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Case Study on the Structural Transformation of an International Cluster: European Perspective

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Abstract

Current article provides empirical evidence on the process of structural transformations of an international cluster. The research is held under the case study approach of the biopharmaceutical cluster Medicon Valley. According to the research results, an organized international cluster has three distinguishing stages of structural transformation during the process of its successful development. The initial stage of the cross-border cluster, being the result of trans-regionalization activities of the neighboring countries can subsequently transform into transnational cluster, involving actors of the remote regions. The prevailing importance of organizational proximity of an international cluster is observed in the scattered localization of its members. Innovation activity holding the predominant role in establishing bonds between the stakeholders is the cause of establishment of the sustainable network between the cluster and the external actors, forming the international cluster-network structure. Similar to the corporate alliances, successful international clusters tend to establish unions or associations, while seeking for new sources of knowledge and competences. This form of co-opetition is defined as international cluster network.

Keywords: cross-border cluster, transnational cluster, international cluster, cluster-network structure, cluster network, cluster internationalization, cluster structure

1. Introduction

In the late 1990th M. Porter was arguing for the fundamental shift in the cluster concept, stating that geographical proximity is not the panacea for competitive advantage and should not be seen as the key feature of a cluster. The prevailing importance is seen in the organizational proximity, defined by R. Boschma along with cognitive, institutional, social as well as geographical or spatial proximity being only a variable of the complex co-opetition system. Organizational proximity reflects a set of shared values, a sort of image that unites likewise-minded people and forms competitive advantage that is expressed in an external innovative environment, located outside clusters, organizations or indeed the industries. Similar patterns were observed within other related studies. According to A. Marshall an external environment that provides a certain competitive advantage to the localized firms is defines as the industrial atmosphere. More recent authors have further developed this idea, identifying such concepts as «buzz», «local broadcasting», «noise», «milieu» and other. The basic uniting idea behind these concepts is the existence of certain emergent properties of the system members. Actors are therefore able to collaborate on the basis of commonalities, such as consimilar level of technological development, aspirations, desires and commitment. This pattern can similarly be observed in other theoretical developments that reflect the latest trends of the new knowledge economy and globalization (e.g. global innovation networks).

The latest evidence on the principles of the open innovation concept has proven that generation of knowledge involves a variety of other stakeholders rather that solely firms. The process of knowledge generation involves stakeholders holding interchangeable and complementary roles, being representatives of the university, business, government and public institutions defined as helices by H. Etzkowitz and L. Leydesdorff. Hence, the sustainable collaboration process is based on cooperation and competition (co-opetition) of equally substantial actors that are able to produce, share and absorb knowledge not on the basis of industry affiliation, but on the basis of actual contribution to the value co-creation process.

The network nature of a cluster has never been as vivid as it is today. Internationalization strategies of the Western European countries demonstrate awareness of the positive effects of international clusters on the socio-economic development. A number of successful international cluster initiatives of the 1990th have resulted into highly developed world-class clusters (e.g. BioValley, Medicon Valley, Bothnian Arc of Knowledge, etc.). According to Köcker and Rosted (2010), current cluster policies of the European countries are directed on promotion of successful clusters and establishment of international clusters. Hence, the major issue is to identify the features of a successful international cluster and to provide insights on the possible scenario of its further development.

2. Theoretical Background

The absence of a rigid determination of cluster boundaries in combination with a high degree of stakeholder integration within the cluster interactions on the basis of organizational commonalities and functionality of their relationships determined the possibility of creating economic clusters at different levels of localization: the micro-, mesa-, macro- and mega-level. One of the most complex formations of cross-country cluster interactions is discussed within the concept of international cluster, which is associated with engagement of actors belonging to different institutional systems.

The concept of international cluster has recently appeared in the scientific literature and has not yet received an appropriate theoretical basis. The review of scientific publications revealed a significant number of terms to refer to the international cluster interactions. However, their diversity is largely due to the vagueness of the international cluster concept and the lack of a uniform terminology.

Most of the articles on international clusters are written by the European scientists, and are concerned with the phenomenon of internationalization of regional clusters. Generally, papers represent empirical research carried out in the framework of specific programs, state funded projects, as well as studies of the best practices in specific sectors of the economy. The following terms received a widespread use to refer to an internationally organized cluster:

- “cross-border cluster” or “trans-border cluster”, cluster members of which are concentrated in the border territories of two or more countries (e.g. Asheim, B. T.; Coenen, L.; Moodysson, J.; Karlsson, Ch.; Royer, S.; Rugman A. M.; TerWal, A.; etc.);

- “bi-national cluster”, members of which are concentrated in two, usually neighboring countries (e.g. Asheim, B. T.; Coenen, L.; Moodysson, J.; Dávila, N. G.; Royer, S.; etc.);

- “transnational cluster”, members which are concentrated in two or more countries, regardless to their spatial distribution (e.g. Walerud, C.; Viachka, A.; Zámborský, P.; etc.).

Articles in other languages, such as Russian, comprise of additional terminology that can be identified: “international cluster”, “interstate cluster”, “cross-country cluster”, “cross-border cluster” and “transnational cluster”. Most scholars identify international clusters within the general classification of clusters, highlighting its level of spatial distribution, while not specifying the structural characteristics. Another aspect is the interchanging of synonymous terms, such as: international, interstate, cross-country, etc. indicating the absence of an established terminological system.

The lack of clear theoretical delineation of these concepts creates certain difficulties in the identification and subsequent study of individual clusters. For example, the term “transnational cluster” (equally substituted and interpreted as an international or interstate cluster) is used to refer to a wide spectrum of cluster members which are located in a geographical area that extends beyond national boundaries of a single country. The use of this term in the form of a phrase – “transnational clustering”, can be used in a meaning of international interactions of two or more distinct regional clusters. However, use of the term in this context intersects with the terms “international cluster network” and “transnational network of clusters”. Most of the scholars covering the subject of the international cluster phenomenon tend to avoid terminology discussion. Instead they use the classic definition of the cluster concept in combination with terminological apparatus of the other areas of geo-economics or regional studies (e.g. such terms as internationalization, trans-regionalization and etc.). This generates difficulties in comparative analysis of the research results and of allocation of the unique features of international clusters.

According to the analysis and based on the aggregation of the existing definitions, the international cluster can be defined as a network of sustainable interactions between a wide range of interrelated, interdependent and mutually reinforcing stakeholders, which are localized in the territories of the two or more countries, operate in related industries, possess similar level of development of skills and techniques, and are involved in joint process

of value creation; international cluster provides a synergistic effect in the development of the related territories and the diffusion of innovation between them.

Cross-border cluster is defined as a form of international cluster, which is characterized by the spatial localization within the border regions of neighboring countries. In turn the transnational cluster is another type of international cluster, which is characterized by the remoteness of the cluster members from the border regions, while it consists of a broad range of independent stakeholders, and regional clusters. Table 1 shows examples of cross-border and transnational clusters in the Baltic Sea Region.

Table 1. International clusters in the Baltic Sea Region

Type of international cluster	Cross-border cluster	Transnational cluster
Terms used in literature	"cross-border cluster", "trans-border cluster", "bi-national cluster", "transnational cluster", "transboundary cluster", "cross-country cluster".	"bi-national cluster", "tri-national cluster", "transnational cluster", "international cluster", "interstate cluster", "cross-country cluster".
Level of localization	Border regions of the neighboring countries	Territories of two or more countries; there may be a common border
Examples of clusters in the Baltic Sea Region	Clusters of the Öresund region – Denmark and Sweden: IT, biopharma, nanotechnology, food, environment, animation, logistics, etc.; Clusters of the Bothnian arc region – Sweden and finland: science and education, metal industry, ICT, wood processing and forestry, tourism; Clusters of the Oslo - Västra Götalands region – Norway and Sweden: medical technology and eco-technology; Clustersof the Jutland route region – Denmark and Germany: eco-technology, tourism, food, medical technology, logistics, science and education.	"Service Cluster Denmark", Denmark, Sweden, Finland, UK; "Baltic Biomaterial Cluster", Germany, Poland, Lithuania and Norway; "Baltic Diabetes Cluster", Germany, Poland, Lithuania and Norway; "MediaEvolution", Sweden, Denmark, Austria; "Oslo Cancer Cluster", Norway, France, Denmark, Germany, USA; "AluCluster", Denmark, Sweden, Norway; "ROBIN" – Denmark and Germany.

Source: adopted from Mikhailov (2013).

International cluster is innovation driven, implying that innovation activities are in the nature of its collaboration network. Taking this into perspective such concepts as the innovative milieu (see: Aydalot, P.; Camagni, R.; Maillat, D.; Monte, D. J. and Paquet, G.) and the proximity clusters (see: Capello, R.; Hart, D. and Simmie, J.; Rabellotti, R. and Schmitz, H.) should be taken into consideration. *The innovative milieu concept is highly related to the cross-border clusters, whereas the proximity clusters concept is applicable in respect to transnational clusters*.

A distinctive feature of the *innovative milieu* concept is its focus on the process of creation and commercialization of innovations, inscribed in the institutional environment of the region. In the framework of this concept the main characteristics of stakeholder networking in cross-border cluster are: the trustworthy relationship based on past experience; collaboration with the leading actors in the respective agglomeration; the exchange of competences by using shared human capital; mutual involvement in risky innovation projects – sharing risks; the distribution of the innovation process within the geographical area of the cluster; the active use of social (human capital), physical (transport and communication), and financial (venture capital, government support) capital. Formation of the value chain takes place in the scope of cross-border region, driven by the need to share various types of resources (labor, material, technical and natural) and by the complementarities of institutional relationships.

The *proximity clusters* concept is based on the interaction of actors that have a high degree of heterogeneity of

the organizational structure and are mainly located at a considerable distance from each other. Geographical location and spatial proximity in this context is not seen as a major source of competitive advantage. Insignificant use of the regional capacity and the desire to collaborate with institutional actors on the basis of common technological and organizational characteristics, and to a lesser extent on the basis of spatial proximity, relates this concept to the transnational cluster.

Based on the key features of the concepts that describe localized innovation networks, where the innovation process is seen as a mutual rather than individual activity, it can be argued that the development of a complex collaboration system of actors in the international cluster occurs within a network approach. Nature of networking in the international cluster is expressed by: - the blurriness of borders and openness of the system, with the possibility of changing the composition of the participants; - the maintenance of the dynamism of the internal structure and high degree of connectivity of the cluster members; - quick adaptability to constantly changing environmental conditions; - the presence of emergent properties of the system and the ability of the system to self-organization. The network basis of the international cluster collaborations also contributes to a greater degree of internationalization of the system, and is characterized by a large proportion of the influence of cross-country cooperation with respect to the competitiveness of its members (e.g. increase of the technological potential of networking companies (Morrison et al., 2008).

Based on the preceding literature review, the author proposes a following hypothesis regarding the developed international cluster:

Hyp.1: The developed cluster is accompanied by the co-opetition process of the actors that represent various institutional helices of the triple helix model, holding interchangeable and complementary roles within the cluster, as well as involving a wide spectrum of external collaboration network.

Another hypothesis is related to the main topic of the paper – the structural transformation of the international cluster, that is:

Hyp.2: The international cluster follows the pattern of structural enlargement and diversification, along with the toughening micro-specialization within its structure, while the spatial concentration of the clusters' core is combined with an increasing number of scattered stakeholders that collaborate on the basis of intangible commonalities.

3. Methodology

The research strategy of this paper is structured under the case study approach, based on the purposeful and the information-rich sample (Stake, 1995; Patton, 1990). The choice of the research method is predetermined by the nature of the phenomenon under study:

- *the organized foundation of the international cluster*; most of the international clusters are planned network structures, being the result of the respective cluster policies. This fact implies the existence and availability of legal documents, that describe the goals, objectives and measures taken to establish a cluster during the cluster initiative activities;

- *the geographical scope of the international cluster*; broad geographical distribution of the cluster stakeholders limits the choice of alternative research strategies. Moreover, since the aim of the research is to identify the possible structural transformations of the international cluster, is it is not seen as possible to predefine the possible dissemination of actors of the cluster network for the purpose of sampling;

- *the inter-organizational structure of the international cluster*; due to the fact that the core objectives of international clusters is generation and diffusion of knowledge, as to foster innovation activity in the region, the international cluster collaborations involve actors of various institutional spheres – universities, government, business, society, etc. Hence such research methods as statistical analysis of the regional data would not be sufficient or representative.

Case study is able to provide an in-depth understanding of the latent processes and mechanisms of the social interactions. The holistic approach of the case study is well suited for conducting research of the complex systems keeping the integrity of the network and its context. The flexible structure of the case study approach, the ability of combining various methods of data collection, as well as the representation of results makes it highly suitable for the current study.

The specific case of research is the international biopharmaceutical cluster Medicon Valley, located in the Öresund region (Sweden and Denmark) of the Baltic Sea region. The choice of this very cluster is based on the following factors: 1) Medicon Valley is one of the few undoubted examples of the international cluster

phenomenon; 2) it has emerged a considerable time ago (since 1995) as the result of an international cluster initiative, which implies the availability of information; 3) this cluster has attracted a substantial amount of attention in the scientific community, hence there are a number of research results available for further analysis and interpretation. The research is held under the instrumental type of case study, aimed at identifying general understanding of the phenomenon based on the clear and vivid example (Harling, 2002).

The structure of the case study is based on the publications of Soy (1995) and Stake (1995), and it follows the following steps: 1) the research preparation – theory conceptualization, formulation of the hypothesis; 2) secondary data collection – research papers, official reports, policy papers, statistical data, interviews, etc.; 3) data analysis and interpretation, representation of results. Understanding of the essence of the phenomenon, in turn, requires using qualitative methods of data analysis. These methods are suitable for creation of new knowledge, based on the questions of "how" and "why" certain phenomenon occurs.

4. Research Results and Discussion

4.1 A Brief Introduction into the History of the Case

Over the past 20 years the joint cooperation of the Danish and Swedish authorities of various levels was aimed at supporting and promoting the integration process of border regions and the creation of a single cross-border region. The commissioning of a bridge connecting the Øresund Strait in the 1993, gave a vital breath to the "Øresund Committee" Euroregion, chaired by the head of the City Council of Malmö and the Lord Mayor of Copenhagen. The committee has successfully implemented a number of projects, including the EU and the Interreg projects, which formed the basis for the creation of innovative cross-border clusters.

The first cross-border cluster in the Øresund region of Denmark and Sweden was formed as an association of regional clusters in the course of a project to create "Medicon Valley Academy", initiated by the universities of Lund (Sweden) and Copenhagen (Denmark) in the framework of the "EU Intereg II" project of the year 1995. The project was supported by major regional TNCs (Novo Nordisk, Lundbeck and Astra-Zeneca) and local authorities on behalf of the Øresund Committee, as well as public venture capital funds "Vaekstfonden" and "Industrifonden".

In 1997, the "Medicon Valley Academy" was reorganized into "Medicon Valley Alliance – MVA", which in 2000 was transformed into a private non-profit organization "Medicon Valley". Medicon Valley, along with other cross-border clusters of the Øresund region (e.g. "Øresund IT", "Øresund Environment", "Øresund Logistics", "Øresund Food") operates under the auspices of the "Øresund Science Region", the main objective of which is to promote innovation development of the region through the mechanism of cross-border cooperation.

Medicon Valley today is an international biopharmaceutical cluster involving research laboratories, centers for pre-clinical and clinical drug trials, and biopharmaceutical industries and other stakeholders, which are mainly localized on the two opposite sides of the Øresund Strait of the Øresund region – the Eastern Denmark (on the islands of Zealand and Bornholm) and south-west of Sweden (in cities of Lund and Malmö). The cluster interactions are carried out on a binary system of the triple helix model, which includes representatives of the science, business sector and the regional authorities of the two countries, with the four main drivers of co-opetition: business, science, clinics and universities (Mikhaylov, 2013a).

4.2 Case Study Research Results and Discussion

The development of an international cluster is followed by the formation of certain internal rules and regulations – the cognitive proximity of interacting agents and actors, based on the collective properties of the cluster. The manifestation of tendencies that are inherent to the economic cluster has a more pronounced character. 1) The developed international cluster has a focused internationalization strategy and a micro-specialization of individual cluster members (e.g. *the Swedish companies are engaged in research and development in the field of health care and biotechnology, while Danish companies - in pharmaceuticals and medical devices; moreover, individual companies and research centers have specific occupational field (e.g. «Centre for Protein Research», and «Bioinformatics and microbial biotechnology» center at the Danish Technical University)*. 2) The influence of the local participants in the system of value co-creation is weakening over time, engaging the global competition into the local environment (Note 1) *(e.g. the Medicon Valley uses the capacity of research institutions from Belgium, Britain, Germany, Israel, Norway, the USA, Finland, France and Switzerland)*. 3) Hierarchical system of interactions on the basis of strategic network becomes more pronounced, highlighting the core of the cluster – a strong player (often large TNCs), that is taking over the management and coordination functions in the cluster *(e.g. the leading role in the process of formation and development of Medicon Valley is played by such big multinationals like NovoNordisk, Lundbeck, LeoPharma, Nycomed, Ferring, AstraZeneca,*

Pfizer, ALK Abelló, Coloplast).

The cluster structure consolidation process is accompanied by the loss of importance of such factors as geographic proximity of participants' interactions, due to the actual geographical remoteness of its members, and the increasing importance of organizational proximity inherent in business networks. Formation of this trend is due to the dynamism of the modern business environment, in terms of speeding up the exchange of information and new knowledge through the use of advanced information and communication technologies. The choice of the location of actors is related to the presence of nodes of information flows and well-established channels of communication (Note 2). The prevalence of organizational, social and institutional proximity to the participants of a complex system of cluster interactions promotes collective learning and the formation of a dynamic synergy of innovation (Aydalot, 1986; Capello, 1999).

The desire to create a sustainable system of interactions that is able to generate continuous innovation had an impact on the formation of the globalization strategies of the cluster. These strategies are based on establishment of a collaboration system engaging members based on the commonalities of their intangible properties, or «a stock of private information of each node» according to Wills-Johnson and Hornby (2007, p. 38). For example, the ability to work in the framework of the Just-in-time mode; or based on the use of a certain quality control system. Gradual expansion of the internal structure of the cluster occurs by the inclusion of new stakeholders into a single value chain. The consolidation of an internal cluster structure is accompanied by the transformation of the entire system of cluster interactions, due to the increasing numbers of stakeholders involved. This is due to: 1) an increased diversity of actors (with respect to institutional sphere and the industrial classification) and their micro-specialization leads to establishment of the new networking contacts beyond the existing cluster boundaries; 2) the toughening of the global competition, as the cluster goes global, implies the process of finding the specific market niche, reflected in the structural transformations. In turn, this provides the possibility of considering the international cluster as a tool for the formation of the international network of value co-creation.

On the basis of the research results the two basic stages of consolidation and transformation of the international network of cluster interactions can be distinguished: the international cluster-network structure and the international cluster network (Figure 1). The transitional phase from the international cluster to the international network of clusters is the international cluster-network structure (Figure 1B), which includes the core - an international cluster, which is based on the doubled triple helix model (Mikhaylov, 2013a), and individual actors interacting with them on permanent basis, but not being the members of the cluster.

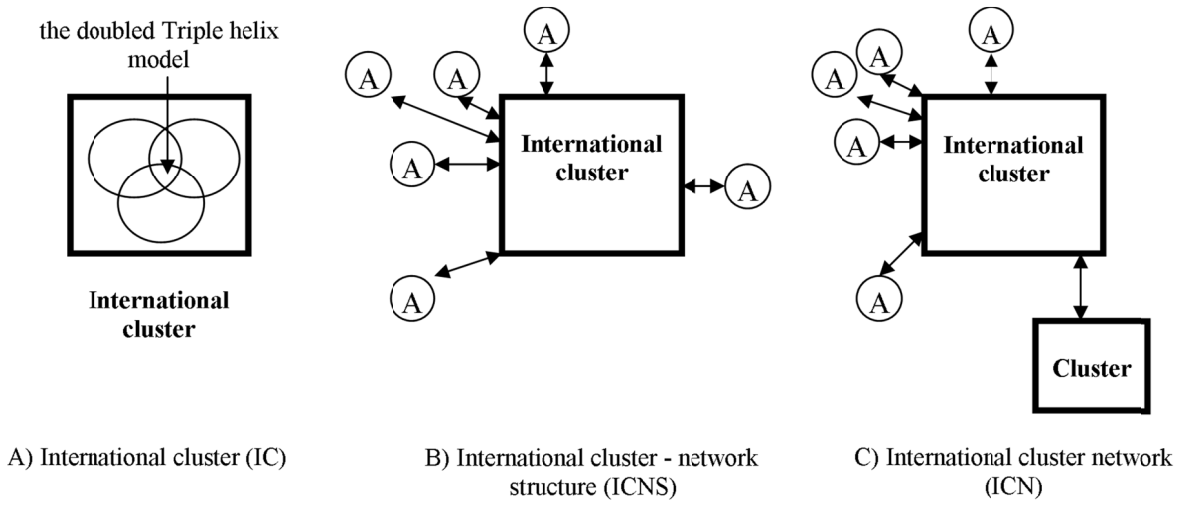

Figure 1. Systems of the international cluster interactions, where A – actor

The practical delineation of the international cluster and the international cluster-network structure is complicated by the principles by which one can establish that the individual actors relate to the cluster. The most effective method of such allocation is considering a self-proclaimed membership in the cluster (Note 3), as well as the data on the list of participants available from the cluster organizations' reports (Note 4). According to the above presented transformation stages it can be argued that to date the international cluster Medicon Valley can be simultaneously attributed to all three types of international cluster interaction systems, depending on the

scope of the study.

Medicon Valley has long past the stage of the cross-border cluster, defined by collaboration processes of the actors located within the border regions of the neighboring countries. The vast spatial distribution of the cluster members implies the transnational nature of this international cluster (e.g. involvement of the Skagerrak region). Moreover, the international cluster-network structure is reflected in sustainable collaboration of certain individual stakeholders of the Medicon Valley with the external actors, represented by firms, universities or even other regional clusters of Sweden (e.g. biotech Stockholm – Uppsala, Gothenburg - Linkoping - Umea) and Denmark (e.g. life science clusters in Aarhus, Odense and Aalborg).

Further consolidation and transformation of the international cluster-network structure is possible by the formation of international cluster alliances – the international cluster network (Figure 1C). The formation of the international cluster network is based on the following objectives: 1) co-innovation activities with regard to the exchange of knowledge, skills and know-how to achieve synergy effect and innovation diffusion; 2) the promotion of domestic commercialization of high-tech innovation; 3) strengthening the clustering effect among existing and potential cluster actors in order to increase the level of innovation development and competitiveness of the macro-region in the global market; 4) the desire to initiate joint R&D as to explore the best practices for a successful implementation of innovative solutions; 5) strengthening of the regional innovation systems and the optimization of resources, infrastructure and supporting services. A characteristic feature of the international cluster network is the unification of clusters and cluster-network structures based on common objectives, technology, strategic planning, market positioning (e.g. from the strategic marketing management perspective), and other features that improve the efficiency and innovation of the overall system. This often means the possibility of merging clusters of initially different sectors of the economy (such as energy and agriculture: e.g. clusters of renewable energy sources «FURGY - Biogas», Denmark and Germany). The Medicon Valley is involved in a number of international cluster networks, such as the network of biotechnology clusters across Europe – "the Council of European Bioregions (CEBR)", launched in 2006 with over 100 full and associated members to date. Other examples of international cluster networks are «INNOTEX», «CASTLE», «ABC-Network», etc.

Hence the hypothesis one is true since Medicon Valley as a highly developed international cluster engages internal and external actors of various institutional helices of the doubled triple helix model into the co-opetition process of value co-creation. The second hypothesis has been detailed with specifying the two key stages of international cluster consolidation and transformation: the international cluster-network structure and the international cluster network.

4. Conclusion

The aspiration to expand the network structure of interactions of the international cluster by the internationalization activities and transformation into the larger forms is reflected in the cluster policy of the European countries (Mikhaylov, 2013b) and the development strategies of mature clusters. The main reason for this trend can be expressed in simplified idea of a network structure of cluster interactions, as an effort to use external (someone else's) potential for self-development, which ultimately has a positive impact on the open system as a whole (Note 5).

The empirical data analysis revealed two major stages of transformation of a developed system of cluster interactions: the international cluster-network structure that is characterized by the presence of external networking of the open system and the international cluster network, which is the most extensive view of the international cluster interactions.

Examination of such multi-cluster interactions from the perspective of an open system is based on the unification of members in accordance with the possession of certain intangible properties (e.g. organizational technologies), reflects the increasing trend of globalization of the world economy and the increasing importance of organizational proximity with the development of network structures such as the international cluster.

Thus, the formation of the cluster policy and the cluster development strategies, as well as the implementation of an international cluster initiatives should take into account the key trends and interactions of the successful examples of international cluster interactions.

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Notes

Note 1. Results of other empirical studies on the interactions of innovative companies in the innovation cluster also show low importance of the factor of territorial location in the inter-firm collaborations (Hart, 2012).

Note 2. The delimitation of the concepts of permanent and temporary proximity reflects the shift of ideology with regards to geographical proximity (Torre & Gallaud, 2004).

Note 3. This method is highly reliable due to the organized or planned nature of international clusters. See: Flash Eurobarometer. Innobarometer on cluster's role in facilitating innovation in Europe: analytical report. The Gallup Organization. 2009. №267. p. 166 URL: http://www.proinno-europe.eu/sites/default/files/Innobarometer_2009.pdf (Дата обращения: 05. 01. 2013)

Note 4. This data is generally available on the clusters' official website.

Note 5. This effect is similar to the one observed by Adam Smith, where private interest is inexplicably coincides with the public interest.