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To meet or to connect? Face-to-face contacts vs ICT in cluster organisations

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ABSTRACT

The main purpose of the paper is to explore how cluster organisations (COs) take advantage of direct (F2F) and indirect (ICT) contacts in fulfilling their main roles. The paper addresses the research question: "How important are Information and Communication Technologies at each level of advancement of cluster cooperation?" The research was conducted in 2016 in four purposefully selected cluster organisations representing metal and ICT industry. The basic method of data collection was an in-depth individual interview. The authors applied the qualitative content analysis as the procedure to analyse the interviews. The research sample comprised of 30 cluster members. The research was based on an original theoretical concept referring to the trajectory of the development of cooperative relationships in cluster organisations. Four levels of development of cluster cooperation as well as three main roles of cluster organisation were distinguished. At each level, COs play one of three identified roles: a direct resource supplier (providing access to resources), a broker (facilitating resource exchanges) and an integrator (integrating into different dimensions), which gives a total of 12 specific roles. The research has shown that both direct and indirect contacts were significant both in fulfilling the roles assigned to the cluster organisations as well as in developing the cluster cooperation. It has been also observed that ICT importance was slightly different at each level of a CO's development. Only in one identified role (at level II: Process integrator) the importance of ICT tools was at least as great as F2F contacts. 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 cluster organisations. It was noticed that even though ICT plays a significant role in the functioning of COs, 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 author to generalise the findings. The first limitation is the small research sample. The second limitation is the subjectivity characterising qualitative research, mainly due to the applied techniques of data collection and analysis.

KEY WORDS

cluster, cluster initiative, cluster organisation, ICT, face-to-face contacts, cooperation

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Introduction

Cluster organisations, 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 organisations 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 organisations) (Lis, 2018, p. 86; Cheba, 2015; Haviernikova et al., 2016; Štverková and Mynarzová, 2017). Clusters are examples of industrial organisations with strong social ties, involving also networks of local enterprises and local institutions

(Elexa et al., 2019). Most publications in scientific literature refer to clusters viewed in geographical or economic categories, yet only a few of them address clusters as organisations.

Meanwhile, the treatment of COs as organisations 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 organisation. The coordination of a CO refers to actions undertaken by both individuals (people who are employed in organisations which are the members of a CO and who are engaged in the activities undertaken by such an organisation) 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 this paper is to explore how cluster organisations (COs) take advantage of direct (F2F) and indirect (ICT) contacts in fulfilling their main roles. 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 organised in the following manner. First, it contains a literature review on the cluster concept and the role of direct (F2F) and indirect (ICT) contacts in the development of cluster cooperation. Second, the paper includes details with regard to the methodology. Third, it reports the empirical results. Finally, discussion and conclusion are provided.

1. Literature review

The concept of a cluster (Porter, 1998, 2000) derives from Porter's earlier publications on international competitiveness, in which he repeatedly emphasises 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 favours 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 coopetition. Numerous and repetitive interactions among enterprises can turn into long-lasting and trust-based relationships. A cluster is also specific owing to its strong specialisation, division of work and key competencies as well as an exchange of complementary resources (Lis and 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 emphasises the possibility of reducing transaction costs due to the cooperation of cluster partners), the theory of flexible specialisation (Piore and Sabel, 1984; Sabel, 1989), and the network approach, which exposes the relationships among companies remaining in different dependencies (Cooke and Morgan, 1993; Johanson and 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 to exchange resources reflect the Resource-Based View (Wernerfelt, 1984; Mahoney and Pandian, 1992; Barney, 1991), which grows out of the company growth theory (Penrose, 1959) and the resource dependency theory (Pfeffer and Salancik, 1978). According to the resource approach, a company is perceived as a bundle of specific resources, abilities and competences that distinguish them from the competitors. The resource approach also emphasises the resource imperfection of a company that is unable

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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 organisations (Pfeffer and Salancik, 1978). As best shown by the concept of clusters (in the form of cluster organisations), obtaining wider access to missing resources encourages companies to create alliances in a form of inter-organisational 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 and Feldman, 1996; Feldman, 1994; Beaudry, 2001; Beaudry et al., 2000; Lawson and 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 popularised by Porter (Porter, 1985). According to this concept, a company is a set of activities carried out 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 scrutinised 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 and 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 coopetition), 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 and Brandenburger, 1996).

2. Role of direct (F2F) and indirect (ICT) contacts in the development of cluster cooperation

The popularity of cluster concept and the widespread use of information and communication technologies in the economy would indicate that approaches combining these both phenomena should appear in the literature quite often. Surprisingly, it is the exact opposite. Searching for scientific publications that include both terms "industrial cluster" and "ICT" resulted in 47 records in the Scopus database and five records in the Web of Science database. What is more, considering the pace of the development of the ICT sector and the dynamics of the modern economy, it must be stated that the vast majority of publications indexed in the previously mentioned databases are outdated (the works published earlier than 2010 dominate). The fact that this is not a new situation is evidenced by the observations contained in the 2008 publication, whose authors expressed astonishment at the small number of scientific papers on the role of information and communication technologies in achieving success by clusters, particularly in the period when a lot of research was conducted on the concept of the cluster (Steinfield and Scupola, 2008). Both of these observations — the very small number of publications related to the use of ICT in cluster enterprises and the low relevance of literature in this regard — lead to the conclusion that there is a large theoretical gap in the problem area undertaken in this paper.

The information and communication technologies present in enterprises have a strong impact not only on the functioning of the company (e.g. improving communication within the value chain) but also, which is perhaps even more important, on creating and applying completely new economic opportunities (Carbonara, 2005), e.g. expansion into new markets. Such possibilities increase owing to the Internet communication characteristics like the speed of transmission, relative easiness of creating and receiving messages by electronic devices, the potential behind processing and analysis of large data sets, etc. The specific nature of ICT also affects cluster companies and clusters as a whole, providing the potential for transforming into one or more effects:

- strengthening the relations of cluster companies with external companies, positively affecting the integration of entities within global supply chains;
- creating an opportunity to establish both lasting and ephemeral contacts with entities outside the cluster;
- broadening the business perspectives of cluster companies;
- managing relations with end markets — offering new services and creating new paths of value creation;

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- supporting innovations developed by cluster companies in cooperation with external entities and receiving and adapting innovations from external sources (Carbonara, 2005).

Information and Communication Technologies is, however, a very broad category containing many different products and services. Therefore, the literature highlights the need to make an internal ICT division (Ciarli and Rabellotti, 2007) — at least a division into IT (mainly affecting activities in the sphere of production, administration and logistics) and CT (setting standards for communication within the enterprise and communication with its environment). Each of the division tips indicated above has its specific features and has a different impact on the operation of enterprises.

The needs and adaptability of IT and CT are also to some extent related to the sector, in which the analysed enterprises operate. In sectors offering standard goods, the possibility of using CT is greater because it supports the rapid exchange of codified knowledge and reduces the transaction costs of internal and external communication (Ciarli and Rabellotti, 2007).

In sectors that require better knowledge of a given product/service (Leamer and Storper, 2001), tailoring it to individual customer expectations or the universality of tacit knowledge in the process of producing the offered product/service, face-to-face relationships play a more important role (Leamer and Storper, 2014). Such a situation took place, e.g. in the Italian region of Biella, known for the production of woollen yarns and fabrics, in which local enterprises were more willing to adapt information technologies than communication due to the importance of transferring tacit knowledge in relations between the suppliers and buyers (this region operated with regard to the principle of an industrial district) (Ciarli and Rabellotti, 2007). A similar situation occurred in the case of biotechnology enterprises located in the Medicon Valley — due to the fact that biotechnology products are far from what is commonly understood as standardised products, no information and communication technology here could replace the personal contacts and careful (personal) product selection (Steinfield et al., 2010).

It is worth mentioning that the scientific literature lacks empirical evidence that the hypothesis concerning the substitution of personal contacts for information and communication technologies can be justified. At the current stage of science development, the contemporary level of ICT and the specific nature of interpersonal contacts, we can only talk about the complementarity of these two worlds — human and digital — and their positive impact on the success of cluster enterprises, especially in knowledge-based sectors (Steinfield et al., 2010). ICT cannot entirely replace personal contacts even in the case of a cluster located in rural areas and cluster enterprises scattered over a fairly extensive area. In this case, information and communication technologies compensate for the lack of permanent geographical proximity, but they do not have the potential to make geographical proximity superfluous. Knowledge transfer or a shared pool of workforce qualified to perform activities specific for a cluster located in rural areas are only some of the factors determining the need to conduct business in geographical proximity (Steinfield et al., 2012).

Personal contacts remain irreplaceable in terms of initiating and creating task groups within the cluster. They also constitute a tool to monitor the quality of activities in these groups and to strengthen the motivation of their members. Face-to-face relations facilitate the coordination of activities in groups and are a panacea for uncertainty resulting from constantly changing business conditions. However, to take full advantage of the benefits of cooperation based on personal contacts, permanent cooperation of motivated individuals (not just their occasional contact) with high intellectual capital is necessary. Although ICT allows to decrease the difficulties resulting from the dispersion of production within the value chain (especially in relation to distributed configuration), it is necessary to cooperate in a common location (Storper and Venables, 2004) to deal with uncertainty that may evoke while performing activities in different places, or processes of creating and implementing new solutions. Therefore, with regard to the arguments presented above, it is essential to recognise the specific nature of cooperation among cluster enterprises and the role of information and communication technologies in this area.

3. Research methods

The paper reports the results of an explorative, qualitative study aimed at analysing the role of Information and Communication Technologies in the development of cluster organisations. 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

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stated in the current research is as follows: "How important are Information and Communication Technologies at each level of advancement of cluster cooperation?"

The research was carried out in the first half of 2016 in the selected cluster organisations in Poland. In the selection of Cos, the extreme cases logic was used to ensure the maximum variability and diversity within the research field. Taking the economic sector as the main differentiating criterion, four cluster organisations were selected for the study – two COs from the metal industry and two COs representing the ICT industry (Tab. 1). 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 organisations, in which Information and Communication Technologies are very popular, with COs from the metal industry, in which these technologies are not so commonly used.

The research sample comprised 30 cluster entities (from each of the four selected cluster organisations), including cluster coordinators, enterprises, R&D institutions, educational institutions and support institutions. The way of selecting respondents was based on the snowball sampling procedure (Goodman, 1961). The interviews were the basic technique of data collection. The cluster entities were represented in the study by one person and several cases by two people — in total 35 individual in-depth interviews were conducted. In addition, one group interview was conducted (in Metal Working Eastern Cluster) to verify the obtained results. The group of interviewees was composed of the company owners or top managers as well as individuals chosen to represent the organisation in the cluster organisation involved in cluster activities.

The interview questions were divided into the following sections: forms of cooperation in COs, the involvement of the coordinator and members in COs, creating opportunities and achieving benefits in COs, and flows of knowledge and information in CO. The selection of the above thematic blocks resulted from the objectives set out within a larger study. Nevertheless, each of these blocks may form the basis for more detailed analysis in the areas related to the main research problem of a larger study. As a part of the current research, the following topics were discussed (Tab. 2).

Tab. 1. Sample characteristics

Cluster initiative name	Voivodship	Creation date	Number of cluster members	Number of institutional entities in the research sample	Number of interviews
Metal Cluster of Lubuskie Province	Lubusz	2008	35	9	11
Metal Working Eastern Cluster	Lublin	2009	78	6	7
Mazovia Cluster ICT	Masovian	2007	200	6	6
Interizon: Pomeranian Region ICT Cluster	Pomeranian	2009	130	9	11

Source: elaborated by the authors based on (Lis, 2018).

Tab. 2. Main thematic blocks in the study

Thematic blocks	Thematic scope
Forms of cooperation in COs	– Forms and level of advancement of cooperation in CO, – The role of face-to-face contacts and direct communication in initiating and developing cooperation in CO, development of relationships and building trust in CO, – The role of ICT and distance communication in initiating and developing cooperation in CO
Involvement of the coordinator and members in COs	– Involvement of cluster coordinator in cluster activity (common activities), – Involvement of cluster members in cluster activity (common activities), – Roles of CO in particular areas, – The role of face-to-face contacts and direct communication in fulfilling the roles of CO, – The role of ICT and distance communication in fulfilling the roles of CO
Creating opportunities and achieving benefits in COs	– Opportunities created in CO (with particular emphasis on face-to-face contacts and ICT), – Benefits achieved as a result of participation in CO (with particular emphasis on face-to-face contacts and ICT)
Flows of knowledge and information in CO	– Knowledge and information flows in CO: internal transfer, acquisition and transfer outside, creation (based on cooperation), codification, – The role of face-to-face contacts and direct communication in knowledge and information flows in CO, – The role of ICT and distance communication in knowledge and information flows in CO

Source: elaborated by the authors based on (Lis, 2018).

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The data analysis and interpretation were based on content analysis and coding. The study ensures methodological and data triangulations since in addition to the interviews, the author provides an analysis of the current data, including the COs' documents, as well as any means of using Information and Communication Technologies by the COs, such as websites, social network accounts, knowledge repositories, Internet forums, etc.

The authors applied the qualitative content analysis (Hsieh and Shannon, 2005; Glaser and Strauss, 1999) as the main procedure to analyse the interviews. The analysis included open, axial and selective coding. At the open coding stage, some common themes emerging from the interviews in each cluster organisation were identified (for instance, these were 'integration', 'broker', 'information system', 'mentor'). In the axial coding, the identified themes were classified with respect to the six distinguished categories and their peculiarities (Tab. 3). In the selective coding, the categories and their peculiarities were horizontally grouped to feature the general and specific roles, systems, F2F contacts and Information and Communication Technologies in each level of cooperation. The results of selective coding are presented in Tables 5–7 and discussed in the next section.

4. Results

Based on the research conducted in selected cluster organisations, 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 organisational level" (Lis, 2018, 2019). As the research survey indicates, despite the differences among the four stages of development of cooperative relationships, cluster organisations may assume three fundamental roles at each stage: of a direct resource supplier, a broker and an integrator.

Cluster organisations play analogical roles at the subsequent levels of cooperation, but each of such roles is affected by the specific nature of a particular level. The specification mentioned above allowed the author to distinguish 12 specific roles — three roles at each of the four cooperation levels (Tab. 4).

The research shows that each of the 12 identified roles of cluster organisations was supported by specific ICT tools, although personal contacts always played a significant role in each of them. Tables 5–7, apart from describing each of the roles of a CO, indicate a particular system necessary to fulfil a given role as well as present the observed forms of face-to-face contacts and the applied Information and Communication Technologies.

4.1. Cluster as a direct resource supplier

A cluster organisation, with regard to its first, fundamental function (Direct resource supplier), can take four detailed roles, namely Informer, Donor, Information Tube and Mentor (Tab. 5). The specific nature of this phenomenon has a significant impact not only on the scope and form of direct interactions among cluster members but also on the use of ICT tools.

The research shows that the characteristic feature of a CO in terms of its role of an Informer is the creation of a one-way information flow system (from a cluster coordinator to the cluster members), which is reflected in a set of ICT solutions used primarily to create an efficient communication platform (Intranet, the CO's website, emailing, newsletters). As far as face-to-face contacts are concerned, formal meetings of the cluster members (initiated mainly by a CO), as well as individual meetings of the members with the coordinator, are the ones that prevail. A cluster organisation that acts as an Informer is the engine of activating its members by providing them with various, yet relatively general, information.

As the research shows, a cluster organisation in the role of a Donor still tries to stimulate its members to cooperate, but changes and extends the scope of its activities, applying additional types of resources (at this level, a CO offers material, capital and human resources). Such a CO still provides information; however, it is more carefully selected to meet the members' needs and expectations. The ICT tools used in this type of CO are also different: apart from the basic solutions that are successful in communication among cluster members, facilities such as knowledge repositories, databases, specialised software to support different phases of the production process or an e-learning platform appear. In terms of F2F contacts, meetings of the members and participation in trainings and workshops dominate.

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Tab. 3. The axial coding

No.	Category	Peculiarities
1	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", • Level IV "Creation and integration at the organisational level"
2	General roles	• Direct resource supplier, • Broker, • Integrator
3	Specific roles	• I.1. Informer, • I.2. Information exchange platform, • I.3. Social integrator, • II.1. Donor, • II.2. Resource exchange platform, • II.3. Process integrator, • III.1. Information tube, • III.2. Connector with the environment, • III.3. Lobbyist-visionary, • IV.1. Mentor, • IV.2. Common resource creation platform, • IV.3. Organisation integrator
4	Systems	• One-way information flow system (inside CO, from outside CO), • Two-way information flow system (inside CO, from outside CO), • Information selection system, • One-way knowledge flow system (inside CO), • Two-way knowledge flow system (inside CO), • One-way resource flow system (inside CO), • Two-way resource flow system (inside CO), • Social integration system, • Process integration system, • Cooperation management system, • Institutional integration system, • Environment monitoring system, • System of impact on the environment
5	Common activities based on F2F contacts	• Meetings within CO, • Meetings with people representing key external actors, • Events, • Trainings, workshops, • Internships, • Specialist advice, • Meetings within task groups, • Meetings within project groups, • Meetings within different forms of cooperation
6	ICT	• Platform for communication, • Profile on social networks, • Platform for collecting and selecting information, • Platform for resource exchange, • Educational portal, • Platform for placing group orders, • Joint online sale, • Visual identification system, • Specialised software, • Platform for cooperation management

Source: elaborated by the authors based on (Lis, 2018).

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Tab. 4. General and specific roles of cluster organisations

Cat. 1. Levels of cooperation	Cat. 2. General roles	Cat. 3. Specific roles
Level I "Integration at the unit level"	Direct resource supplier	I.1. Informer
	Broker	I.2. Information exchange platform
	Integrator	I.3. Social integrator
Level II "Allocation and integration at the process level"	Direct resource supplier	II.1. Donor
	Broker	II.2. Resource exchange platform
	Integrator	II.3. Process integrator
Level III "Impact on the environment"	Direct resource supplier	III.1. Information tube
	Broker	III.2. Connector with the environment
	Integrator	III.3. Lobbyist-visionary
Level IV "Creation and integration at the organisational level"	Direct resource supplier	IV.1. Mentor
	Broker	IV.2. Common resource creation platform
	Integrator	IV.3. Organisation integrator

Source: (Lis, 2018, p. 226).

Tab. 5. Cluster organisation as a direct resource supplier – F2F vs ICT

Cat. 1. Levels of cooperation	Cat. 2. General roles	Cat. 3. Specific roles	Cat. 4. Systems	Cat. 5. F2F contacts (common activities)	Cat. 6. ICT
Level I "Integration at the unit level"	Direct resource supplier	I.1. Informer	One-way information flow system (inside CO)	Meetings within CO Events	Platform for communication Profiles on social networks
Level II "Allocation and integration at the process level"		II.1. Donor	Information selection system One-way resource flow system (inside CO)	Trainings, workshops	Platform for collecting and selecting information
Level III "Impact on the environment"		III.1. Information tube	Information selection system One-way information flow system (from outside CO) Environment monitoring system	Meetings with people representing key external actors	Platform for communication
Level IV "Creation and integration at the organisational level"		IV.1. Mentor	One-way knowledge flow system (inside CO)	Specialist advice	-

A CO in the role of an Information tube is a one-way transmitter of selected information from outside the cluster. This role of a CO clearly corresponds to the role of an Informer (due to the use of a one-way information flow) yet with a difference: a CO as an Information tube focuses more on monitoring the closer and further surroundings and the transmission of the most important, selected information from outside the cluster to the cluster members. At the level of ICT, similar tools like in the case of the Informer role – the communication platform, such as the cluster's website, Intranet, emailing and newsletters – are used. However, at the level of personal contacts, meetings with the people from outside the cluster become the most important, which can significantly contribute to the development of either the entire cluster organisation or its specific sub-groups.

A CO in the role of a Mentor is a crucial exception among all the roles performed by a cluster organisation: the feature of being both a teacher and

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a guide for other entities excludes – as it turned out — the intermediation of ICT tools in this area. The emphasis is put on face-to-face contacts, in which the process of one-way knowledge transfer is the most effective. It is related to the peculiar nature of mentoring, which, apart from transmitting official (codified) knowledge, concerns diffusion of tacit knowledge, which is difficult to transfer via ICT tools.

4.2. Cluster as a broker

A cluster organisation in its second form — the broker — plays four detailed roles: as an Information exchange platform, a Resource exchange platform, a Link with the environment and a Common resource creation platform (Tab. 6). The most important factor that distinguishes the previously described form — the direct resource supplier — from the broker is bidirectional communication: information and other resources flow not only from the coordinator to the members but also among some or all the cluster entities.

As the research results show, a CO as the Information Exchange Platform focuses on creating solutions that facilitate the two-way flow of information among cluster members and between cluster members and the coordinator. For this purpose, ICT tools are used, making up a CO's internal communication platform (discussion groups, forums, video and virtual conferencing) as well as creating and maintaining its identity (profiles on Facebook, Instagram, LinkedIn). At the face-to-face level, an important role is played by meetings of various nature (formal, networking and integration), yet which are not focused on the unilateral transfer of information (as it is observed in the form of a direct resource supplier). They aim at creating conditions for better integration and establishing relationships based on mutual trust. This role is also continued by means of events (conferences, seminars, fairs, economic missions) in which the cluster members participate.

The role of the Resource Exchange Platform means creating (by a CO) certain crucial conditions necessary for easy and effective exchange of resources of various types. Similarly to the previously described role (Information Exchange Platform), the Resource Exchange Platform also focuses on the bidirectionality of the transmitted resources. ICT tools used in this role must facilitate an exchange of information with the other cluster members (in relation to competences and resources as well as requirements and needs). Such circumstances improve the implementation of interactive communication platforms, platforms for collecting and selecting information (databases, competence maps) and the ones applied to exchange resources within a given CO (job exchanges, raw material platform, virtual stock exchanges, etc.). At the level of personal contacts, a CO as a broker creates conditions for the cooperation of the members within task groups, conducting trainings by the cluster members themselves, offering internships for the employees of the cluster entities, etc.

Tab. 6. Cluster organisation as a broker – F2F vs ICT

Cat. 1. Levels of cooperation	Cat. 2. General roles	Cat. 3. Specific roles	Cat. 4. Systems	Cat. 5. F2F contacts (common activities)	Cat. 6. ICT
Level I "Integration at the unit level"	Broker	I.2. Information exchange platform	Two-way information flow system (inside CO)	Meetings within CO Events	Platform for communication Profiles on social networks
Level II "Allocation and integration at the process level"		II.2. Resource exchange platform	Information selection system Two-way resource flow system (inside CO)	Meetings within task groups Trainings, workshops, Internships	Platform for communication Platform for collecting and selecting information Platform for resource exchange
Level III "Impact on the environment"		III.2. Link with the environment	Two-way information flow system (from outside CO)	Meetings with people representing key external actors	Platform for communication
Level IV "Creation and integration at the organisational level"		IV.2. Common resource creation platform	Two-way knowledge flow system (inside CO) Cooperation management system	Meetings within project groups Meetings within various forms of cooperation	Platform for cooperation management

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As shown by the research, a CO in the role of a Link with the environment concentrates its objectives on creating a two-way system of information flow between cluster members and the surrounding. Therefore, in addition to the fact that such a cluster organisation transmits information from outside to the inside of the CO, it also creates conditions for the flow of information in the other direction: from the CO and its members to their environment. The ICT tools that are considered useful are the ones that function as the Information tube: the CO's website, Intranet, mailing system and newsletter. In the field of F2F contacts, the cluster members establish relationships with selected people from the environment, but in contrast to similar contacts taking place as a part of the Information tube role, the cluster entities can be equal partners, not being only passive recipients of the information transferred by entities from outside the CO.

Being a Common resource creation platform means that a CO provides its members with conditions to establish and develop cooperation oriented towards creation of new resources (e.g. knowledge). The research shows that in this case the technologies that improve group work (e.g. working in the "cloud", groupware software) prove to be useful tools, however, their use is only applicable as a complement to the F2F interactions established within various forms of the cluster cooperation. These interactions usually take a form of project group meetings, in which the representatives of the R & D sector play an important role. It should be noted that the phase of personal contacts must be initial with regard to the use of ICT tools — personal meetings of project team members guarantee the highest level of concentration and efficiency in creating new ICT solutions and motivate the team members to establish relationships based on trust (they are also an excellent opportunity for a multilateral diffusion of implicit and tacit knowledge). ICT tools are therefore successful when a group of people connected by a common, specific goal consciously undertakes actions focused on its implementation.

4.3. Cluster as an integrator

A cluster organisation in its third, the most advanced form (Integrator) plays four detailed roles: as a Social integrator, a Process integrator, a Lobbyist-visionary and an Organisation integrator (Tab. 7). A characteristic feature of this form is the broadly understood integration of various spheres of a CO's activity and a shift of the relation balance among the cluster members from the association pole towards the community pole.

Tab. 7. Cluster organisation as an integrator – F2F vs ICT

Cat. 1. Levels of cooperation	Cat. 2. General roles	Cat. 3. Specific roles	Cat. 4. Systems	Cat. 5. F2F contacts (common activities)	Cat. 6. ICT
Level I "Integration at the unit level"	Integrator	I.3. Social integrator	Social integration system	Meetings within CO Events Training, workshops Internships	Support from the communication platform
Level II "Allocation and integration at the process level"		II.3. Process integrator	Process integration system	Meetings within task groups Meetings within different forms of cooperation	Support from the communication platform Specialised software Platform for placing group orders Joint online sale Visual identification system
Level III "Impact on the environment"		III.3. Lobbyist-visionary	System of impact on the environment	Meetings with people representing key external actors Meetings within different forms of cooperation	Support from the communication platform Educational portal
Level IV "Creation and integration at the organisational level"		IV.3. Organisation integrator	Institutional integration system	Meetings within project groups Meetings within different forms of cooperation	Platform for cooperation management

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As the research study shows, a CO acting in the role of a Social integrator primarily aims at achieving a state in which the cluster members will establish (to varying degrees — depending on the openness of individual entities) deeper, trust-based relationships. They are strengthened — at the level of personal contacts — by formal and informal meetings and the common participation of the cluster members in various events (such as fairs, exhibitions, conferences, seminars, economic missions, etc.). ICT tools play a supporting role here, maintaining and strengthening the effects of face-to-face contacts. This particularly applies to solutions facilitating a long-distance contact, e.g. e-mails or instant messengers (text and visual).

The Process integrator role means focusing a CO's objectives on the improvement of processes carried out by some or all the cluster members (such as the process of supply, distribution, promotion, quality standards, etc.). In this role, personal contacts developed most often by cooperation within task groups are less important (in comparison to the other roles), which, according to the research findings, can be replaced by certain ICT tools. In this role, a CO can take advantage of relatively many ICT facilities: a communication platform, a platform for joint orders, a joint online system and a common visual identification system.

Acting as a Lobbyist-visionary forces a CO to go beyond the cluster not only in the search for attractive external stimuli, boosting the activity of the cluster members (as it was the case with the roles of Information tube and — partially — the Link with the environment), but, above all, in order to have such an impact on the external environment, which will adapt to the expectations and needs of the CO members. A CO can use the cluster communication platform (website, mailing), but also — in relation to shaping the educational area — the functionality of already existing or established by the CO educational portals. For the role of a Lobbyist-visionary, however, the most important area of influence is defined by direct contacts: meetings with influential people from the CO's environment (having a high position in the hierarchy of power), emphasising own opinions and care for common interests of the cluster members in the form of lobbying activities (e.g. the introduction or removal of specific regulations in the created laws) or co-shaping the regional educational base (creating classes with profiles convergent with the needs of the cluster companies, creating a system of internships, etc.).

The essence of the last of the distinguished roles — the Organisation integrator — is to bring about the total or partial institutional integration of the entities that have remained as autonomous entities. Based on the research, among the ICT tools supporting the processes of institutional integration, we can distinguish the joint use of ERM (Enterprise Resource Planning), CRM (Customer Relationship Management), SCM (Supply Chain Management), accounting, etc. As far as personal contacts are concerned, they may be the result of cooperation among entities within project groups, cooperation at the strategic level (alliances, start-ups, spin-offs) or creation of a joint commercial market offer. However, it should be clearly emphasised that, similarly to the role of the Common resource creation platform, also in the case of Organisation integration the level of personal contacts is the key factor, whereas the sphere of ICT solutions is the subsequent one, ancillary to F2F relationships.

4.4. Cross-sectoral differences

The research results indicate that the surveyed cluster organisations showed some similarities due to industry membership. The cluster organisations representing the metal industry primarily developed level I "Integration at the unit level", assuming the three roles assigned there: I.1. Informer, I.2. Information exchange platform, I.3. Social integrator. They were also highly active at level III "Impact on the environment", playing three roles: III.1. Information tube, III.2. Connector with the environment, III.3. Lobbyist-visionary. Level IV "Creation and integration at the organisational level" was the least developed level in the surveyed metal clusters. The majority of the respondents from these organisations admitted that they had not reached this stage of cooperation. In turn, both cluster organisations representing the ICT industry, in addition to levels I–III, were able to develop the cooperation assigned to the level IV and meet the three goals defined there: IV.1. Mentor, IV.2. Common resource creation platform and IV.3. Organisation integrator.

The research also shows that the cluster organisations from the metal industry put more emphasis on F2F contacts than on ICT solutions. This was particularly evident in comparison with the surveyed ICT organisations, which in turn placed much greater importance on using ICT tools to fulfil the three roles at each distinguished level of development of cluster cooperation. The respondents representing the metal industry showed great interest in establishing contacts with unknown or poorly known members, cared for the development of the relationships with the cluster

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partners and tried to improve them. Thus, they were very engaged in activities facilitating the personal contacts within the cluster organisation. It was mainly manifested in their participation in the meetings and events organised as a part of the first three levels of the development of cluster cooperation, primarily in the form of forum meetings, trainings, workshops, internships and meetings with people representing the key external actors. Meetings within task groups were a less frequently practised form in this group of cluster organisations, which results from the weak activity of metal organisations in this area. The surveyed cluster organisations from the metal industry rarely used the ICT tools (primarily those reserved for the lowest levels of cluster cooperation, namely a platform for communication and a platform for collecting and selecting information).

As far as ICT cluster organisations are still concerned, the sphere of personal contacts was important. This was evident at all four levels of cluster cooperation development, although – in the case of levels I and III – with a slightly lower intensity than in the cluster organisations from the metal industry. Participation in task groups (assigned to level II), project groups and consortia (level IV), i.e. involvement in activities aimed at developing face-to-face contacts, reached a higher level in the cluster organisations from the ICT industry than in the metal organisations. Meetings organised as a part of these activities allowed the cluster partners to build trust-based relationships, which encouraged the exchange of confidential information and knowledge. As the research shows, ICT organisations take advantage of ICT tools in almost all their activities. At each level of the development of cluster cooperation, ICT organisations used ICT tools to fulfil defined roles (except for role IV.1. Mentor, for which the appropriate ICT solution was not identified). In addition to the tools reserved for the role of a direct resource donor, ICT organisations also used advanced platforms for cooperation management, i.e. tools assigned to the role of a broker and an integrator at the highest level of cluster cooperation (level IV: IV.2. Common resource creation platform and IV.3. Organisation integrator).

5. Discussion of the results

The results of the research show that cluster organisations, 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.

A cluster organisation 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. Nevertheless, 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 (Informer, Donor, Information tube). In the role in which one-way transmission of knowledge occurs (Mentor), 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.

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). What appears essential to ensure this bidirectionality in the case of the first three described roles (Information exchange platform, Resource exchange platforms and the Link with the environment) is appropriately selected ICT tools. At the highest level of cooperation (a CO in the role of the Common resource creation platform), ICT solutions play a less important role (although they facilitate cooperation). To use these tools effectively, it is vital to initiate the process with establishing a group of CO members joined by both strong relationships and a common goal (the joint creation of new resources).

Due to its specific nature, a cluster organisation 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 organisation. 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 organisation acting as an Integrator uses ICT tools for communication purposes primarily among socially integrated member entities, thus with regard to the role of a Social integrator (integration inside the CO) or a Lobbyist-visionary (integration of the cluster members with the closer and further envi-

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ronment). Many more ICT solutions appear in connection with the roles of a Process integrator and an Organisation integrator, which indicates the presence of dedicated software for basically every aspect of the organisation's operation and cooperation. Their application, however, is directly dependent on the prior establishment of face-to-face contacts and the development of stronger relationships characterised by a relatively high level of mutual trust. In the case of the Process integrator and the Organisation integrator roles, 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.

A cluster organisation 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 the roles of a Process integrator and an Organisation Integrator. As far as the Process integrator 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 the Organisation integrator, ICT solutions play an important, yet only a complementary role, facilitating the implementation of institutional integration in a specific form. For the Social integrator, 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 role of a Lobbyist-visionary — although ICT solutions can be beneficial to fulfil 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 organisations via face-to-face contacts and the use of Information and Communication Technologies. The results contribute to the state-of-the-art knowledge in the clustering literature since they have exposed a wider view on 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 emphasised 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 organisations, 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 organisations and their members. As the research shows, almost for every role distinguished in the paper, geographical proximity and direct contacts are a prerequisite for the constitution and development of cluster cooperation at a given level. Therefore, even though indirect contacts established and developed based on Information and Communication Technologies play a significant role in the functioning of cluster organisations, they cannot replace face-to-face contacts. This particularly applies to the first level of development of cluster cooperation, when the network of relationships among cluster members is being built (CO as the Social integrator). As the study results show, only in two identified roles (the Process integrator and — to a lesser extent — the Organisation integrator) the importance of ICT tools was at least as huge as F2F contacts. In the case of the other roles (Direct resource supplier and Broker), ICT were an important complement to the face-to-face contacts at every level of the 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 organisations should always start with building personal contacts among members and only when relationships based on mutual trust are sufficiently developed, it is worth introducing Information and Communication Technologies 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 author to generalise 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 organisations representing various industries as it will provide a wider universality of the discovered phenomena.

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