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CLUSTERING AS AN EFFECTIVE TOOL FOR INCREASING THE COMPETITIVENESS OF INDUSTRIAL ENTERPRISES

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Abstract

The article discloses the problem of increasing competitive advantages of industrial enterprises based on clustering. It is a relatively new management technology for the Russian Federation. The regularities of the formation and functioning of the industrial cluster were identified. They reflect the following: territorial and geographical community; long-term relations of enterprises which are the cluster members; the presence of a complex of regulatory mechanisms, etc. The conditions conducive to the formation of innovative industrial clusters are defined. They include a favourable economic and geographical location of the territory; a well-developed transport system, the presence of large competitive industries with stable energy sources; the presence of large cities with a sufficient density of population. The directions for increasing the level of competitiveness of non-ferrous metallurgy enterprises were determined on the basis of the cluster approach, including: stimulating demand and creating new enterprises-consumers of non-ferrous metals; introduction of innovative production technologies and management; import substitution; creation and development of a network of small and medium enterprises for the production of a wide range of products from non-ferrous metals according to the market demands, especially in the process of implementing innovative technologies. The structure, content, sequence of implementation and the performers of the stages of the process of creating an industrial cluster have been developed. A conceptual model of the industrial cluster is presented on the example of Boguchansk district of Krasnoyarsk Krai.

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Keywords: Clustering, industrial cluster, competitiveness, enterprise, import substitution, innovative development.

1. Introduction

The analysis of the international and national practice of the vertical and horizontal integration of industrial enterprises shows that one of the promising areas for the development of cooperation among industrial enterprises is their clustering. The approach to regional development based on clusters began its formation in Russia in 2005 with the Concept of Long-Term Social and Economic Development of the Russian Federation, approved by the Decree of the Government of the Russian Federation on November 17, 2008, No. 1662-p. The Decree set out the creation of the network of territorial and manufacturing clusters that will implement competitive potential of the territories; the formation of a number of innovative high-tech clusters in the European and Asian parts of Russia (Ivanov & Muravyova, 2015). The application of a cluster approach leads to the emergence of a synergistic effect. The effect stimulates an increase in efficiency indicators within the cluster itself, as well as the related sector of the economy (Elola, Valdaliso, López, & Aranguren, 2012). At the same time, the main specific feature of the cluster is its innovative orientation.

The Concept of the Long-Term Social and Economic Development of Russia until 2020, the Strategy for the Innovative Development of the Russian Federation for the Period until 2020, and other regulatory documents consider clusters as the main object of the state innovation policy. However, clustering has not been widely spread in a number of the national industries (Stepanov, 2013), particularly, in the metallurgical complex.

2. Problem Statement

The Russian metallurgy is one of the global players in the metal products market. It actively develops in the global system of economic relations. At the same time, in the current market conditions and growth of political and macroeconomic risks, metallurgical enterprises face an acute problem of ensuring a sustainable competitiveness (Ibrayeva, 2015). The strengthening positions of China and other countries of the Asian region in the world metal market require the creation of a new spatial innovation-oriented production and social structures in the adjacent territories, including Siberia. Clusters represent one of the forms of concentration of industry and enable mobilizing a new network resource of the organization of territories (Ivanov & Muravyova, 2015).

Moreover, the need for a balanced development of the metallurgical sector of the Russian industry and the improvement of its competitive advantages requires the use of innovative production technologies and environmentally friendly policy at the enterprises. There is also a necessity to create the network of small and medium-sized enterprises producing a wide range of innovative metal products and to provide enterprises with qualified personnel, applying effective financing mechanisms.

3. Research Questions

Due to the insufficient study of the industrial clustering problem, it is necessary to solve the following research problems:

1. To identify the regularities of the formation of competitiveness of metallurgical enterprises.

2. To assess the impact of the industrial cluster on competitiveness.

3. To determine the sequence of implementation and the performers of the process of creating the industrial cluster.

4. To develop a conceptual model of the industrial cluster.

4. Purpose of the Study

The purpose of this study is to develop recommendations for improving the competitiveness of industrial enterprises through the formation of industrial clusters.

5. Research Methods

The methodological framework of the research includes the studies and developments of the national and foreign scientists involved in investigation the problems of the cluster approach to improve the competitiveness and efficiency of the regional economy, public and private partnership for the social and economic development of the undeveloped territories of the country. The methodological framework of the research also includes methodological materials, legal and regulatory acts of the Government of the Russian Federation on the studied problem, and other documents.

The methods of the systematic approach, the statistical method, the methods of analogies and comparisons were applied in the work.

The empirical base of the study was compiled with the help of statistical data and reference materials of the Federal State Statistics Service, the strategy of social and economic development of the regions of the Russian Federation, the materials of ministries, federal services, news agencies, metallurgical companies, scientific publications in journals which were systematized by the authors in the course of the study, and the authors' research.

6. Findings

6.1. Determinants and factors of the formation of competitiveness of metallurgical enterprises

The competitive advantages of the national non-ferrous metallurgy are characterized by the following factors:

1) Russia has reserves of almost all non-ferrous metals and is among the top ten countries in the world in terms of availability of raw materials;

2) the industry has a high level of the concentration of production. About 90% of the output is carried out by the enterprises of four vertically and horizontally integrated companies with large deposits within the country and abroad;

3) the leading companies, as a rule, include enterprises for the extraction of ores, their processing and concentration, as well as sales and distribution networks;

4) the Russian companies "RUSAL" and "Norilsk Nickel" hold leading positions on the global metal market of aluminum and nickel, respectively.

Having studied the negative changes in the competitive environment, as well as the negative impact on the development of the industry of a number of external and intra-industrial factors (Ermolaev

& Natashkina, 2016), the authors conclude that the competitiveness of the Russian companies on the world market of non-ferrous metals can significantly decrease, and the export can become low profitable and even unprofitable. The key problem in this case is the stimulation of the national demand and the creation of new enterprises-consumers. The solution to this problem can be a cluster support of the production chains. Industrial clusters provide best conditions for increasing competitiveness, because clusters have the most developed determinants (Colovic, 2012; Trippl, Grillitsch, Isaksen, & Sinozic, 2015; Skalholt & Thune, 2014; Boschma & Fornahl, 2011). Table 1 presents the determinants of the competitiveness of metallurgical enterprises and the formation factors formulated by the authors.

Table 01. The main determinants and formation factors of the competitiveness of metallurgical enterprises

Level I – determinants of competitiveness	The formation of production factors – D1	Stimulation of demand – D 2	Application of cluster approach – D 3	Identification of the trends of strategic development of enterprises – D 4
Level II – factors of competitiveness	The support of the necessary raw materials and energy resources - D 1.1	Increase of the competitiveness of products on the world market - D 2.1	Formation of industrial clusters in the territory of location (the Russian Federation) – D 3.1.	Creation of modern organizational and managerial structures of metallurgical enterprises - D 4.1
		Import substitution in the domestic market - D 2.2		
	The level of technical and technological equipment - D 1.2	The increase in income of product buyers - D 2.3	Education and development of progressive forms of spatial organization of production (diversified, trans-boundary and transnational clusters) - D 3.2	Improving the management of metallurgical enterprises - D 4.2
	The system of professional training of staff - D 1.3			
	Investment attractiveness - D 1.4			

6.2. Impact of the industrial cluster on competitiveness

The assessment of the influence of the industrial cluster on the competitiveness of the industry is carried out on the basis of calculations of the optimization model of the factors of competitiveness formation represented by the objective function:

$$\sum_{j=1}^{m} di \times C_{ij} => max$$

where di is the criterion weight of assessment; $\sum di = 1$;

C_{ij} — is the expertise assessment of j factor according to i criterion;

m is the number of expertise assessments and $C_{ij} = 1$;

i — 1, 2 — m (m is the number of assessment criteria);

j — 1, 2 — n (n is the number of the factors of single level).

The criterion of optimality of the objective function in the assessment of factors is the improvement in the state of competitiveness of the industry for a certain period as a result of the formation of a cluster.

The effect of the influence of industrial clusters on the competitiveness of enterprises of the metallurgical complex takes place, as a rule, after a long period of time, in its various manifestations and can be assessed mainly by indirect measures (Table 2).

Table 02. Types of effect from the influence of industrial clusters and its indicators

Effect	Effect indicators
Economic	Sustainable development of the economy of the cluster location. Increase of the economic effectiveness of enterprises involved in the cluster: • support with the resources needed; • increasing the level of technical and technological equipment of enterprises; • improving product quality; • development of transport infrastructure. The increase of additional investments due to the attractiveness of both cluster formations as a whole and some enterprises within their structure.
Ecological	Increase of waste processing and reducing emissions.
Social	Employment growth in small and medium-sized business in the cluster. Improving the standard of living of the population. Development of social infrastructure of the territory.
Scientific	The increase of the number of engineering and technological centres that carry out major research and development for the clustered enterprises, as well as research and educational centres.
Technological	Expansion of import substitution of metal products, primarily of innovative trends.
Scale economy	Growth of the number of small and medium-sized enterprises within the cluster that are networked to produce a wide range of metal products meeting the market requirements. Development of innovation, production, transport and logistics, and socio-economic infrastructure of the territory of the cluster. Using the experience of cluster interaction in the development of new deposits in the Far North and the Far East.
Knowledge effect	Considerable support of knowledge exchange among the clustered enterprises.

6.3. The content and order of the process of creating an industrial cluster

The creation of an industrial cluster is a complex and all-embracing process that takes place under the influence of many various factors (Ingstrup & Damgaard, 2013; Kovrov, 2014; Titova, 2015). In our opinion, this process involves a project approach and consists of 5 stages (Table 3). They include a pre-project stage, the actual development of the project; the identification of a cluster strategy; confirmation of the adequacy of the developed project to the regulatory requirements, and the creation of a cluster management system. The practical application of this sequence will form a more efficient industrial cluster in terms of time, material and labour resources.

Table 03. The structure, content and performers of the stages of the process of creating an industrial cluster

Stage name	Stage content	Performers
1. Pre-project stage (preparatory stage)	1. Identification of potential participants. 2. Learning the incentives for the creation of a cluster. 3. Assessment of the possibility to create a cluster. 4. Assessment of the activity vector.	Specialized council consisting of managers and specialists of the industry stakeholders who are potential participants of the industrial cluster.
2. Development of the cluster project	1. Specification of the objectives and goals of the cluster. 2. Assessment of the resource potential of the prospective cluster. 3. Working out cluster infrastructure. 4. Conducting feasibility study of the project. 5. Formation of the regulatory framework of the cluster. 6. Determination of a specialized cluster organization and conclusion of an agreement with it on participation in the cluster's industrial activity.	Specialized (coordination) council of managers and specialists in the industry. Managers of enterprises participating in the industrial cluster.
3. Development of cluster strategy	1. Specification of the scale of joint activities of participants. 2. Development of an industrial cluster development programme. 3. Organization of interaction among cluster members, educational and scientific institutions, banks and other organizations. 4. Formation of the mechanism of cluster interaction with the administration of the region. 5. Development of a functional map of an industrial cluster organization (a scheme of territorial distribution and functional dependence of the industrial cluster members).	Specialized council in conjunction with a specialized organization. Specialized organization (commercial or non-profit organization established in accordance with the legislation of the Russian Federation, carrying out methodological, organizational, expert-analytical and informational support for the development of an industrial cluster). Specialized council in conjunction with a specialized organization.
4. Confirmation of the compliance of the industrial cluster with the requirements for industrial clusters in order to apply to it incentive measures in industry (according to the decree of the Government of the Russian Federation of July 31, 2015, No. 779).	1. Collection and preparation of the documents to confirm compliance with the industrial cluster. 2. Submission of the package of documents to the Ministry of Industry and Trade of the Russian Federation.	Specialized organization.
5. Implementing sustainable management of the cluster development.	1. Monitoring the efficiency of cluster functioning. 2. Organization of entering the market of new products produced within the industrial cluster. 3. Development of cooperation of participants of the industrial cluster in the scientific and technical spheres. 4. Working out the scenario for the long-term development of the cluster.	Specialized organization.

6.4. Development of the conceptual model of the industrial cluster on the example of Boguchansk district of the Krasnoyarsk Krai

Boguchansk district is one of the municipal territorial units located in the northeast of the Krasnoyarsk Krai in the Lower Angara region. At present, the region's territory is equated to the lands of the Far North, where gas deposits (fuel and non-combustible), coal, peat, iron, manganese, titanium, vanadium, apatite ores, gallium, rare earth metals and other natural resources are located. The region is in the process of an active industrial and infrastructural development associated primarily with the implementation of the large-scale investment project Integrated Development of the Lower Angara Region, which is being implemented with federal support.

Figure 1, developed by the authors shows the conceptual model of Boguchansk innovation-industrial cluster, which is being formed on the territory of the newly created large high-tech business.

The implementation of an effective cluster policy ensures high rates of economic growth and diversification of the economy as a result of increasing the competitiveness of enterprises forming the territorial production cluster (Bazhanova, 2015; Vertakova, Kozieva, & Pinyaeva, 2017). According to the preliminary social and economic results of the activity of Boguchansk cluster, it is necessary to note the creation of 10,000 new jobs, provided both during the construction period and during the operation period. Functioning of the factory will allow achieving a significant multiplicative effect in the framework of the Integrated Development of the Lower Angara region. Reducing the cost of delivering alumina to the plant and finished products to consumers will provide additional opportunities to reduce cost prices.
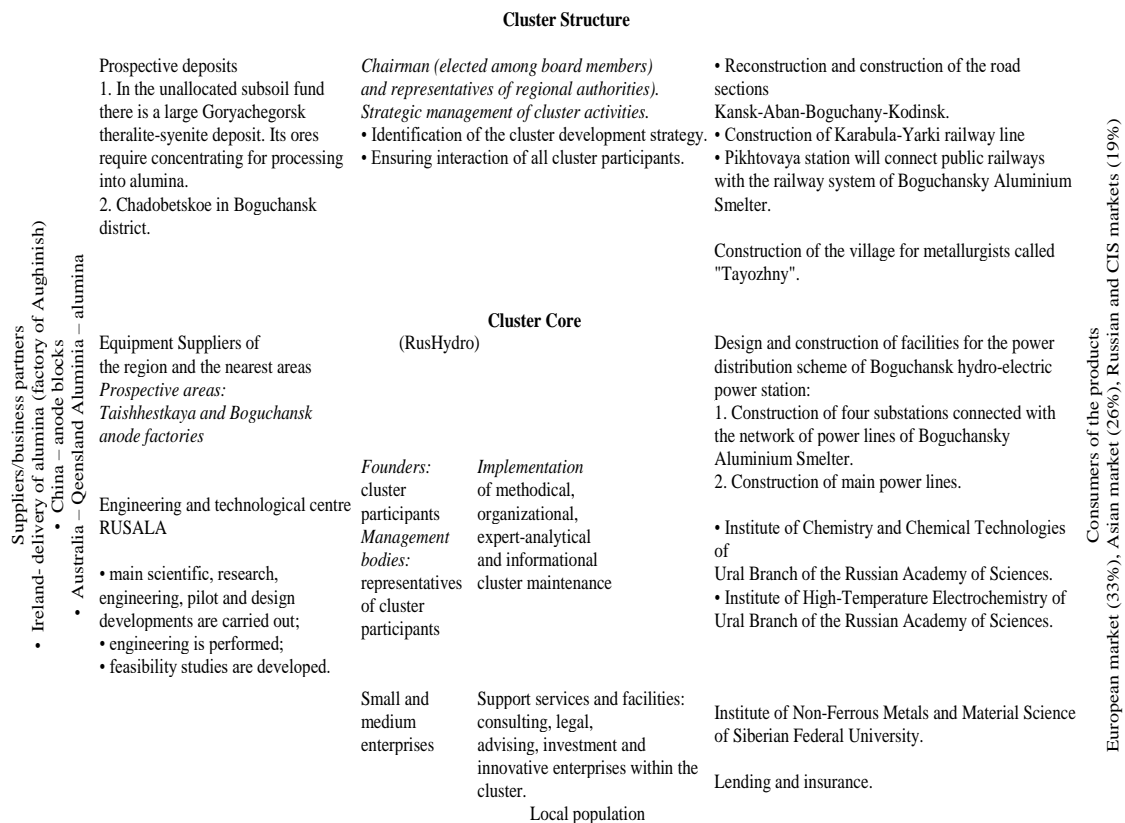
Cluster Structure

Left margin (vertical): Suppliers/business partners
• Ireland- delivery of alumina (factory of Aughinish)
• China – anode blocks
• Australia – Qeensland Alumina – alumina

Right margin (vertical): Consumers of the products
European market (33%), Asian market (26%), Russian and CIS markets (19%)

Prospective deposits
1. In the unallocated subsoil fund there is a large Goryachegorsk theralite-syenite deposit. Its ores require concentrating for processing into alumina.
2. Chadobetskoe in Boguchansk district.

Chairman (elected among board members) and representatives of regional authorities). Strategic management of cluster activities.
• Identification of the cluster development strategy.
• Ensuring interaction of all cluster participants.

• Reconstruction and construction of the road sections Kansk-Aban-Boguchany-Kodinsk.
• Construction of Karabula-Yarki railway line
• Pikhtovaya station will connect public railways with the railway system of Boguchansky Aluminium Smelter.

Construction of the village for metallurgists called "Tayozhny".

Cluster Core
(RusHydro)

Equipment Suppliers of the region and the nearest areas
Prospective areas: Taishhestkaya and Boguchansk anode factories

Design and construction of facilities for the power distribution scheme of Boguchansk hydro-electric power station:
1. Construction of four substations connected with the network of power lines of Boguchansky Aluminium Smelter.
2. Construction of main power lines.

Engineering and technological centre RUSALA

• main scientific, research, engineering, pilot and design developments are carried out;
• engineering is performed;
• feasibility studies are developed.

Founders: cluster participants
Management bodies: representatives of cluster participants

Implementation of methodical, organizational, expert-analytical and informational cluster maintenance

• Institute of Chemistry and Chemical Technologies of Ural Branch of the Russian Academy of Sciences.
• Institute of High-Temperature Electrochemistry of Ural Branch of the Russian Academy of Sciences.

Small and medium enterprises

Support services and facilities: consulting, legal, advising, investment and innovative enterprises within the cluster.

Institute of Non-Ferrous Metals and Material Science of Siberian Federal University.

Lending and insurance.

Local population

Figure 01. Conceptual model of Boguchansk industrial cluster

7. Conclusion

As a result of the study, the authors developed recommendations to ensure the competitiveness of industrial enterprises through the formation and development of clusters.

Four determinants of the competitiveness of metallurgical enterprises and eleven factors forming them have been formulated. They are basic elements of the objective function. The criterion of optimality of the objective function in the process of assessing factors makes for the improvement of the competitiveness of the industry over a certain period of time. This is the result of the formation of a cluster.

The structure, content and sequence of the process of creating an industrial cluster was developed taking into account the requirements of the regulatory documents of the Government of the Russian Federation on cluster support issues. The conceptual model has been presented as a specific example. Practical application of this sequence will form the industrial cluster which is more efficient in terms of time, material and labour resources.

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