach to the evaluation of innovation activities and cluster-network innovation system of the regional industrial sector was proposed, tried and tested.

References

Abalkin, L. I. (2000). *Selected works.* Moscow: Ekonomika.

AIRR (2018). Rating of innovation development 2018. Retrieved from http://i-regions.org/eng/ratings /rating-of-innovation-development/2018 Accessed: 02.12.2018.

Aliev, F. A. (2016). Information and communication technologies in the conditions of innovative economy. *Young Scientist, 10,* 591-595.

Alisov, A., & Khorev, V. (2000). *Economic and social geography (general geographic review).* Moscow: Gardariky.

Anisimova, V. Y., Tyukavkin, N. M., & Chirkunova, E. K. (2019). Energy audit of industrial enterprises on the basis of energy and resource saving evaluation. In A. Zheltenkov (Ed.), *Topical Problems of Architecture, Civil Engineering and Environmental Economics, E3S Web of Conferences, 91* (03003). Les Ulis: EDP Science.

Chiaroni, D., Chiesa, V., & Frattini, F. (2010). Unravelling the process from closed to open innovation: Evidence from mature, asset-intensive industries. *R&D Management, 40*, 222-245.

Ermakova, Z. A., Belotserkovskaya, N. V., & Ivanchenko, O. P. (2014). Content and correlation of concepts: Marketing of innovations, innovative marketing, marketing innovations. *Innovations, 6*, 49-54.

Marshall, A. (1993). *Principles of economics.* Moscow: Publishing group "Progress".

Mokina, L. S. (2018). Mechanism of the formation of integration processes in the innovation environment of the aerospace cluster. *Russian Entrepreneurship, 19*(9), 2453-2464.

Order of the Chairman of the Government of the Russian Federation dated August 28, 2012 No. DM-P8-5060. Retrieved from http://akitrf.ru/upload/iblock/f4c/f4c65a0adcb32f7a6d82a718c21ea29b.pdf Accessed: 02.09.2019.

Porter, M. (2003). *Competition.* Moscow: Williams Publishing House.

Ratner, S. V. (2010). Scenarios of the stratification of the scientific innovation network. *Large-Scale Systems Control, 30*(1), 774-798.

Shorov, K. M. (2012). Integration of information technologies in automated control systems in modern conditions. *Young Scientist, 4*, 191-195.

Steinle, C., & Schiele, H. (2002). When do industries cluster? A proposal on how to assess an industry's propensity to concentrate at a single region or nation. *Research Policy, 31*(6), 849–858.

Terwiesch, C., & Xu, Y. (2008). Innovation contests, open innovation, and multi-agent problem solving. *Management Science, 54*, 1529-1543.