

The Use of Information and Communication Technologies in Cluster Organizations

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Abstract. *The purpose of the paper is to explore how cluster organizations (COs) take advantage of Information and Communication Technologies (ICT). The paper addresses the research question: "How do cluster organizations take advantage of ICT in fulfilling their main roles?". The research was carried out in the first half of 2016 in four purposefully selected cluster organizations. The main research strategy involved Grounded Theory; the basic method of data collection was an in-depth individual interview. The research sample comprised 30 cluster entities – members of four cluster organizations representing metal and ICT industry. The research has shown that Information and Communication Technologies are an important tool in the development of cooperation in cluster organizations. Nevertheless, it has been observed that ICT plays a slightly different role at each level of a CO's development. The research was based on an original theoretical concept referring to the trajectory of the development of cooperative relationships in cluster organizations. Four levels have been distinguished in the development of COs. At each level, cluster organizations play one of three identified roles: a Direct resource supplier (providing access to resources), a Broker (facilitating resource exchanges) and an Integrator (integrating in different dimensions). The specific nature of each level of cooperation determines the type of information technology used. The research study contributes to the literature which refers to the question of face-to-face contacts established in geographical proximity versus the ones set up by using Information and Communication Technologies in COs. It was noticed that, even though information technologies play a significant role in the functioning of cluster organizations, they cannot replace face-to-face contacts. They can only be their important complement at every level of CO development. There are also some limitations connected with the qualitative approach, which does not allow the authors to generalize the findings. The first limitation is the small research sample. The second limitation is the subjectivity characterizing qualitative research, mainly due to the applied techniques of data collection and analysis.*

Keywords: *cluster; cluster initiative; cluster organization; communication; ICT; face-to-face contacts, cooperation*

Introduction

Cluster organizations, also referred to as bottom-up clusters or cluster initiatives (Sölvell et al., 2003, p.9; Lindqvist et al., 2013, p.1), are in the focus of attention in the following publication. They are formally established organizations which function at a higher level of aggregation, composed of institutional members that have joined them purposefully and act actively in order to achieve some collective objectives (related to the development of a specific cluster) or individual objectives (aimed at developing their mother organizations) (Lis, 2018, p.86). Most publications in scientific literature refer to clusters viewed in geographical or economic categories, yet only a few of them address clusters as organizations.

Meanwhile, the treatment of COs as organizations which function at a higher level of aggregation is extremely valuable when viewed from the perspective of the management sciences, because it forces collective entities to assume an intentional and engaged approach towards the functioning in the structure

of a higher rank. At the same time, it also imposes the necessity to provide management to such a complex organization. The coordination of a CO refers to actions undertaken by both individuals (people who are employed in organizations which are the members of a CO and who are engaged in the activities undertaken by such an organization) and collective entities (institutional members). Therefore, the level of advancement of a cluster cooperation is, on the one hand, largely determined by the level of development of the relationships of cluster partners (unit level); on the other hand, based on the use of Information and Communication Technologies (in short: ICT), which facilitates contacts not only at the individual but also at the institutional level. ICT refers to technologies that provide access to information through telecommunications (with particular emphasis on communication technologies, such as the Internet, cell phones, and other communication mediums).

Taking the above into account, the purpose of the paper is to explore how clusters take advantage of Information and Communication Technologies in achieving more advanced levels of development. The research goes beyond the state-of-the-art knowledge in the clustering literature by exposing a wider view of cluster cooperation, particularly in connection with the role of ICT in the development of cooperation networks based on geographical proximity.

The discourse is organized in the following manner. First, it contains a literature review on the cluster concept. Second, the paper includes details with regard to the methodology. Third, it reports the empirical results. Finally, discussion and conclusions are provided.

Theoretical foundations of the cluster concept

The concept of a cluster (Porter, 1998; 2000) derives from Porter's earlier publications on international competitiveness, in which he repeatedly emphasizes the importance of geographical proximity to achieve competitive advantage (Porter, 1985; 1990). The definition of a cluster by Porter includes its most important attributes, namely geographical concentration, sectoral concentration and interactions among enterprises, being a derivative of the two previously mentioned attributes. A small distance favors the establishment and development of contacts, whereas sectoral concentration enables to create various systems of connections based on the similarity or diversity of enterprises operating in a cluster. The heterogeneity of cluster partners is advantageous for the development of vertical links along the value chain, while their homogeneity is the basis for the development of horizontal connections based on cooperation. Numerous and repetitive interactions among enterprises can turn into long-lasting and trust-based relationships. A cluster is also specific owing to its strong specialization, division of work and key competencies as well as an exchange of complementary resources (Lis & Lis, 2014).

The relations between the location and the competitive advantage were studied by the representatives of classical economics (Smith, 1954) and neoclassical economics (Marshall, 1890). The discussion on industrial clusters is also continued within other theories, including the agglomeration theory (Scitovsky, 1954; Perroux, 1950; Krugman, 1991), which explains the reasons for the formation of industrial clusters, the theory of transaction costs (Williamson, 1985) (which emphasizes the possibility of reducing transaction costs due to the cooperation of cluster partners), the theory of flexible specialization (Piore & Sabel, 1984; Sabel, 1989), and the network approach, which exposes the relationships among companies remaining in different dependencies (Cooke & Morgan, 1993; Johanson & Mattson, 1993). All these theories address the significance of trust as an important determinant of cooperation, bringing benefits to all the cooperating entities, as well as geographical proximity, facilitating the development of relationships.

The assumptions of cluster cooperation are also consistent with the resource approach. Companies operating in clusters and cooperating with one another in order to exchange resources reflect the Resource Based-View (Wernerfelt, 1984; Mahoney & Pandian, 1992; Barney, 1991), which grows out of the company growth theory (Penrose, 1959) and the resource dependency theory (Pfeffer & Salancik, 1978). According to the resource approach, a company is perceived as a bundle of specific resources, abilities, and competencies that distinguish them from the competitors. The resource approach also emphasizes the resource imperfection of a company that is unable to create or acquire all the necessary resources. Dependence on resources is a factor that drives entities to enter into more or less stable exchange relations with other organizations (Pfeffer & Salancik, 1978). As best shown by the concept of clusters (in the form of cluster organizations), obtaining wider access to missing resources encourages companies to create alliances in a form of inter-organizational ties with a non-hierarchical and non-market character (Czakon,

2011). Enterprises in clusters have access to various types of resources, including, first of all, information and knowledge, circulating “in closure” (Coleman, 1988). In clusters, the observed effect of tacit knowledge spillover (Audretsch & Feldman, 1996; Feldman, 1994; Beaudry, Breschi, & Swann, 2000; Lawson & Lorenz, 1999) is based on personal, face-to-face interactions, which are facilitated by geographical proximity.

Cooperation in clusters also illustrates the concept of the value chain developed and popularized by Porter (Porter, 1985). According to this concept, a company is a set of activities carried out in order to design, produce and market a final product, enabling to create value for customers. Actions that prevent a company from gaining a competitive advantage should be scrutinized in terms of their outsourcing to other market players that are able to provide the desired advantage. The effect of this approach is to extend the value chain beyond the boundaries of an individual enterprise. As a result, the value chain becomes a supply chain (Handfield & Nichols, 2002) and even – in a broader sense – a supply network (Christopher, 2005). Cluster cooperation creates opportunities for integration of activities into one common value chain, where competitive advantage is achieved collectively by all the interconnected entities. Due to the special type of cluster relationships (based on co-competition), the value chain in clusters can be extended to a value network, including – apart from suppliers and recipients – competitors and entities providing complementary goods (Nalebuff & Brandenburger, 1996).

Methodology and sample

The paper reports the results of an explorative, qualitative study aimed at analyzing the role of Information and Communication Technologies in the development of cluster organizations. This is a part of a larger study aimed at identifying the levels of advancement of the cooperation among enterprises in selected COs in Poland (Lis, 2018). The question stated in the current research is as follows: “How do cluster organizations take advantage of Information and Communication Technologies in fulfilling their main roles?”.

The research was carried out in the first half of 2016 in the selected cluster organizations in Poland. In the selection of COs, the extreme cases logic was used to ensure maximum variability and diversity within the research field. Taking the economic sector as the main differentiating criterion, four cluster organizations were selected for the study – two COs from the metal industry and two COs representing the ICT industry. From the point of view of the main aim of the paper, such a research sample provides additional benefits because it serves to compare ICT cluster organizations, in which ICT is very popular, with COs from the metal industry, in which these technologies are not so commonly used. The basic techniques of data collection were interviews conducted with coordinators and selected cluster members (35 in-depth interviews, 1 group interview). The data analysis and interpretation were based on content analysis and coding. The study ensures methodological and data triangulation since in addition to the interviews, the authors provide an analysis of the current data, including the COs’ documents, as well as any means of using ICT by the COs, such as websites, social network accounts, knowledge repositories, Internet forums, etc.

Fulfilling the roles by cluster organizations with the use of ICT – research results

On the basis of research conducted in selected cluster organizations, it has been established that cooperation in COs can take different forms, which separated into sets, can form a hierarchical system consisting of four levels of cooperation: level I “Integration at the unit level”, level II “Allocation and integration at the process level”, level III “Impact on the environment” and level IV “Creation and integration at the organizational level” (Lis, 2018; 2019). As the research survey indicates, despite the differences among the four stages of development of cooperative relationships, cluster organizations may assume three fundamental roles at each stage: a direct resource supplier, a broker and an integrator. Cluster organization in the role of a direct resource supplier provides the members with access to a certain set of resources in the CO, while CO as a broker facilitates resource exchanges. The third of the distinguished roles of cluster organizations - an integrator – refers to different dimensions of integration between cluster entities, based on jointly undertaken activities. Integration within cluster organizations can be considered as a complex process, which includes social integration (at the unitary level), and then integration at the level of processes and organizations, and even integration of the entire industry.

The results of the research show that cluster organizations, fulfilling the roles assigned to them, slightly differ in the combination of factors related to the development of personal relationships of cluster entities and the use of Information and Communication Technologies. Personal contacts established and developed during various meetings within the cluster organization prove to be significant at every level of cluster cooperation. Nevertheless, ICT can help to fulfill each of the three distinguished roles of COs, supporting interactions between cluster entities and the development of cluster cooperation. The table below (Table 1) presents the most important forms of meetings (conducive to the development of face-to-face contacts) and ICT solutions characteristic of each of the three distinguished roles of cluster organizations, identified on the basis of the conducted research.

Table 1. Face-to-face contacts (F2F) and Information and Communication Technologies (ICT) in cluster organizations

Role	F2F		ICT
	Common activities	Specific activities	
Direct resource supplier	<ul style="list-style-type: none"> • Meetings within CO • Events • Training, workshops • Meetings with people representing key external actors 	<ul style="list-style-type: none"> • Specialist advice 	<ul style="list-style-type: none"> • Platform for communication (CO's website, Intranet, mailing, newsletter) • Platform for collecting and selecting information (knowledge repositories, databases)
Broker		<ul style="list-style-type: none"> • Internships • Meetings within task groups • Meetings within project groups • Meetings within various forms of cooperation 	<ul style="list-style-type: none"> • Platform for communication (forum, discussion groups, teleconferencing system) • Profiles on social networks (Facebook, Twitter, LinkedIn, etc.) • Platform for collecting and selecting information (databases, competence maps) • Platform for resource exchange (job exchanges, raw material platform, virtual stock exchanges) • Platform for cooperation management (groupware software)
Integrator		<ul style="list-style-type: none"> • Support from the communication platform • Platform for placing group orders • Joint online sale • Visual identification system • Educational portal • Platform for collaboration management (Enterprise Resource Planning, Customer Relationship Management, Supply Chain Management) 	

Cluster organization as a Direct resource supplier

A cluster organization appearing in its first form – the Direct resource supplier – puts a great emphasis on the sphere of personal contacts: both within the cluster and with external entities. Most of the interaction based on various meetings and events organized within the cluster organization. In this way, the coordinator is able to provide some resources (information and knowledge, material and financial resources, etc.) to individual cluster members. The applied ICT tools are an important complement to the effects of face-to-face meetings – at least with regard to the roles concerning the distribution of information. Coordinators of the surveyed cluster organizations use a communication platform and a platform for collecting and selection information to transfer of information both within the cluster and with entities from outside the cluster. In the role in which one-way transmission of knowledge occurs, ICT tools prove to be of little use, because, despite their technological advancement, they are not effective enough at generating an atmosphere and conditions conducive to the diffusion of tacit knowledge.

Cluster organization as a Broker

According to the obtained research results, a CO that takes the role of a Broker focuses its objectives on creating conditions for the functioning of its component entities in which it will be possible to provide bidirectional flow of information (allowing a CO, for example, to establish a relation of exchange). Bidirectional information flow is ensured primarily through meetings, both those characteristic of the role of the Direct resource supplier (meetings, events, training, etc.), as well as those undertaken within more advanced forms of cluster cooperation (such as internships, meetings within task and project groups, etc.). What appears essential to ensure this bidirectionality is appropriately selected ICT tools. At lower levels of cluster cooperation, the surveyed cluster organizations acting in the role of the Broker use similar ICT solutions as in the role of a Direct resource supplier, with the fact that these solutions have additional functionalities that allow a direct exchange of information between cluster members. The COs use a communication platform (with functions enabling direct information exchange, such as forums, discussion groups, profiles on social networks) and a platform for information collection and selection (facilitating the identification of resources owned by cluster partners – databases, competence maps, etc.). At the highest level of cooperation, ICT solutions play a less important role (although they facilitate cooperation). These include all solutions that allow the exchange of resources of cluster companies, such as a platform for resource exchange or a platform for cooperation management. To use these tools effectively, it is vital to initiate the process by establishing a group of CO members joined by both strong relationships and a common goal (the joint creation of new resources).

Cluster organization as an Integrator

As the research study shows, a cluster organization acting as an Integrator is based primarily on meetings (organized within or outside the CO), and uses ICT tools for communication purposes primarily among socially integrated member entities, thus with regard to the integration inside the CO or the integration of the cluster members with the closer and further environment. Many more ICT solutions appear in connection with both process and organizational integration, which indicates the presence of dedicated software for basically every aspect of the organization's operation and cooperation. It is worth to mention here, for example, a platform for placing group orders, joint online sale, educational portal or a platform for collaboration management. Their application, however, is directly dependent on the prior establishment of face-to-face contacts and the development of stronger relationships characterized by a relatively high level of mutual trust. In the case of process integration and organization integration, ICT solutions implemented by a CO are not likely to be helpful in the development of such relationships – they are only convenient tools for implementing decisions made via direct relations among people representing the cluster constituent entities.

Discussion

The results of the research show that the specificity of each of the three roles assigned to cluster organizations gives different significance to both personal contacts as well as ICT tools. Due to its specific nature, a cluster organization in the form of a Direct resource supplier and a Broker correlates with the resource theory – the two mentioned forms of a CO are focused either on ensuring access to a certain pool of new resources (primarily information) or on creating a platform of information exchange co-managed by constituent entities of the cluster organization. Communication proximity created and maintained with ICT tools in these two forms has a complementary role in relation to the personal contacts established and developed by virtue of geographical proximity.

A cluster organization in the form of an Integrator comprises the concept of a value chain (and in some cases the value network concept) – this particularly applies to process and organizational integration. As far as process integration is concerned, ICT tools play a predominant role (when compared to their use by the CO in other distinguished roles) – in principle, they can replace the F2F contacts established within geographical proximity. However, in the case of organizational integration, ICT solutions play an important, yet only a complementary role, facilitating the implementation of organizational integration in a specific form. For social integration, ICT tools are expected to be relatively insignificant since the face-to-face contacts facilitated by the geographical proximity of the cluster partners remain irreplaceable. The

same issue concerns the integration of the industry – although ICT solutions can be beneficial to fulfill this role, meetings and personal contacts of the cluster members definitely prevail.

Conclusions

The study findings have indicated a variety of roles fulfilled by cluster organizations via face-to-face contacts and the use of ICT. The results contribute to the state-of-the-art knowledge in the clustering literature since they have exposed a wider view of cluster cooperation by using the identified cluster roles at every stage of its development. They have also implemented the Resource-Based View, a value-chain concept and emphasized the significance of F2F contacts (established and developed within geographical proximity) as well as ICT in the processes of resource exchange and integration in different dimensions among cluster partners. Additionally, the research augments prior research as it solely addressed cluster organizations, which – contrary to the concept of a cluster – has been scarcely explored so far.

The conclusions from the conducted research indicate the invariably crucial importance of geographical proximity as a factor strongly affecting the functioning of cluster organizations and their members. As the research shows, almost every role distinguished in the paper, geographical proximity and face-to-face contacts are a prerequisite for the constitution and development of cluster cooperation at a given level. Only in one identified role – an Integrator (but with reference only to process integration and – to a lesser extent – organizational integration) the importance of ICT tools was at least as huge as F2F contacts. Therefore, even though information technologies play a significant role in the functioning of cluster organizations, they cannot replace face-to-face contacts. They can only be their important complement at every level of CO development.

The empirical findings can also suggest some practical implications for cluster coordinators and members – they can be treated as a practical tip in the process of development of COs. Cooperation in cluster organizations should always start with building personal contacts among members and only when relationships based on mutual trust are sufficiently developed, it is worth introducing ICT as a factor facilitating the achievement of the set goals (individual or common).

Due to the research limitations resulting from the specific nature of qualitative research (a relatively small research sample and the subjectivity of qualitative research, which does not allow the authors to generalize the conclusions), future research should also include quantitative research to confirm the observed dependencies. It is also advisable that the future research sample should include cluster organizations representing various industries as it will provide a wider universality of the discovered phenomena.

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