Cluster Paradigm with Blockchain Principles in the Region Development

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Abstract

Relevance The study of such a complex category as a "cluster" is not always ensured by a comprehensive examination of the significant elements of the designated category. From the point of view of the content of its elements and in relationships between them. The purpose of the study is to consider various approaches to determining the essence of a cluster and building classifications of cluster structures, as well as to determine the principles of integration. *Methodology* The authors highlight the cluster approach as a promising method for integrating organizations in the region. In combination with the principles of blockchain in terms of organizing the interaction of economic entities both in the region and interregional cooperation. *Results* It is shown that modern approaches to the formation of organizations on the territory of regions indicate that clusters are considered hybrid forms. Which occupy their niche in organizational structures of economic entities in the region, between market and hierarchical entities formed by participants in the integration process. It is proposed to use the principles as a tool for the formation and functioning of clusters. *Discussion* Moreover, the reference definition of such a socio-economic category as a "cluster" has not yet been developed due to the versatility of the category itself and various options for cooperation among cluster members, as well as the subject area of their activity. An abundance of research works in the field of clustering testifies to the relevance of the considered aspects of modern socio-economic systems and the possibility of applying blockchain technology to the methods of clustering. *Conclusion* It has been established that an exclusive blockchain, as a chain of blocks of a cluster network, allows: firstly, decentralization (data exchange between cluster members directly), and secondly, transparency of information about transactions within the cluster that cannot be faked or changed. Since all blocks are available for viewing by the cluster members and they can see all transactions within the cluster. Thirdly, the reliability provided by special encrypted keys available only to cluster members.

Keywords

Cluster • Structure • Networks • Model • Typology • Region

JEL Classification

O18 • O29

1 Introduction

As noted by the famous American theorist in the field of strategic management. Hamel (2012) was also a successful business consultant on business management. At present, it is difficult to win in the market of goods and services due to continuous change, fierce competition, and unstoppable innovation (Gloor, 2006).

Under these conditions, the emergence of new forms of business becomes a necessary reality, which, in particular, explains the emergence at the end of the last century of such a phenomenon in business organization as a "cluster".

Historically, the idea of forming a cluster is rooted in the English economist Alfred Marshall, who at the end of the nineteenth century in his "Principles of Economics" highlighted three options of benefit, which get close to the

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organizations: sharing knowledge and innovation, sharing of labor resources, and access to suppliers.

But the creation of the "theory of clusters" is attributed by right to Michael Eugene Porter (American economist), which is based on the justification of the competitive advantages receive by close-located enterprises.

In Russian literature, the definition of a cluster given by Porter is interpreted and supplemented.

At the same time, small and medium-sized enterprises, when combined, get not only mutual benefits from the combination, but also realize the opportunity to enter the world market with aggregate products (Veilleux et al., 2012).

2 Materials and Methods

The cluster's characteristic is not only the orientation of the cluster as a whole towards competitive confrontation in the market of goods and services but also the maintenance of competition within the cluster itself. The cluster's border is determined by how close the location of enterprises ensures the intensification of interaction between them. It is ensuring the implementation of such a property of systems as "emergence" underlying the law of synergy.

In order to present the systemic content of the category "cluster", we turn to the method of studying complex phenomena with the construction of mental maps.

The essence of the cluster can be seen in the framework of four main units, reflecting the content of the cluster: economic entities of the cluster, cluster environment, authorities, and networks.

The cluster itself is often formed around the so-called core—a large enterprise that produces final products that are delivered to the market, and small and medium-sized enterprises that supply raw materials and semi-finished products for the core enterprise. As a rule, they are manufacturing in the same industry.

By combining, small and medium-sized enterprises benefit from strategic alliances and cluster formation (Veilleux et al., 2012). In addition, the cooperation strategy allows for the dynamic development of enterprises within the cluster (Osarenkhoe, 2010).

Moreover, due to the fact that enterprises belong to the same agglomeration, it is easy for them to integrate and provide interaction and communication processes.

By interacting, the enterprises included in the cluster maximize the growth of the added value of all enterprises in the cluster, while reducing costs. In the first place, transaction costs are reduced due to the reduction of transactions. And the analysis of certain types of activities of cluster enterprises allows us to estimate costs along the entire value chain (Porter, 2006), which the consumer can evaluate, which again makes it possible to obtain a strategically significant competitive advantage (Lapygin, 2014).

The cluster approach, which underlies the construction of a cluster as an economic system, reflects the agreement of stakeholders regarding cooperation between competing enterprises (Agarkov, 2016).

Synergy, as the implementation of a new quality (emergence) that appears in enterprises belonging to a cluster, basically determines those qualities that provide it with competitive advantages.

In the era of intelligent machines created on the basis of digital technologies, new methods have emerged in the management of large systems, including unifying entities. Such methods, in our case, include blockchain methods that provide unique interaction among cluster members, which creates a new type of competitive advantage in the market of goods and services.

3 Results

The construction of clusters typologies for various reasons allows us to get a comprehensive idea of the cluster's existence.

Within the cluster itself, one can also distinguish typical structures: production, innovation, marketing, design, implementation, cluster units for technology transfer, etc.

Cluster environment includes not only suppliers and consumers of products, as well as direct and indirect competitors, but also a significant variety of infrastructure. The innovative part of the infrastructure usually includes business incubators, technology parks, industrial parks, technology transfer centers, subcontracting centers, design studios, energy conservation organizations, etc.

It should be noted that the effectiveness of innovations is affected not only by communications within the cluster enterprises themselves but also by the organization of intercompany networks (Colombo et al., 2011). Joint creativity and implementation of innovations throughout the whole cycle of "novation-introduction-innovation" becomes possible with the formation and functioning of the innovation cluster network (Gloor, 2006).

Educational subsystem of the cluster infrastructure not only provides preparation and advanced training of cluster workers but also can perform search work on cluster orders.

The serving infrastructure subsystem, as a rule, is represented by organizations that provide transport, information, engineering, environmental and other services.

In the environment, first of all, we should mention the block of financial structures, which includes not only banks but also mutual and investment funds, as well as venture funds that provide financing of cluster risk projects.

Traditional blocks of external environment factors, such as politics, economy, society (socioculture of the population of the country), technologies (scientific and technological progress), ecology, and institutions (laws and by-laws). Those factors have an indirect effect on the operation.

A block of non-profit organizations, which should include organizations of those organizational and legal forms that are provided for by the Civil Code of the Russian Federation (Lapygin, 2014): charitable foundations, associations, unions, and various institutions.

Important for the cluster should be considered the block "Authorities", in which it is possible to distinguish not only the hierarchical structure of levels of power (federal, regional, municipal) but also the subsystem. Which is demonstrating support for the processes of formation and development of the cluster.

It should be noted here that regional authorities can provide not only support but also initiate the creation of a cluster (including municipal authorities) (Agarkov, 2016). However, as the practice of implementing the government's initiative on the organization of the cluster testifies, this way of forming a cluster is not always successful, as evidenced by the experience of the Japanese Ministry of Economy.

In conclusion, we consider a block called the "network", stipulating that researchers understand a network as a group of interacting entities in which interaction is accompanied by long and repeated connections. Moreover, in such a group there is no authority authorized to resolve controversial issues in the process of exchange procedures in the group. At the same time, cluster initiatives develop the network and improve the quality of the network itself (Holmen et al., 2010).

Considering the cluster internal network researchers note that inter-organizational interaction (Beck et al., 2014) contributes not only to the formation of the internal cluster network but also the formation of internal networks within the organizations themselves.

And, despite the fact that internal connections between cluster members become more intense than connections with the outside world, external networks are being formed to ensure the manifestation of systemic effects and the implementation of the law of synergy.

The network of clusters in the works of researchers is characterized as a network model formed on the principles of openness, decentralization, non-linearity, self-organization, and autonomy of network nodes, which ensures the creation of competitive relations and orientation of network participants to increase efficiency. Along with retail chains, there are also innovative, intermediaries, and consumers networks.

Among the principles of forming the network structure, it is necessary to single out principles: the principle of saving from the agglomeration of enterprises, the principle of consistency in the formation of the cluster structure, the principle of public–private partnership, the principles of combining competition and cooperation within the cluster, innovative development, openness for those wishing to become a member of the cluster, etc.

Management companies (Egorova, 2016) provide cluster enterprises with services related to the growth of innovative potential and the quality of human capital, business process reengineering services, and the intensification of entrepreneurial activity. They represent the interests of the cluster in the external environment. Management companies monitor trends in the market of goods and services, organize the cluster's products on the market, maintain databases necessary for the cluster, and ensure interaction with government and management.

Thus, the main content of the cluster as a socio-economic phenomenon can be represented by a mental map that reflects the significant blocks and subsystems of the cluster and allows to comprehensively represent the cluster elements and the relationships between them, which provides a better understanding of the specifics of the cluster and its interaction with the environment.

Prerequisites for cluster structures creation were associated with the development of organizational forms of business management and the rapid pace of change in competitive markets in the second half of the last century. When divisional and linear-functional structures could no longer cope with the need for growth to ensure operational decision-making and implement separation labor, which was aimed to increase productivity.

Now we are considering the clusters as a new type of self-organization of the socio-economic system, as the possibility of a transition from a not always inefficient sectoral approach to more advanced forms of organization of production. For this reason, the researchers identify a number of signs of such a phenomenon as a cluster. Among these signs are the effects of the environment, enhanced by territorial proximity. Mutual trust, which is leading to the development of innovations, the effects of vertical disintegration, reducing transaction costs, and a specific corporate culture based on trust.

Cluster approach to the management is currently considered in a large number of scientific publications of domestic researchers, among which one can distinguish the study of common issues (Babkin & Novikov, 2016), consideration of classifications methods, the essence of cluster policy (Bondarenko, 2016) features of creation and functioning, as well as the development of clusters networks (Maracha & Krasnikova, 2019) in modern Russian regions.

However, the divergence in approaches in order to build a typology of clusters leads to the analysis of the existing classifications in order to streamline ideas about this multifaceted socio-economic phenomenon.

Some researchers believe that the very appearance of the cluster as a scientific category dates back to the times of handicraft production (Babkin & Novikov, 2016) while noting that the term "cluster" was introduced into scientific circulation by the English economist Alfred Marshall, who studied industrial at the end of the nineteenth century District of Great Britain. Others refer to small-scale handicraft production of the early eighteenth century (Bondarenko, 2016), followed by an emphasis on conditions for cluster development at the end of the nineteenth century and a reflection of the development of industrial areas as a new category (the previous category of "cluster") in the writings of the head of Cambridge marginalist school A. Marshall.

The theory of "cluster" is considered to have been put into scientific circulation when considering economic relations among production entities by the American economist Porter (2006). Although it is known that the term "cluster" was in the late 1930s. was used in mathematics when performing cluster analysis, and inorganic chemistry under this category denoted the class of chemical compounds, which include a different number of transition metal atoms.

Moving from other areas of application of the term "cluster", Porter (2006) used it to analyze economic linkages in industries and organizations. It allowed him to show the presence in clusters of partnership and competition simultaneously, as well as lay the basis of the formation of the theory of clusters in industry. At the same time, in his reasoning, he referred to the work of Alfred Marshall, August Lösch, Walter Isard, and other economists who studied the processes of concentration of production in the 1890s–1950s.

However, from the definition of a cluster according to Porter, the boundaries of the cluster and the number of participants is not clear, as well as the tightness of the connections of such cluster members. This situation allows us to conclude that at present no single cluster formulation has been developed, which leads to the interpretation of this concept by researchers who consider this complex socio-economic phenomenon from different points of view.

For example, Babkin and Novikov (2016) summarizing the various definitions, form a matrix made up of them, and come to the conclusion that it is not possible to make a single definition of the cluster, although some researchers, after analyzing the existing definitions, give their own idea of it (Belotserkovskaya et al., 2017).

However, there is an assumption that by highlighting the grounds on which clusters could be classified, then within each cluster type it is possible to formulate its definition.

The morphological description by researchers includes such elements as geographical concentration, specialization, cluster members, cluster driving forces and connections, critical mass, cluster life cycle, and innovation. The geographical concentration reflects the availability of geographically defined resources, and geographical proximity reduces transaction costs and provides economies of scale through the division of labor and specialization of producers. This is ensuring productivity growth and simplifies the process of information exchange (innovation), supported by the close socio-cultural relationships that characterize the territory under consideration.

Specialization contributes to the formation of horizontal connections between cluster members, and intersectoral connections provide an impetus for the emergence of new products and services.

Cluster members themselves (government, business, science, and the local community), begin to better understand the logic of the development of the territory and form the basis for self-organization, as well as support for cluster initiatives.

Competition, combined with the cooperation of cluster members, on the one hand, increases the competitiveness of the cluster as a whole and each participant individually, and on the other hand, to share fixed assets and technologies, receiving economies of scale of production. The economies of scale are also enhanced by the cluster reaching a critical mass of its participants.

The cluster can be at one of the stages of the life cycle, which are characteristic of any socio-economic system (Lapygin, 2017): the origin (the formation of economic agglomeration and the beginning of cooperation), growth (increase in the number of participants and links between them), maturity (the number of participants reaches the critical mass), onset of the crisis (decline in activities) and, if the transformation of the cluster does not occur (change, structure, activities, etc.), then a liquidation stage begins. But as a basis for classifying the content of the concept of a cluster, researchers often take not only the stages of the cluster's life cycle or its size, but also territorial coverage and industry, the degree of innovation of the products, the level of aggregation of the participants, or differences in the structure of relationships.

Along with the above grounds, there may be classifications according to the structure of the core (core and non-core) or according to the level of development (strong, stable, potential, incipient), according to the degree of centralization (centralized—formed around the cluster core and decentralized—based on network forms), according to the nature of territorial coverage (municipal, regional, interregional), according to the systemic dependence of the cluster (strong dependence of the participants, normal, mutual dependence of the participants) (Maracha & Krasnikova, 2019).

Attempts to reduce and generalize cluster types lead to an understanding that industry, regional, innovative, and life-cycle phases (Fig. 1) are the main clusters.

The combination of the considered clusters types allows us to speak about the possibility to characterize each of them

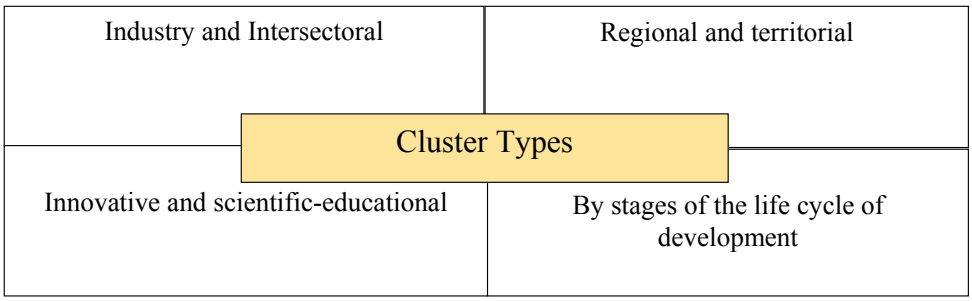

Fig. 1 The main types of clusters

from the standpoint of different bases, which allows obtaining the necessary information for an integrated view of its content, the relationship between private and the external environment, as well as its potential and competitiveness. In addition, the cluster can be classified as a mixed type, it will combine the characteristics of several types of clusters.

It should be noted that the unification of small and medium enterprises is promising. Especially since, according to experts around the world, the importance of small and medium enterprises in clusters increases.

Currently, clusters based on the principles of blockchain can become a special type of cluster. It is customary to attribute such principles to the blockchain: transparency, decentralization, reliability, and unlimited scope of scaling.

In relation to clusters, the principles of blockchain can create conditions for ensuring decentralization of the economic activities of cluster members, on the one hand, and the rapid exchange of information about transactions and tasks within the cluster as a whole, on the other hand. The versatility of the blockchain allows us to adapt it to the specific tasks of the cluster, both in terms of the implementation of the managerial functions of cluster members (forecasting, planning, organization, coordination, accounting, and control) and in relation to the formation of corporate databases.

4 Conclusion

Thus, we can talk about a universal definition of such a socio-economic phenomenon as a "cluster" has not been developed at present due to the great diversity of the subject area of integrable organizations and the conditions of association, as well as the socio-economic condition of the regions themselves. This circumstance gives a wide range of options for organizing clusters, which allows us to speak only about the element composition of clusters and the diversity of classifications of unifying organizations.

As modern principles of the organization and functioning of clusters in the regions. It is advisable to turn to a unique blockchain technology that can guarantee both reliability of contacts and decentralization in the management of integrated organizations. In addition, the transactions within the cluster themselves, when applying the principles of blockchain, become transparent for cluster members. This reduces transaction costs and ensures that reporting information cannot be replaced, and the ability to coordinate current and strategically significant issues in the process of interaction between cluster members ensures increased efficiency due to synergistic effects.

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