OPPORTUNITY FINDINGS AND THE PREREQUISITES FROM NETWORK STRUCTURE

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Abstract

According to Kirzner (1997) it is the finding of market opportunities based on novel knowledge that drives the market process. There are also technological opportunities, which can be viewed as new ways of combining resources without necessarily exchanging the new combination of resources with other actors. Technological opportunities correspond well to four of the five loci, which Schumpeter (1934) suggests are sources for change: creation of new products or services, discovery of new raw materials, new methods of production and new ways of organizing. The fifth locus refers to new geographical markets, which fall under the definition of market opportunities. Optimal findings and exploitations of opportunities are recognized to have different prerequisites. This paper puts forward that these are manifested through the network and the business relationships thus showing the different roles that the network has from a market as well as technological aspect.

Key words: market and technological opportunity, industrial networks, network structure, knowledge

Introduction

Establishment of relationships and technology development represent two important issues in the industrial marketing literature: finding new markets i.e. establishing new relationships and finding new products or technology. Several scholars observe that both the network and the relationships in themselves have an impact on how the industrial firm gains and deals with new knowledge. At the same time, it is clear that relationships and networks are not homogeneous, but tends to differ in their configurations (Araujo et al. 1999, 2003; Cannon and Perreault 1999). We discuss why new knowledge might emerge differently, depending on the firm's relationships and networks. Given that the industrial firm is operating in relationship networks new knowledge might flow through the network from one firm to another or be created within the firm or within the relationship between two firms.

Most relationship establishment and technology development are results of joint learning in the network, which, in turn, has effects on how the benefits are later exploited. When learning complex knowledge is important, the high degree of relational embeddedness and networks with strong connectivity are clearly superior (Coleman 1990; Hansen 1999; Kogut, 2000). Also in other fields such as international business strategy and regional development the use of the concept of embeddedness has been popular (Andersson and Forsgren, 2000; Davis and Meyer, 2004; Ivarsson, 2002; Schmid and Schurig, 2003). In such a settings it has been shown that a high degree of network embeddedness might enhance competitive advantages (Birkinshaw and Hood, 2000; De Propris et alm 2005; Driffied and Munday, 2000). However, scholars have also recognized that there is a risk for inbreeding in such situations[1] and that firms will have to look for ties that might give new inputs and opportunities. Otherwise the over-embeddedness (Uzzi, 1997) will in fact lead to a collapse.

The more the firm's network contains intense and deep relationships, i.e. a high degree of relational embeddedness, the more likely that the knowledge flowing is of complex nature. If the network configuration is also of a closed type we can expect that the exploitation of this knowledge will be facilitated by the cooperative and coordinative character such networks have. On the other hand, new knowledge is more easily accessed in a network of many unconnected participants having relations with a low degree of embeddedness to each other. In such a network the firm assimilating the knowledge also has a better possibility to keep the knowledge inside the firm and can earn profit during the exploitation phase. It is in a sense difficult to imagine any firm being situated in any of the above-mentioned 'ideal' situations; in reality a firm has relationships characterized by both high and low degrees of embeddedness. Likewise, no system, i.e. network, is totally open or totally closed, even if parts of the system could reflect such a homogenous character. One important conclusion from the reasoning above ought to be that an ideal network should contain relationships of varying degrees of embeddedness and be of a semi- open/closed structure to ensure survival of the firm in the long run. Extending the boundaries of the studied network will reveal different and even contradictory results from the reasoning above. There are complicated situations that bring contradictory forces to the firm's possibilities to find opportunities. One such a complicated situation is when the firm is having highly embedded relationships at the same time being part of an open network. On the one hand, a high degree of relational embeddedness promotes assimilation of complex knowledge and joint problem solving while an open network means a possibility to control knowledge flows and to acquire explicit knowledge. Such complicated situations can easily occur as a misfit between the network structure and the overall business goals of the firm and make a real challenge to the management. This paper is an attempt to further these thoughts on the effect from network structure on the firm's opportunities to find market and technological opportunities.

First we will make a short review on how relationship establishment and technology development have been dealt with in the literature followed by a conceptualizing on network structure and relational embeddedness.

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[1] In international business strategy literature it is usually recognized as a managerial problem in the sense that subsidiaries become autonomous in relation to MNC headquarters as a consequence of being highly embedded on local markets.

Literature review

Establishing relationships

Establishing relationships is a difficult and costly venture for most industrial firms, which makes this process critical. Several researchers in management (Ring and Van de Ven 1994), entrepreneurship (Larson 1992), and industrial marketing and purchasing (Ford 1980; Dwyer et al. 1987; Halinen et al. 1999) have put forward models that describe and analyze how relationships are established and developed. Perceived uncertainty seems to prevail prior to the relationship's establishment, which makes the reputation of the potential counterpart as a fair and trustworthy firm critical (Anderson and Weitz 1992; Larson 1992). By doing business with an entity that has the reputation of treating its counterparts fairly, the firm can expect to be treated in a similar manner. The source of reputation is neither the industrial firm nor the potential counterpart. Rather, the source is the experience and knowledge of other firms in the network—firms that have knowledge about the potential counterpart.

Another notion in the literature on establishment of new relationships refers to the point at which the industrial firm becomes aware of the potential counterpart (Dwyer et al. 1987), or at which the firm already knows about the counterpart's existence and may have some indirect experience with the firm (Ford 1980). The establishment of a relationship can start from a position of either mutual ignorance, where the industrial firm and the potential counterpart have no knowledge of each other's existence or from a situation where they are already mutually aware of each other, which can be a result of other actors providing knowledge about them.

The previous observations on awareness, prior experience, reputation, and ignorance as factors characterizing relationship establishment relate to what should be considered as "knowledge." They further indicate that knowledge about the potential customer or supplier and the configuration of the firm's relationships and networks influence the establishment of a new relationship.

Technology development

Technology development is a process whereby the firm designs, tests, changes, rejects, or accepts new solutions in technology. The development is seen as an evolving learning process where firms increase their competitiveness by developing their products and production processes (Utterback and Abernathy 1975; Sahal 1981; Håkansson 1989). Although the industrial firm might receive knowledge of some sort from another actor and develop its technology in-house, the knowledge gain usually accrues from the firm's relationships with customers and suppliers (Håkansson 1989). As activities progress to improve the use of resources and new knowledge unlocks new fields of use, firms' activities and resources are pooled in new ways leading to further technology development.

Since technology builds on knowledge of different resources and activities, the development of technology is dependent on access to knowledge. Requests from customers and suppliers often trigger the development of technology, leading to adaptations and the solving of common problems between the firm in focus and its suppliers and customers (Brown and Eisenhardt 1995; Håkansson 1989; von Hippel 1988, 1994). The IMP perspective implies that strong relationships or relationships in which the parties have a high degree of embeddedness are conducive to the development of technology (e.g. Holmen et al. 2005; Håkansson 1987).

Industrial networks

We propose that relational embeddedness and the industrial network, in terms of an open or a closed system, have a formative effect on the flow of knowledge and problem solving among actors. We aim to exploit observations made both by social network scholars (e.g. Dyer and Chu 2000; Grabher 1993; Granovetter 1985, 1992; Gulati 1998, 1999; Gulati et al. 2000; Kogut 2000; McEvily and Zaheer 1999; Rowley et al. 2000; Uzzi 1996, 1997; Zukin and Di Maggio 1990) and by researchers within the Industrial Marketing and Purchasing (IMP) perspective (e.g. Anderson et al. 1994; Håkansson and Snehota 1995; Ford 1980; Axelsson and Easton 1992) to demonstrate what drives or hinders the industrial firm in making changes as well as acting upon changes in its network.

Social network theory emphasizes how and why knowledge can flow and be transferred among actors in the network. Significant for these scholars (e.g. Granovetter 1985; Zukin and DiMaggio 1990; Lin et al. 2001) is that they argue against an under- as well as an over-socialized view, emphasizing the notion of bounded rationality and that rational economic behavior is limited by a person's socially embedded context. Factors that promote or hamper the knowledge flow are of specific interest (Owen-Smith and Powell 2004). The idea is that knowledge under various conditions can be moved from one actor to another. Individuals will engage in networking because the network facilitates knowledge flow, which in turn affects performance.

The IMP perspective, on the other hand, tends to neglect transfer of knowledge and instead sees the activities performed in terms of interaction in the network as the main source of knowledge (Anderson et al., 1994; Axelsson and Easton 1992; Ford 1980; Håkansson 1982, 1987, 1989; Turnbull et al. 1996). The IMP tradition views the management of relationships as an organizational problem and the acquisition of knowledge as results from a local search for solutions to problems that have occurred in the relationship (Cyert and March 1963; Håkansson 1982). In this tradition, what the firms are doing critically affects the type of knowledge gained.

The following discussion aims to conceptualize industrial networks as open or closed systems, and is followed by an explanation of the notion of relational embeddedness.

Industrial networks as open or closed systems

Several researchers commonly describe the network as an open or closed system (Burt 1992; Coleman 1990; Kogut 2000; Uzzi 1996). In an *open system*, the non-redundant, unique, relationship between two actors is the paramount construct. A relationship is considered non-redundant if it is the only pathway linking two actors, and a completely open system is in place when all relationships between involved actors are of a non-redundant character (see Figure 2a). In line with the ideas of social network theory (Burt 1992; Coleman 1990), the open system promotes the flow of unique knowledge from each supplier and customer to the industrial firm, as it is less likely that two actors in the open system have the same knowledge to transfer.

In principle, an actor having two or more non-redundant relationships with actors who are not connected to each other occupies a strong brokerage position termed a *structural hole* (Burt 1992). Figure 1a illustrates the industrial firm as the possessor of the structural hole. The firm has two suppliers and two customers, none of which has a relationship with any other. Actors situated in structural holes have the most powerful position within a network as they can control the knowledge flows among the other actors. This view is also true for actors that are the node between two networks, irrespective of the degree of redundancy within each of the separate networks, as long as the actor in question is in the only position connecting the two networks (ibid.). Networks of this type tend to have a "hierarchical" structure—in fact, several hierarchies. The actor bridging these networks, i.e. positioned in the structural hole, is the one controlling the flow of knowledge among the networks or actors (Kogut 2000).

FIGURE 1A ABOUT HERE

The *closed system*, on the other hand, builds on the notion that actors in the network coordinate their efforts and actions (see Figure 1b) because knowledge from customers and suppliers can reach the industrial firm in at least two ways. In principle, the industrial firm can obtain the same information from let's say the supplier (upper left of the diagram) as the firm obtains from the customer (upper right), i.e. the relationships provide redundant knowledge due to the connectedness in the closed system.

FIGURE 1B ABOUT HERE

Continuous interaction among the actors in the network improves coordination (Coleman 1990). The redundant relationships among the network actors result in a resolution to collective action problems (Kogut 2000), and the closed system also allows the actor to check out the quality of, and to reflect on, compare, and evaluate, the received knowledge. This close interaction and redundancy of relationships with other actors result in difficulties in keeping knowledge within the firm. Instead, the interaction fosters trust and shared routines. Contrary to the open system, the closed system produces a sharing of knowledge among the actors. A closed system hampers the flow of non-redundant knowledge as it is always likely that knowledge received from one actor will later be received from another actor as well.

In an open system, the knowledge an industrial firm gains tend to be of a novel type as the firm collects non-redundant explicit knowledge from its customers and suppliers. The collected knowledge in a truly open system is unique, and the combination of knowledge resides in only one place, inside the firm. If the firm is bridging a structural hole, then its combined, collected knowledge is truly unique. In this case, the developing actor is a solitary actor and the knowledge gathered from the others is impossible to check out and test, other than internally. If the knowledge is shared with the other actors, the advantage of being the sole actor with all the critical knowledge is lost, and the uniqueness of the knowledge decreases. In other words, this type of system facilitates the transfer of knowledge and not so much the creation of it, in terms of solving problems through collaboration and cooperation.

More of creation than transfer occurs in a closed system; that is, in a network where all actors are linked to one another, new knowledge will often appear as the actors solve problems by adapting products and processes toward each other, rather than because new knowledge enters the system or the industrial firm from the outside. In this type of system, 'new' knowledge first and foremost appears when existing knowledge is combined in new ways in the adaptation process among, for instance, customers and suppliers. The adaptation between two actors in a closed system inevitably affects the connected actors in this relationship, meaning that one adaptation very often requires another adaptation in a second step, that is, toward the connected actors. Consequently, changes mostly take the form of incremental development, but also the developments made are less arduously exploited in the network as a whole (e.g. Håkansson 1987).

Relational embeddedness

When analyzing relationships in industrial networks researchers often put forward the notion of *relational embeddedness* (Reagans and McEvily 2003; Uzzi and Lancaster 2003; Bonner and Walker 2004). In the present paper, the arguments around embeddedness build on Granovetter's (1985) seminal article, as well as on findings reported within the IMP tradition.

Granovetter states that economic behavior is not an autonomous activity. Economic behavior is not performed in isolation from institutions, technology, political or cultural conditions and, especially, not removed from the social context. Marketing scholars have made similar observations. In the interaction approach (Håkansson 1982), relationships between suppliers and customers contain four types of exchange: product or service, information, financial, and social exchange. Johanson and Mattsson (1992) see the network of relationships as having two interdependent levels, namely the exchange level and the production and technology level. In the same vein, a relationship between a supplier and a customer in an industrial network has been treated as having five bonds: technical, temporal, knowledge, social, and legal and financial (Hammarkvist et al. 1982).

A relationship between industrial firms has several dimensions, and performing several types of activities simultaneously follows. However, these dimensions and activities are parallel meaning that the relational embeddedness concept implies that they are interdependent. The focus here is on three specific dimensions of relationships in industrial networks: social relations, exchange of resources, and combination of resources. Thus, exchange in a relationship between two firms can be more or less embedded in a technological structure, where firms combine resources and invest and adapt their resources toward the counterpart. This exchange embeds in a set of social relations.

Relational embeddedness is defined here as the interdependence between social relations, exchange of resources, and combination of resources in the relationship. The rationale for this definition is twofold. First, the definition is consistent with Granovetter's (1985) ideas and second, the definition captures the development of the IMP perspective (e.g. Hammarkvist et al. 1982; Wilson and Mummalaneni 1986). Thus, a high degree of embeddedness is a result of high interdependence between the "how, when, and why" of two firms' exchange of resources and what types of resources they combine in the relationship. In this case, the exchange in the relationship embeds in the two firms' technological structure and social relations (Figure 2).

FIGURE 2 ABOUT HERE

Relationships in industrial markets are characterized by adaptation (Hallén et al. 1991; Brennan et al. 2003) and commitment (Anderson and Weitz 1992; Gundlach et al. 1995; Blankenburg Holm et al. 1999), in turn creating mutuality. This is a result of the relationship process where the firms make relationship-specific resource investments (Håkansson and Snehota 1995) and integrate and link their activities to each other (Richardson 1972; Dubois 1998; Håkansson and Johanson 1992; Håkansson and Snehota 1995; Johanson 2004). The mutuality in turn builds up the network structure which tightness is depending on the level of mutuality and its components adaptation and commitment.

Moreover, the present paper advances the idea that in a relationship, the three dimensions; *exchange of resources, combination of resources, and social relations* are mutually adapted and that the firms' investment in, for instance, combination of resources, is related to the social relations, which, in turn, increases the relational embeddedness.

The establishment of relationships more or less embeds in a technological structure and a set of social relations. When firms try to find and exploit relationships with customers and suppliers they have to consider both the social relations and technological issues (see Figure 2). On the other hand, in relationships with a high degree of relational embeddedness, developing new technologies is contingent on an exchange structure and the social relations in the relationship. The way firms exchange resources and handle social relations has an impact on the process of development of new technologies.

Relational embeddedness not only affects how and when the relationship establishment and technology development are made, but also influences how they are exploited. Wide and intensive cooperation and interaction characterize relationships with a high degree of relational embeddedness. The exchange of resources is dependent on social relations between people involved in the interaction and the combination of resources deployed in the technology. Therefore, changing the character of, for instance, the exchange of resources cannot be done autonomously from the social relations. This makes exploitation of change a more complicated process than in relationships with a low degree of embeddedness. Thus, identifying problems and finding solutions are integrated, not separate activities in relationships with a high degree of relational embeddedness. Moreover, in these relationships the firms are likely to have common values and to share an understanding of each other's capabilities and needs. They also tend to possess more common knowledge about each other compared to firms that have relationships with a low degree of embeddedness. In relationships with a low degree of relational embeddedness, the industrial firm's knowledge instead concerns internal issues.

To settle the starting-point of our research agenda we can summarize the last section on relationships and networks by the following:

A firm's ability to gain new knowledge is dependent on its network structure, in terms of closure, as well as on the characteristics of its relationships, in terms of embeddedness. The degree of relational embeddedness and the structural configuration produces the two main ways to bring the new knowledge within reach i.e. through knowledge flows or problem solving. Thus, relationship establishment and technology development are identifiable as two essential manifestations of change in the network.

Change and stability in industrial networks

Gaining new knowledge leads to changes in activities like absorption, deployment, and implementation. Consequently, the prevailing knowledge base in the firm's relationships and networks must have the capacity to absorb knowledge (cf. Cohen and Levinthal 1990; Lane and Lubatkin 1998) and adapt to changes (Gadde and Mattsson 1987; Håkansson 1987, 1989). Two aspects seem to be especially important for how firms gain knowledge in industrial networks.

First, consider the aspect of having many sources, which relates to the novelty of the knowledge absorbed. In general, the more non-redundant relationships with customers and suppliers, the more new knowledge can enter the system. This situation seems to require that the firm has relationships with a low degree of embeddedness, due to limited resources, and that a sufficient share of its relationships is with unconnected actors, i.e. a part of the network has to be open.

Second, consider the characteristic of absorbing knowledge. Tacit knowledge seems to be easier to absorb in relationships with a high degree of embeddedness and where the firm is in a position enabling cooperation and coordination with customers and suppliers, accordingly being part of a closed system. This situation occurs because tacit knowledge tends to be a product of 'doing,' while explicit knowledge, on the other hand, is easier to transfer between firms in the network. The more tacit the knowledge, the greater the need for extensive interaction and a high degree of relational embeddedness in order for the firm to have good opportunities to absorb the knowledge (Lane and Lubatkin 1998).

How knowledge is gained and what type of knowledge is gained influence change and stability of the industrial network. However, the social network theory and the IMP perspective have different opinions on this issue. The IMP perspective suggests that in an industrial network where firms are extensively connected with each other and where the relationships are strong the firms will interact and cooperate with several actors, and, in turn, adapt and commit not only to specific customers and suppliers, but also to the whole network. Such a network, with a closed structure and a high degree of relational embeddedness, several firms are involved and their specialization and capabilities provide a variety of solutions on the problems that occurred, based on already existing knowledge (Håkansson, 1993). The time provided by the stability gives the firms opportunity to reflect, compare and repeat what they have learned by re-combining the existing knowledge. This type of network is therefore likely to sustain for a long time.

> P1: An industrial network, which is characterized as a closed system with a high degree of relational embeddedness, is likely to be a stable structure that exists for a long period of time as a result of the continuously ongoing problem solving resulting.

However, following Burt's (1992) and Coleman's (1990) arguments there is at the same time a risk for inbreeding in this type, firms will have to look for ties to firms which are not part of the closed system with the high degree of relational embeddeness, which could provide new ideas. Otherwise the over-embeddedness (Uzzi, 1997) can in fact lead to a collapse. This type of network is time-limited in one way or another.

> P2: An industrial network, which is characterized as a closed system with a high degree of relational embeddedness, is likely to exist for a limited time as only existing knowledge is circulated.

The following section depicts how network closure and relational embeddedness impinge on the type and character of knowledge that is feasible for industrial firms in different situations. Discussion follows on how relationships are established and technology is developed, depending on the type of network structure in which the firm operates.

The effects from the network

Opportunities for the industrial firm to gain new knowledge increase if the firm has relationships with many customers and suppliers. Structurally, this is the case when the firm's relationships are unrelated to each other, i.e. an open system (Burt 1992). In an industrial network setting, for instance, the firm may be ignorant of customer's customers or supplier's suppliers. Moreover, when an open network contains relationships with a low degree of relational embeddedness, the firm can expect to be in a good position to receive *explicit knowledge*, of the kind that is relatively easy to transfer from customers and suppliers to the industrial firm. In an industrial network of this type, one would further expect that knowledge received from (say) one customer seldom replicates knowledge from another customer (or supplier, for that matter).

However, as the flow of explicit and new knowledge is abundant, timing becomes important in this type of network. The timing factor has to do to with the nature of the knowledge. Explicit knowledge can render a first mover advantage, even though any firm in the network could likely absorb and use the knowledge because of the possibilities to control and keep knowledge private in an open system.

The novelty of the knowledge is another issue of timing. Closely relating to gaining new knowledge is the point of time at which the industrial firm is fortunate to realize the importance of that novelty. In this case, relationships with a low degree of relational embeddedness operating within an open network can be the source, for example, of technology development and the establishment of new relationships.

As Cohen and Levinthal (1990), Coleman (1990), and Lane and Lubatkin (1998) point out, it is difficult to achieve the level of coordination and cooperation among various firms that is necessary for the integration of more tacit knowledge, as the relationships in an open system are not connected and therefore contain less of a common knowledge base. Another characteristic of this type is that the industrial firm can relatively easily keep critical knowledge inside the firm and not let the customers and suppliers, with which the firm has relationships, share the new knowledge. Consequently, such a type tends to be a good basis for exploitation of explicit and new knowledge, while exploiting tacit knowledge is less likely. The reason for this is that tacit knowledge is difficult to transfer from one firm to another. Consequently, Proposition 3 of this paper is as follows:

> P3: In a network structure characterized by unrelated actors, that is, an open system with a low degree of relational embeddedness between the actors, the industrial firm gains new knowledge of an explicit character through knowledge flows from its customers and suppliers.

A completely different situation to the one in this discussion and in Proposition 1 occurs when the industrial firm is operating in a closed system and with a high degree of relational embeddedness. This view implies a situation where the industrial firm has good insight into the operations of firms beyond the direct relationships with customers and suppliers; joint cooperation and coordination of activities are extensive, involving several firms, but also involving a risk of receiving mostly redundant knowledge through the relationships with customers and suppliers. Such is the case when an actor is connected to other actors, which in turn are interconnected; the actor is locked in and receives mostly existing knowledge.

However, as the relational embeddedness is high, the situation will, in turn, promote development of tacit knowledge as a consequence of problems being solved within relationships. In contrast to the previous (open system) type, this situation gives the firm a good position from which to compare existing knowledge with the slightly new knowledge emerging inside the network. Through repetition and reflection, the industrial firm can check the content and quality of the knowledge and can solve problems jointly with customers, suppliers, and firms that are connected indirectly. In solving the problem, the firms combine and re-combine existing knowledge.

The combination of a closed system and a high degree of relational embeddedness brings about a highly stable structure where the problem is not to find the missing piece in the puzzle. The challenge instead is to learn collectively how to modify the puzzle and adapt to the customers and suppliers. The situation implies that the possibilities for development of new technologies are good (Coleman 1990; Hansen 1999; Kogut 2000). In turn, most relationship establishment and technology development result from joint learning in the network, but the “thickness” of this type of network makes it rather unlikely that new relationships are established; if they do happen, they will be based on the fact that the two firms in the new relationship already have some experience of each other (Ford 1980). This can be summarized by Proposition 4:

> P4: In a network structure characterized by actors extensively connected to each other, that is, a closed system with a high degree of relational embeddedness between the actors, the industrial firm is likely to gain new knowledge of a tacit character based on the re-combination of existing knowledge in cooperation with its customers and suppliers.

Network structure and relationship establishment

Consider the establishment of new relationships as a process that starts from a point where the industrial firm may be ignorant of potential counterparts beyond its existing direct relationships with customers and suppliers. Counterpart firms are unknown because the customers and suppliers control knowledge of their existence. Here, one should distinguish between *ignorance* and *awareness*. Establishing a relationship from a point of ignorance implies that the firm still has to identify and specify what it is looking for. However, relationships may start from a situation where the firm is initially ignorant about the counterpart, but the firms become mutually aware of each other's existence (Dwyer et al. 1987). Completely reducing the ignorance about a potential customer or supplier can take place through a flow of knowledge that is explicit and new.

The establishment process just described may occur in a network structure characterized by an open system and a low degree of relational embeddedness. The open system still comprises a large number of potential relationships that are not established, making it relatively easy to establish completely new relationships. Moreover, the low degree of relational embeddedness implies that with little difficulty, a firm can break already established relationships and thereby replace a customer or a supplier in an existing relationship. This replacement can occur as the low degree of relational embeddedness renders existing relationships relatively easy to terminate or dissolve and incurs low switching costs. Therefore, Proposition 5 can be stated as follows:

> P5: The industrial firm in an open network structure with a low degree of relational embeddedness establishes relationships with new customers or suppliers based on knowledge transferred from established relationships with customers or suppliers.

Ford (1980) views experience with a previous supplier as a factor in the evaluation of new potential suppliers. In this type of network, where most firms are mutually aware of the other actors over a long period, derived experience is important in the establishment of a relationship. The industrial firm and its potential counterpart have both been operating in the same network for a long time, known about each other through other firms, but have never bought from or sold to each other. However, this network type implies that most relationships are established on existing and tacit knowledge and that, owing to the high degree of relational embeddedness, they difficult to terminate. This relationship makes it difficult both to establish completely new relationships or to break up an already existing relationship and replace a customer or supplier. Consequently Proposition 6 is that:

> P6: The industrial firm operating in a closed system structure with a high degree of relational embeddedness establishes few new relationships with customers and suppliers, and those relationships which are established are with firms who have been part of the network for a long time and with which the industrial firm has experience.

Network structure and technology development

The process of developing technology closely relates to gaining new knowledge; thus the industrial firm's network can be a mechanism for finding new knowledge (Håkansson 1993). However, when the industrial firm resides in an open system with a low degree of relational embeddedness the firm has only one path to its customers and suppliers. Much of the knowledge that travels through this network will be new, but also explicit, as this type of knowledge does not require a high degree of relational embeddedness. This situation resembles the conditions of classic economic transactions. The firm operates at arms-length from its counterparts, i.e. through relationships with a low degree of embeddedness in a structure where connections between actors are few. In such a network structure, knowledge can more easily be packaged, codified, and transferred to other actors. Knowledge is not situation-specific and, when moved in the network, often originates beyond the industrial firm's direct relationships.

However, as technology development tends to require a large component of tacit knowledge, it is likely that an open system and a low degree of relational embeddedness can only play a minor role in technology development. This type of network favors the flow of explicit and new knowledge; further, the network makes control of knowledge flows possible, but this knowledge has less significance than the knowledge the firm gains from combining existing knowledge within its own boundaries. Good opportunities arise to keep the technology within the boundaries of a specific relationship and to assure that knowledge of the technology is not spread to other firms. In sum, the lack of trust and other features necessary for mutual adaptation and joint development lead to Proposition 7:

> P7: The industrial firm in an open network structure with a low degree of relational embeddedness develops new technologies in-house without participation from customers and suppliers.

A high degree of relational embeddedness seems to favor change based on tacit knowledge (e.g. Hansen 1999), which is especially the case for technology development (e.g. Håkansson 1989; Laage-Hellman 1989). A high degree of relational embeddedness also enhances the acquisition of fine-grained knowledge between two firms and the opportunity for joint problem solving (Uzzi 1997). When several firms operate in a network characterized by a closed system and a high degree of relational embeddedness, their specialization and capabilities provide a variety of solutions to the problems, based on existing knowledge (Håkansson 1993). Further, the time-saving achieved by this kind of stability gives firms the opportunity to reflect, compare, and repeat what they have learned by re-combining existing knowledge. Thus, the interaction is likely to be extensive and frequent and to involve several staff—because the exchange of resources is embedded in the combination of resources, commercial issues and negotiations tend to require production staff and engineers to take part in the interaction. It follows that problems appear when the firms run the daily operations in the relationship—one can expect that the higher the degree of relational embeddedness, the more extensive the interaction; and the more extensive the interaction, the more problems. Technology development often results from solving problems that have occurred while interacting, which in turn obliges the firms in the relationship to cooperate in finding the solutions. Hence, Proposition 8:

> P8: The industrial firm operating in a closed system structure and with a high degree of relational embeddedness develops new technologies through joint problem-solving involving more than two firms.

Discussion

The following discussion builds on the assumption that the general proposal of this paper is valid. Every single firm seeks control. Although the firm has some control over the market (cf. Cyert and March 1963), an industrial firm has no simple way to achieve control over the type of networks described in this paper. The basis for forming a judgment on the developmental opportunities of different network configurations comes down to fundamental criteria for business economy, including resources. Clearly, since the network extends beyond the boundaries of the firm, the control cannot be expected to be very strong, and attempts at managing networks will incur associated costs. One such cost originates as a consequence of the over-embeddedness and the loss of opportunities to gain novel knowledge when actors in the same area are involved with each other (cf. closed system with a high degree of relational embeddedness). Another cost arises from the simple fact that managing relationships takes up scarce resources. Therefore, it is reasonable to avoid managing relationships more closely than necessary.

However, as most industrial firms depend on resources owned by other firms, they are inevitably involved to a varying extent in relationships as well as networks. The issue is realizing what consequences arise from the prevailing structure and what is needed to capture given opportunities in the prevailing situation. For instance, one consequence of being in an open system with a low degree of relational embeddedness is that the opportunities for collaborating on technology development are less frequent. On the other hand, a closed system with a high degree of relational embeddedness is dysfunctional for the establishment of relationships in new markets.

FIGURE 4a ABOUT HERE

Being prepared for change might imply reconsidering the industrial firm's prevailing relationships. For instance, changes from an open towards a closed system and a deepening of relational embeddedness has implications for management, as articulated in previous sections of this paper. The same goes for the opposite situation, when the situation changes from closed to open and the relational embeddedness perishes. When changes move along these dimensions in these directions (from A to B or vice versa in Figure 4a), the expected consequences are fairly consistent; the consequences of the A and B situations have already been argued in this paper.

Two other possible situations challenge the managerial skills of the firm (and would constitute an interesting theme for future research). The situations arise when changes occur in other directions (i.e. from A to D, from A to C, from B to C, or B to D) along the two dimensions; the consequences will be more problematic. These two situations are (1) an open system with a high degree of relational embeddedness (position C) and (2) a closed system with a low degree of relational embeddedness (position D). Even though these situations are less commonly found in their complete form and may not even last for a particularly long time, they seem to exist in specific markets. Consider, for instance, the turbulent situations that can occur in transition markets or the effect of dramatic political changes that may prohibit certain businesses.

FIGURE 4b ABOUT HERE

Position C in Figure 4b implies a situation with a high degree of relational embeddedness in an open system. This leads to problem solving and creation of tacit knowledge side-by-side with the flow of new knowledge coming from other parts of the network. Mutual knowledge characterizing the relationships with customers and suppliers has a tendency to promote the search for local solutions in these relationships, rather than stimulating the firms to try to find solutions to relationship-specific problems in other contexts. This tendency, in turn, implies that the majority of the solutions are based on tacit knowledge. The flow of new and explicit knowledge from a remote part of the network can cause problems when combined with tacit knowledge. The firm will probably have difficulty absorbing the new and explicit knowledge. Thus, the key network issue here is how to combine absorptive capacity with dyadic cooperation and development.

The other situation with a low degree of relational embeddedness in a closed system (position D in Figure 4b) will in its extreme form not be functional at all. According to the theory, a flow of explicit knowledge will exist; but in a closed system, everyone will receive the same familiar knowledge, which has only a small component of novelty. The knowledge tends to be superficial and to lack detail and richness. Due to the low degree of relational embeddedness, problem solving or creation of tacit knowledge will not occur in the relationships. These relationships will be easy to break, while new ones will be easy to establish. The firm has to reconsider its resource priorities, not least when reflecting on suppliers and customers that might be good partners for cooperation in quality development.

Closed systems with a low degree of relational embeddedness usually prevail in industries like banking and other types of services that firms buy and sell. This situation is due to the low degree of relational embeddedness. Industrial firms use technologies that are adapted to each other, in terms of transportation, logistics, production etc., depending on the social relations and exchange of resources. In such a network, the key issue is how the industrial firm can actively try to increase the relational embeddedness in its relationships with customers and suppliers, in comparison to the competitors, as just a small increase of relational embeddedness increases switching costs for the customers and suppliers as they terminate relationships with the industrial firm. Because of the narrow scope for adapting and committing resources in terms of tangible investment and technology to the relationships, this is a thorny task. In this network, technology development is an internal activity. Building social relations is the critical network activity.

One difficult task will then be to estimate how much it takes to reach a significant return on such an investment in terms of time and managerial efforts. Although this paper does not present any solutions as such, it is clear that the model described captures problems that are critical for the industrial firm to handle. Nevertheless, to further prove the model's validity, significant measurements along the two dimensions remain to be made.

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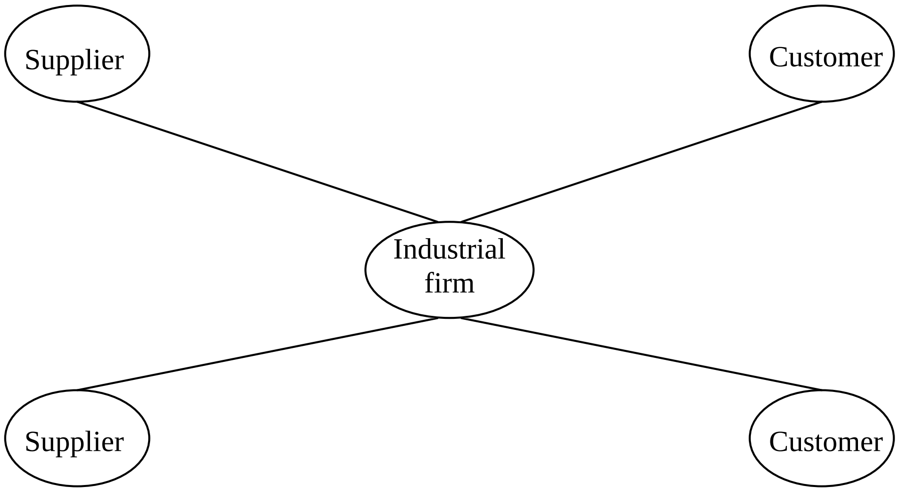

Figure 1a. Open system

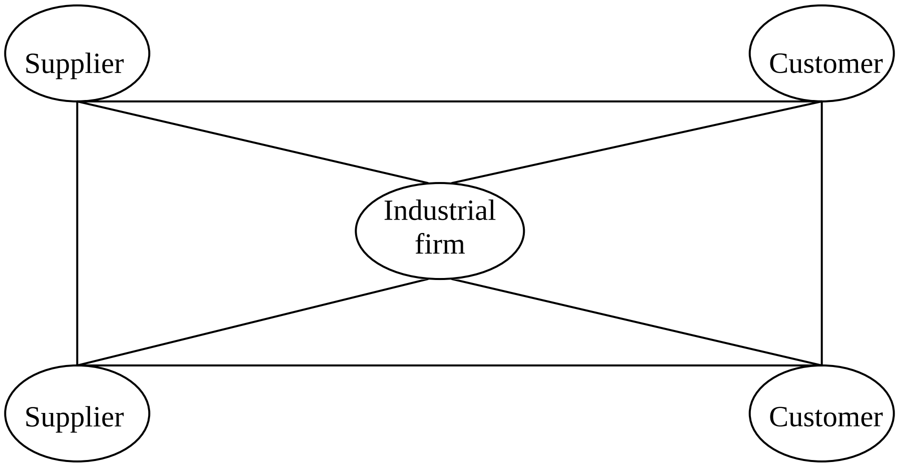

Figure 1b. Closed system

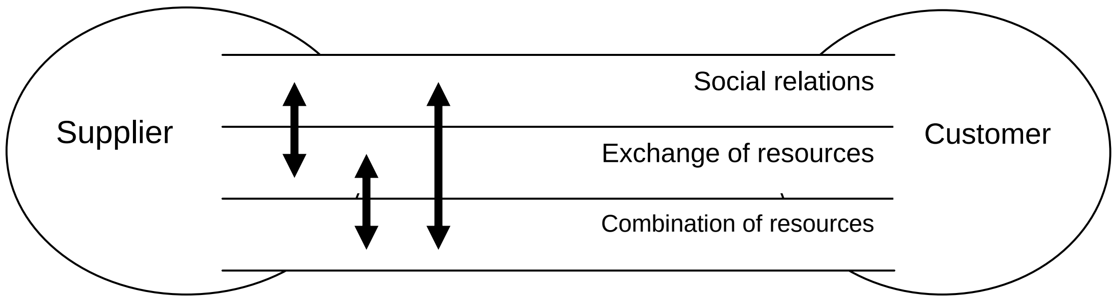

Figure 2. Relational embeddedness

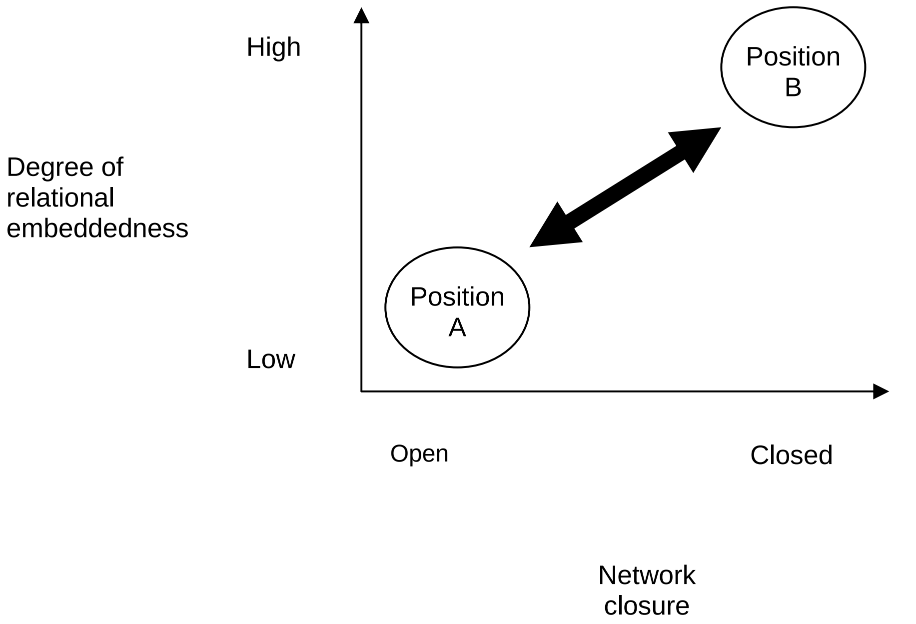

Figure 3a. Changes along the two dimensions: network closure and relational embeddedness.

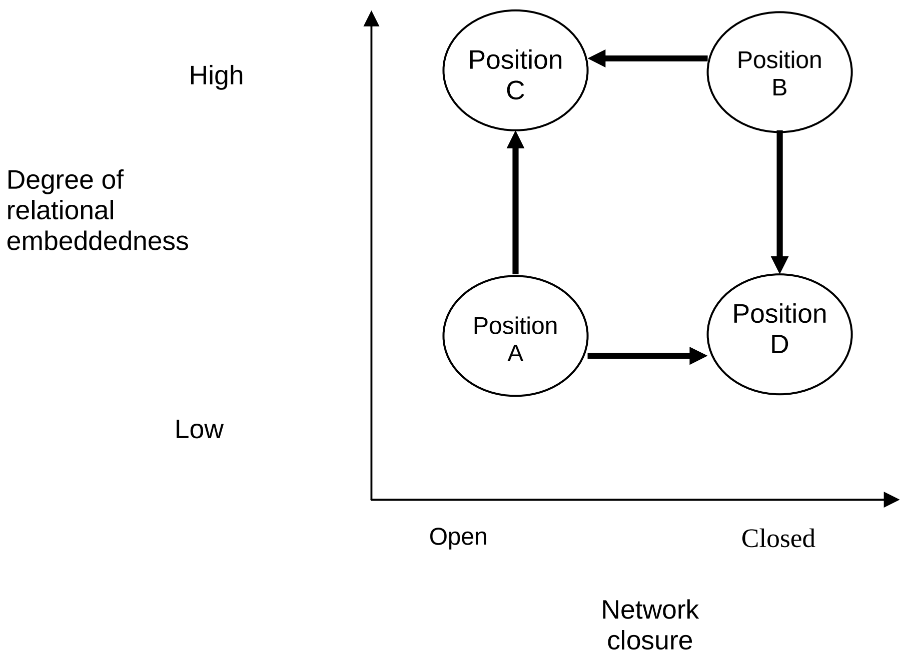

Figure 3b. Changes towards complicated situations.