Chapter 7.

Knowledge Creation in Case of Clusters

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Introduction

In the era of globalization, organizations in both developed and developing countries tend to take a new approach cooperation and collaboration. The access to international and local knowledge has become fundamental in the new economy. In the theory of organizational economics, organizations are regarded as open systems that process information to be turned into profits (Cook, 2007).

It means that in the global knowledge economy, knowledge becomes more and more essential and necessary. Effective knowledge sharing is the most important target for firms and other organizations to look for (Carayannis, Wang, 2008).

Clusters refer to a geographic area cointaining a number of companies, organizations and intermediate agencies. They are usually formed and developed following the linkages in a value chain (OECD, 1999) and imply cooperation, trust and distributed knowledge. Organizations in a well developed cluster tend to search for external knowledge and R&D partners within the cluster FORMED (Carayannis, Wang, 2008). Therefore, it can be assumed that clusters as a type of organizational networks are conducive to creation of inter-firm knowledge and skill development, which shall be discussed further on within this chapter.

7.1. Clusters as organizational networks – characteristics

Clusters are defined as

a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. The geographic scope of a cluster relates to the distance over which informational, transactional, incentive, and other efficiencies occur (Porter, 2000).

According to D. Jacobs i A.P. De Man clusters can be defined as (Jacobs, Man, 1996):

» geographically concentrated groups of companies from related sectors, often associated with centers of knowledge,
» networks formed by the major companies operating in a specific geographical area in narrowly defined sectors where vertical chains of products can lead to very significant externalities. They are simple information structures, limiting the process of knowledge spreading, which leads to significant innovations,
» highly concentrated sectors without peculiar regional dimension. They are usually placed at the level of national, rather than regional.

In turn, P. Cook emphasizes the element of interaction between the members in his definition of a cluster. He points out vertical and horizontal linkages between firms that cooperate and compete in the same or similar branches (Cook, 2002).

More than single branches, clusters encompass an array of linked industries and other entities of importance in the process of competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services as well as providers of specialized infrastructure. Clusters also often extend downstream to channels or customers and laterally to manufacturers of complementary products or companies related by skills, technologies, or common inputs (Porter 2000). Many clusters include governmental and other institutions (e.g., universities, think tanks, vocational training providers, standards-setting agencies, trade associations) that provide specialized training, education, information, research, and technical support.

Meyer-Stamer recognize that clustering offers unique opportunities to engage in a wide array of domestic links between users and producers, and between the economy's knowledge-producing sector (universities and R&D institutions) and its goods-and-services-producing sector. All of these linkages stimulate learning and innovation (Meyer-Stamer, 1998). Mytelka emphasizes the role of clusters in promoting the kind of interactivity that is an important stimulus of innovation, but, on the other hand, he cautions that the collocation of actors in geographic proximity does not automatically lead to interaction, learning and innovation (Zeng, 2008).

According to many scientists there are three kinds of externalities important for clusters (Marshall, 1890; Krugman, 1991; Russo, 1985; Pyke, 1990):

» economies of specialization: where clusters are created as concentrations of firms and support institutions,
» economies of labor pooling: where the existence of specialized labor force attracts firms,
» technological externalities: where the process of communication between actors is facilitated.

There is a great diversity of clusters types. The following characteristics can help in define them (see: Roelandt, Gilsing, van Sinderen, 2000; Chiarvesio, Micelli, 2002; Knorringa, Meyer-Stamer, 1998; Markusen, 1996; Porter, 2000):

» Formal vs. informal: Some clusters have a contractual or legally sanctioned basis (e.g. strategic alliances, export consortia, business associations), others are without any such basis owing to the mutual interests of the parties concerned (e.g. industrial districts).
» Hierarchic vs. non-hierarchic: Some clusters have a clear hierarchical structure (e.g. supplier networks, networks of hollow corporations2), while others have more egalitarian structures that do not necessarily develop a tendency toward hierarchical organization over the course of time (certain Italian industrial districts fit into this category).
» Vertical vs. horizontal: In terms of division of labour, certain clusters are organized vertically along the value-added chain (e.g. supplier / subcontractor networks), others are structured horizontally (networks of researchers, industrial districts in terms of information spill-over).
» Time-limited vs. long-term: Certain clusters (e.g. technology clusters) are established with an eye to a concrete goal and thus for a limited period of time, others (e.g. districts, business associations) are long-term arrangements.

Clusters capture important linkages, complementarities, and spillovers in terms of technology, skills, information, marketing, and customer needs. The character of networking influences the structure of clusters in many ways, which can be considered more or less profitable in terms of interaction, cooperation and development. According to Cook (Cook, 2002) we can distinguish the following types of cluster networks:

» informal networks, based on family, friends or business partners,

» formal networks created mostly among firms, but including financiers, accountants, lawyers and other professional advisers, as well,
» soft ongoing networks, enabling experience sharing between actors with broad common interests,
» hard networks, contractual, legally binding and action-oriented with an elaborated business plan and a set time span,
» vertical networks, focused on supply-chain or supplier development group activities; may be formal and associative and result in hard network contracts,
» lateral networks link firms of a similar size with complementary assets, through some between competitors are known, who generally work in formal or hard networks to achieve some business objective they could not consider individually.

Some researchers consider clusters to be more efficient than other forms of cooperation. Using key indicators of competitiveness, such as productivity, innovation and creation of new firms Porter proved that clustered production systems are superior to cooperation structures, since knowledge, human capital and technological applications in clusters flow more swiftly than within cooperation structures (Porter, 2001). Cook, on the other hand, stresses the following benefits brought by clusters (Cook, 2002):

» Lower costs of specialization, cheaper local sourcing because of minimal inventory requirements, lower transaction costs because of the existence of high trust relations;
» Innovation gains come from proximity between customers and suppliers where the interaction between the two may lead to innovative specifications. Localized benchmarking among firms on organizational as well as product and process innovation is facilitated in clusters. Qualified personnel are more easily recruited and are of key importance to knowledge transfer. Informal know-how trading is easier in clusters than through more distant relationships;

New businesses are more readily formed where better information about innovative potential and market opportunities are locally available. Locally available inputs and skills further reduce barriers to entry.

Extensive market, together with technical and other specialized kinds of information accumulate in the firms and local institutions within a cluster where they can be accessed better or at a lower cost, allowing firms to raise current productivity by getting closer to the productivity frontier. The same factor also

applies to the flow of information between different units of the same company. Proximity, supply and technological linkages, as well as existence of repeated personal relationships and community ties fostering trust, facilitate the innovation flow within clusters (Porter 2000).

Many researchers have conducted studies and provided examples of clusters with high performing innovative capabilities. Clusters are often connected to leading edge universities in the business area of the clusters. One of the arguments for the concentration of innovative activities within clusters is the faster knowledge flow inside and the slower information flow outside and across its borders (Brusco, 1990). Another factor contributing to the innovative performance of the companies located in clusters are the channels of communication facilitating knowledge diffusion (Russo, 1985). They are created by informal contacts emerging between individuals in different companies within the network.

7.2. The theory of knowledge creation

Knowledge is defined variously as:

expertise, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject, what is known in a particular field or in total; facts and information or awareness or familiarity gained by experience of a fact or situation. Philosophical debates in general start with Plato's formulation of knowledge as "justified true belief (Oxford English Dictionary).

There is no single agreed definition of knowledge presently, and there remain numerous competing theories. However, there are distinguished three types of knowledge (Kraaijenbrink, Faran, Hauptman 2006): latent, explicit and tacit knowledge. Each knowledge type tolerates a different sort of activity and people need to be motivated to execute any of them.

Latent knowledge is the type of knowledge that can be used by its holder exclusively – others can imitate it, but only blindly. Therefore, the only activity to make it explicit is elicitation (see table 7.1). In turn, explicit knowledge is the kind of knowledge that is easy to manipulate. Only explicit knowledge can be acted upon directly. As for tacit knowledge, similar to latent knowledge, only their outcomes are distinguishable. Tacit knowledge is also inexplicable and tightly delimited (see table below).

Table 7.1. Activities for knowledge

Activities for latent knowledge	Activities for explicit knowledge	Activities for tacit knowledge
Elicitation	Codification Detection Assessment Transfer of knowledge	Transfer of knowledge holder Nurturing

Source: Based on Kraaijenbrink, Fran, Hauptman (2006).

Knowledge can be also divided in order to origins of knowledge. Knowledge can be embodied in process, product and also person (Cook, Brown, 1999).

Person-embodied knowledge can be defined as information that is relevant, actionable, and based at least partially on experience. There are two forms of person-embodied knaowlege: explicit and tacit knowledge (Chai, Gregory, Shi, 2003)

The existence of tacit knowledge depends on the degree to which knowledge can be articulated. It means that knowledge remains tacit when it cannot be articulated fast enough to improve performance (Leonard, Sensiper, 1998).

In addition to tacitness, other factors that characterize knowledge are: complexity, independence of a system, and embeddendness (Garud, Nayyar, 1994).

Typology of knowledge based on embeddedness and tacitness developed Y. Doz and J. Santos (Doz, Santos, 1997). They distinguished four types of knowledge: explicit, experiental, endemic and existential (see figure 7.1).

Figure 7.1. Types of knowledge
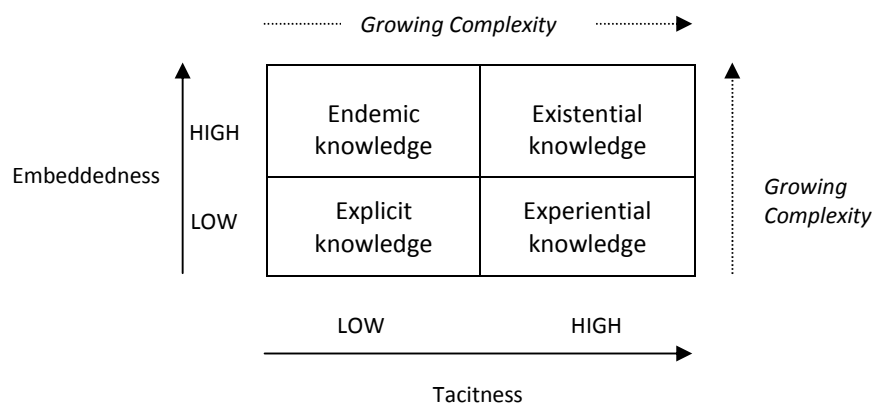
Source: Doz, Santos (1997).

Endemic knowledge, according to Doz and Santos (1997), is articulated and it usefulness can be apprehended only when its context is well understood. On the other hand, explicit knowledge is also articulated but less context-specific. In turn, experiential knowledge is a type of knowledge, which is accuire through experience and practice, is also high in tacitness but low in embeddedness. On the contrary, existential knowledge is tacit and deeply embedded in its context. This knowledge is learned by living and feeling, developed through participation in the situation (Doz, Santos, 1997).

According to Nonaka and Takeuchi (1995) one of the fundamental premisses of a theory of knowledge creation is the tacit-explicit dichotomy of knowledge. Also they emphasize the importance of human activity and social interracion to the creation and development of knowledge. Their theory refers to knowledge assets, that are categorized into four divisions (Nonaka, Takeuchi, 1995):

» conceptual knowledge assets (explicit knowledge in the form of symbols and language);
» experiential knowledge assets (tacit knowledge shared through experience);
» routine knowledge assets (tacit knowledge embedded in organizational routines and practices);
» systemic knowledge assets (systematized explicit knowledge).

Spender (1996) proposed a four-dimensional model structuring information and knowledge within an organisation (see table 7.2).

Table 7.2. Types of organizational knowledge

	Explicit	**Implicit**
Individual	Conscious knowledge	Automatic knowledge
Social	Objective knowledge	Collective knowledge

Source: Spender (1986).

Nonaka and Takeuchi (1995) underline, that only explicit knowledge can be managed. Nevertheless, tacit knowledge may also become explicit and manageable if only enabled. However, one cannot forget that there is a big difference between sharing knowledge and information and actually using creativity in their application (Wilson, 2002).

7.3. Characteristics of knowledge sharing

According to Zeng, we can distinguish three common types of knowledge flows: formal learning (schools, training institutions, universities), non-formal learning (structured on-the-job training) and informal learning (skills learned from family members or people in the community) (Zeng, 2008).

The knowledge of the organization is dependent on the knowledge of their workforce. There are three important categories of that knowledge (Nosek 2004; Smith 2005):

» static knowledge – unchanging facts independent on the knower,
» dynamic knowledge – changeable facts, feelings, emotions; knowledge may be created and is inherently subjective,
» static or dynamic knowledge – the product of the knowledge system at the point where the knower interacts with the world.

In organizations knowledge sharing is highly dependent on effective collaboration. Effective knowledge-sharing is supported by skills, talents and abilities of workers in organizations.

Knowledge sharing mechanisms may have four different characteristics (Almeida, Grant, 1998):

» capacity,
» breadth of communication,
» richness of communication,
» formality.

The motives for sharing knowledge and information are a mixture of organisational and individual preferences. In order to set out the pattern of information behavior we can define five features (Widen-Wulff 2007):

» the information culture and communication climate,
» values, attitudes and cooperation of the group,
» individual roles, expertise and status,
» the role of networks, trust and timing.

The emerging emphasis on the importance of effective knowledge sharing has focused attention on the prevailing organizational culture – culture as the shared values, beliefs, practices of the people in the organization (Schein, 1992). Most directors, managers and owners od companies will agree that their organization's strategic capital is not only heavily dependent on the knowledge of their workforce, but that it is also dependent on the attitudes of their organi-

zation's workforce. Their employees have personal opinions, experience, insights, that are shaped through their everyday activities and human interactions – through formal and informal knowledge sharing (Smith, 2005).

There is no one way to get people to share knowledge. These various forms of knowledge sharing are facilitated in scores of different ways reflecting the values and style of the organization, the category of the knowledge to be shared, and the efficiency and effectiveness of knowledge sharing tolerated by the organization, e.g. training, internet, intranets, query systems, libraries, communities od practice, communities of interest, meetings, etc (McDermott, O'Dell, 2001). The success of these or any other knowledge sharing activities will depend on (Smith, 2005):

» how individuals and groups feel about the process; e. g. the experience and advice can led to share sknoledge highly effectively because people enjoy the social activity,
» how they feel about the network of people with whom they are socializing in sharing knowledge.

Recent studies have shown that different mechanisms have different efficiency at different stages of sharing, and also different mechanisms transfer different types of knowledge. Types of knowledge in order to transfer mechanisms are presented in the table below.

Table 7.3. Transfer different types of knowledge

Types of knowledge	Transfer mechanisms
Explicit	Reports, periodicals, standard operating procedures
Endemic	Best practice guidelines, periodicals, benchmarking, forums, team work
Experiential	Expatriation (expert to recipient sites)
Existential	Overseas training (trainee to the expert site)

Source: Chai K., Gregory M., Shi Y., 2003.

Explicit knowledge, with low tacitness and low embeddedness can be easily transferred through documents (reports, periodicals, procedures), and can be retained without further information on the context. Endemic knowledge, unlike explicit one, is highly embedded in its context, which may not be similar between the originator and potential receiver. Best practices and process improvements are examples of transfer mechanisms of this knowledge. In turn,

experiential knowledge, with high level of tacit elements, can be transferred only through the use of a rich medium – individuals who have the knowledge. The fourth type of knowledge, existential knowledge (tacit and deeply embedded in its context) can be distributed among specialists (Chai, Gregory, Shi, 2003).

### 7.4. Knowledge creation in networks and clusters

Nowadays, knowledge is the firms' and clusters' strategically most important resource. There are a few essential characteristics of networks and clusters in terms of knowledge creation (Hislop 2005):

» multidirectional knowledge sharing,
» flexibility and adaptability (structures easy to modify),
» dispersed working (work colleagues not collocated),
» dispersed knowledge (knowledge required to carry out work tasks geographically dispersed),
» technology-mediated working (ICTs are an important means of communication and coordination),
» flat hierarchies (few layers of management),
» decentralization (non-hierarchical structure),
» blurred boundaries (the boundaries between functions, business units, and organizations involved in networks become blurred).

Another important issue in clusters, which is worth having a closer look at, is the context of knowledge sharing. Apart from the cultural perspective, the cluster approach deals with the social structure of a person and group, as well as with the structure of the relationships existing around a person, group and organization, within which the actual information sharing emerges. We can define this process in terms of (Widen-Wulff 2007):

» actors, activities, resources,
» social conditions,
» links of communication,
» and collaboration.

Information and knowledge sharing is a collective and complex phenomenon with a few aspects of high importance in this process, such as: networks, trust, knowledge, motives and timing (see figure 7.2).

Figure 7.2. The knowledge sharing context
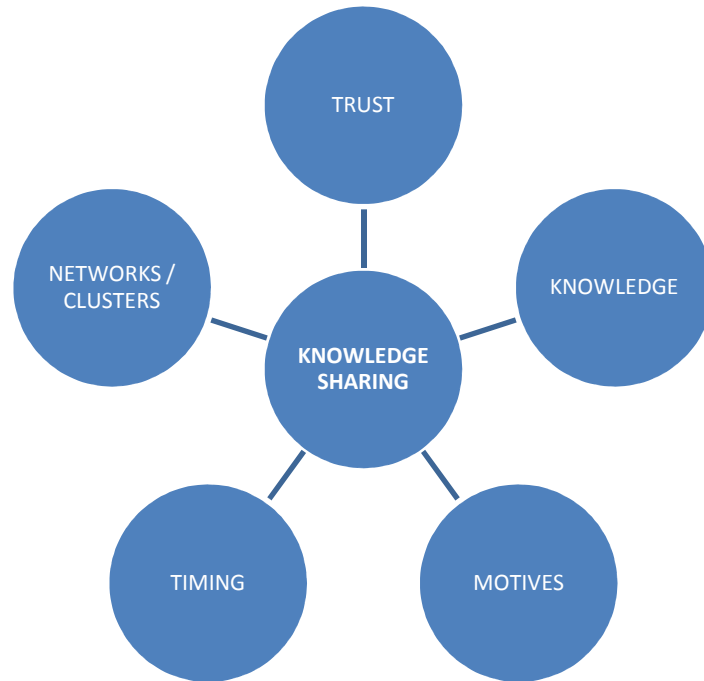
Source: Widen-Wulff (2007).

Actors and their role within the cluster are important in the process of knowledge sharing, because of the connections between different areas of activity and interests. First of all, they socialize with each other, which require knowledge distribution within the network. Secondly, they gain their social relationships through research communities and invisible colleges (Borgman 2000).

Apart from the relations between employees and groups within networks, very important appears to be also the timing of knowledge sharing within networks. This concept refers to a proper judgement of when to make a move and usually depends on interpersonal interactions and private motives (Widen-Wulff 2007).

Knowledge may demand several iterations to realize, proximity offers an added advantage over distance. Trust found in networks and clusters is volunteered by members who understand the potential for mutual advantage to be obtained from it (Cook, 2002).

Trust holds employees and whole groups of workers together. It allows structures to grow and develop. It is based on expectations and interracions in the group. Building trust is a difficult process including time aspects and roles of actors in the network and the role of their organization in the network. It is important because if affects the level of trustworthiness and influences the process of trust emerging (Huotari, Iivonen 2004).

A comparative investigation of interactions in networks produced a three-fold categorization of trust (Perry, 2005):

» Competence trust – referring to the confidence that the trading partner will perform his obligations competently and that he has the skills and capacity claimed.

» Contractual trust – related to the confidence that specific agreements will be adhered to. Different degrees of contractual trust may exist depending on the willingness to accept oral agreements over written ones and the degree of written detail required.

» Goodwill trust – meaning mutual expectations of the partners that both of them have an open commitment to each other, reflected in the willingness to do more than what was agreed at first. It means that there is less emphasis on establishing explicit commitments than on maintaining an ongoing relation in which both partners are prepared to take initiative for the sake of mutual advantage whilst refraining from opportunistic behavior. In clusters the goodwill trust seems to be the most important, because it encourages mutual learning and the sharing of expertise in ways that promote improvement and innovation. Goodwill trust emerges through frequent and intensive communication, implying experimentation through searching processes (Perry, 2005).

Firms located in clusters share a common set of values and knowledge so important that they form a cultural environment. In this environment they are linked by formal and specific informal relations in a complex mix of cooperation and competition. In the above mentioned culture, services such as the organization of conferences, seminars, social activities and trade fairs are provided, which results in the formation of relationships (Brusco, 1990).

In Saxenian's comparison of the regional agglomeration in Silicon Valley and Route 128, disparity emerges in the creation and character of networks, clusters. In Silicon Valley informal contacts between individuals are important, mutually beneficial and widely observed. With the culture supporting informal relationships and a variety of regional institutions providing network services by arranging trade fairs, conferences, and social activities, the individuals (co-

workers, competitors, formerco-workers, suppliers, customers etc.) keep meeting each other, resulting in the formation of relationships and informal contacts (Dahl, Pedersen, 2003). Information (eg. technical information, market information, innovation details, experience, and advice) is exchanged because the Silicon Valley culture lets them discuss details about their work. In turn, in the Route 128 case, information contacts were few and the culture discouraged networking, cooperation, exchange of information and knowledge. The extent of informal activity in Silicon Valley is important for the evolution of whole cluster (Dahl, Pedersen, 2003).

Clusters can emerge as the outcome of sets of relations. Those interactions are based of course on spatial proximity, but also on organizational proximity, cooperation of communities and knowledge diffusion (Orsenigo, 2007).

7.5. Knowledge transfer mechanisms in networks and clusters

Formal personnel contacts within cooperating institution provide employees with general knowledge and best practices or benchmarks based on collective knowledge. The explicit knowledge is transferred through various mechanisms, such as seminars, training, detailed manuals and is largely used. In turn, informal contacts are an important mechanism for the transfer of tacit, more operational know-how (Varum, 2006). The tacit knowledge is transferred in very limitted way, usually through personnel exchanges (see table 7.4).

Table 7.4. Knowledge transfer mechanisms

Knowledge category	Transmission mechanizm	
	Formal	**Informal**
Explicit	Seminars Demonstrations Manuals Training	Personal contacts
Tacit	On-the-job Personnel exchanges	Personal contacts

Source: Varum (2006).

Colleagues from different firms give each other advice, expecting that their favors will be returned in the future. They share their experience through informal contacts as well. For instance, an employee in the production process

might solve an unforeseen technical problem by communicating with a colleague using the same producing equipment in a competing firm belonging to the cluster. The colleague from the other firm has to decide whether to provide him with the necessary information. If it creates disadvantages for his firm, he might want to keep it. Otherwise, he would disclose it with a future favor in mind (Schrader, 1991).

Studies by Rogers (1982) show, that the transfer of knowledge is a part of relation based on mutual exchange. It is generally agreed that receiving a benefit will enhance the probability of the favor being returned with a similar transmission of knowledge and information. This depends on the value of information: the higher the benefit, the larger the chance it will be returned. That is why the information trading firms tend to favor partners promising the most useful knowledge in return (Dahl, Pedersen, 2001).

The creation of informal networks of contacts starts with the knowledge transfer between two individuals. Repeated interactions between the two lead to the reduction of costs of the future interactions due to the development of routines and conventions. This makes the relationship become stable. Both vertically and horizontally related firms may benefit from an ambience of trust and mutual understanding, which facilitates less formal contacts and interaction both at the level of the firm and the employee. Firms learn from the success and failure of others and are able to monitor, discuss, and compare solutions applied by other companies. In this way, firms in clusters participate in a continuous learning process by comparing different solutions, selecting, imitating and adding their own ideas (Maskell, 2001).

Parallel to the use of formal and informal means of communication, a blend of formal and informal control mechanisms is needed in order to manage a cluster. Formal control mechanisms are necessary primarily in order to give structure to the cluster. In turn, professionals, such as experts collaborating on product development in clusters, are managed and motivated best through informal control mechanisms (Rutten, Boekema, 2008).

With regard to collaboration in clusters, a very important indicator is the actual intensity of the communication between its partners. It should be high, because only through intensive communication can the tacit knowledge be exchanged. This, in turn, is necessary for the new product development in a cluster. Futhermore, a variety of models of communication should be employed, like face-to-face communication, electronic forms of communication, group meetings, contact on the phone, etc. Implementation of different models of communication in clusters allows for knowledge exchange between partners and new knowledge creation (Stoerring, Dalum, 2008).

Cooperation in clusters include more than knowledge exchange between individuals. Many clusters include governmental and other institutions (e.g., universities, think tanks, vocational training providers, standards-setting agencies, trade associations) that provide specialized training, education, information, research, and technical support. Universities are found to be an important part in clusters. The university is seen as a source of new knowledge (Feldman, 1994; Saxenian, 1994; Anselin et al., 1997). University research and knowledge is flowing from the university to companies in cluster. This knowledge diffusion can take place as formal cooperation, through mobility of graduates, and through informal social networks (Ostergaard, 2009).

In networks there are many direct and indirect interactions between universities and companies. They interact through formal research projects (e.g. joint research projects or contract research), mobility of scientists, raining, consultancy, education of highly skilled graduates, and informal contacts between employees in firms and university researchers (Lawson, 1999; Mueller, 2006). Firms locate close to the universities benefit from knowledge spillovers (Feldman, 1994; Saxenian, 1994; Anselin, 1997). These knowledge flows are often measured by patent citations, academic papers, and size of academic staff or university research spending in regression models (Ostergaard, 2009).

Examples of clusters with leading universities, such as Stanford in Silicon Valley and MIT in Boston Route 128 have shown that universities often play an important role in clusters (Ostergaard, 2009). The universities have traditionally had two missions: Basic research and training, but recently there has been an increasing focus on the thirdmission: Commercialisation of knowledge.While some traditional universities have focused mainly on the advancement of knowledge there are many universities, where cooperation with industry and clusters has become common (Etzkowitz, 1998).

Conclusions

Knowledge has becomes the main strategic asset, based on which entrepreneurs build their competitive advantage. Clusters described within the chapter are a relatively new form of knowledge sharing through cooperation between companies, which – simultaneously – raises their competitive potential. The very concept of clusters is based on the idea that the geographical proximity of firms constitutes economy, not only in form of a group of entities but also due the effect of their synergy that occurs as a result of cooperation of firms and cooperation between firms and universities, and R+D institutions.

The most important benefits of clusters are the capacity to generate new knowledge by combining the existing data from organizational knowledge bases of clusters and their partner-institutions with novel external information inflows. Knowledge creation, including process of knowledge sharing, has emerged as one of the most influential new organizational practices. This occurs throughout the emergence of a goodwill trust between companies cooperating in a cluster, when colleagues and partners provide each other with advice, share experience, and provide each otherw with solutions to problems. However, the role of informal contact in clusters cannot be overlooked either.

For the time being, little is known about the value added to the firm as a result of cluster accession, as well as the effects of such relations on its performance. Such and other issues can only be raised after thorough research is conducted to this topic.

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