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Choosing Terminology to Define "Knowledge-Based Clusters"

[1]V. Petruk Galina, [2]D. Boush Galina and [3]A. Shcherbakova Elena
[1]Department of Economics and Management,
Vladivostok State University of Economics and Service (VSUES), Vladivostok, Russia
[2]Department of Management, Politics and Law, Omsk Humanitarian Academy, Omsk, Russia
[3]Department of Intercultural Communication and Translation,
Vladivostok State University of Economics and Service, (VSUES), Vladivostok, Russia

Abstract: The study examines and performs critical analysis of "cluster" definitions, made by both foreign and Russian researchers. It also gives an insight into the phenomenon of "knowledge-based cluster" and provides the authors' idea of this term. The triad approach that is used and developed by the theory of dynamic information systems serves as a methodology for defining the term "knowledge-based cluster".

Key words: Cluster, knowledge-based cluster, economy of knowledge, approach, triad approach, theory of dynamic information systems

INTRODUCTION

At present a new economy is emerging the knowledge-based economy where business entity competitiveness depends on scientific and technological developments and the creation of new knowledge and information and communication technologies are penetrating all spheres of economic activity. Mobile, plastic and integrated network structures assume prominence in the organization of the economy. Network Systems (conglomerates) may be grouped and concentrate geographically where there is a direct contact between business entities and where a constant exchange of information and knowledge is carried out. In the opinion with knowledge playing a special role, clusters are the most effective network structure of the emerging model of socio-economic systems, because they have a unique opportunity to generate new knowledge, business ideas, a sci-tech technology, using the productive partnership of scientific, educational and business structures (Petruk, 2015).

Obviously, in the context of the progressive development of the knowledge economy a new type of clusters with specific features will form. Since intellectual production becomes an attribute of this new economy, a number of issues must be solved. The issues which are connected with the identification of distinctive features of this type of clusters and with formation of the terminological system for their description. In view of the above, the main objectives of this study are:

- Selection of the most adequate term, reflecting the intrinsic characteristics of clusters that arise in the new economy the knowledge-based economy
- Identification of the essential characteristics of clusters of economic nature
- Determination of the selected definition

MATERIALS AND METHODS

Selection of a category to define clusters in the knowledge-based economy: Recently, the economic literature has formed a fairly wide range of terms used to name different types of clusters. The problem of finding an appropriate term is actualized by the need to use the best term, reflecting the features of clusters in which the function of knowledge generation and expansion in the new economy acquires a dominant role. We believe that the type of clusters that interests us is described by the following names: knowledge-based, innovative, scientific innovation, education. This variety of names indicates an unformed conceptual system of the studied phenomenon. Therefore, an urgent task of the current level of the study is to choose the term that captures the essence of the phenomenon under study the cluster producing knowledge. Review of the literature let us identify the grounds on which different authors suggest different names to define the phenomenon.

Thus, a number of researchers use the term "education cluster" (Chuchkalova and Mosunova, 2013; Sokolova, 2014; Tieman, 2009), stressing that the central

Corresponding Author: V. Petruk Galina, [1]Department of Economics and Management,
Vladivostok State University of Economics and Service (VSUES), Vladivostok, Russia

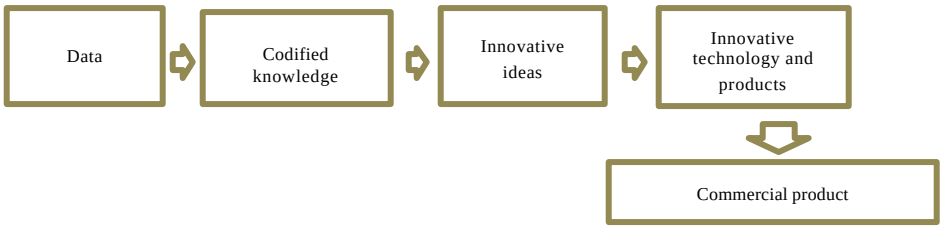

Fig. 1: Transformation of data into innovative products

role in the cluster is devoted to universities. Chuchkalova and Mosunova (2013) indicate that the educational cluster traces an interaction between all the parties (educational institutions, scientific organizations, business entities, authorities), operating in the field of vocational education in order to achieve a common goal based on the aims of individual participants. Culatta (2012), Sokolova (2014), along with the term "education cluster" where the main feature of the cluster acts as the integration of educational institution and businesses, uses the term "education and innovation" where there is a complex interaction between research, educational and commercial partners.

A distinctive trend in the development of modern economics is the active formation of clusters called innovative, reflecting changes in economic systems at the global, national and regional levels. A platform of innovation clusters is formed by "flows and spillovers of knowledge with a geographical concentration of property and the ability of a company to their absorption" (Baptista and Swann, 1998). In such clusters, scientific studies act to determine the competitiveness of an economic entity in the current market conditions. Most often, the researchers connect new production with innovative clusters. This point of view is encouraged by Andersson *et al.* (2004), Simmie and Sennett (1999), Bortagaray and Tiffin (2000), Mihranyan (2002), Tsikhan (2003). "Innovation" literally means implemented novelty, a new product or service put into production, i.e., associated with the process of commercialization (Porter, 1990). However, some authors associate innovation clusters with the creation of of new knowledge. Thus, Tsiglyaev indicates that the innovation cluster is a "strictly based system of dissemination of new knowledge and technologies". Egorova (2007) states that they (clusters) quickly and efficiently produce and distribute the new knowledge and technology Bortagaray and Tiffin (2000) determines that they are based on the concentration of knowledge, interactive training and joint social values.

Let us, note that the process of data transformation into an innovative product has several stages (Fig. 1): the information is transformed into codified knowledge which is transformed into innovative ideas, forming innovative technology and products and further distribution of the product to a consumer takes place. Obviously, codified knowledge is not always transformed into an innovative product. It may stay in the form of fundamental knowledge, the initial stage of the innovation process, so will not always have a practical result (only 3% of fundamental research is used in practice). However, codified fundamental knowledge can serve as a platform for the production of new knowledge. As shown in the process of data transformation (Fig. 1), the first four stages relate to acquisition of new knowledge and only the 5th one to the production of an innovative product (the 2nd phase of the innovation process: development, production and distribution). Thus, the concept of "innovation cluster", in our opinion, did not accurately reflect the essence of the phenomenon of a new type of clusters in the emerging knowledge economy.

Taking into consideration the above arguments, the term "knowledge-based cluster" carries the most accurate meaning, in our opinion, as the category of "knowledge" reflects the result of a process of understanding reality, adequately recreating it in the human mind in the form of ideas, scientific laws and theories. This very term was used by Porter *et al.* (2010) in the description of knowledge-clusters of Massachusetts, led by Massachusetts and Harvard University. The use of the category "knowledge-based business cluster" occurs in Boush (2009)'s research in which the author states that this is an entity that creates knowledge, satisfying certain social needs. However, the author does not give a specific definition of knowledge-based cluster. That is why, we must implement stages of the study, the main task of which is to identify the basic features of the economic nature of clusters as well as special features of clusters in the knowledge economy and on their basis the formation of a full definition of the required categories.

Table 1: "Cluster" definitions with their fundamental features

Definition	Universal features of clusters	Researchers (year)
Foreign researchers		
A cluster is a geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related sectors and related institutions (e.g., universities, R&D institutions, trade associations etc.) in fields that compete but also cooperate.	Geographical proximity interconnection complementarity	Porter (1998)
A cluster is a concentration of companies capable of producing synergies due to their geographical proximity and the interdependencies between them	Integration cooperation geographical proximity interdependence	Rosenfeld (1997)
Economic clusters are not just joined and capable of sustainable industries but are also related and supporting institutions that are more competitive by virtue of their dealings	Interconnection competitiveness	Feser (1998)
A cluster is a large group of firms in related industries at a particular location	Interconnection geographical proximity	Swann and Prevezer (1996)
A cluster is a group of firms that are functionally related to the market both vertically and horizontally	Interconnection	Elsner (2000)
Clustering is a process of colocation of firms and other actors within a concentrated geographical area, cooperating around a certain functional niche and establishing close linkages and working alliances to improve their collective competitiveness	Integration geographical proximity interconnection competitiveness	Andersson *et al.* (2004)
Russian researchers		
A cluster is a group of geographically localized interconnected companies, suppliers of equipment, components, specialized services, infrastructure, research institutes, universities and other organizations, complementing each other and reinforcing the competitive advantages of individual companies and the cluster as a whole	Geographical proximity interconnection competitiveness complementarity	Rudneva (2007)
A cluster is a set of inter-related economic entities of various industries combined into a single organizational structure with elements functioning together for a specific purpose	Integration interconnection interdependence cooperation	Larionova (2007)
A cluster is a geographic concentratration of related companies and organizations united by a common field of activity		
A cluster is a geographic concentratration of related companies and organizations united by a common field of activity	Geographical proximity interconnection integration cooperation	Kutsenko (2009)
A cluster is a voluntary informal (not institutionalized) association of independent economic entities in terms of territorial, industrial and cultural proximity and complementarity of products and resources	Integration geographical proximity complementarity cooperation	Boush (2009)
A cluster is a group of interconnected companies concentrated in a particular area with specialized suppliers of raw materials, components, products, services and related organizations (from educational institutions to specialized government agencies)	Geographical proximity interconnection cooperation	Gluhova (2012)

Identification of the fundamental traits of clusters of economic nature: From about the 1990's, the term "cluster" has been used in the scientific literature to describe the economic phenomenon of concentration of enterprises in the localized territory. According to national (Russian) and international research into clusters as an economic phenomenon, a rather wide range of definitions of the concept exists, indicating the absence of a certain common approach to the perception of the clusters. By what was said at the current stage of the study, it seems appropriate to carry out a review and critical analysis of existing of definitions of modern science and to identify the essential characteristics of clusters that are most frequently noted by researchers into this phenomenon. For this purpose, definitions are summarized in the table and universal features of clusters that are highlighted by different authors are listed in a separate column (Table 1). "Cluster" definitions with their fundamental features Analysis of all the definitions indicates that the authors often emphasize such universal features of clusters as geographical proximity and localization of active elements; closer economic cohesion of elements in the interaction, complementarity, mutual cooperation, enhancing the competitiveness of the participants. It should be emphasized that almost all researchers agree that clusters represent integration associations the local level.

At the same time, conceptual definitions do not indicate the features of clusters in the knowledge-based economy. Therefore, the objective of the next phase of research is to determine the universal traits of clusters that arise in the new economy the "knowledge-based economy" and to construct the corresponding definition to reflect these traits.

Identification of specific features of clusters in the knowledge-based economy and construction of definitions: To choose the most accurate definition capturing the truly fundamental features of the phenomenon under study, we use the methodological approach of Boush (2007) and construct the required definition based on the method of two-level triadic decryption of the basic category which is one of the applications of the theory of dynamic information systems (Tsikhan, 2003). The content of the method lies in the implementation of the following stages:

- Selecting a category, requiring the development of definitions (basic category)
- Decoding of the basic category with the three categories which reflect the essence of the phenomenon more complete and accurate; phenomenon named the base category (the first level of decryption)
- Decoding of decrypting categories, fully reflecting their content (the second level of decryption)

From the point of view, defining the knowledge-based cluster, it is necessary to display specific structural elements representing its component parts; specific processes occurred therein; specific results in the occurring processes within the structural elements. Thus, the first level of decryption of the basic category "knowledge-based cluster" identifies the following triad of categories of the first level: elements, processes, results (products). On the second level, each of the three-decryption categories, in turn, is also exposed to the decipherment. Analysis of a number of definitions of clusters, described by a variety of names, but aimed primarily at building knowledge, allows identification of the specific elements, processes and results of this type of clusters (Table 2). Thus, the category of "elements" for the knowledge-based cluster can be decrypted by the following categories:

- Scientific sphere
- Educational sphere
- Business sphere

The scientific sphere is the basic element in the creation of fundamental scientific knowledge. It is an institution dedicated to the reproduction of intangible resources "knowledge assets". The main role of the educational sphere is to train qualified personnel. In this segment, created knowledge is a key to the competence of future specialists. However, we cannot deny the importance of the educational sphere in the creation of fundamental knowledge. Dissemination of knowledge in the form of the finished product, technology, i.e., the process of commercialization is impossible without the business sphere. Interaction of presented institutional spheres (higher education, science and business) has a paramount importance for the development of the knowledge economy, scientific partnership, business and educational sectors. Creation of the close connections between the elements in the triad of institutions mostly of informal nature is the key to the emergence of new knowledge in the cluster. The category of "processes" is decrypted by the following categories:

- Knowledge generation
- Knowledge transfer
- Knowledge commercialization

These processes form a special "triangle" of knowledge in which each of them is a continuation of the following one to build a logical chain from knowledge creation to its mass use of consumers. The process of knowledge generation relates to its creation, as mentioned before, in the framework of scientific and educational institutions. Knowledge transfer involves its diffusion from the creator, owner of knowledge to users and includes the processes and institutional arrangements through which knowledge, including experience and technology is transferred to a wide range of users, allowing not only to expand the range of new media skills, but also to formalize non-algorithmic knowledge. The process of commercialization is associated with the use of acquired knowledge in practice, when the owner of knowledge can obtain compensation from their consumers. These aspects provide a platform for the creation and exchange of new knowledge in knowledge-based clusters. This characteristic actually serves as a platform for the emergence of partnerships, cooperation and collaboration. The category of "products" in turn is decrypted by the following triad of categories:

- Knowledge
- Technology
- Information

Table 2: Features of knowledge-based clusters reflected in the definitions

Definition	Elements, processes and results	References
An educational innovation cluster is a union of representatives of the sector: universities, research centers, industry through the creation of local zones with certain preferences, where all the participants of the value chain, from the beginning of the development to the completed innovation product (research institutions, small innovative companies, test centers, expensive equipment common use centers, patent offices, specialized certified laboratories, universities and training centers, delivering relevant specialists to these companies) would be in a constant interaction	Higher education research CentersIndustry; development cooperation; innovative completed product	Teryoshin and Volodin (2010)
An education cluster is a learning system, mutual learning and self-study innovation chain of education, technology, production, based mainly on horizontal links within the chain (the construction of an integrated system of multi-level training for the companies based on the integration of educational institutions and businesses, employers, providing high quality, reducing terms of preparation, consolidation of graduates in enterprises, the creation of a flexible system of training qualified employees considering the current and expected production requirements)	Higher educationSpecialized schools; Research organizations; Training	Rastvortseva and tools in the Cherepovskaya (2013)
An educational cluster is a system of inter-related universities, specialized schools and research organizations which allows cluster members to combine their efforts and resources to promote educational services in the global market An education cluster is a connection of an employer and educational institutions with the help of the complex cross-cutting programs	Higher education Specialized schools Research organizations; Training Educational services	Tieman (2009)
An education cluster is a connection of an employer and educational institutions with the help of the complex cross-cutting programs	Higher educationProduction; Training; Personnel training	Anistsina (2010)
An innovation cluster is the most advanced form of integration interaction of educational and research institutions with business and industry as well as the authorities. This is not a spontaneous association but a strictly oriented system of dissemination of new knowledge and technologies	Higher educationResearch organizationsIndustry and business; development cooperation; new knowledge and technologies	Tsiglayev. (2011)
An innovation cluster is a set of geographically isolated companies and organizations with a common scientific base and forming technology, logistics and infrastructure chain, based on taking advantage of the simultaneous action of various market mechanisms (cooperation and competition), quickly and efficiently produce and distribute new knowledge and technology	Higher education research organizationsIndustry and business; Production and distribution; new knowledge and technologies	Egorova (2007)
A regional innovation cluster is a set of institutions and organizations of various forms of property in the territory of the region engaged in the creation and dissemination of new knowledge, products and technologies, as well as organizational and legal conditions of their management of certain public research and innovation policies regional policies pursued at the federal level and socio-economic policy in the region	Institutions organizations of various forms of ownership; creation Expansion; new knowledge products technologies	Kazantsev and Nikitin (2011)
A scientific and educational cluster implements the synthesis of science, education production and management of all stages of the innovation process from training to implementation of new technological solutions and new ideas of progressive development	Science education production; Stages of the innovation process; new ideas technologies	Vanyurikhin and Zakirov (2011)
An educational cluster should be innovative and represent a group of related educational, research and business organizations, aimed at the production and implementation of innovations and their promotion on the local and global markets	Science education scientific research and business structures; Production realization; innovation	Culatta (2012)

In the context of our research, skills are considered as a subjective image of objective reality, the result of human cognitive activity which acts as a learned body of ideas, concepts, opinions, theories and principles. In the flow of any information, a transfer of a certain body of knowledge is kept. Later it is transformed into either private or publicly available knowledge. Results of the usage of new knowledge can move into a market in the form of the product or the process new technologies. With the help of information and communication technologies, codified, discrete knowledge (the latest scientific developments, technology, etc.) quickly spreads over long distances and becomes available to society as a whole, regardless of the level of socio-economic development and technological order.

Thus, the functions of knowledge-based clusters are logically arranged in a process chain of generation and use of knowledge, transformation of information into codified knowledge, transmitted by information and then it, along with uncodified knowledge is transformed into new ideas, technologies and knowledge. The elements of knowledge-based clusters interact with each other, share resources and create a flow of information (educational sector), technology (business organizations) and knowledge (scientific sphere).

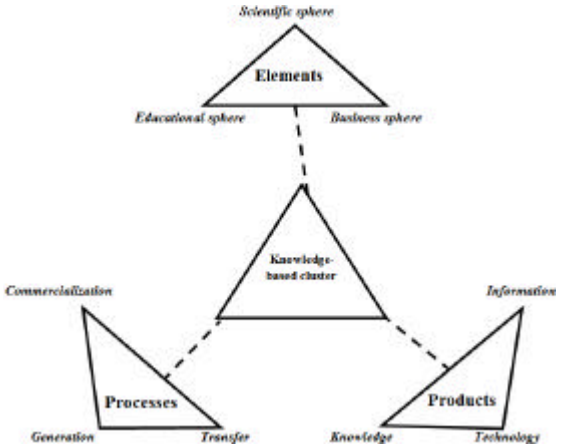

Fig. 2: Model of the definition of category "knowledge-based cluster"

Let us note that all the stated elements, processes and products are pointed out by the researchers into knowledge-based clusters and, in other words, are reflected in the definitions, but, unfortunately, outside the particular system. Figure 2 shows the operation of deciphering of the category "knowledge-based cluster" of the second level.

As stated in the second phase of the study, 'integration association "which includes all spheres of economic entities is a universal feature of any type of cluster, including knowledge-based clusters. Thus, the context of the study allows us to formulate the definition of the object of the study: a knowledge-based cluster is the integration of educational, scientific and entrepreneurial fields, based on the processes of generation, transfer and commercialization of knowledge, information and technology.

CONCULSION

The large number of definitions of clusters in the modern economic literature presents readers with some cognitive dissonance, but it has become possible to eliminate this dissonance by identifying the fundamental characteristics of the cluster phenomenon. Geographical proximity, close economic cohesion of elements allowing interaction, complementation and mutual cooperation, improving the competitiveness of all participants all are emphasized by many researchers into this phenomenon, but rarely reflect universal features of a particular type of cluster formed in the knowledge-based economy. Using content analysis and a two-level triadic method of decryption of the basic categories makes it possible to identify categories reflecting the intrinsic characteristics of clusters operating in the knowledge-based economy and to construct a definition of the category "knowledge-based cluster".

Application of the two-level triadic decryption of the basic category develops a methodological platform for the scientific concept of economic clusters, as well as economic theory in general. It is a reliable methodological tool for investigating the most significant aspects of economic phenomena, reflecting their nature, in order to formulate appropriate definitions.

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