THEORETICAL PRINCIPLES OF CLUSTER FORMATION IN METALLURGICAL INDUSTRY ENTERPRISES

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Abstract.

The theoretical and practical underpinnings of cluster formation in the metallurgical sector are investigated in this article. The scientific approaches of scientists who conducted research on the formation of industrial clusters, the classification of clusters by branch affiliation, as well as models of industrial clusters of developed countries around the world, factors influencing the development of metallurgical clusters, and so on, were specifically examined.

Key words. Cluster, metallurgical industry, enterprise, internal environment, external environment, competitiveness, competitive advantages, innovation, cluster approach, sustainable development.

Cluster theory has grown significantly in global practice as a route of successful growth of the economies of industrialized nations and regions. Cluster theory has become an essential component of modern governments' economic policies. Despite the fact that this theory is relatively "new," the circumstances for its genesis began to emerge in the nineteenth century. A. Marshall is regarded as the first economist to investigate the causes of the concentration of companies with high labor productivity (Concepts of Industrial Areas. 1890). According to A. Marshall, when groups of small and medium-sized firms are concentrated in one location of the country and specialize in a certain stage of the overall production process, their efficiency is not inferior to that of large enterprises.

Michael Porter's interpretation of the "cluster" notion has become a classic and is utilized in numerous publications. A cluster, he defines, is "geographically concentrated interconnected companies, specialized suppliers, service providers, firms in related fields, as well as groups of organizations in certain fields related to their activities and competing with each other, but working together (for example, universities, standardization agencies, and trade associations)." [1].

When we examine the metallurgical cluster from a systematic standpoint, we see it as a collection of various elements that interact with one another and with the external environment, and are linked by the presence of comparable qualities. Industrial companies in one location have many similar demands and possibilities to engage with one another and with other economic entities, which adds to the establishment of clusters. The metallurgical cluster is an organization founded on the unification of metallurgical enterprises and

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[1] Портер М. Э. Конкуренция / Пер. с англ.: уч. пос. М.: Вильямс, 2005. 608 с.

other economic entities linked to them through long-term cooperative relationships, and it was formed with the goal of gaining additional competitive advantages and increasing profits in the long run. A multilateral agreement is generally used to strengthen such an alliance.

Multi-level technological cooperation, internal competitive environment, mechanisms for coordinating management decisions of cluster members, competitive advantages of participating enterprises based on intra-cluster interactions, and a large number of specific assets, the same functions (certain types of production) are, in our opinion, the characteristics of the metallurgical cluster that distinguish it from other models of organization and integration of enterprises.

We can determine the sorts of clusters and explain their key characteristics after analyzing a number of regulatory and legislative papers, as well as scientific articles, and taking into consideration the network's unique peculiarities. (Table 1).

Table 1
Classification of clusters by network affiliation [2]

Names of clusters	Main characteristics of the cluster
Discrete clusters	Consisting of small and medium-sized enterprises that produce products from discrete components (suppliers, assembly enterprises of mechanical engineering, automotive industry, aviation industry, shipbuilding, engine manufacturing and other industries).
Process clusters	organized by enterprises in process industries (chemical, pulp and paper, metallurgical industry, agriculture, food industry)
Transport-logistics clusters	infrastructure and companies specializing in the storage, tracking and delivery of cargo and passengers; organizations providing services to port infrastructure facilities; companies specializing in sea, river, surface, air transportation; logistics complexes and others
Innovative and "creative" clusters	includes enterprises, educational institutions and research institutes providing services related to information technologies, biotechnology, development of new materials and creative activities.
Tourism clusters	are organized on the basis of tourist destinations and include enterprises in various fields that provide services to tourists (tour operators, hotel and restaurant chains, souvenir manufacturers, transport companies and leisure centers)
Mixed clusters	can combine the characteristics of different clusters

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[2] compiled by the author

Clustering has been shown to be most widespread in nations such as France, India, the United Kingdom, Italy, the United States, and Russia over the previous two decades. According to analysts, clustering accounts for over 50% of the world's major countries' economies[3].

The examination of cluster formation traits enabled the identification of numerous industrial cluster models, including Italy, Japan, Finland, North America, India-China, the former Soviet Union, and Russia. They have distinct traits and may be identified by particular properties and signs:

- The Italian model of the industrial cluster is based on associations of small firms that band together to increase their competitiveness;

- The Japanese model of the industrial cluster is based on a leading firm with large production that attracts many suppliers at various stages of its technological chain.

- The basis of the industrial cluster in the Finnish model is the high level of internationalization of business and the availability of innovations;

- In the North American model, the basis of the industrial cluster is interfirm competition, mutual relations are primarily regulated by the supply and demand market;

- In the India-China (Asia) model, the basis of the industrial cluster is foreign investments that attract advanced technologies and ensure the release of innovations;

It should be highlighted that interactions with the outside world are critical while developing an industrial cluster. The cluster environment is the collection of all elements influencing its performance. It is vital to distinguish between the cluster's exterior and internal environments. The external environmental factors influencing the activity and development of the industrial cluster can be divided into three categories based on their degree of influence on the cluster: the first category is the state (general economic policy of the state, tax policy, industrial policy, socio-demographic policy, policy in the field of science and education, legal system, and others); the second category is the region (includes resource supply and infrastructure of the region); and the third category is the region (includes resource supply and infrastructure of the region).

The internal environment of the cluster consists of employees, the organization of the cluster management system, auxiliary units, the production and technical potential of the participating enterprises, marketing, resource supply system and finance. We will consider the interaction of the external and internal environment on the example of "Uzmetkombinat" JSC (Figure 1).

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3 Карта кластеров России. URL:
http://map.cluster.hse.ru/list.
Кластерная политика в России. URL:

http://cluster.hse.ru/cluster-policy/#show.

Duties:
- preparation and processing of scraps and waste of ferrous metals;
- production and sale of grade rolling, steel balls, pipes and other metal constructions;
- production and sale of glazed dishes and other consumer goods;
- to carry out trade activities;
- providing various types of paid services to the residents and enterprises of our republic.

"Uzmetkombinat" JSC

Objectives:
Main consumers:
- Non-ferrous metallurgical mining enterprises of Uzbekistan (AGMK, NGMK);
- strengthening positions on the foreign market;
- increasing the competitiveness of manufactured products;
- development of new raw material deposits in the territory of partners;
- introduction of modern resource-efficient technologies

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External environment

Raw material suppliers:
- "Vtorchermet" KHRUP
- Various ministries and agencies of the Republic of Uzbekistan;
- Enterprises of Uzbekistan, Spain, Germany, Ireland, Russia, Slovakia, Great Britain, Russia, Slovakia, Great Britain

Main consumers:
- OZR non-ferrous metallurgical mining enterprises (AGMK, NGMK);
- companies from near and far foreign countries

Ways to use resources:
- introducing innovative technologies into the production process

Forms of production organization and supplier management:
- Associations, corporations, concerns, joint-stock companies subordinated to various ministries and agencies of the Republic of Uzbekistan
- subsidiaries;
- firms and private enterprises.

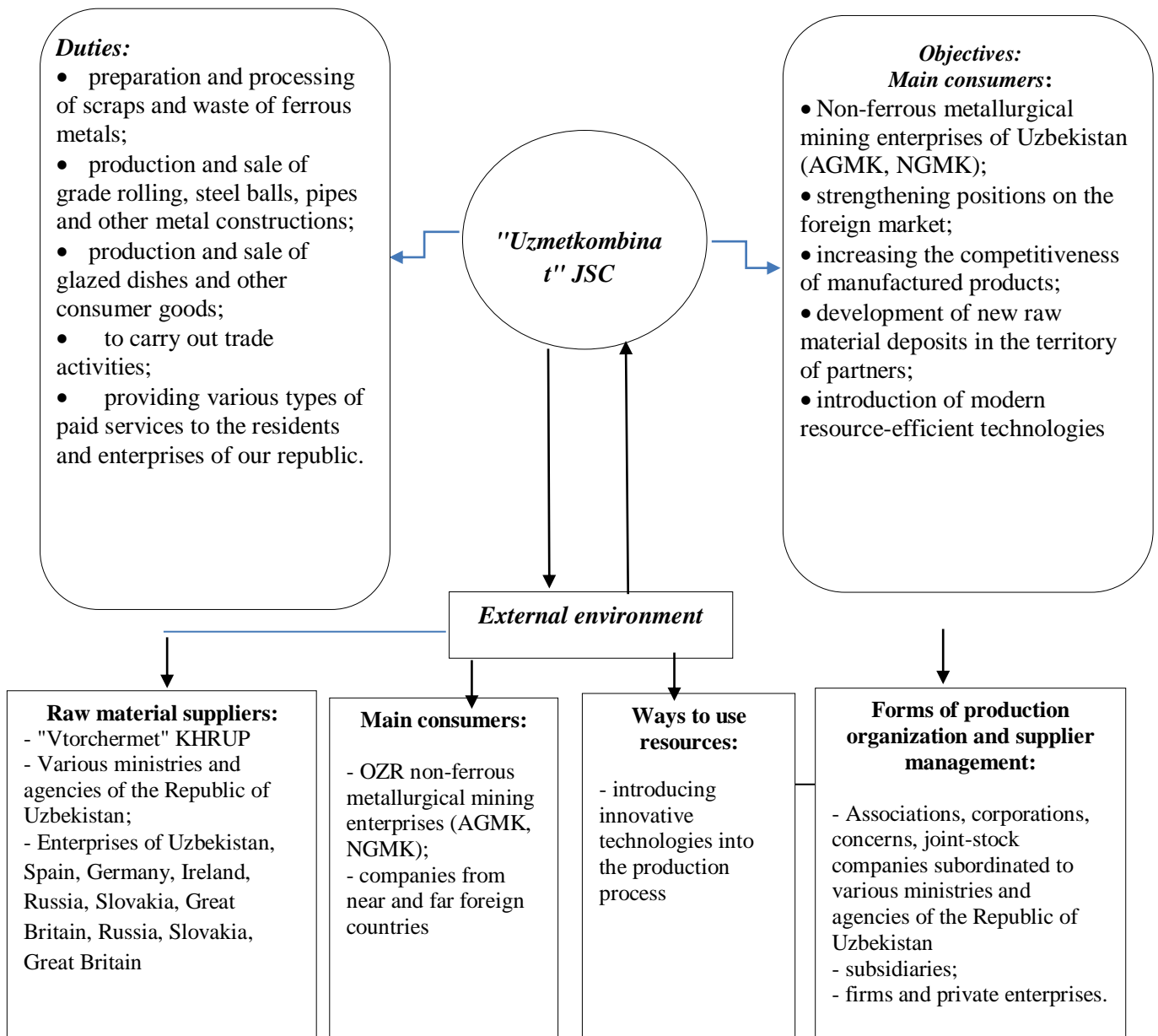**Figure 1. Interactions of "Uzmetkombinat" JSC with the external environment[4]**

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[4] compiled by the author

We examined Ozmetkombinat JSC's activities and depicted in Figure 1 the most stable overseas suppliers of extra raw materials and materials that have collaborated with the firm in recent years. The primary customers of this enterprise's goods in the domestic market are ministries and agencies, mining companies, construction enterprises, and nonferrous metallurgical enterprises. "Uzmetkombinat" JSC's market spans the whole country of Uzbekistan.

Currently, the firm under study's market is not confined to Uzbekistan; a portion of the enterprise's products are sold to Far and Near Eastern nations. Afghanistan, Iran, Mongolia, the Netherlands, Estonia, Russia, Kazakhstan, Kyrgyzstan, Turkmenistan, Tajikistan, and Azerbaijan are the CIS nations' main overseas customers of finished goods.

Despite the benefits of clustering under current situations, we found and systematized various elements that impede this process (Table 2).

At the same time, it should be noted that in order to estimate the potential of a metallurgical company, it is necessary to examine the internal environment in order to identify the enterprise's strengths and limitations.

Table 2
Factors affecting the development of metallurgical clusters [5]

Factors contributing to the development of metallurgical clusters	Factors hindering the development of metallurgical clusters
- availability of highly qualified engineers, scientific staff, as well as their training base;	- non-availability (lack) or poor quality of raw materials
- Availability of scientific-technical and experimental laboratories for carrying out Scientific Research and Experimental Design Works	- lack of demand for professional training and research programs for the needs of the metallurgical industry;
- traditions of industrial cooperation;	- Weak collaboration (or lack thereof) between ITI institutions and industry;
- the active role of the state in the formation of the metallurgical cluster;	- low quality of the business environment for the establishment and development of economic entities (administrative barriers, financial resources, etc.);
	- low efficiency of network and trade unions;
	- lack of an effective strategy for the development of clusters of metallurgical enterprises;
	- bureaucratic obstacles in the organization and operation of clusters in state organizations

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[5] compiled by the author

The state's involvement in the process of cluster activation and development is to operate as one of three equal partners, each of which executes its specific functions. The basis of this strategy is that collaborative operations of the state, business, and scientific communities may most effectively assure creative growth.

In practice, relationships associated to the invention or usage of innovations sometimes resemble a "three-way spiral," such as the state-science, business-science, and government-business[6]. The major emphasis of the metallurgical cluster is rivalry within the sector. At the same time, a cluster can be made up of diverse moving persons, resources, and sorts of activities that are all working together to create, produce, and sell various commodities and services. In contrast to a regional cluster, it has broader limits and may encompass a whole area or even a nation[7].

A SWOT analysis should be used to examine the possibilities and dangers that may occur in the external environment, as well as to establish the enterprise's strengths and weaknesses. (Table 3).

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[6] Дежина, И. «Тройная спираль» в инновационной системе / И. Дежина, В. Киселева. - 2007.

[7] Павленко, Д.Ю. Проблема создания кластеров в России: региональный аспект / Д.Ю. Павленко // Вестник экономической интеграции. - М., 2011. - №2. – С. 139-143.

Table 3
SWOT analysis for "Uzmetkombinat" JSC[8]

Strength	Weakness
- Diversification of production and expansion of manufactured products; - Increasing the export potential of the combine - substitution of imported products (ferrosilicon, ferrosilicomanganese, steel ropes, metallocord, fasteners, etc.) - create new jobs	- Deterioration of quality and quantity indicators of manganese ores during development of Dautash mine; - Increase in the value of the investment project for the production of ferrosilicomanganese; - high production cost; - high wear and tear of main equipment
Opportunity	**Threat**
- expanding the export geography; - supply of own raw materials due to attracting mines (quarite - Kokpatas, manganese ores - Dautash and iron ores - Tebinbulok); - increase in production capacity of steel and metal rolling; - Commissioning of Casting complex in 2023; - emergence of demand for cluster products in the domestic market.	- Failure to achieve cost competitive parameters for ferrosilicomanganese; - Failure to achieve competitive cost parameters in pig iron production by developing the Tebinbulok mine; - Lack of own funds to finance the investment program; - increase in the shortage of metal waste in the republic; - negative attitude of the population to the opening of new "harmful" industries.

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[8] compiled by the author

The impact of clusters on increasing the efficiency and competitiveness of the regional economy can be considered in a three-way vector[9]:

1) Clusters boost the productivity of firms and industries;

2) Clusters can offer production and inventive growth prospects for the region;

3) Clusters promote and facilitate the establishment of new enterprises that support innovation and the expansion of clusters.

Unlike other types of group relationships, these orientations, in our opinion, can be regarded special properties of clustering.

Based on a review of the economic literature, it is possible to infer that there is no one way to evaluate the potential for cluster development. The absence of assessment of particular cluster participants and the lack of quantitative assessment of cluster formation potential are significant limitations of the methodologies under consideration.

As many countries' experiences have shown, the cluster approach not only serves as a means of achieving goals in the fight against competition, but it also enhances innovative activity, is a powerful tool influencing the increase of employment, wages, budget allocations at various levels, increasing the efficiency and stability of metallurgical enterprises, and thus contributes to the country's development.

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