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Structure and significance of knowledge networks in two low-tech clusters in Poland

Milad Abbasiharofteh[a,b] ⓘD and Wojciech Dyba[c] ⓘD

ABSTRACT
The co-location and networking of firms and institutions, also known as clustering, positively influences the innovativeness of firms. The cluster literature provides a single-sided understanding of how clusters function due to an overemphasis in the literature on clusters in high-tech and developed economies at the expense of clusters in low-tech industries in less-developed regions. Applying social network analysis (SNA), this paper studies two furniture clusters in the Wielkopolska region of Poland. The findings demonstrate that: (1) the critical factor is the impact of institutionalization on the mechanisms of knowledge flows, Marshall's externalities and, in consequence, innovativeness of firms; and (2) the underlining clusters do not show a tendency to build cluster-external linkages, opposing the dominant premise in the cluster literature. In the absence of national and international relations, managers of small and medium-sized firms and local institutions are the main sources of novelty for the clusters at the sustaining stage of their life cycle. The findings pave the way for initiatives aiming at creating and developing knowledge networks in lagging and catching-up regions in Europe, particularly those specialized in low-tech sectors.

INTRODUCTION

The co-location of firms and institutions, also known as clusters, positively influences informal interactions, learning and cooperative local networks (Audretsch & Feldman, 1996). Social networks in clusters are widely considered the driving forces of knowledge sourcing and innovation (Boschma & Ter Wal, 2007). However, most research focuses on high-tech sectors in prosperous regions of North America and Western Europe (Giuliani, 2013). Little is known about how a

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cluster functions in terms of knowledge sourcing and innovativeness in less-developed regions, especially in mature, low-tech industries. Having a more nuanced understanding of such processes can contribute to the development of policies in lagging regions.

This paper seeks to answer two questions: (1) How do knowledge networks differ depending on the institutionalization of cooperation in a given low-tech cluster? (2) How does the position in the knowledge network impact the innovativeness of the firms? They are answered by studying two furniture clusters in Wielkopolska in western Poland,[1] using social network analysis (SNA) as a research method.

CLUSTERS AT THE SUSTAINING STAGE

Marshall (1920) argues that the co-location of firms causes input and output linkages, skilled labour pooling, and knowledge transfer. Cluster 'dimensions' change over time: as clusters grow, not only do new firms, institutions and relations appear, but also knowledge stocks become more advanced and coherent (Stough, 2015). Exogenous forces dictate changes in clusters. These forces could be a change in a market or a new scientific breakthrough. Thus, clustered firms respond to new forces in order to survive and grow. Altering firms' routines and knowledge-sourcing patterns renew cluster characteristics. Menzel and Fornahl (2010) use firms' size, knowledge sourcing pattern, change in the rate of new entries into a cluster and employment as benchmarks to define different stages in a cluster life cycle.

Clusters at the sustaining stage of a life cycle (e.g., the automobile cluster in southern Germany) play a significant role in the economic prosperity of a region by providing stable employment growth and knowledge spillovers. However, mature clusters are likely to lose their capability of renewing themselves in terms of novelty and innovativeness. This phenomenon, also known as lock-in (e.g., the steel and coal cluster in the Ruhr area; Grabher, 1993) endangers regional futures.

Despite the significance of mature clusters for regional development, there is little knowledge on how to avoid lock-in at the sustaining stage. Firstly, regional policy actors lack the knowledge to comprehend how firms gain novel knowledge in traditional sectors in less developed regions (Giuliani, 2013). Secondly, various initiatives have different impacts on knowledge sourcing and on cluster development trajectories in the long run (Lindqvist, Ketels, & Sölvell, 2013). This aspect has not been investigated in mature clusters in developing regions. Learning from a few studies on clusters at the sustaining stage, old firms rely strongly on their constant collaborating partners and are not capable of building new relations (Hassink, 2005). At this stage, technological lock-in hampers further diversifications, while the key firms leave the cluster, and entrepreneurial activities rarely emerge (Østergaard & Park, 2015).

Against this background, we map and explore how knowledge networks are structured in the two low-tech clusters in western Poland. We explore knowledge network configurations to enrich our understanding of how cluster entities initiate mutual learning. Finally, we analyse the knowledge-sourcing pattern and its significance for innovation in clusters at the sustaining stage.

METHODOLOGY AND CASE STUDY

Visualizing and investigating knowledge networks is part of the relational approach that has been gaining importance in regional studies in the last two decades (e.g., Bathelt & Glückler, 2011). One key tool for exploring knowledge networks is SNA. It allows one to investigate knowledge-sourcing mechanisms by drawing dyads–bilateral links between knowledge sources and knowledge receivers and, therefore, showing patterns of gaining new knowledge necessary for firms to innovate (Ter Wal & Boschma, 2009; Giuliani & Petrobelli, 2011).

We selected two furniture clusters in Wielkopolska – a historic and administrative (NUTS-2) region in western Poland with high furniture production and export. The furniture sector is established as a smart specialization focus at both the country and regional levels of Wielkopolska ('interiors of the future'). The selected furniture clusters are in Swarzędz commune and Kępno *poviat*, where the proportion of furniture firms significantly exceeds the country average, as confirmed by high values of the location quotient (LQ) (8.82 and 12.23 respectively).[2]

In order to investigate knowledge networks in the two selected clusters, we used two different research perspectives articulated in the SNA (Wasserman & Faust, 1994). In Swarzędz, interviews were conducted in firms that were part of a cluster initiative, i.e., which in 2011 signed a letter of involvement in the formal cooperation agreement. The initiative allowed firms to apply for external funds for projects concerning cooperation with research institutions, training conducted by specialized external firms, participation in fair trades – therefore enabling various forms of knowledge interchange. A list of all firms and three institutions of the cluster initiative was presented at the beginning of each interview. Among others, two questions to managers were then asked: (1) With whom – from the list – did you speak or correspond in order to get useful information about the furniture production? (2) Have you introduced any changes (product, process, organizational or marketing innovations) in your business over the last two years? The first question was part of a 'roster recall' method in SNA since a person recalls the relationship with all the other agents inside a certain network (here, a cluster initiative). The relations between the nodes are non-directed (bilateral).

In the second cluster, without institutionalized cooperation agreement, first we asked one local leader – the director of the Society of Kępno Land Friends, who has been living and working in Kępno in various administrative units for over 30 years – to indicate three most important and known furniture firms in the area. The starting point was to collect the opinions of their managers about from whom they or their workmates acquired new knowledge.

Each respondent in Kępno gave a list of agents: firms and institutions that were sources of technological knowledge for their firm. Managers from the firms then indicated by the first respondent were asked the same question. Another manager gave a list which expanded the circle of entities being part of a knowledge network within the furniture cluster, and another added agents and so forth. This method of network analysis is called a 'snowball' because the network of agents involved in the investigated issue (here, a knowledge network in a furniture cluster) grows with every interview until a certain saturation point (e.g., mentioning the same entities) is reached. All furniture firms were additionally asked how many innovations they had introduced in the last two years. Table 1 provides a brief description of the case studies and the empirical approaches.

Answers were then put in a table and used in the further analysis of knowledge networks. We measured the centrality of firms – the number of direct relations (ties) to all other agents (nodes) inside a network – and correlated it with the innovativeness of a firm, reported by a firm representative during the interview (using the V Cramer correlation coefficient, as one variable – the existence or not of a tie – is in a nominal scale). Computations and visualizations were made using the Ucinet VI and Netdraw software (Borgatti, Everett, & Freeman, 2002).

KNOWLEDGE NETWORKS AND FIRMS' INNOVATIVENESS IN TWO FURNITURE CLUSTERS IN POLAND

The results of the interviews allowed knowledge networks to be drawn for both investigated clusters: the firms and the institutions (nodes) were connected by relations (links) showing from what sources novel technological knowledge for innovative activity was gained (Figures 1 and 2). The first network is more dense and all firms claim to have created some relations to other firms as well as three research institutions taking part in the cluster initiative. The second cluster consists of several cliques created by firms around various institutions cooperating with the furniture

Table 1. Two research perspectives for investigating knowledge networks in clusters.

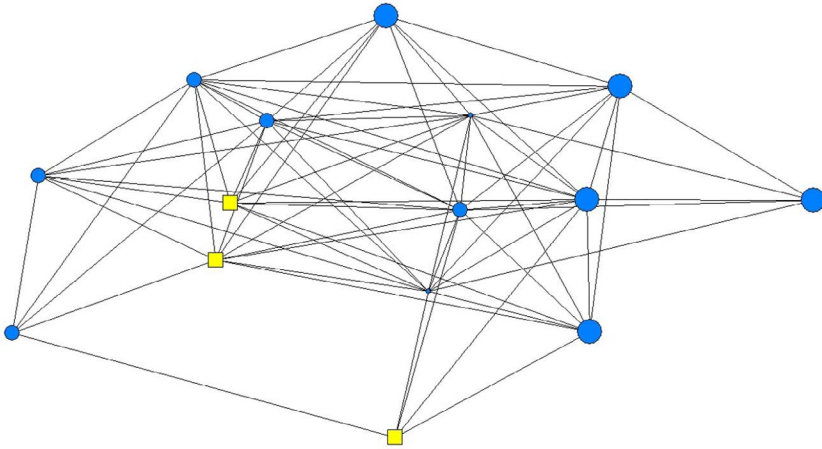|	Swarzędz cluster	Kępno cluster
Characteristic features	Micro-, small and medium-sized firms, mostly with long traditions and united in a local guild; highly spatially concentrated	Firms of all sizes including several large ones, without formal cooperation, many export oriented, located in a larger area
Social network analysis (SNA) approach	Roster recall: interviews with all firms in cluster initiative: assessing all cooperating firms as knowledge sources when looking at the list	Snowball: starting from three firms indicated by one local leader, then interviewing firm representatives indicated as cooperation partners and knowledge sources to create a network
Number of interviews	Twelve furniture firms – members of a cluster initiative	Twenty-six furniture firms located close to each other

Figure 1. Knowledge network in the Swarzędz furniture cluster, Poland.
Note: Circles = firms (the size of a symbol reflects the size of firms: (a) micro/small, (b) medium and (c) large); and squares = cooperating institutions.
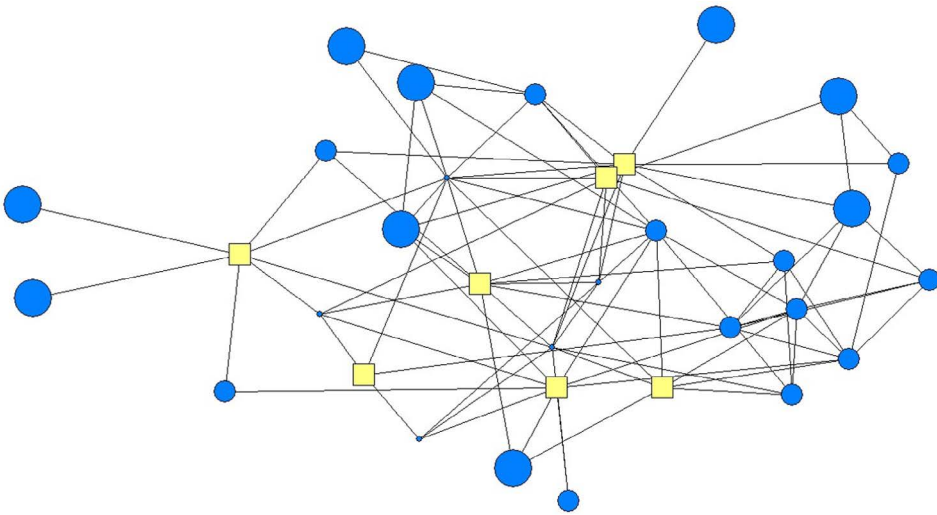

Figure 2. Knowledge network in the Kępno furniture cluster, Poland.
Note: Symbols are as for Figure 1.

industry. Links between firms are occasional. Therefore, a higher network density, counted as the number of ties out of all possible ties, was observed in the first network: 0.562 (standard deviation (SD) = 0.496); in the second it was 0.139 (SD = 0.346). Table 2 illustrates clusters' characteristics.

The second part of the analysis was devoted to the role of knowledge gained through the cluster in introducing various innovations in firms. In the first cluster, 12 interviewed firms declared to have introduced a total of 34 innovations, while in the second, 26 firms innovated 77 times. The most innovative firms introduced eight and 11 innovations respectively; in both cases innovations comprised new or significantly improved products (furniture series, equipment, machines), organizational changes (e.g., cooperation with designers, different organizational structures), as well as new processes and ways of promotion. Product and organizational innovations were most common, but marketing and process also were reported. A correlation was then calculated

Table 2. Cluster characteristics: results of the research.

Cluster	Network density	Role of institutions in knowledge networks	Total number of introduced innovations	Correlation (V Cramer): firms' centrality and innovativeness
Swarzędz furniture cluster	0.562 (SD = 0.496)	Local guild plays a role in bringing firms together	34	0.62 (p = 0.05)
Kępno furniture cluster	0.139 (SD = 0.346)	External institutions offered an individual consulting services	77	0.39 (p = 0.05)

Note:
SD, standard deviation.

between the centrality of individual firms in knowledge networks and the number of implemented innovations. In the Swarzędz cluster, the result was 0.62 (p = 0.05) and in Kępno the results was 0.39 (p = 0.05). The positive correlation coefficients show that in both cases the more central the position of a firm in the knowledge network (the more links to various knowledge sources), the more innovative the firm. However, while in Swarzędz most respondents explained during the interview that new products or changes in the production or organization methods would not be possible if it had not been for the new external knowledge gained through personal contacts in clusters, in Kępno most respondents claimed that other sources of knowledge (internet, fair trades) were more important.

DISCUSSION: THE SIGNIFICANCE OF KNOWLEDGE NETWORKS IN CLUSTERS

The research shows that Marshall externalities are an important source of knowledge for the firms in the two investigated clusters, but institutionalization of cooperation (contacts through the cluster in Swarzędz) proved important for the scale and type of those externalities. We found differences in the composition of knowledge networks in Swarzędz and Kępno furniture clusters. In Swarzędz, a formalized cooperation coordinated by a formal entity, managed to create mutual trust and – as a consequence – the initiation of knowledge flows. In Kępno, where relations concerning cooperation and knowledge flows are purely market driven, ties are less frequent – firms search for new knowledge mainly in external, specialized institutions and only sometimes cooperate with local firms. Some large firms subcontract part of their production (one part of a value-added chain, one set or kind of products) to medium or small firms first of all to fulfil their commitments to business partners (in many cases foreign). Consequently, the smaller the size of the firm, the more links to other firms were indicated. Three large firms that took part in the study were self-sufficient in their activity and acquired new knowledge only from cooperating with business environment institutions: high competition between dominant firms favoured individual ways of gaining new knowledge. According to the respondents, 'business does not like publicity' and being afraid of losing the competitive advantage, they avoid any contacts with their local competitors.[3]. This challenges a fundamental premise in the cluster literature, defining trust as one of characteristics of mature clusters (Iammarino & McCann, 2006) where collective actions and reciprocal learning take place effortlessly.

Furthermore, significant differences in knowledge network densities between the two investigated clusters were observed. A higher value of the Swarzędz network suggests that the

institutionalization of cooperation leads to more opportunities for the acquisition of valuable knowledge. In Kępno, without institutionalization, there are fewer opportunities for collective learning/knowledge dissemination and, therefore, for various knowledge externalities for the surrounding area. Despite this, several large companies in Kępno perform well, with some using their own channels of knowledge acquisition to expand their production and, as a consequence, managing to achieve better results than any investigated company in their cluster. The results are in line with the findings of Potter and Watts (2014), who showed empirically that Marshall's externalities still play an important role in terms of knowledge scouring in the mature metal cluster in Sheffield, UK.

Finally, by facilitating knowledge sourcing, the two clusters enabled the firms to implement various innovations. The more active (central) the firms were in this process (the more central position they managed to get), the more innovative they became. This suggests that it is worth participating actively in knowledge networks, as the novel knowledge helps to introduce positive changes. Especially in the institutionalized Swarzędz cluster, firm representatives declared that innovations would not be introduced without knowledge sources accessed through the cluster. A positive correlation between the value of firms' centralities in knowledge networks and innovations suggests that for many firms it was worth taking part in projects of cluster initiatives in order to access valuable knowledge.

CONCLUSIONS

This study showed that clusters in less-developed regions function differently in terms of knowledge transfer and innovation when compared with high-tech, growing clusters. We found, firstly, that Marshall's externalities are the main source of knowledge for the firms located in the low-tech clusters at the sustaining stage. However, contrary to the dominant literature on the cluster life cycle, we have not observed a tendency to build national and international relations among firms. Secondly, the initiatives by local institutions facilitate the process of knowledge transfer and innovation, counteracting the possible lock-in effects. Thirdly, we found that embeddedness in the local knowledge networks plays a much more significant role than the co-location in terms of knowledge sourcing. Lastly, small and medium-sized enterprises engage more strongly in the knowledge exchange.

The study highlights the need for providing new supportive mechanisms for new entries into the mature clusters as a source of novelty in the long run. Worth supporting are also various initiatives aimed at the institutionalization of cooperation as they help to develop and share knowledge between cluster stakeholders, leading to innovations.

Future research replicating interviews at different time intervals could provide a dynamic knowledge network overview, which would enrich our understanding of how these evolve. Finally, more similar case study research is needed to develop a more comprehensive policy framework for clusters in low-tech sectors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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NOTES

1. Wielkopolska is an example of a region with an economy to a large degree based on traditional sectors, with gross domestic product (GDP) in 2016 of less than 75% of the European Union average, so it is a 'lagging' or 'catching-up' region.
2. The LQ was calculated as the proportion of furniture firms in the territorial unit: Swarzędz commune/Kępno *poviat* in the set of all firms registered in this unit, divided by the proportion of all furniture firms in the set of all firms registered in Poland. LQ = 1 means the average proportion; LQ > 1 means the excess of the phenomenon.
3. It could be connected with the informal, most popular way of doing deals in an communist, centrally planned economy, which Poland was before 1989

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