Anne Haugen Gausdal

How can network education contribute to innovation in the system?

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Preface

In this paper I give an overview of social network theory, and discuss how the theory can be used in a case study of how an education programme, developed in co-operation with a network of electronics industry in a region and the regional university, may contribute to innovation. I also discuss the needs for further research in social network theory.

The paper was written for the PhD seminar “Organizational Learning, Networks and Communities: The emerging Strategic Entrepreneurship Field”, Vrije University, Amsterdam, June 2004. The paper constitutes the theoretical foundation at the point of departure in my PhD project.

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Anne Haugen Gausdal
1 Introduction

The core question in this paper is: How can network education contribute to innovation in the system? The system is the "Electronic Coast", a network of about 50 electronics firms, the regional university college, the municipality and the regional county. Network education is tailored educational programs organized by the network in collaboration with the regional university college. It seems to me at present, that it is reasonable to assume that if network education results in weak ties, it will contribute to innovation. But if network education builds strong ties, it may be positive for exploitation, but because of the danger of over-embeddedness, the effect on innovation may be negative. I further find it reasonable that if the network education class has some elements of a community of practice in the education period, it will probably contribute to innovation in the system. Network education may also contribute to innovation if it contributes to foster networks of practice, which may provide timely access to resources and knowledge that are otherwise unavailable, and therefore serve as a locus of innovation. I find it reasonable that network education may function as one of the “connections between participants” activities that contribute to building a regional advantage of knowledge dynamics and innovative regions. The effect of network education on innovation will probably be increased if a group of the participants in network education comes from outside the industry. To insert some more innovation into the discussion, I finally introduce a kind of upside down thinking to the concepts of ties and structural holes: Maybe one recipe to innovation is to cut strong ties and thereby create new structural holes and new weak ties?

Because the research question is closely linked to the setting, I start with a presentation of the setting in chapter 2. Afterwards I give a reasoning and presentation of my research question: "How can network education contribute to innovation in the system?" Then, in chapter 4, I use literature and some findings to deepen the discussion about my research question. I find many areas of interest and implications for further research and summarize them in chapter 5.
2 The setting

The study will be carried out in the network "Electronic Coast", which is committed to network building with the aim of promoting growth and innovation in electronic- and ICT-based companies in Vestfold County, Norway. The Electronic Coast network exists of about 50 (of totally about 200) electronics firms from the same region. The field can therefore be classified as a kind of cluster (Porter, 1990). The electronic history in the region started with one firm in 1964, and the growth has been dominated by spin-offs. The development of the cluster the last 10 years can be characterized with some small ups and downs, but totally close to zero. Some firms have gone bankrupt, but nearly all of them have risen again in a slimmer release. There have also been a few spin-offs and a few spinning-ins. The Electronic Coast network also consists of a regional university college, the municipality and the county, and is thereby not only a cluster, but also a regional triple helix network (Etzkowitz and Leydesdorff, 1997).

The network has established a "Management Academy" in cooperation with Vestfold University College. The Management Academy develops and provides tailored educational programs in collaboration with the network. Employees from different companies participate in the same classes and work together on student projects, combining practical and theoretical development projects in the companies. Thereby they have increased the interorganizational social interaction between the companies in the network.

The acknowledgement of knowledge, learning and innovation as the main driving forces in economic development, and the assumptions that networking activities, through interorganizational social interaction and trust, contribute to knowledge development and innovation, form the basis of my project. Innovation and enhancing human capital (the skills and competences embodied in the work force), are together with entrepreneurship and ICT the areas of greatest importance for economic growth (OECD, 2001). Innovation is defined as "Any idea, practice, or material artifact perceived to be new by the relevant unit of adoption" (Zaltman et al., 1973: 10). This definition is quite broad, and include both product and process innovation. Innovation occurs when different kinds of knowledge that have not earlier been combined, are connected.
A comprehensive benchmarking study of the OECD nations’ focus on identification of mutual efforts of the 7 most innovative countries (These nations are, in scored sequence: Switzerland, Germany, Japan, Sweden, USA, Holland and Finland. Norway is ranked as number 14 of totally 27 nations). The results point out R&D collaboration between companies and universities/research organizations as the main condition for innovation (Nyholm and Langkilde, 2003). OECD (2001) also claims that promoting the flow of knowledge between science and industry will foster innovation, and improving the links between education and the labour market will enhance the human capital. I want to search for other patterns in the flow of knowledge between science and industry than only R&D collaboration. The relationship between universities and industry has traditionally been conceived in the form of: Research leads to innovation, and education leads to increased competence in the labor marked. This does, however, represent a linear form of the relationship. The question yet to be answered is: How can education more directly lead to innovation? The universities core activity is educational programs. The kind of educational programs that will be focused on, are tailored research based educational programs, developed and organized as a network activity where companies and universities collaborate. This will be denoted as network education. And the research question is: How can network education contribute to innovation in the system? This calls for a more interactive and complex understanding of the relationships between research - education and innovation.
3 Research question

The interest in organizational learning both in the academic and popular press has grown dramatically in the recent years and several theorists have worked on this issue (See Crossan et. al, 1999 for an overview). Essential understanding of knowledge as a strategic resource, is an understanding of the nature of knowledge itself. Polanyi introduced the concept of Tacit Knowledge. He argued that “we know more than we can tell” (Polanyi, 1966: 4) and divided knowledge into two categories: Explicit and tacit knowledge. "Explicit knowledge is that which can be written down, encoded, explained or understood by anyone with a basic understanding of the technology or phenomenon at hand – inside or outside of the firm” (Lei 1997: 213). Tacit knowledge is defined as “non-codified, disembodied know-how that is acquired via the informal take-up of learned behaviour and procedures” (Howells, 1966: 92). Nonaka (1994) suggested that transferring and utilising tacit knowledge is essential to the process of knowledge creation. Since "Individual face-to-face interaction is the only way to capture the full range of physical sensation and emotional reactions that are necessary for transferring tacit knowledge" (Von Krogh et al., 2000: 181), the social interaction is of great importance. Nonaka describes a knowledge helix where he combines 4 kinds of interaction: Individual, collective, face-to-face and virtual. The helix represents a dynamic process, which starts with tacit knowledge at the individual level and grows in size subsequent to the movement to higher ontological levels. The transition from individual to group-, organizational and inter-organizational knowledge is critical to achieve learning in and between the organizations, and in this transition, social interaction is an important catalyst (Nonaka, 1994). Hence social interaction is important to both the directions of the knowledge creation of the helix process, both the epistemological and the ontological.

Nonaka et al (2000) maintain that knowledge needs an area for development and that “there is no creation without place”, and this place is called "ba". The concept derives from Japanese philosophy, and is defined as a common context where knowledge is shared, created and utilised. Ba is not only a physical space. It is a concept that unites physical space, for example an office, virtual space, for example e-mail, and mental space like shared ideas. The core process in ba is interaction, and the participants need to participate actively in the interaction, they can not be spectators. In this project I will examine whether participation in network education may function as an inter-organizational ba. Nonaka (1994) and Hustad (1998) have
both indicated that it is reasonable to assume a positive connection between individual learning and learning in organizations, and that social interaction assumes to effect positively this connection. Crossan et al. (1999) propose that organizational learning is multilevel: Individual, group and organization, and that these three levels are linked by social and psychological processes: intuiting, interpreting, integrating and institutionalising – the 4 I's. It could, however, be argued that the 4 I's take place by social interaction in Nonaka's ba.

Networks can be defined as very loosely coupled systems of people and groups working together (Pedler et al., 1997), and can be seen as a part of an answer to the challenges of the learning economy. Frednes (2001) asserts that networks create and recreate themselves by learning. Networks can be more or less symbolic without particular activity and contents. A network with all its opportunities may weaken our engagement and motivation for making any contribution ourselves. They can also create dynamic relations, great flexibility and make access to knowledge easier, and thereby be a space for knowledge, collaboration and learning. This can also be connected to the notion of strategic networks, which Amit and Zott (2001) denote as stable inter-organizational ties which are strategically important to participating firms. Networks may take the form of strategic alliances, joint ventures, long-term buyer-supplier partnerships, and other ties. Man-shaped networks depend on people shaping motion into the system (Frednes 2001), and a crucial question is: How can we shape the motion into the system that makes the network a Strategic Network or "ba"? In this study I intend to find out whether network education may contribute to this motion and creation of ba's.

Hence the research question:

*How can network education contribute to innovation in the system?*

In spite of the way the question is formulated, I want to underline that I am aware of the risk that the phenomenon network education may not contribute to innovation at all.

The underlying assumption of why network education for an Industry-University network may trigger innovation in the system, is however the presumable influence on social interaction and trust. And, as mentioned above, the assumptions that inter-organizational social
interaction and trust contribute to innovation. This leads me to the three sub-questions of the research question:

- How is innovation influenced by network education?
- How is innovation influenced by inter-organizational trust in the system?
- How is innovation influenced by inter-organizational social interaction in the system?

These assumptions and sub-questions will, however, not be handled explicitly in the discussion. But since they will indirectly form my way of thinking, it is important to mention them. According to the subject, the core research question will be given the main focus in this paper.

4 Discussion

The intention of this chapter is to search for a more precise definition of network and deepen into network theory in general. Further to discuss the connection between networking and innovation, and the concept networks of practice in relation to innovative regions, and finally discuss network education in relation to this.

Networks and innovation

The concept of network and its constructs is, because of lack of a core theory, not well defined (Hoang and Antoncic, 2003). But there has been a lot of research on the benefit of networks, and from both the relational view (Dyer and Singh, 1998) and the resource-based view (Penrose, 1959), the firms’ network relationships represent critical avenues for the acquisition of resources necessary for firm survival and growth (Gulati, 1988; Jarillo, 1989). Hoang and Antoncic (2003) argue that the network-based research in Entrepreneurship has examined three areas: Content of network relationships, governance and structure. Simsek et al (2003: 427) extend Granovetter’s theory to develop an explanation of entrepreneurial behaviour, and define it as “the sum of the firm’s innovation, venturing, and strategic renewal activities”.
Hence because entrepreneurial behaviour include innovation, theories of entrepreneurship are relevant for my research question.

In chapter 3 I have defined network as very loosely coupled systems of people and groups working together (Pedler et al., 1997). Amit and Zott (2001) denote strategic networks as stable inter-organizational ties which are strategically important to participating firms. Networks may take the form of strategic alliances, joint ventures, long-term buyer-supplier partnerships, and other ties. Gomes-Casseres (2003) defines alliances as any governance structure to manage an incomplete contract between separate firms and in which each partner has limited control. He further (ibid.1996) defines constellations as a set of firms linked together through such alliances and that compete in a particular competitive domain; the constellation may compete against other constellations, or against firms. I find Gomes-Casseres’ constellation very close to what the other scholars call network. Jones et al, (1997: 914) define inter-firm network as “a select, persistent, and structured set of autonomous firms engaged in creating products or services based on implicit and open-ended contracts to adapt environmental contingencies and to coordinate and safeguard exchanges. These contracts are socially not legally binding”. This last definition is rather extensive and contains many important elements. First “select” says that network is good with all its possible benefits. Then “persistent” as something stable that is going to last for a while. “Structured” tells that a network has to be organized in some way, and “autonomous firms” says that the firms still are their own legal units, and that the coupling of firms is a bit loose. “Implicit and open-ended contracts” tells together with “contracts are socially not legally binding” that the level of formalities is low and the level of inter-organizational trust is high in governance mechanisms of network, which is in accordance with what Hoang and Antoncic (2003) found that characterized network governance mechanisms in their review. Then to “adapt environmental contingencies and to coordinate and safeguard exchanges” say something about the contents of the network, that demand a certain level of collaboration. I find this definition both extensive and precise, and will use this from now on.

In this discussion of all the possible benefits of networks, I find it important to mention that network activity is time consuming and not always profitable. Gulati (1998: 310) claims that "not all networks provide equal benefits to their members, and some networks are better than others". Gomes-Casseres (2003) follows up and states that constellations do not necessarily
confer advantage to a firm, whether they are helpful or not, depends of the context. Networks can also be more or less symbolic without particular activity and content (Amit and Zott, 2001).

Granovetter (1973: 1365) refers to a tie as a “local bridge of degree $n$” if $n$ represents the shortest path between two points (other than itself) and $n > 2$. A more sophisticated definition of ties is “inter-organizational relationships when the direct involvement of the individuals that played a role in their formation is no longer needed for the relationships to be sustained” (Hoang and Antoncic, 2003: 176). “The strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confinding), and the reciprocal services which characterize the tie” (Granovetter, 1973: 1361). A given tie is strong, weak or absent (ibid). The mark of strong ties is connections with high intensity of emotional closeness and frequent communication (Granovetter, 1973; Burt, 1984; Hansen, 1999). The concept weak ties is noted by Granovetter (1973) and he defines the content of weak ties as distant and infrequent relationships that are efficient for accessing novel information. As a measure for tie strength Granovetter (1973) uses frequency of contact, and divides the frequency into the categories often, occasional and rare. Often (strong tie) is measured as contact at least twice a week, occasional (weak tie) less than twice a week but more than once a year, and rare (absent tie) as once a year or less.

The importance of weak ties has filled the debate on the relative value of weak versus strong ties (Hoang and Antoncic, 2003). Hence a network characterized by weak relationships and thus, low level of reciprocity, is more conductive to entrepreneurship, which includes innovation. Because they provide awareness of new ideas and insights, innovation should be higher in networks that are rich in weak ties and thus "structural holes" (Burt, 1992). The concept of structural holes is defined as the absence of ties between actors. By bridging structural holes, firms can profit from establishing ties that bridge them with unconnected actors (Burt, 1992). This opportunity for non-redundant contacts, spanning structural holes can also increase the firms exposure to novel information, which in turn can lead to learning and development of internal capabilities that ultimately enhance performance (McEvily and Zaheer, 1999; Baum et al., 2000). Baum et al (2000) showed that alliance partner heterogeneity had a positive effect on firm’s subsequent financial performance and innovative capability, and thereby support the benefit of structural holes. Reagans and McEvily (2003)
also argue that bridging structural holes in external networks results in greater creativity and innovation.

Hoang’s (1997) study of biotech industry showed that the network position and thereby the information and collaborative networks that the small firms were able to create were argued to be critical to innovation within the industry. Bruderl and Preisendorfer (1988) found, however, in an impressive large-scale survey that strong ties were more critical than weak ties in explaining firm success measured by survival, and a much smaller impact on sales growth. Reagans and McEvily (2003) did an interesting finding, that the positive effect of knowledge transfer provided by a strong tie, increases up to a point, and then flattens out. Uzzi (1996) argues that the most valuable network is balanced and consists of both weak and strong ties. Hoang and Antoncic (2003) found, however, that some of the network research suggests that the advantage of diversity in information and knowledge flows should not be overstated. According to Simzek et al. (2003: 434) the discrepancy between these competing arguments may be an effect of differences in focus. "The strength of weak ties perspective tends to focus on finding new information, detecting environmental changes, and discovering new entrepreneurial opportunities. The strength of strong ties perspectives, on the other hand, concentrates on how strong ties facilitate exchanges of high quality information, knowledge, and resources between organizations and, therefore, help network members discover new ways to exploit opportunities that are already known or already existing within the network”. They further argue (: 434) that “the extent to which reciprocity norms are more significant in relationship to radical entrepreneurial behaviour, and strong reciprocity norms are more significant for incremental entrepreneurial behaviour”. And that cognitive differences are necessary for radical entrepreneurial behaviour. Heterogeneity of cognitive content stimulates discussion, decreases group-thinking and leads to more original ideas (Janis, 1972; Katz, 1982; Weick, 1976). This importance of cognitive diversity is also central in March's (1991) arguing of the trade-off between exploration and exploitation. Hansen (1999) showed that weak ties are conducive to search for useful knowledge in other subunits. But weak ties impede the transfer of complex knowledge. To transfer complex knowledge, strong ties tend to be required. To explain this, Hansen (1999) refers to Weick's (1976) notion of the benefit of loose couplings, and the correlation between loose couplings to other entities and adaptivity. This is because of the importance of autonomy for innovation (Hansen, 1999).
Strong ties transfer better complex and tacit knowledge (Granovetter, 1973; Hansen, 1999; Reagans & McEvily, 2003) and weak ties are more efficient to transfer codified or explicit knowledge (Hansen, 1999; Reagans & McEvily, 2003). Reagans and McEvily (2003) argue that strong ties and cohesion tend to co-occur, and that it is difficult to determine whether cohesion or tie strength is the driving force. They found that strong ties and cohesion were correlated, but that it was a mistake to equate their effects. They also state that gaps in social structure represent a critical bottleneck to the knowledge transfer process. The findings by Reagans and McEvily (2003) are consistent with an emerging line of work emphasizing that the optimal network structure combines elements of cohesion and range.

Uzzi (1997) argues that tightly coupled relationships may negatively influence radical knowledge sharing among firms because the social aspects of exchange supersede the economic imperative to learn. He also found that information exchange in embedded relationships was more proprietary and tacit than the price and quantity data that were traded in arm's length ties. He further found three conditions that turn embeddedness into a liability for the system: 1) unforeseeable exit of a core network player, 2) institutional forces rationalizing markets, or 3) over-embeddedness characterizing the network.

The problem with over-embeddedness is according to Malmberg (2004) who argues that knowledge and innovations are more or less automatically spread among local firms, and that the big challenge in innovation is connection to the global flow of knowledge. Further that firms that manage in building relations with sophisticated customers locally and globally will be more innovative. Reagans and McEvily (2003) stated that promoting network diversity could be inefficient in the short term, but potentially more valuable in the long term, because diverse projects can add social capital that could be infinitely more valuable tomorrow. All the students in the network education except one, were employed in the electronics industry, and there is a danger that the students represent too similar organizations. Powell et al. (1996) also consider diversity and state that learning in a community may require different kinds of organizations and organizational practices to access that community. The electronics firms participating in the network education also represent a mature industry. I therefore want to follow up this arguing with Christensen's (1997) perspective, that in mature industry the change comes from outside the industry. The consequence of this is to invite firms from other industries or services to participate in the network education together with the participants.
from the electronics firms, and try to enlarge the network with firms outside the industry.

Hite & Hesterly (2001) use the classification of networks as identity based or calculative. Identity based networks are defined as egocentric networks that have a high proportion of ties where some type of personal or social identification with the other actor motivates or influences economic actions (Granovetter, 1992; Uzzi, 1996). The term calculative network is borrowed from Williamson (1993) who refers to egocentric networks where the focal actor's ties are primarily motivated by expected economic benefits. Compared to identity based networks, calculative networks are characterized by a greater majority of weak ties that are more likely to be less redundant, more sparse and better able to build structural holes (Burt, 1992). Further calculative networks involve a larger and more diverse set of purposeful work-based or functional ties suggesting the firms growing ability to proactively manage the network rather than simply accept the constraints of the path dependence of identity-based network ties (Hite & Hesterly, 2001). The most fundamental difference between the two kinds of networks is related to embeddedness. Identity based networks are based on predominantly social embedded ties, and calculative networks have a greater balance between embedded and non-embedded connections (Hite & Hesterly, 2001). “Social embeddedness is defined as the degree to which commercial transactions take place through social relations and networks of relations that use exchange protocols associated with social, non-commercial attachments to govern business dealings” (Uzzi, 1999: 482). The concept overlaps to a great extent with other network concepts such as strong ties (Granovetter, 1985) and socially based ties (Larson and Starr, 1993). Embeddedness exists when the interaction between ties is not primarily economically motivated but rather is grounded more on personal relationships, social capital or the history of dyadic interactions (Hite, 1999). According to Granovetter (1985) an examination of close relationships suggested that they reflected the concept of embeddedness. I assume that an identity based network is dominated by strong ties, and a calculative network by mostly weak ties.

The interest in this paper is to analyze what kind of network development network education is assumed to contribute. The network education leads employees from different companies to participate in the same classes and work together on student projects, combining practical and theoretical development projects in the companies. They therefore increase the inter-organizational social interaction between the companies in the network, and develop new ties.
grounded on identity in the same group (class) and personal relationships. The collaboration between the students is motivated by learning and achieving a good grade, and even though Uzzi (1997) calls it the economic imperative to learn, I think that the collaboration is not primarily economically motivated. Hence I argue that network education may contribute to development in direction of more identity based network and increased social embeddedness. Hite & Hesterly (2001) consider that calculative networks involve a larger and more diverse set of purposeful work-based or functional ties than identity based networks. My research question is however about contribution to innovation, not economic actions directly. I therefore have to find out more about how calculative and identity based networks influence innovation.

According to Hoang and Antoncic (2003) the key benefit of networks for the entrepreneurial process is the access they provide to information and advice, multiple resources and problem solving. The benefit can also have a reputational or signaling content. In their review of network-based research they also identify mutual trust as a frequent and cost advantage governance mechanism (Hoang and Antoncic, 2003). Uzzi (1997) found that trust was viewed as an explicit and primary feature of embedded ties. Further that the primary outcome of trust as a governance mechanism was that it promoted access to privileges and resources difficult to put a price on, but that it enriched the organization's ability to compete and overcome problems, especially when firms cooperatively traded resources that produced integrative agreements. A critical factor in enhancing innovation through inter-firm collaboration is trusting behaviour, because of its positive impact on information flows (Hausler et al, 1994).

Dyer & Nobeoka (2000) describe Toyota's knowledge sharing network with the suppliers. The network has Toyota as a powerful nodal firm. They describe three main dilemmas and the instruments Toyota uses to solve them. The first one is how to motivate participation and knowledge sharing. This is handled partly by offering all the network members free access to help from a support centre, and partly by a culture and a formal deal that all the knowledge in the network is the property of the network, and not the single firm. Production of knowledge is viewed as the property of the network rather than the individual firm. The next dilemma is how to avoid free riders, which is handled by sanctions and a lot of effort put into developing of shared identity. Shared identity establishes explicit and tacit rules of coordination in firms and network. The last dilemma is how to maximize knowledge transfer in a large group. This
is solved by building strong ties between the suppliers, and suitable systems for transfer of explicit and tacit knowledge, but it has the main focus on sharing tacit know-how. They examine learning that is facilitated through inter organizational routines that are designed to facilitate knowledge transfer across organizational boundaries, and find a greater diversity of knowledge within a network than a firm (ibid.). The firms in the Toyota case are mostly the same kind - auto industry suppliers, which give them a high redundancy which is supposed to increase knowledge creation (Nonaka, 1994; Nilsen, 2002). Dyer & Nobeoka (2000) also acknowledge that strong a tie network produces trust (social capital) and facilitates tacit knowledge transfer, and diffusion of existing knowledge, which is conducive to exploitation, rather than exploration for new knowledge. Their findings support my previous assertion that identity based strong tie networks contribute to exploitation and calculative weak tie network contribute to exploration and innovation.

The core argument of Simzek et al (2003: 439) "is that structural embeddedness, with its focus on the network as a whole, and its two consequences, relational and cognitive embeddedness, individually and collectively influence incremental and radical forms of entrepreneurial behaviour". To follow this arguing, and since radical entrepreneurial behaviour and exploration are very close to innovation, it is reasonable to assume that weak ties and structural holes have a positive impact on innovation in a network system.

**Networks of practice - innovative regions**

Brown and Duguid (1991) have a practice based standpoint and view learning as the bridge between working and innovating. They argue that evolving communities of practice are significant sites of innovating. Communities of practice are often non-canonical and not recognized by the organization, and often crossing the restrictive boundaries of the organization to incorporate people from outside. Their shape and membership emerge in the process of activity, they cannot be created by someone to carry out a task. Brown and Duguid (1991) argue that the central question is the detection and support of emergent or existing communities. Because the communities are non-canonical, they are often invisible, and reorganization of a workplace into canonical groups can disrupt these highly functional communities. To foster working, learning and innovating, an organization must close the gap between espoused and actual practice. I find this very similar to Argyris and Schön's (1978) discussion between espoused theories and theories-in-use. Brown and Duguid (1991)
continue, in this task it needs to re-conceive itself as a community-of-communities, not a community of individuals, and legitimise and support the myriad enacting activities (Brown & Duguid, 1991). Innovative firms succeed by bringing together different communities, which is a difficult process that must always battle with the diversity it seeks to unify, and the risk of resistance involved in making everyone adapt to a new idea that may or may not succeed. My research question is “How can network education contribute to innovation in the system?” According to the theory introduced above. The question is if the class may function as a community of practice in the education period? The group of people (the class) is however created to carry out a task, and not emerged from people working together. But what happened in practice in my case, was that the collaboration between the students increased through the education period (10 months). As a part of the exam they had to do a combination of a practical and a theoretical thesis as a group task over a period of 7 months. The practical part had to involve the work place of at least one of the group members. The creation of the groups was almost non-canonical, but they were encouraged to organize inter-organizational groups. The result was that all the groups were consisting of students from 2 to 4 firms, and only 1 of 7 groups needed a hand from the teacher to get coupled. In addition they seemed to find a lot of common tasks in relation to their practice, which was outside the educational subject. They also found it useful to visit each other's plants. I argue that this shows that some elements of community of practice have emerged in the process of activity in the thesis groups.

Because the network exposed in the network education is also a regional network, Brown and Duguid's (2000) writings “Mysteries of the region” caught attention. In the theory of community of practice they noted that much knowledge is sticky to the firm (Brown & Duguid, 2001). They also noted the leakiness of knowledge between firms in the Silicon Valley, and they searched to find the explanation of this paradox. They suggest that it could refer to guilds or other types of professional or craft associations that extended beyond employers, linking people who do similar jobs for different firms. These sorts of networks are frequent in the Silicon Valley. Brown and Duguid (2000, 2001) call these “networks of practice”, to emphasise that they are related to, but distinct from, communities of practice. The relations between network members are significantly looser than within a community of practice (ibid, 2001). In networks of practice people don’t necessarily work together, but are engaged in the same or very similar practice, and therefore share a great deal of insight and implicit understanding (ibid, 2000). This shape conditions where new ideas can circulate, but
they circulate on the back of similar practice, not through collaborative, coordinated practice and direct communication as in a community of practice. The leakiness is also explained by Arrow’s (1974) arguing that classic knowledge workers, are often as loyal to the knowledge they work with as to the organization they work for. In such networks, knowledge is spread among practitioners, following routes prepared by practice and crossing the boundaries of particular organizations. Knowledge often leaks along these routes, to the extent that common practice has prepared the way (Brown and Duguid 2001, Powell et al 1996). It is also important to note Brown and Duguid’s (2001) warning that networks of practice also may inhibit the flow of knowledge. Ideas and information that can be disadvantageous for the network members’ risk of meeting resistance and can be stopped. Brown and Duguid (2000, 2001) further argue that new ideas will travel along networks of practice until they find a better home and the possibility to be used. They thereby show that such networks may be important for innovation.

Reagans and McEvily (2003) concern about network range, understood as relationships that span multiple knowledge pools, and the knowledge transfer process. They argue that networks that span multiple communities of practice can give the ability to convey complex ideas. Knowledge transfer and therefore learning follow the path of least resistance (Levinthal & March, 1993), and the ease of transfer is a primary explanation for why individuals transfer knowledge to some individuals and not to others (Reagans & McEvily, 2003). They further argue that there is a number of explanations for how the transfer of knowledge occurs. One series of explanations is grounded in social and cognitive psychology, and deals in absorptive capacity and associative learning (Cohen & Levinthal, 1990; Simon, 1991). Another group of explanation emphasizes tie strength and the embedded nature of knowledge transfer (Uzzi, 1997; Hansen, 1999)

Powell (1990) asserts that sources of innovations do not reside exclusively inside firms; they are commonly found in the interstices between firms, universities, research laboratories, customers and suppliers. Brown and Duguid (1991: 48) summarized this view by stating "the central issue in learning is becoming a practitioner not learning about practice". Powell et al (1996) argue that network serves as a locus of innovation because they provide timely access to resources and knowledge that are otherwise unavailable. They conclude that the network
has to sustain a fluid and evolve a community. But innovative activities cannot be reduced to a simple process of information acquisition (ibid).

Powell et al (1996) further argue that experience in managing ties helps a firm to move quickly in identifying new projects and pilot them inside the organization, enabling growth to occur, that is conversely analogous to absorptive capacity. And they (ibid: 142) state that "the development of absorptive capacity (Cohen & Levinthal, 1989, 1990) and skill at managing collaborations, as well as the increased awareness of new projects and reputation as a valuable partner, are all serendipitous benefits of collaboration". I find this very interesting and since network education gives some experience in managing ties and collaboration, it may contribute to building collaboration competence and thereby also innovation. As Brown and Duguid (2000) argue, the links across a network may be fairly distant, and even people from different firms that do know each other may meet only sporadically. People participating in network education, however, meet regularly over a period, and discover employees from other firms in the neighbourhood that are engaged in similar practice.

Brown and Duguid (2000) argue for seeing a region as an ecology whose growth is ultimately a collective process and is a home to multiple species, and that the ecological view provides a systemic perspective. And further "From the ecological perspective, the means of communication are only a small part of the overall complexity of the knowledge dynamics of the region. Ecological robustness is built - mysteries are put in the air - through shared practice, face-to-face contact, reciprocity, and swift trust, all generated within networks of practice and communities of practice" (ibid: 37). They do not believe that it is possible to construct the knowledge dynamics of the region, or implement it mechanically, but suggest that the necessary collective competencies are grown organically. And that knowledge ecosystems develop over time as a result of a practice with building connections between participants until they reach a critical mass and take on a collective dynamics all of their own (ibid). It probably takes a great deal of time, effort, experience, and trial and error to get a region to this level (ibid). The system in my research question is a regional network. I believe that the phenomenon of my research, network education, can function as one of the building connection activities, and hence contribute to building knowledge dynamics and innovative regions.
Conclusion

In this chapter I have argued that the best definition of inter-firm network is “A select, persistent, and structured set of autonomous firms engaged in creating products or services based on implicit and open-ended contracts to adapt environmental contingencies and to coordinate and safeguard exchanges. These contracts are socially not legally binding” (Jones et al., 1997: 914). Then I have discussed the concept of ties in relation to the phenomenon network education. I find the literature interesting and relevant for my research question, and even if some arguments express the contrary, it seems to me at present that it is reasonable to assume that if network education results in weak ties it will contribute to innovation. And if network education builds strong ties, it may be positive for exploitation, but because of the danger of over-embeddedness, the effect on innovation may be negative. What kind of ties the phenomenon builds depends partly on the starting point of the relationship between the organizations. If the starting point is a strong tie, I assume the result will be an even stronger tie. If the starting point is a weak tie, I assume the result will be either maintenance of the tie, or a development of a strong tie. If the starting point is absent tie, the result may be a weak tie. There is of course also a danger that the relationships built through the network education are too weak to be categorized as weak ties, and therefore are absent ties.

I have further discussed the concept community of practice (Brown & Duguid, 1991), and networks of practice (Brown & Duguid, 2000) in relation to innovative regions. I found it reasonable that if the network education class has some elements of a community of practice in the education period, it will probably contribute to innovation in the system. I further argue that network education may contribute to innovation in the system because it is reasonable to assume that it contributes to foster networks of practice, which may provide timely access to resources and knowledge that are otherwise unavailable, and therefore serve as a locus of innovation. Since network education may contribute to building collaboration competence (Powell et al., 1996), the phenomenon is also supposed to have an indirect impact on innovation. Finally I found it reasonable that network education may function as one of the “building connections between participants” activities that contribute to building the regional advantage (Brown & Duguid, 2000) that consists of knowledge dynamics and innovative regions.
Because network diversity seems to have a positive impact on innovation (Powell, 1996; Reagans & McEvily, 2003; Malmberg, 2004) and the setting is a mature industry, where changes seem to come from outside the industry (Christensen, 1997), it is reasonable that participation in network education from non electronics firms will increase the potential of innovation.

To insert some more innovation into the discussion, I want to introduce a kind of upside down thinking to the concepts of ties and structural holes. Maybe one recipe for innovation is to cut strong ties and thereby create new structural holes and new weak ties? Even if it sounds like a paradox, and none of the theoretical contributions comprehend this suggestion, I find it so interesting that I want to follow this path in my further research. But I am also aware that this will surely raise new challenges and problems as for instance uncertainty and resistance.
5 Further research

Dyer and Nobeoka (2000) state that although there has been considerable theoretical discussion of organizational and network learning, the empirical research has been sparse. Hoang and Antoncic (2003) argue that few process-oriented studies have been conducted and only partial empirical confirmation exists for a theory of network development. Further, more longitudinal and qualitative work on a greater integration between process- and outcome oriented research is needed (Hoang and Antoncic, 2003). Gomes-Casseres (2003) further argues that in a world of collective competition, we need a new framework to guide strategy and organizational design, and that this framework must explain how forces internal to the constellation shape what the member firms can appropriate from the group. Gulati (1998) asserts that a longitudinal study of the development of an alliance network can provide unique insight into the development of networks.

Brown and Duguid (2000) believe that in the future, "regional advantage" will play a significant economic role, and that clusters will continue to exist in industries where fast-breaking knowledge is an advantage. Hoang and Antoncic’s (2003) critical review of network based research in entrepreneurship seems to provide adequate grounds for further research. They examined three areas: Content of network relationships, governance and structure. Simsek et al (2003) develop a theory and model of the effects of inter-organizational networks on both radical and incremental forms of firm-level entrepreneurial behaviour. Radical forms of firm-level entrepreneurial behaviour are very close to innovation, and therefore of interest in my research.

One of my sub questions is "How is innovation influenced by inter-organizational trust in the system?" Uzzi's (1997: 43-44) trust discussion is interesting according to the discussion of this question. Brown and Duguid (2000) argue that reciprocity in collaboration seems to be needed to develop the grounds for trust, but that the Silicon Valley seems to give rise to what Meyerson, Weick and Kramer (1996) call “swift trust”. They put this kind of trust in contrast to long-term social capital and trust that exist in the familial communities in Northern Italy. Swift trust can on the other hand develop over short, intense periods of interaction. Gulati (1998: 303) mentions norms of equity or "knowledge-based" trust and "deterrence-based" trust. I want to find out more about these different kinds or levels of trust and what kind of
trust that is supposed to increase by network education, and the assumed effect of this trust on innovation.

The process of innovation can be divided into four “episodes”: Agenda formation, selection, implementation and routinization. The term “episodes” is used as opposed to “stages”, because the different aspects of innovation are iterative, overlapping and ultimately conflated, and do not occur in a linear sequence (Swan & Clark, 1992). Agenda formation concerns the initial awareness of new ideas and of the challenges they may help to address. Selection relates to the processing and promotion of ideas within the organization, and the choice of some ideas to go forward for further development. Implementation is the process of actually introducing the selected ideas and applying them to the local context. The final episode, routinization, describes the understanding where the innovation has developed to a point in which its use has to become routine and seen as a standard working practice (Newell et al. 2002; Rogers, 1995). Newell et al (2002) state that different approaches to knowledge management are necessary for innovation in the different episodes. The agenda forming episode needs a networking approach. The primary activity is knowledge acquisition where knowledge is acquired through access to external networks and sources of innovation, and weak ties are important, and social capital a critical resource. Then in the selection and implementation episodes a community approach is necessary and the primary activity is knowledge creation and application. Knowledge is created and applied through development of social communities, strong ties are important, social and intellectual capital is critical resources and trust is a critical success factor. In the final episode routinization of a cognitive approach is necessary. The primary activity is knowledge reuse, capture and storage where the intellectual capital is the critical resource (ibid).

I find that the term “episodes” as “stages” is a term that includes a time perspective. In for instance a fairytale story, episode two starts when episode one is finished, which also gives associations to a linear sequence. Instead of episodes I therefore suggest to use the term “perspective”. And because the different aspects of innovation are iterative, overlapping and have a circular sequence, I find a spatial perspective more suitable than a time perspective. The focus in this paper has been on the agenda formation perspective and the network approach.
References
Frednes, Kjell (2001): Læringsmiljø for kompetente. kompetansegullet @ det nye arbeidsliv. Brandi, Hildebrandt og Nordhaug (red) Gyldendal Akademisk
Granovetter, M.S. (1973) The strength of weak ties. American Journal of Sociology, 78 No 6, 1360-1380
Dynamic Knowledge Creation. Long Range Planning Vol. 33 5-34.


Pedler, Burgoyne and Boydell (1997): Den lærende virksomhet. Forlaget Ankershus


Greenwich, CT: JAI Press


Polanyi, M (1966): The tacit dimension. New York: Doubleday & Company


