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Social Learning in Cluster Organizations and Accumulation of Technological Capability

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The purpose of the paper is to present how members of cluster organizations perceive their role in the accumulation of technological capability through social learning. The paper presents the results of a qualitative study of four cluster organizations. The theoretical foundation of the study are the communities of practice and the organizational inertia theories. The study indicates that the dynamics of technological capability of cluster organizations' companies varies regarding three identified communities of practice, namely Participants, Cooperators and Locomotives. The so-called Dead souls (not included in any of the identified communities of practice) did not accumulate technological capability, while the companies classified as Participants increased their technological capability through social learning in cluster organizations provided that the cluster organizations offered comparatively high benefits. Those members of cluster organizations, identified as Cooperators and Locomotives, exhibited relatively high initial technological capability and increased it when the benefits received through social learning in cluster organizations were aligned with their technological trajectories. The study adds to the underdeveloped knowledge of cluster organizations by examining their role in enabling social learning that helps cluster firms accumulate technological capability.

Keywords: *Cluster Organizations; Communities of Practice; Organizational Inertia; Social Learning; Technological Capability.*

Introduction

Due to interactions and networking effects in clusters, learning is perceived as an immanent aspect of their functioning that determines the innovativeness and competitiveness of cluster firms (Brosnan *et al.,* 2016; Hernández *et al.,* 2017; Lin, Chuang, & Wei, 2014; Lorenzen, 2018). Given the fact that it involves interactions among cluster members which stimulate the formation and flow of knowledge, it is social in nature. Learning in clusters occurs primarily via informal processes, namely during social interactions and participation in cluster practices. In the context of globalization, it is even more critical than before because codified knowledge is globally accessible and the role of tacit knowledge acquired through an informal learning process is gaining importance (Beerepoot, 2005; Gausdal, 2008; Perez-Aleman, 2011).

Although learning in the clustering literature is emphasized in several concepts rooted in the idea of Marshall's industrial district, e.g. epistemic communities, learning networks, learning by interactions, innovative milieu or collective learning *(Becattini, 1990; Brosnan et al.,* 2016; Lis, 2018; 2019; Staber, 2009), a limited number of studies have documented social learning in clusters or cluster organizations (COs). In this paper, COs or cluster initiatives are understood as formally established organizations comprising other entities that joined COs intentionally to achieve certain collective or individual goals. Cluster organizations are formed to strengthen the growth and competitiveness of clusters and their members (Lis, 2018; Lis & Lis, 2021; Solvell *et al.,* 2003). It should be emphasized that clusters and COs differ in many aspects (Ibn-e-Hassan & Talib, 2015; Lis & Lis, 2021; Morgulis-Yakushev & Solvell, 2017; Solvell *et al.,* 2003), but, as far as the topic of the paper is concerned, one difference is more vital than the others, namely COs ought to facilitate spontaneous, informal, face-to-face interactions that are conducive to the flow of knowledge and social learning in the CO and, as a result, they may support the competitive strength of the cluster (Richardson, 2013; Solvell *et al.,* 2003). Due to this reason, it may be justified to investigate COs as distinct from clusters. In addition, studies concerning COs are still rather scant, yet needed (Ibn-e-Hassan & Talib, 2015).

Clusters and COs are local or global sources of learning which may enable member companies to increase their technological capability (Geenhuizen & Nijkamp, 2012; Hansen & Lema, 2019; Upadhyayula *et al.,* 2017). Technological capability is perceived as a strategic resource that contributes to the competitiveness of firms since it frequently helps them to be more innovative and adaptive to market conditions (Jin & Zedtwitz, 2008; Tzokas *et al.,* 2015). It is also seen as a significant factor in the economic development of countries as highly developed economies have companies with well-developed technological capability (Dutrenit *et al.,* 2018). The concept of technological capability has been addressed in the clustering literature primarily through studies concerning the

relationship between technological capability and innovation. Regarding the knowledge about the role of COs in supporting social learning that helps CO companies to accumulate technological capability, there is still a gap. Therefore, this paper presents how members of COs perceive the role of COs in the accumulation of technological capability through social learning and addresses the following research question: In view of the accounts of CO members, what is the role of COs in supporting social learning and how do companies in COs accumulate technological capability?

The theoretical underpinnings of our study are the communities of practice theory, further supplemented by organizational inertia theory. As for the former, it has become popular in other fields, yet it has only been addressed marginally in the management literature, and in the clustering studies, it is almost absent (Wang & Helms, 2019; Rozkwitalska & Lis, 2020). Similarly to Wang and Helms (2019), we believe that the concept of communities of practice can be useful in exploring the learning process which occurs among various entities in COs. Cluster organizations are social entities consisting of participants that increase common knowledge by becoming involved in practices. In this paper, we build on our previous work (Rozkwitalska & Lis, 2020; Lis & Rozkwitalska, 2020) and show how the accumulation of technological potential in companies occurs through social learning. This aspect has not been analyzed so far either by us or by other researchers. Therefore, this paper is an extension and at the same time an attempt to integrate two different concepts (social learning and technological capability) in the underdeveloped literature on CO.

The paper reports the findings from a qualitative study conducted in four COs operating in the metal and ICT industry in Poland. Although the study was carried out in relation to only one economy, it provides results that can be verified with respect to other states, particularly in Central and East Europe. There are some similarities among COs in the region since they were established and developed based on the cluster policies applicable in these countries. On the other hand, the COs in Europe differ in terms of their setting, objectives, organization and performance, which explains why it is better to analyze them in relation to one state. Since the quantitative measure of technological capability (e.g. patents, investments in R&D, R&D intensity) caused a lot of confusion and gave inconsistent results in previous studies (Srivastava *et al.,* 2015), and because of the nature of the analyzed phenomenon, we carried out a qualitative research. We contribute and develop the current literature on COs since the paper integrates the idea of social learning in improving technological capability in COs. We explain how CO coordinators and companies can enforce technological capability by inducing and engaging in social learning.

To answer our research question, we first describe previous research and the theoretical basis of social learning in COs. Subsequently, previous literature on technological capability in COs is reviewed and the theoretical foundation for our further analysis is described. Then we present the details of methods, samples and coding procedure. Afterwards the empirical findings with discussion are reported. The last section explains our research contribution, implications for practice and theory, limitations, and possible directions of future studies.

Literature Review

Previous Research on Social Learning in Cluster Organizations

Introduced by Porter (1990, 2000), the concept of industrial clusters, namely a concentration of firms and various other entities connected through industries in a geographical area, has appeared in a significantly growing body of literature since the 1980s (e.g. Enright, 1992; Becattini, 2002; Giuliani, 2011; Giuliani *et al.,* 2014; Parrilli *et al.,* 2010), whereas COs gained importance in Europe in the 1990s, which also led to an extensive development of the literature (for its overview see e.g. Morgulis-Yakushev & Solvell, 2017; Lis & Lis, 2021). It is, however, to some extent a disadvantage that it mostly results from overall studies on clusters.

According to the subject literature, clusters enable the spreading of business information, know-how, and technological expertise among entities in their social networks (Wang & Helms, 2019). They are "dynamic arrangements based on knowledge creation, increasing returns (…) and innovation" (Solvell, 2008, p. 15). Participation in social networks may reduce transaction costs and contribute to the growth of enterprise efficiency (Giuliani *et al.,* 2014). Moreover, clusters are sources of learning in the local/national and global contexts (Geenhuizen & Nijkamp, 2012; Upadhyayula *et al.,* 2017). Learning is one of the main phenomena that have been studied in the literature on clusters (Li *et al.,* 2008; Staber, 2009).

As far as learning is concerned, the following topics have been examined, namely the flows of knowledge, the relationship between learning in clusters and innovations, learning channels and learning dimensions, learning mechanism, the role of institutional support and spatial proximity in learning, etc. (Capello, 1999; Cotic-Svetina *et al.,* 2008; Keeble & Wilkinson, 1999; Li *et al.,* 2008; Lin *et al.,* 2014; Lis, 2019; Parrilli *et al.,* 2010; Svetina & Jaklic, 2008).

The social aspect of learning is reflected in the collective learning concept, which is sometimes called localized or interactive learning. However, it still remains a fuzzy idea addressed rather marginally in the clustering literature (Capello, 1999; Castro, 2015; Cotic-Svetina et al., 2008; Franco & Esteves, 2018; Keeble & Wilkinson, 1999; Li *et al.,* 2008; Lin *et al.,* 2014; Liu, 2012; Mozzato & Bitencourt, 2014; Svetina & Jaklic, 2008) as our search of literature proves. Collective learning is in fact social learning as it assumes that individual participation in social life, i.e. engaging in various activities, being involved in conversations, reflections and other types of interactions, invigorates learning (Capello, 1999; Wenger, 2010). In collective learning, individuals are involved in practices, their exchange and modification, to solve problems; such shared rules and procedures lead to the accumulation of knowledge. Social interactions are the basis for gaining common knowledge and understanding (Doos & Wilhelmson, 2011), whereas the characteristics of clusters and their representatives determine the scope of such learning (Beerepoot, 2005).

However, it is worth emphasizing that interactions do not have to be close each time and members learn both with one another and from others (Staber, 2009). Reed et al. (2010) suggest that for a learning process to be considered social, it should meet three criteria: 1) the individuals involved change their understanding; 2) the change spreads to broader social units or communities of practice; 3) it is embedded in social interactions between different individuals in a social network.

There are numerous studies on learning in the clustering literature, yet research that is solely focused on collective or social learning in clusters and, particularly, in COs is insufficient. Based on the Scopus bibliometric search (March 12, 2020) for title, abstract and keywords in the field of social sciences, business, management and accounting, using the pair of keywords "clusters" AND "collective learning" and "clusters" AND "social learning", we found 54 and 44 papers, respectively. Additionally, the concept of collective learning in the clustering literature is under-theorized and empirically it has been treated sketchily (Staber, 2009; Svetina & Jaklic, 2008). As a result, social learning theories have rarely been used in the subject literature to study learning. Therefore, using the theory of communities of practice to analyze the role of COs in supporting social learning in the process of technological capability accumulation appears to be an important and interesting scientific issue.

Previous Research on Technological Capability Improvements in Cluster Organizations

In the literature, technological capability is defined as: 1) an ability of a company to use various technologies (Zhou & Wu, 2010); 2) all the capabilities of a firm used to generate and manage technical changes in processes, products, and machines (Hansen & Lema, 2019); 3) an internal competence of absorbing and using technological knowledge as well as creating new knowledge (Kang *et al.,* 2017; Srivastava *et al.,* 2015); 4) a comparative advantage in technologies (Eum & Lee, 2019). With time, technological capability becomes more rooted in organizational routines and, as a result, less imitable and substitutable. Techno-logical capability determines absorptive capacity, which may influence the company's innovation (Saunila & Ukko, 2012; Tzokas *et al.,* 2015; Zhou & Wu, 2010).

Improving technological capability is the process by which firms gradually accumulate skills and knowledge, increasing their ability to manage the necessary technological changes (Dutrenit *et al.,* 2018; Hansen & Ockwell, 2014). Various authors describe different levels in a technological capability trajectory ranging from more basic and routine to more complex levels where innovative activities are performed (Figueiredo, 2005; Hansen & Lema, 2019; Hernandez *et al.,* 2017). Previous studies confirm that companies with higher technological capability invest more intensively in R&D and innovative activities (Hansen & Ockwell, 2014; Kang *et al.,* 2017; Kumar *et al.,* 2008).

The capability is tacit in nature, which is why its distribution among companies, evolution or transfer may be challenging (Eum & Lee, 2019). The existing literature outlines internal factors (such as the quality of human resources or learning culture) and external ones which may facilitate technological capability improvements, whereas functioning in clusters or COs can be seen as an external determinant that supports the accumulation of the capability (Hansen & Lema, 2019; Hansen & Ockwell, 2014; Kumar *et al.,* 2008; Sobanke *et al.,* 2014, Lis & Rozkwitalska, 2020). Clusters are sources of local/national or global learning (Geenhuizen & Nijkamp, 2012; Hansen & Lema, 2019; Upadhyayula et al., 2017) that fosters technological improvements and innovations of focal firms. Learning in clusters or COs frequently occurs in a tacit form, the so-called 'learning-by-interacting', or results from other agglomeration advantages which mainly reside in knowledge dissemination among cluster members (Boschma *et al.,* 2014; Hansen & Lema, 2019; Romijn & Albaladejo, 2002). The development of technological capability in clusters and COs may be leveraged through interpersonal relationships, mobility of workforce, and interactions at exhibitions, trade fairs or other meetings within social networks created in clusters (Lis & Rozkwitalska, 2020). Moreover, analogous to strategic alliances, cluster members are introduced to various ideas and solutions that potentially encourage them to think innovatively. Furthermore, more active members may motivate others to become involved in innovative projects. Different technological resources of cluster companies can be combined, which helps to deal with organizational inertia that is a barrier to innovation (Srivastava et al., 2015). However, the knowledge about the role of COs in the process of technological capability improvements has not been sufficiently analyzed in previous research (Lis & Rozkwitalska, 2020).

Theoretical Foundations

Cluster Organizations as Communities of Practices

Social learning is a deliberate activity of cluster firms to share, generate and "disseminate knowledge through the establishment of a community of practice" (Wang & Helms, 2019, p. 2). In this regard, communities of practice theory (Wenger, 1998, 2009, 2010) can help in understanding the social nature of learning in COs. Similarly to COs, communities of practice have an emergent structure with complex, formal and informal relationships (Dessne & Bystrom, 2015). They are self-organized; their boundaries are flexible and dynamic, while their ongoing negotiation facilitates the creation of identity and cultural meanings.

Individuals in rather loose networks gradually develop connections among members and transform into communities. They are a relational space which binds people through interactions and shared expertise (Wang & Helms, 2019). More systematic interactions occur when individuals develop the sense of shared domain. It may stimulate learning from one another as communities of practice adopt a common base of knowledge allowing members to manage their actions when searching for a solution to a problem. They gradually build the practice including the means used to deal with problems within the domain (Dessne & Bystrom, 2015).

According to the theory of communities of practice, social learning in communities of practice goes beyond the acquisition of knowledge and skills and includes social becoming, i.e. identity and practice development (Wenger,

2010). Furthermore, social interactions are the driving force of learning in communities of practice, while memberships in a community may be full or peripheral (Dessne & Bystrom, 2015).

The theory posits that communities of practice may "emerge, merge, split, compete, complement each other, and disappear" (Wenger, 2010, p. 182). Along with an increase in studies on communities of practice, more authors perceive them not only as emergent and informal structures with a voluntary membership, but also as designed and managed organizations established to facilitate learning (Dessne & Bystrom, 2015; Rajaeian, Cater-Steel & Lane, 2017). Moreover, various authors see clusters or COs as social communities (Castro, 2015; Gausdal, 2008; Giuliani, 2011; Staber, 2009; Turner, 2010; Wang & Helms, 2019; Rozkwitalska & Lis, 2020); consequently, the formation of COs may, on the one hand, be treated as the development of communities of practice. On the other hand, the spontaneous emergence of various communities of practice within COs, with their own domains, practices and identities, is also possible (Rozkwitalska & Lis, 2020).

We traced only a few studies on clusters that have used communities of practice theory, but none of them referred to COs. They have analyzed 1) how communities of practice helped accumulate knowledge-based assets in a region and enhance a locational competitive advantage of clustered organizations (Wang & Helms, 2019); 2) how an educational program helped invigorate the Electric Coast cluster by creating a community and how the community stimulated collective learning (Gausdal, 2008); 3) communities of practice organized through professional associations (Faulconbridge, 2007; Turner, 2010); 4) the role of technological gatekeepers in localized learning in a wine cluster (Giuliani, 2011). There was also a recommendation to treat clusters as communities of practice in order to adopt a community-based knowledge management approach to strengthen innovation (Castro, 2015).

Technological Capability and Organizational Inertia

To better describe the improvement path in technological capability we refer to organizational inertia theory. It posits that companies may be bound to their existing technological trajectories due to organizational inertia, which is reflected in the organizational rigidness of actions and resistance to radical changes due to the routines established by them to elicit automatic responses and to maximize the efficiency of their operations *(Petti et al.,* 2019; Zhou & Wu, 2010). Organizational inertia develops over time as organizations are more rooted in their unique routines based on their past experience (Dosi & Marengo, 2007). Consequently, companies follow the same patterns of resource allocation and investment, which may limit their adjustment to technological discontinuities and ability to improve technological capability.

Based on the theory of organizational inertia, it can be assumed that well-developed technological capability of firms potentially impedes its further development by leveraging external knowledge (e.g. from other CO members) as it creates "not-invited-here syndrome". In addition, being successful in a certain technological path makes companies less willing to deviate from it, which may be necessary to develop technological capability. Hence, when technological capability is high, enterprises may be more inclined to search for internal knowledge, protect it from outside companies and devaluate the knowledge that resides in the network. It will reduce their engagement in social learning. On the other hand, firms with higher technological effort (the extent of the commitment of resources to the search for and development of knowledge) are more motivated to both explore new knowledge and use external knowledge. They may also be perceived by others in a network as more valuable and desired partners in innovation activities (Murovec & Prodan, 2009; Srivastava *et al.,* 2015). As a result, companies with high technological effort may still value searching for external knowledge and engage in social learning even if their technological capability is high.

Methodology

Research Methods and Sample

In this paper we refer to the results of an exploratory and qualitative study that aimed to answer the following research question: In view of the accounts of CO members, what is the role of COs in supporting social learning and how do companies in COs accumulate technological capability? Our intention is to show how members of COs perceive the role of COs in the accumulation of technological capability through social learning. It should be emphasized that the study presented in the paper is part of larger research project which was focused on the identification of the levels of cooperation among companies in selected cluster organizations in Poland (Lis, 2018; Lis & Lis, 2021).

With regard to the theoretical underpinnings of our research, we predict that 1) various communities of practice emerge within COs with their own practices and identities (Rozkwitalska & Lis, 2020); 2) communities of practice in COs differ in terms of social learning which is reflected in the accumulation of technological capability; 3) high initial technological capability of a company can be enhanced through social learning in COs when its technological effort is also high and the external knowledge it may absorb is compatible with its internal technological trajectory (Lis & Rozkwitalska, 2020). We understand communities of practice as a spontaneously emerging or designed social unit whose members' identities are based on a common area of interest and who are engaged in practices, i.e., various activities to solve common problems or meet common needs.

The extreme case logic technique was used to select the research sample, guided by the desire to ensure maximum variability and diversity within the adopted research field. According to the accepted logic, two very different industries were selected for the study: the metal industry, representing primarily the medium-low technology sector and the information and communication technologies (ICT) industry operating in the high technology sector. The dissimilarity of these industries was considered a factor potentially determining the development of relationships among cluster members. The selected industries differ significantly in many aspects, such as for example the importance of location and type of relationship. Companies belonging to the metal sector form long-term relationships and cooperate within

their value chain. The proximity of their cooperators is essential for developing relationships among firms; accordingly, the companies are located in the same geographical area. The dominant form of cooperation in the ICT industry is the joint implementation of projects, based on numerous, but short-term relationships established between entities. Consequently, the location of partners is of minor importance because the companies can work remotely.

Four COs located in Poland were selected for the purpose of the study; each of the selected industries was represented by two cluster organizations. It was assumed that if the theoretical saturation on such a sample is not achieved, the next COs operating in the selected industries will be introduced into the study.

One of the authors conducted research among 35 members of the studied COs including companies (the owners of the companies or top managers as well as individuals chosen to represent the organization in COs), R&D institutions, educational institutions, and support institutions, which were selected on the basis of the snowball technique (Flick, 2010). They were chosen as the so-called key informants (Kumar *et al.,* 1993) about the COs and the role of their organizations in a particular CO.

The research was initiated in 2016. The way in which the surveyed COs have operated over the past six years has not changed significantly, which was also due to cluster policy in Poland, which has not been very favorable during this period. Although the COs have undertaken various activities, they did not change their patterns in terms of social learning and technological capabilities development. This is also confirmed by the observations of one of the authors, who had contact with all four COs during the implementation of other projects, e.g. Cluster Benchmarking in Poland – Edition 2018 (Wielec *et al.,* 2018). The universality of the observed processes, expressed in the data and the presented results, is still of great importance for COs and their members.

In total, 44 hours of in-depth interviews were conducted in the offices of the organizations; an average time of each interview was 75 minutes. The number of interviews in both CO groups was similar. A total of 18 interviews were conducted in metal COs (in CO_A-7, CO_B-11) and 17 in ICT COs (CO_ C-6, CO_D-11). The study involved coordinators (7) as well as members with longer experience, heavily involved in CO activity. In order to maximize the differences, the study included cluster companies (20) of different age, size, activity profile and competitive position. Moreover, the research also involved R&D institutions (4), educational institutions (3), and support institutions (1).

The interview covered, among other things, the topics related to the forms and intensity of cooperation in the cluster, the levels of commitment of coordinators and members in the COs, the cluster benefits, including the flows of knowledge (Lis & Rozkwitalska, 2020).

An additional method was also adopted in the study to ensure methodological and data triangulations (Maxwell, 2005), i.e. document analysis, which was in turn facilitated by using multiple sources of information (i.e. subjects from various CO members).

Coding Procedure

Data analysis, including coding and triangulation, was performed after all interviews had been completed. To code the interview data and obtain the results, we carried out the conventional qualitative content analysis (Hsieh & Shannon, 2005). The interviews were coded separately and the collected empirical material was analyzed and interpreted gradually, based on theoretical sampling and continuous comparison method. Each interview and theme emerging from it were constantly compared to one another, which made it possible to abductively define codes and central categories (Glaser & Strauss, 1999). Line-by-line coding was used to identify as many material codes as possible emerging within the data. The above coding method is recommended by Glaser and Holton (2010) due to the fact that it forces verification and saturation of the categories, and also minimizes the risk of overlooking an important category.

Such analytical procedures are based on three steps. The first one, known as open coding, involved the identification of some common threads running through the accounts in each CO (e.g. general information, demonstrating, working groups, etc.). The axial coding consisted in determining each thread according to the level of cluster cooperation (Level), the strength of relationships (R), the type of information and knowledge (I&K), symptoms of learning (L), communities of practice (communities of practice) with their domain (D), meaning (M), identity (I), and the dynamics of technological capabilities (TCD). The selective coding stage involved grouping into categories possible scenarios for the development of communities of practice shown through the lens of the evolution of CO collaboration.

Empirical Results

Levels of CO Cooperation

The conducted study shows that cooperation in the COs underwent four stages. The first, basic level of cooperation was ‘Integration at the unit level’, where the development of cooperative relationships in the COs took place. The aim of activities at this level was to create a basic network of relationships among CO partners. The next two levels: level II ‘Allocation and integration at the process level’ and level III ‘Impact on the environment’ ran simultaneously. At the level II, two main goals were set, namely facilitating access to the increased pool of resources and increasing the quality of products and services and/or reducing business costs. By taking joint actions, the CO members tried to create the best possible conditions inside the COs for the exchange of various types of resources, e.g. material, human, and information ones. They also made efforts aimed at integrating selected processes with other CO entities, including marketing (e.g. joint promotion), quality (e.g. common quality standards) and logistics (e.g. joint procurement). The main goal of level III was to exert impact on the external environment of the organization. The CO members tried to adjust favorable environmental conditions to their parent organizations, especially in the areas related to law-making and the development of regional skill resources. Cooperation with actors external to the CO (such as

educational institutions, universities, other companies from the same industry and region), which also took advantages of solutions developed together with CO entities, also played an important role. The last and most mature level, i.e. level IV 'Creation and integration at the organizational level', focused on setting up conditions to create common added value for pooling resources. At this level, the selected CO partners attempted to integrate at the organizational level.

The research also revealed three significant observations: 1) all four identified levels of cooperation could operate simultaneously within one CO; 2) not all CO members reached the same levels of cooperation within the same CO at the same pace, and with the transition to the next levels, the number of entities operating there decreased; 3) CO cooperation was dynamic, which was reflected in the transition of CO members between different levels, depending on their current needs and commitment.

Referring to the specificity of the studied COs, all four of them undertook activities typical of the distinguished levels of cooperation. Each CO created a solid foundation in the form of level I for the development of higher forms of cooperation. For the other three levels, some differences between metal COs and ICT COs were observed. The former mostly developed the cooperation at levels II and III, while level IV efforts aimed at developing the cooperation within the value chain did not bring the expected results. In addition to cooperation at levels II and III, the ICT COs were also heavily involved in activities assigned to level IV, which, in the case of this industry, took the form of project cooperation (Lis, 2018; Lis & Lis, 2021).

Social Learning in Cluster Organizations

Along with the development of CO cooperation and passing through the levels, the relationships among CO members strengthened, which initiated the social learning processes. Level I mainly involved establishing contacts, which helped CO entities to break the barriers of anonymity and get to know each other better. Direct contacts formed the basis for further stages of the development of cooperative relationships in the studied COs. Actions undertaken at subsequent levels led to the gradual breaking of the distrust barrier, which prompted the cooperating entities to initiate further joint activities. The apogee, in terms of cooperation, level IV was reached primarily by partners bound by strong ties, not only formal, but primarily informal ones, based on trust, grounded in earlier levels of cooperation.

The development of relationships strongly influenced the access to information and knowledge. At level I, insufficiently developed relationships limited the flow of information inside the CO. Admittedly, the CO members had access to a variety of quite general information. At level II, where the ties among the members were strengthened, which resulted in greater openness and reciprocity, the information sent between them became more detailed, personalized, and tailored to the individual needs of the CO entities. At level III, the members preferred to obtain key information about the environment due to their commitment and relations with external actors. Finally, at level IV, the selected members, thanks to the established trust-based relationships, were granted access to confidential information, reserved only for verified partners. Moreover, cooperation at this level required the sharing of knowledge or joint generation of new knowledge.

The access to knowledge strongly influenced the learning process in the studied COs. Two basic symptoms of learning, i.e. transfer of information and raising of awareness, were observed at all levels. In the case of the former, as a result of their participation in the CO, the CO entities were stimulated by various information (depending on the specific level of cooperation), which enriched their knowledge about other CO members, as well as about their task and general environment. In addition, the members became more aware of, for example, the benefits of participation in the CO and cooperation, especially based on coopetition. Significant differences became apparent between level I and other levels. At level I, the CO members acted primarily as recipients, and the source of information was the coordinator, while at levels II-IV, due to more firm relationships, the exchange of information occurred directly between the CO members (who played both roles: recipients and sender) to a much greater extent. At these levels, there were also other symptoms of learning that were absent at level I, i.e. demonstrating and inspiring. They included two-way and often unconscious activities, because, on the one hand, the CO entities acted as demonstrators and, on the other hand, they could observe and be inspired by other members. The last symptom of learning identified at level IV – motivating – was slightly different in nature. At levels II and III, the members acted mainly as recipients, which means that they were motivated to be involved in specific actions characteristic of a given level. Level IV participants received similar reinforcement, nevertheless some entities appeared as motivators (senders). At this level, the last symptom of learning observed was educating, which was a completely conscious action like motivating.

The differences between metal and ICT COs, especially in terms of the development of cooperation at level IV, were related to social learning. All the aforementioned symptoms of the social learning process were observed only in ICT COs that reached all four levels of collaboration. The trust gained during the implementation of joint projects facilitated the flow of knowledge and confidential information. Metal COs, on the other hand, integrated the CO entities and helped to foster relationships between selected members. However, due to the fact that the most mature forms of cooperation did not occur there, it was not possible to build and verify the trust of partners and to generate knowledge together. The last two distinguished symptoms of learning, i.e., motivating (full version) and educating, were also not observed there (Table 1) (Rozkwitalska & Lis, 2020).

Table 1

Levels of Cooperation in COs and Social Learning

Level	I	II	III	IV
Strength of relationships (R)	Establishing contacts: overcoming the barrier of anonymity	Development of relations within the CO: overcoming the barrier of distrust	Development of relations with actors outside the CO: development of relationships	Trust development
Type of information and knowledge (I&K)	General information	Detailed information	Significant information about the socio-economic environment	Confidential information New knowledge
Symptoms of learning (L)	Transferring information (r), Raising awareness (r)	Transferring information, Raising awareness, Demonstrating, Inspiring, Motivating (r)		
				Motivating, Educating
Selected quotes	'A cluster is a place where you can meet and talk about various topics, and after multiple meetings, share unofficial information on various topics; it certainly helps to do discuss, for instance, what is going on the market, whether a new standard will come into force or whether a new, unofficial, requirement will be implemented.' (D7)	'At the beginning, everyone looked at each other with a bit of distrust. There was some resistance, because theoretically companies in the metal industry would compete with each other. But then relations improved.' (A5)	'We have a regular contact with employers. Thanks to the cluster, we got to know each other. And now, during training or talks, we can discuss various things because employers belonging to the same cluster participate in our conferences twice a year.' (B10)	'Knowledge arises in projects. Some of the documents are available to everyone, and some only to people who implemented these projects.' (D5)

Development of Technological Capabilities within Communities of Practice in COs

We identified three communities of practice among the analyzed COs, such as Participants, Cooperators and Locomotives. Moreover, within the Cooperators group, we delineated three subgroups that exhibit the idiosyncrasy of a given level of cooperation. We have to stress that the boundaries between various communities of practice do not overlap with the levels of cooperation. Furthermore, there was a significant share of the CO members that we could not assign to any CoP. We called them Dead souls due to their low, or even a lack of, involvement in the CO activities. The participation of these entities in the CO in many cases was limited to paying membership fees, which guaranteed them the status of a CO member.

While studying the Cos, we found the unique domain, meaning, and identity in each of the identified CoP. Participant were observed at level I, Cooperators at levels II-IV, and Locomotives at level IV.

Participants defined their domain through meetings and various events. Each studied CO organized regular meetings at the CO forum, and additionally some of them initiated integration and networking meetings, such as business breakfasts or integration trips. Through the COs, their members participated in conferences, seminars, fairs, and economic missions. We did not observe significant cooperation at this stage, since all the above-mentioned activities were undertaken by Participants in order to satisfy their particular needs. Nevertheless, the integrative function of meetings and events, which occurred at each level of cooperation in the COs, led to stronger relationships and the creation of a certain common cluster identity (even though - in the case of this CoP - it was at a very low level).

With regard to Cooperators, we noticed high in-group heterogeneity, as it is present at three successive levels (II-IV). Cooperators manifested a certain observable community of activities that passed into higher forms, such as the community of goals (level III) and the community of interests (level IV). Joint activities influenced the development of bonds, which resulted in the appearance of the four symptoms of learning described above. The basic domain at level II was task groups in which the selected CO members participated, striving to achieve particular goals related to their parent organizations (e.g. gaining access to an increased pool of resources, increasing quality or reducing costs). The interviewees allowed us to identify the lobbying activity as the domain of Cooperators at level III. The aim of lobbying was to influence the external environment. Unlike Cooperators at level III, those at level IV were linked through project groups and consortia, which brought together entities creating added value in their common interest. We observed a gradual increase in the group identity when the relations strengthened. Cooperators at level II had a weak identity mostly due to the temporary nature of their joint actions. The identity at level III was average, finally becoming the strongest at level IV. Some interviewees admitted that they had identified more with a given project group than with the entire CO.

Based on the study results, we delineated two communities of practice at level IV as in the case of some COs, apart from Cooperators, we observed Locomotives. Even though there were no significant differences in key CoP attributes such as domain, meaning, and identity between the two, Locomotives embraced the most active members who initiated projects and decided whether to invite other CO entities (Rozkwitalska & Lis, 2020).

We observed that the dynamics of technological capabilities varied in different communities of practice, similarly to differences in the nature of cooperation, access of the CO members to a specific information pool, as well as the symptoms of social learning (Table 2).

Table 2

Communities of Practice and Technological Capability

Level	I	II	III	IV	
Not CoP	Dead souls	-			
CoP name	Participants	Cooperators (II)	Cooperators (III)	Cooperators (IV)	Locomotives
Domain (D)	Meetings & events	Task groups	Lobbing	Project groups	
Meaning M)	Particularity of activities	Community of action	Community of goals	Community of interests (business projects)	
Identity (I)	None or weak	Weak	Medium	High	
Selected quotes	'Meetings in the cluster can hardly be called joint activities. People go there to the so-called Christmas party. To listen to others and learn something.' (B7)	'There was a concept in one task force to select one company to carry out the calibration of the equipment. Obviously, the aim of this was to save costs, which is, by the way, one of the reasons why companies join the cluster.[…] So cooperation pays off.' (D6)	'However, this is an industry cluster, so it was clear from the beginning that its aim was to solve problems in the industry in the region. The primary motivation for joining the cluster was the possibility of developing something new, influencing, learning from others, and discussing problems.' (D4)	'People engage in the cluster due to the Accus project. We identify ourselves more with the project than with the cluster.'(D9)	
Dynamics of technological capabilities (technological capability)	0 or low	Medium	Medium	High	
Selected quotes	It is difficult to express participation in the cluster into knowledge and information. These are mostly meetings and direct contacts, especially in moments when we need to help each other.' (C4)	'To complement and increase my capabilities, I got to know the local market very well and the cluster allowed me to do that among other things. And then we know exactly which company and what kind of machines it has - we can take advantage of that, because we got to know each other well enough.' (A6)	'Because if something new is going on at a certain point in the country, or politicians show that something will be preferred, you have to have your finger on the pulse, you have to get that knowledge.[…] That's what the cluster is for among other things.' (B2)	'The consortia, the projects that we have mostly involve innovative activities […] Normally, technologies are produced there, which are used by companies to develop products.' (D1)	

As far as Participants are concerned, we did not observe any technological capability development and the dynamics was barely noticeable. Similarly, the initial stage of cooperation and the nature of the information received (which improved the situation of companies in the market and might further translate into better business decisions), could not significantly increase the technological capability of the CO companies. This observation possibly concerns those companies with a low initial technological capability level, which, however, enriched their knowledge base by transferring information and raising awareness. As far as Cooperators are concerned, the dynamics of technological capability is considered to be average. Close ties with both other CO members and external stakeholders, as well as the information received made it possible to gain certain competitive advantage over non-CO companies. The study shows that both companies with low and high initial technological capability values benefited. Information and other resources obtained at the levels discussed put the CO companies in a privileged position in relation to those not belonging to COs, and it was additionally supported by the following symptoms of learning, i.e. demonstrating, inspiring, and motivating. However, the highest level of technological capability dynamics was observed in the case of Cooperators at level IV, that is, the companies with a high initial technological capability value, which, as a result of cooperation, accessed new knowledge. We inferred that trust built at level IV, restricted knowledge, confidential information and support provided by Locomotives in this respect in the form of motivating and educating could enhance technological capability. It is worth noting that the greatest increase in technological capability was identified in the case of the companies with high technological efforts, the technological trajectories of which were consistent with the domain, imposed, in particular, by Locomotives. Considering the enterprises with a low initial technological capability level, the technological capability dynamics was also low.

Based on the comparison of the studied COs, we found Dead souls in each CO. They did not contribute to the growth of a given CO, neither they derived any major benefits from the membership. In the case of COs operating in the metal industry, we identified Participants and Cooperators even though the latter only had attributes typical of levels II-III. This CoP achieved a medium identity and was driven by the community of goals (thus treading in common directions, striving to achieve common goals, etc.). In contrast, all three communities of practice were identified for the ICT COs. Moreover, ICT Cooperators and Locomotives constructed

strong identity and were motivated by the community of interests (understood as the convergence of the most important motivators, underlying the setting of common goals). The process of acquiring technological capability in metal and ICT COs was similar within the same type of communities of practice. This mainly applies to Participants and Cooperators from levels II-III, and their technological capability dynamics can be described as low or medium. A significant change in the technological capability was only observed in ICT COs at level IV (Cooperators and Locomotives).

Discussion and Conclusions

Theoretical Implications

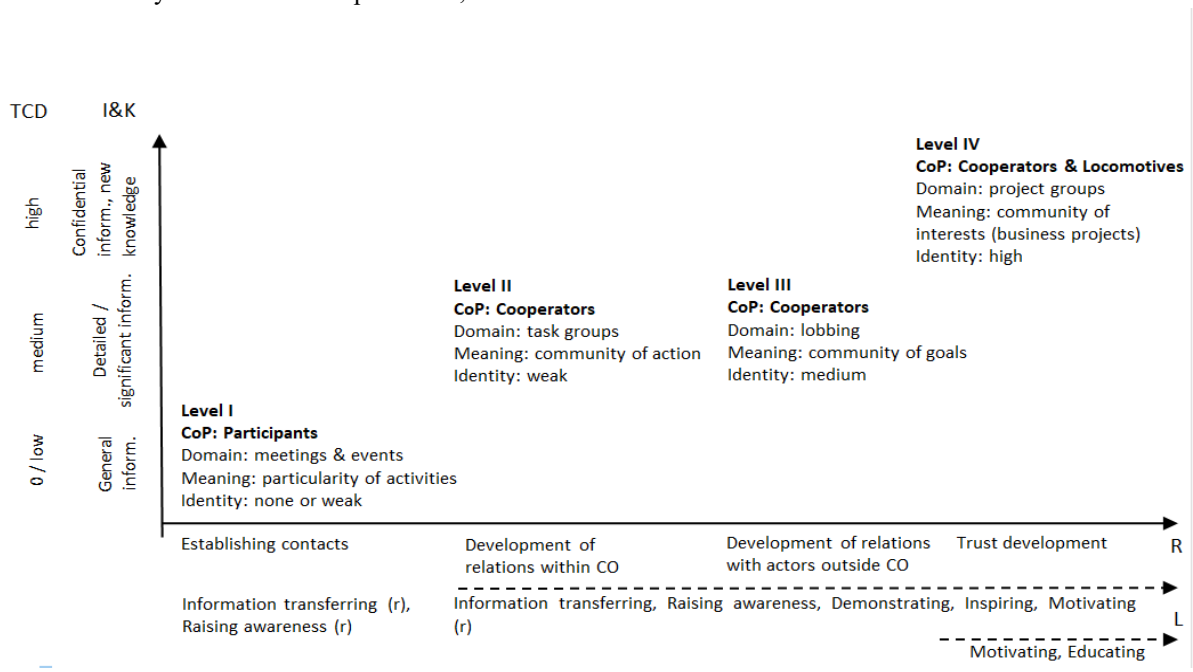
Our study can fill the gap left by previous research because we used the theory of communities of practice to analyze the role of COs in supporting social learning in the process of technological capability accumulation. Since enhanced technological capability may translate into innovation in COs, it is vital that regional economy and society may benefit from the peculiarities of COs. We have linked several phenomena poorly documented in the clustering literature (Lis & Rozkwitalska, 2020; Rozkwitalska & Lis, 2020), i.e. social learning and technological capability dynamics in COs.

In our study, we have shown that there was a social learning process in COs, which was based on relationships gradually developed among CO members and it was clearly visible how they went through the identified levels of cooperation. Additionally, these relationships also affected access to a specific pool of information and resources. Communities of practice theory and previous studies confirm that social interactions are a prerequisite for social learning. Furthermore, the theory posits the spontaneous emergence of various communities of practice (Wenger, 2010). In this study, in conformity with our first prediction, we also identified spontaneous communities of practice in the COs such as Participants, Cooperators and Locomotives with their respective domains, meanings, and identities. The complexity of activities carried out by the members of communities of practice increased (domain) along with the transition to their higher and more mature forms, the motivation to undertake such activities changed (meaning), the identity of communities of practice strengthened as well as new symptoms of social learning occurred (in line with prediction 2) (Rozkwitalska & Lis, 2020).

Empirical Implications

We have also attempted to imply how the cooperation of COs is related to the dynamics of technological capability through social learning in communities of practice (prediction 2). Previous studies indicated that the improvement of technological capability is a gradual process (Dutrénit et al., 2018; Hansen & Ockwell, 2014) and our research has confirmed that (Lis & Rozkwitalska, 2020). Participants, Cooperators and Locomotives perceived the role of the CO in the accumulation of technological capability differently, namely Participants barely improved technological capability, while Cooperators operating at level IV were able to increase their technological capability, especially if their technological trajectories coincided with Locomotives, which were the driving force of joint activities. This evidence is partially coherent with our third prediction concluded from the organizational inertia theory.

To sum up, our findings suggest that the cooperation in the CO reflected in social learning might have fostered the accumulation of technological capability in the CO companies. Some literature points out to external sources of technological capability creation (Caniëls & Romijn, 2003; Murovec & Prodan, 2009; Sobanke et al., 2014; Srivastava et al., 2015). Figure 1 summarizes our results.



Note: I&K – information and knowledge, R – relationship, L – learning, r – recipient

Figure 1. Social Learning and Technological Capability Accumulation in COs

Our research has showed that the communities of practice formed at each level of CO collaboration were linked by increasingly strong relationships (from ad hoc contacts to relationships based on trust). The specificity of these communities, closely related to their identity, meaning, and domain, was reflected in the forms of social learning that became more sophisticated as they moved to the next level, from providing information (as recipients) to inspiring, motivating, and educating. Moreover, all of the identified communities had the opportunity to enhance their technological capability through social learning, provided, however, that the knowledge and information was appropriately tailored to them. This was especially true for the more mature communities of practice (Cooperators and Locomotives).

Practical Implications

The study offers practical implications. The findings emphasize the legitimacy of the support provided by cluster coordinators who are responsible for interactions among members (as channels of social learning) and joint activities undertaken within the CO (and adjusting them to the desired level of the CO companies). To foster the relationships in the CO on which the social learning process is based, coordinators should engage members in a variety of activities that advance common actions, goals, and interests while strengthening identification with other CO partners. The identification of the main motivations behind the activity of individual CO members may help coordinators to divide the CO into subgroups – communities of practice, which are united by the community of goals and interests, in which it is easier to develop a common identity (see also Rozkwitalska & Lis, 2020). In particular, they should support the establishment of communities of practice composed of companies with similar technological capability, because it may translate in its higher dynamics.

Research Limitations and Directions for Future Studies

Our study is not free of limitations that mostly result from the specificity of qualitative research, i.e. a relatively small research sample and a certain subjectivity that prevents the generation of results. Nevertheless, the methodological regime used at the stage of collecting and analyzing data enabled us to partially eliminate such limitations.

As far as our results are concerned, previous studies indicate that advanced technological capability should lead to innovation (e.g. Castro, 2015; Hernández et al., 2017; Jin & Zedtwitz, 2008; Tzokas et al., 2015). In fact, we have not investigated whether such innovation occurred, therefore future research could follow this direction.

Although we have tried to describe sectoral differences with regard to the studied phenomena, we have not formulated any predictions in this respect; further research may be carried out to analyze such aspects as well as include more industries.

Data collected by us were obtained from only one economy, but our findings can be verified in relation to other states, particularly in the region, to find any similarities and discrepancies among various countries.

In our paper, we have focused on CO members, aiming to determine how they perceive the role of COs in the accumulation of technological capability through social learning. However, we have not quantitatively measured technological capability itself, its initial level and dynamics.

Moreover, we have discussed possible relationships between social learning and technological capability in the COs by inferring them from the accounts of our interviewees. It should also be noted that the relationships between the variables we described in the empirical section, such as the relationship between social learning and the accumulation of technological capability, have emerged in an abductive manner. Despite the fact that two authors analyzed the data, which could broaden the perspective, it is difficult to avoid the subjectivity of findings in qualitative studies. Therefore, it may be worth carrying out further quantitative, longitudinal research to confirm our observations.

Finally, we see another potential for future study; it can develop measures of social learning adapted to the idiosyncrasy of COs.

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