

## **INTER-CLUSTER PIPELINES: THE DRIVING FORCE OF KNOWLEDGE CREATION AND ECONOMIC DEVELOPMENT**

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### **--Abstract--**

Even though cluster-based economic development has become more appearing, there has been much argument on various aspect of clusters. One going debate concerns some clusters generate high innovation associated with economic growth. The purpose of this stud is to illustrate the utility of inter-cluster pipelines for securing high knowledge creation and growth rates. As inter-cluster pipelines are based on social relations and ties, in addition to economic geography literature, we use social network theory (SNT). One advantage of SNT is that it enables to explore the processes of how pipelines are created and the potential value of them.

**Key Words:** *Clusters, Pipelines, Knowledge Creation*

**JEL Classification:** 030

### **1. INTRODUCTION**

The knowledge-centred theory of cluster highlights two alternatives sources of knowledge creation and combination: clusters could learn either internally (by stimulating knowledge interactions among clusters' members) or externally by looking outside their barriers to explore new knowledge.

In the pursuit of new and creative opportunities, local knowledge networks (i.e. intra-cluster knowledge dynamics) are considered of pivotal importance. Sorensen, for instance, claims that "industries cluster because entrepreneurs find it difficult to access the information and resources they require when they reside far from the sources of these valuable inputs" (2003: 513).

On the other hand, an important stream of literature has discussed the importance of accessing external sources of knowledge, of increasing the external connectedness through the development of so-called "knowledge pipelines" (Bathelt et al., 2004; Owen-Smith and Powell, 2004) catalyse clusters'

performance. Those pipelines, by offering the opportunity to tap into external pools of knowledge, allow clusters to obtain new knowledge, thus enhancing their innovativeness and resilience.

This paper deals with the nature of pipelines and investigates how they come about, using social network theory and economic geography literature. The paper is conceptual and structured as follows: the second section provides an outline of the theoretical debate on intra and extra-cluster knowledge systems and social networks. Section three unfolds the creation of pipelines. Finally, section four involves the conclusion.

## **2. INTRA AND EXTRA-CLUSTER KNOWLEDGE SYSTEMS AND SOCIAL NETWORKS**

This section reviews the theoretical foundation of the paper. First, clusters and subsequently knowledge systems are addressed. Secondly, theory on social networks is presented.

### **2.1 Why Clusters Matter**

Agglomeration economies can be distinguished by using a simple classification scheme delineating efficiency advantages versus innovation advantages of clusters on the one hand, and agglomeration in general versus agglomeration of technologically related actors on the other. This division leads to four main types of agglomerations which are namely cities, industrial districts, creative regions and clusters (Malmberg, Sölvell & Zander, 1996).

Cities and industrial districts can be explained mostly by efficiency gains and flexibility, one can distinguish two other types of agglomerations which are considered as centres of knowledge creation and innovation.

The first type we refer to as *clusters*, where sustained competitiveness is based on capabilities that are linked to a particular location (Porter, 1998). Clusters are not conceived as fixed flows of goods and services, but rather as dynamic arrangements based on knowledge creation, increasing returns and innovation in a broad sense. Thus, clusters contain the intense exchange of business information, know-how, and technological expertise both in traded and untraded forms.

The last type of agglomeration involves knowledge creation and creativity in a region without any sectoral boundaries. Though Porter's (1998) main concern has been the existence and reproduction of clusters of technologically related firms, there are corresponding attempts to analyse the learning abilities and creativity of regional and urban agglomerations of the general type. Instead of specialisation

and spatial clustering of related industries, emphasis is placed upon the presence of a regional variety of skills and competencies, where the often-unplanned interaction among different actors can generate new and sometimes radical ideas and creative designs, products, services and business concepts (Andersson, 1985).

Using data from the European Cluster Observatory ([www.clusterobservatory.eu](http://www.clusterobservatory.eu)), it can be interpreted that there is an important relationship between *degree of clustering and innovative performance (measured as patenting levels)*. So what are the mechanisms behind this? Why do we see a greater degree of innovation emerging inside clusters? Rosenberg (1982) reported that the economic effects of technological breakthroughs are not really about the sophistication of a technology itself, but instead are connected to the degree to which the technology is commercialized and diffused into society. In instances that deal with an actual technological invention, incremental innovation and the adjustment of the business model and the management of the budget often come to be more important than the invention itself. This is exactly where clusters enter into the picture. Clusters provide a favourable atmosphere in which frequent, day-to-day and face-to-face interactions can transpire, and where ideas, concepts and beta versions are tested over and over again, within particular institutional setting, amongst personal networks and on a foundation of shared trust that has been built up over time (Malmberg, Sölvell & Zander, 1996).

## **2.2 Knowledge Creation and Combination by Clusters**

A significant line of argument within the geography of knowledge exchange literature focuses on the role of tacit and explicit knowledge with respect to the emergence and growth of clusters. Basically, tacit knowledge is regarded as a substantial determinant of “*the geography of innovative activity*” (Gertler, 2003: 79). From this perspective, tacit knowledge is considered to resist easy codification and, therefore, is difficult to share across long distances. More importantly, tacit knowledge is claimed to be spatially sticky owing to its context specific nature, suggesting that actors can only share tacit knowledge effectively when sharing a similar social context. This social context is, to large extent, depicted to be defined locally. Additionally, the process of innovation is increasingly formed on tacit interactions between actors, meaning that the process is characterised by interactive, social learning (Gertler, 2003).

Local knowledge flows take as been qualified as “local buzz” in the sense that it occurs in a natural and, sometimes, unintended way. Marshall (1920: 225) described it as something “in the air”. As pointed out by Bathelt et al. (2004: 11), “the buzz refers to the information and communication ecology created by face-

to-face contacts, co-presence and co-location of people and firms within the same industry and place or region....Actors continuously contributing to and benefiting from the diffusion of information, gossip and news by just being there”.

### ***Clusters’ learning through external knowledge flows***

Maskell et al. (2004) named inter-cluster knowledge linkages as ‘pipelines’. Pipelines bridge geographical distances and thus create social proximity between clusters. The concept of pipelines takes its point of departure in the recognition that new and valuable knowledge will always be created outside any cluster- no matter how innovative it is. Firstly, firms with ties to actors located in other clusters benefit directly from the knowledge obtained through these pipelines. Bathelt et al. (2002: 19) indicated that “firms build pipelines to access knowledge that is not already part of their repertoire”. Secondly, the knowledge that enters the cluster is likely to spill over to the other actors located in the cluster through the firm’s local knowledge network. Finally, inter-cluster knowledge inflows allow local competencies to be nurtured and thus catalyse local buzz, suggesting that internal and external learning might cross fertilise, and that global pipelines might be considered as a way to cope with internal lock in problems.

As mentioned earlier, the local buzz is considered as the consequence of frequent face-to-face interaction. In contrast to this cluster internal focus on individuals, pipelines are described as linkages between firms (explicit examples are Maskell et al., 2004 and Guillani, 2005). Maskell et al. (2004) propose international events such as conferences, trade fairs, congresses, and the like, as vehicles for inter-cluster interaction among entrepreneurs and firms to take place, thus providing in a temporal context for intensified knowledge exchange and social interaction. In addition to that, since the construction and maintaining of pipelines are risky and resource-consuming activity face-to-face interaction through conferences and trade fairs is an important foundation for creating external connectedness.

This study recognised that inter firm links are part of pipelines and, such links are risky and expensive to establish. But, we believe that we need to enhance our comprehension of how these inter-cluster linkages come about, by shifting focus from firms to individuals within clusters. With ties between highly mobile knowledge workers (Gertler, 2003; Trippel et al., 2009) as the fundamental unit of analysis it appears to tap into the literature on social networks and thus get a broad theoretical framework for analysing of ties between people and ties between people separated by geographical distance.

### **2.3 Social Networks and External Connectedness**

Social Network Analysis (SNA) is a methodology for detecting, describing and analysing the relationships among a group of people or organisations. In SNA, the focus of interest is not on individuals as discrete units of analysis; instead, it is concerned on the relationships of those individuals. The underlying premise of SNA is that the behaviour of people and organisations is affected by, and in turn shapes, the social networks in which they are involved. In other words, social context matters (Carrington, Scott & Wasserman, 2005). Actors are viewed as interdependent entities with their relations (ties); ties are considered as channels for transfer of different resources. When analysing social networks two features are of particularly great interest: the value of certain network structures and the value of centrality. According to Borgatti (2006), the network structure transforms the collective performance while the actor's position (the centrality or connectivity of node) provide opportunities or constraints.

Sorensen (2003) applied social network theory and showed how being embedded in a social network context offers better access to information, financing and labour to the entrepreneur. And due to the importance of face-to-face interaction in forging social network ties these benefits have a tendency to be geographically concentrated- particularly for high-tech industries. As Sorensen (2003) pointed out the value of the cluster and the residing social networks is a greater trust in the economic actors' abilities and clustering comes into existence because of the localized nature of such networks.

Although there are a variety of ways to assess the different types of social interactions an individual may have, the concept of tie strength has been considered a basic characterization of social relationships (Granovetter, 1973). Given an individual's set of direct interactions, stronger relationships involve a high level of emotional closeness and relatively frequent interaction and reciprocity (Granovetter, 1973). These relationships have a variety of intuitive benefits, such as social support and trust. However, weaker relationships, those involving comparatively low level of closeness and interaction, may be especially beneficial for creativity despite the intuitive "strength" of strong ties (Perry-Smith & Shalley, 2003).

In his seminal weak tie theory, Granovetter (1973) proposed that weak ties are more likely than strong ties to be nonredundant connections between two disparate social circles. For individuals, this means that each weak tie may represent his or her sole connection to a particular social circle. Instead of being connected to multiple individuals in a clique, a person is likely to be connected

with just one individual in this clique by the weak tie. In contrast, the strong tie is likely to be associated with a dense collection of redundant ties (Granovetter, 1973). In strongly tied networks, an actor will tend to receive the same information from different contacts, because this information will tend to travel over circular and redundant paths. In contrast, information travelling via weak tie is more likely to originate from outside of one's immediate social circle. As a result, weaker connections may be associated with nonredundant information. This information may not necessarily be creative in nature, but is less likely to repetitive. Also, the type of relations among people which is likely to have the greatest effect on pipelines is weak ties, since they serve to break out of the densely clustered network of relations formed by strong ties.

The valuable contribution to Granovetter's study has been made by Burt (1992). He discussed that the importance is not the strength of the tie, but the social gap it spans. While strong ties are of local nature, weak ties often span both social and geographical distances. In the terminology of Burt (1992), a social relation, that cross a cluster's boundaries is much more valuable than other social relations, as it spans a crucial structural hole. Weak ties (bridging ties) connect together otherwise separated worlds and thus catalyse spread of information and adaptation of innovations (Barabási, 2003).

The combination of strong ties and bridging ties produce what is called a 'small world'. The incidence when local networks are linked through few, albeit seminal, ties concludes in a joint "small world<sup>1</sup>" network (Barabási, 2003). This study suggests that the phenomenon of industrial clusters that are connected through pipelines is important case of small world networks. It is highly beneficial for a cluster to be a part of a small world network, since it allows the cluster to simultaneously enjoy effects of clustering (localised learning) and access to global resources, learning and markets.

Most small world networks are both scale free and modular with hubs bridging otherwise separated local clusters (Barabási, 2003). Ties to hubs are fundamental in order to reap the benefits of the small world network structure. But at the same time, possessing many ties is a 'mixed blessing' (Barabási, 2003). Although lots of ties mean lots of access points to information they also require a great deal of maintenance. This indicates the importance for those network nodes that are not hubs themselves to possess to hubs among their relatively few ties.

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<sup>1</sup> The small world phenomenon is characterized by high internal clustering combined with a few global links, of which many lead to so-called 'hubs'.

Connection does not come easily and being well connected is not sufficient to attract new ties. Many interpersonal ties between people in specific clusters aggregates to pipelines between the clusters and thus are creating the social proximity which allows knowledge to be exchanged across great geographical distances and diffuse into the local buzz. Some personal ties evolve into formalised alliances between firms, others remain personal and informal. This does not mean that pipelines lead to the out performance of geographical proximity by social proximity. Rather the two type of network ties coexist performing different needs related to the coherence and innovation in clusters and thereby reinforcing each other. But though the network ties of pipelines social proximity overcomes geographical distance (Gertler, 2003) and knowledge transported between clusters.

For the cluster as a whole a small world network structure will be useful as the cluster internal buzz is fertilized through the pipelines. For firms such a structure will offer both local buzz of high quality and direct links to information from knowledge hubs. And for the individual such a structure provides a challenging working environment along with possibilities for pursuing professions at the innovative centres in their field.

### **3. THE CREATION OF PIPELINES**

As indicated in the previous section, one discussion for the creation of inter-cluster knowledge linkages has been that they take form of strategic alliances between companies, and that one way to catalyse this process is through international events (Maskell et al., 2004). The point put forward in the literature on clusters that these events operate as temporary clusters and offer some of the benefits usually associated with clusters and hence they are places for sharing tacit knowledge. Our argument is that this is one explanation and hardly reveals all sides of the creation of pipelines. Many pipelines come out the results of social network ties, and even if relations among economic actors may build pipelines, such relations often spring from personal relations among people. Therefore, the central point should be on how network ties between people can span geographical distances when most existing literature underline the value of face-to-face interaction.

Jack (2005) demonstrated that ties between people can remain solid for years and still be activated on request. Based on her study it has been stressed that frequency of interaction between people is not an essential determinant for social relations at all times- if people have once been linked the tie can be re-invoked without difficulty even after years of separation (Jack, 2005). Previous ties remain within

the network structure as latent knowledge and resources. In a similar way ties between people can be anticipated to remain though they are no longer practicing day-to-day contact within some geographical area. Though geographical proximity is of essence when building network ties the value of 'being there' becomes less when it comes to preserve those ties. Granovetter (1973) states this process for change of social context: "*When a man changes jobs, he is not only moving from one network of ties to another, but also establishing a link between these*". Thus, pipelines can be built though the geographical stretching of ties between people. This stretching takes place when people move about. Network ties that cross cluster boundaries often originate within one cluster but have subsequently been stretched across cluster boundaries, as actors move in order to live and/work in another geographical locale, but keep their relations to actors in their cluster of origination. Granovetter (1973) claimed that where there is 'strength of weak ties', there is added value in stretching them as this may create small world networks.

The 'people move about' discussion generates the question of where people move to and from. In the world of clusters, people are pulled towards those clusters that are global nodes of excellence. The reason for that these places maintain both ties and the quality of cluster internal buzz. The process of stretching ties is also ruled by preferential attachment and thus adds to the creation of hubs. As a result, the nodes with the most ties and the highest quality of internal buzz attract the most new ties. Therefore pipelines and buzz are mutually reinforcing (Bathelt et al., 2002) and not competing directions of the small world network. But, clusters that are hubs or connected to hubs have great chances of success.

#### **4. CONCLUSION**

Pipelines between clusters contain aggregations of (mainly weak) stretched ties between people, whereof some has evolved into more formalised strategic alliances between firms. Although face-to-face interaction is necessary for forming ties, they can survive across geographical distances without regular face-to-face interaction. Pipelines are therefore an aggregation of what Burt (1992) conceptualizes as bridging ties, stretched between clusters. As such pipelines are valuable sources of new ideas, innovations and perspectives. The value added from pipelines is thus the innovative capability of bringing together different perspectives and knowledge within the social context of the mutual framework of clusters. This combination of cluster internal buzz and stretching pipelines produce small worlds in which the new can be absorbed by means of network relations. The absorptive capacity is enhanced by the stretching process: the

people at each end of the pipelines are friends, colleagues or neighbours who have previously enjoyed of being part of the same cluster and hence shares the same local network and cluster internal buzz.

While the study's combination of economic geography with social network theory adds value in itself, the study also contributed towards opening the black box of pipelines through critically investigating some of the claims made about them and using social network theory in order to explore their structure and economic value.

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