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How Personal Networks Shape Business

An Anthropological Study of Social Embeddedness, Knowledge Development and Growth of Firms

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HOW PERSONAL NETWORKS SHAPE BUSINESS

Peter Parker

How Personal Networks Shape Business

*An anthropological study of social embeddedness,
knowledge development and growth of firms*



LUND MONOGRAPHS IN SOCIAL ANTHROPOLOGY 14

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Abstract

The research draws from anthropological work on social exchange and later work on embeddedness in an exploration of how personal networks shape business. The purpose of the research is to contribute to an understanding of how social relations shape economic processes and vice versa.

The research takes its starting point in small manufacturing firms in southern Sweden primarily in the plastics industry. Internal and external relations of these firms are studied using qualitative methods and formal network analysis.

Qualitative methods are used to identify important mechanisms of personal networks. It is argued that personal networks provide a domain of interaction outside short term economic rationality but at the same time, the development of personal networks is fuelled by the need for coordination in achieving business ends. Particularly personal networks are essential for gaining access to a diverse set of expertise. They may create informational advantages, trust and quality of communication. Personal networks are shown to be an integral part of both effective production and firm development in these firms. This is in stark contrast to notions of impersonal markets and bureaucracy that still shape discourse on business.

Formal network analysis, starting from recurring problems of coordinating production, provides an important complement and expansion of the findings. It becomes evident that certain structures of informal organization provide an individual with means of gaining recognition and a means of navigating a dynamic environment. The same structures are also found to be important on a firm level. Certain structures of informal organization provide a better basis for acquiring useful information and meaningfully integrating in the firm. There is a strong correlation between the structure of informal organization and firm growth. These structures of informal organization also seem to be linked with more intangible aspects of communicative climate.

The research develops relatively simple methods to differentiate a beneficial informal organization from less beneficial ones, at least in terms of firm development. It also outlines factors shaping the development of beneficial personal network structures in and between firms. These findings, if corroborated in subsequent research, have important implications both for understanding knowledge development and growth of firms and also for understanding how individuals are shaped by the informal structures of their work experience. Hopefully, the research will stimulate further dialogue between anthropology and research on social embeddedness.

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CHAPTER I

Introduction

Background

Most people find that personal networks are important. Those we exchange information with, discuss issues and ideas with, are important in introducing us to new facets of life and new opportunities. Contacts may also be vital because they embody trust and enable higher quality communication and thereby provide a platform for coping with uncertainties. Personal networks therefore shape an individual's perception of a situation, open opportunities and help deal with difficulties.

Personal networks also have an impact on the development of organizations as wholes. For instance, some firms afford an atmosphere of lively and productive exchange of ideas. In others, even relatively simple problems become difficult and even the best ideas seem to have little chance of surviving. These differences seem related to the existence and structures of personal networks in the organizations. The impact of these differences can be substantial. An open communicative climate increases the ability of firms to find flexible solutions, adapt and develop.

This is a study of the role of personal networks in small business. It concerns issues of how personal networks shape the development of both individuals and firms. In several respects the research can be understood as continuing a line of anthropological work on social exchange and informal organization. However, the research also seeks to develop new ways of understanding personal networks in business.

Stated briefly, anthropological interest in business has two important roots. Firstly, firms seem to provide an obvious starting point for the study of social processes in industrialized societies. The very number of firms and other formal organizations as well as their impact on the lives and livelihoods of people make them an obvious point of interest. Firms also seem to provide excellent sites. Fundamental issues of conflict and coordination in wider society are reflected in microlevel interaction in the firm. Practices developed in work play an important role in shaping individual strategies and perceptions in other social contexts as well.

Anthropological interest in firms stems however not only from its usefulness as a site but also reflects a theoretical issue. Studies of informal organization are almost always conducted in implicit or explicit critique of neoclassical economics. The issue

at stake may perhaps be understood as questioning when, if ever, a concept of the individual shorn of all social relations can provide a useful basis for understanding of interaction. However, the theoretical issue runs deeper than simply refuting the atomistic assumptions of economic models. Research in this tradition tends also to be driven by dissatisfaction with overly structural models. The deeper issue is to develop a model that can adequately take both economic and social factors into account.

In relation to these theoretical issues, business, being the site par excellence of economic man might provide a fertile ground for contesting old models and developing alternate ones. Although few researchers today hold that economic man is realistic portrayal of the individual's relation to his environment, the conceptualization of atomistic rational interaction still underlies influential models both in academic writing and popular discourse. This is due, in some part at least, to the lack of adequate alternate models of socio-economic interaction. The challenge of creating such a model still remains.

In the last two decades, there has been an increasing interest in exploring how economic processes are embedded in a wider social matrix. There is broad discussion across different academic disciplines on how economic processes are contingent upon cognitive, cultural, political and social structures. The embeddedness approach, as this research direction is called, concedes that market-like mechanisms are important but holds that they are mediated and shaped by factors that lie outside the market and which must be taken into account in order to provide an adequate understanding. While this standpoint is hardly novel, what is novel is the breadth of research being conducted in this vein. This interdisciplinary interest in embeddedness provides an important opportunity for anthropology to recapture and develop a classic strain of research in the subject and bring this understanding to new fields. Ultimately this dissertation seeks to make a contribution in this direction.

Before proceeding to the study of personal networks in business it is necessary to provide some background in terms of central concepts and themes brought up by previous anthropological research in this field. Particularly, a brief review of some aspects of exchange theory is pertinent to the development of the argument. The discussion draws on work from rather disparate settings such as Polynesia and Morocco. This is not because personal networks are more relevant to economic exchange in such places, but simply that the study of these issues has more often been conducted in non-western settings (Granovetter 1993).

Social exchange

Exchange is one of anthropology's central concepts. Studies of patterns and strategies of exchange form a central part of most early anthropological studies. For anthropologists exchange patterns provide a kind of data or mapping of complex social interactions, while the close study of particular instances of exchange provides insight into

the interrelated nature of cultural forms. Exchange, in this perspective, is seen as both an important indicator of social structure but also a strategic means of shaping social relations. This focus on social aspects of exchange in anthropology has often been in explicit contrast to economic perspectives that might tend to see the circulation of goods in quite different terms.

Perhaps the most famous early study of systems of exchange is Bronislaw Malinowski's study of the Kula (Malinowski 1922). Some aspects of his analysis are most certainly relevant to the present study despite striking differences in setting. Particularly, his analysis may serve as an interesting example of social exchange.

The Kula is an elaborate and ritualized system of exchange in Polynesia. The items exchanged are of specific types. Necklaces are exchanged for armbands in one direction and conversely armbands for necklaces in the other direction in a vast geographic area. Malinowski argued that this exchange serves no direct economic ends. Yet the Kula is conducted with great effort and seriousness on the part of individuals. Moreover, the structure of exchange relations in the Kula system as a whole has also been shown to have a strong impact on the partaking societies (Persson 1999). To account for the significance of the Kula, Malinowski developed a notion of what might be called social exchange. Social exchange differs in both logic and expression from economic exchange. However, Malinowski still considers it a system of trade.

... the a priori current notion of primitive trade would be that of an exchange of indispensable or useful articles, done without much ceremony or regulation, under stress of dearth or need, in spasmodic, irregular intervals - and this done either by direct barter, everyone looking out sharply not to be done out of his due, or, if the savages were too timid or distrustful of one another by some customary arrangement, securing by means of heavy penalties assuring compliance in the obligations incurred or imposed. Waiving for the present the question how far this conception is valid in general - we have to realise clearly that the Kula contradicts in almost every point the above definition... (Malinowski 1922)

Perhaps the notion of social exchange is easier to understand when related to gifts. If the Kula is seen not as an economic exchange of goods but as an exchange of gifts then this helps clarify some of its character. In Gregory's famous typology gift exchanges are about shaping qualitative aspects of personal relations. In contrast, commodity exchange is about establishing quantitative equivalence between sets of objects and is therefore impersonal (Gregory 1982; Gregory 1983). The shaping of relations by social exchange is often an important end in itself by creating identity and conferring status. Even so it can also be used in a strategic and competitive ways. In other words individuals may seek to achieve their aims by means of social exchange just as they may in economic exchange. In the Kula example a strategic element is important. The configuration and qualities of exchange relations has an impact on both individuals and societies. The argument may perhaps simply be stated that exchange involves two important dimensions a social or relational dimension where the configuration and quality of relations is important and an economic dimension where the value of products and service exchanged at a given time is what is impor-

tant. Neither dimension can be reduced to the other¹. However, they are often deeply intertwined (Smart 1993; Graeber 2001; Lin 2001).

Thus social exchange can be an end in itself i.e. as a means of establishing identity or gaining status. However social exchange can also be a means of shaping relations in ways favorable for economic exchange. In general, having a good set of social relations can be essential to gaining access to resources controlled by others. This is an essential component of social capital (Lin 2001). Conversely, economic exchange strategies may serve the purpose of accumulating wealth, but wealth may be used as means of establishing relations and identity. David Graeber puts this succinctly in his recent treatise on value:

This is why economic models, which see those actions as aimed primarily toward individual gratification, fall so obviously short: they fail to see that in any society- even within a market system- solitary pleasures are relatively few. The most important ends are the ones that can be realized in the eyes of some collective audience (Graeber 2001).

The intertwining of different forms of exchange may cause somewhat paradoxical situations. In business for instance social exchange may further instrumental ends but does so only when it clearly not governed by instrumental motives.

The relevance of social exchange for small business may become clearer when it is understood that social exchange, just like economic exchange, is not limited to goods. Social exchange does not take place only through necklaces and armshells, it can take place simply by passing on information, doing someone a favor or even abstaining from opportunism. This kind of social exchange is common in business and in everyday life. In fact social exchanges in a business may be seen to form a part of a system that has very real individual and firm level effects.

Social relations are an important component of probably most economic interaction although the relative importance of social and economic dimensions of exchange certainly varies. However, even in interaction that is considered dominated by economic rationality, it is often necessary to build good working relations in order for economic exchange to take place or at least be gainful.

Social exchange and social systems

In anthropology and sociology two broad approaches to social exchange developed (Ekeh 1974). One approach to exchange emphasizes that patterns of exchange are determined by collective processes. Patterns of exchange are therefore used as a means

¹ Being overly economic and calculating in the exchange of gifts may be explicitly recognized as an ineffective and lowly. Malinowski writes for instance that the Trobrianders: "When criticizing an incorrect, too hasty, or indecorous procedure of Kula, they will say: He conducts his Kula as if it were gimwali (barter). (Malinowski 1922 P96). Smart (Smart 1993 makes a similar observation concerning the Chinese practice of gift giving)

of exploring underlying cultural forms. Though analysis of exchange, at a collective level, may be essential to understanding aspects of the wider social system it is an approach that is largely incapable of dealing with, and perhaps uninterested in, individual strategies.

Collectivistic approaches to exchange, such as structuralism, leave unanswered questions as to how social systems evolve or how they are maintained (Friedman 1974). To use Coleman's expression it is a social science without an essential spring or driving mechanism (Coleman 1988).

These were precisely the problems that provided an impetus toward developing a transactionalist approach to exchange². The transactional approach seeks to take individual strategy in both social and economic exchange relations as a starting point and develop an understanding of how this shapes social systems. For instance, Barth undertakes to show how ethnicity, forms of kinship and the stability of political leadership are outcomes of rational strategy (Barth 1959; Barth 1959; Barth 1966). A collection of studies demonstrating how fishing villages in northern Norway are transformed by entrepreneurial activity provide an example of how individual strategy both reshape social systems but also how the social system itself shapes what strategies are viable (Barth 1963).

A number of studies were conducted in a broadly transactional approach following primarily on Barth's lead but also with inputs from the work of Peter Blau (Blau 1964). For these approaches individual strategy formed an essential starting point for the analysis of socio-economic systems (Mitchell 1969; Kapferer 1972; Kapferer 1976). Although deriving impetus from different sources Clifford Geertz classic work on the socio-economic organization of the Bazaar may serve as an example of the approach. For Geertz the colorful and chaotic multitude of the bazaar was a result of rational strategies of interaction, but these were strategies that were shaped by the particular circumstances of trade. Particularly, clientelistic buyer-seller relations developed as a response to the quintessential issue of gaining access to relevant information about availability, quality and alternatives. A net of personal and economic relations provided order in seeming chaos of the bazaar (Geertz, Geertz et al. 1979). For actors in the bazaar such relations were crucial. However, competitive strategies of both buyers and sellers are concentrated on obfuscating this essential information for others. Personalized trading in the bazaar is not adequately understood as trading minus 'modern' institutions, it is a socio-economic system in its own right.

Although transactional approaches are disparate they share an effort to understand how particular forms of socio-economic systems are maintained or transformed by actor strategies. They tend to emphasize individual strategy in both social and economic exchange as a primary means of understanding social process. In the following sections I draw heavily on Kapferer (Kapferer 1972) and a recent synthesis by Lin (Lin 2001) to outline a framework building on what I understand to be the central points of transactional analysis in anthropology.

2 I will use the term transactionalist in a broad sense to refer to approaches that take individual strategy as a starting point for the analysis of social systems.

Relational values

In a recent work Nan Lin has coined the term relational values (Lin 2001). This concept conveys the notion that structural and qualitative aspects of a persons network of relations such as recognition and status can be conceived of as values. What Lin suggests is that in certain respects the pursuit of relational values, such as recognition and status, can be understood as similar to economic pursuits. Both relational and economic values can be seen as the object of individual strategy and both can be understood from the perspective of individual rationality (Lin 2001).

In treating socio-economic interaction, that is interaction that contains both economic and social exchange, a strong notion of rationality, in the calculative sense, is intractable. The reason for this is quite simple. Relational strategies depend by definition on the actions, perceptions and motivations of others. This necessarily introduces a degree of uncertainty in any relational strategy and limits the usefulness of being rational in a calculative sense. Actors in socio-economic interaction are likely to make use of heuristics and 'feel for the game'. This is not because they 'lack the wits to be rational'. On the contrary, the use of heuristics seems the only viable strategy in this type of interaction (Uzzi 1997). Nonetheless, with a weak form of rationality and attention to relational values the economic and transactional approaches are compatible. The concepts of economic and relational rationality provide a basic framework shared, if not always explicitly in these terms, by transactional approaches (Barth 1963; Kapferer 1976; Geertz, Geertz et al. 1979). In these approaches individual struggles for advantageous positions and advantageous economic exchange provide a basis for understanding how social systems are maintained and transformed.

Naturally, if transactional approach is to be useful it is necessary to have some form of mapping of the specific social context. This has been a major impetus toward the development of network analysis. Network graphs provide means of mapping social exchange and uncovering important dynamics. A transactional approach also needs some means of explaining and taking into account social systemic properties. That is properties of the social system that arise from individual interaction but have no individual level counterpart.

Emergent properties

Emergent properties are aspects of social structures that arise as a result of individual strategies in social interaction, often as unintended consequences. These emergent properties, properties of the social system as a whole, in turn shape individual strategy (Kapferer 1972; Kapferer 1976).

A property of a social system can be considered emergent, that is, truly social, when it has no counterpart on the individual level. The division of labor is an emergent property. The division of labor, much like an age distribution, exists only on a social level (Blau 1964). It is a product of individual strategies of exchange but it

brings about effects often unintended by any particular actor. The division of labor also affects individual strategy, not directly of course, individuals do not encounter the social property as such, only its expression in their particular situation. For instance, in a society with an extensive division of labor it may be a viable strategy to become a lawyer or an accountant but hardly a subsistence farmer. Conversely, in a society that depends mostly on subsistence farming a career choice in accounting is difficult to realize.

A competitive market is also an excellent example of an emergent property of the social system³. Competitive markets arise squarely from individual strategy but also from particular forms of constraint and openness in social structure. Markets have no counterpart on the individual level. Nonetheless they enable and constrain what actor strategies are viable. Geertz' analysis of the bazaar demonstrates one of many possible variations (Granovetter 1993; Granovetter and Swedberg 2001).

Other forms of emergent social properties may also be important for understanding socio-economic process. It is often claimed for instance, that certain configurations of relations between individuals might form a system that allows for mutual trust, social control or allow for the rapid dissemination of information. This social infrastructure may be important in shaping actor strategies as well as affecting their likelihood of success. However, while each individual partakes in building specific relations the effects of the infrastructure as a whole may be largely unintended and nonetheless highly important. These are central notions of the discussions on social capital (Coleman 1988; Portes 1988; Burt 1992; Portes and Sensenbrenner 1993). The concept of emergent properties highlights how social factors enable and constrain actor strategies in significant respects. This may perhaps equally well be treated by concepts of social structure, but the concept of emergent properties also makes it necessary to link the emergence of social structure to actions on an individual level. Social structure has to be rooted in social action.

In sum, transactional analysis seeks to take into account both social and economic dimensions of exchange. It is an approach squarely based in individual strategy but which attempts to understand social process, that is, how social organization evolves. The approach clearly accepts that there are important systemic properties of social systems but demands that these systemic properties be understood, anchored in, an understanding of actual interaction between individuals. In this way the approach steers clear of both atomistic individualism and purely structural approaches to social systems. Although not always stated expressly in these terms I think these themes have been central to the anthropology of business in the past.

3 I am indebted to professor Peter Gärdenfors, Lund University Cognitive Science, for this example (personal communication).

Anthropology of business and bureaucracy

The study of business in anthropology is almost as old as the discipline itself. The interest goes back to Malinowski and Radcliffe-Brown, both good friends of Elton Mayo, a founding figure of the school of organization known as the human relations school (Baba 1986; Wright 1994; Jordan 2003). The direct participation of anthropologists in the latter part of the famous Hawthorne studies (1931-32) certainly had a role in highlighting the importance of social organization in the workplace (Roethlisberger and Dickson 1947; Morgan and Emmet 1982; Whyte 1991). The concept of informal organization which derives from Hawthorne research seeks simply to highlight this social aspect. Formal organization refers to codified roles and lines of authority in the firm. Informal organization refers to the actual personal interrelations of the members of the organization which are not represented by, or inadequately represented by, the formal organization and yet which are perceived as important for how work is conducted (Roethlisberger and Dickson 1947; Chapple 1953).

A group of industrial anthropologists elaborated and developed the work from Hawthorne and produced a series of studies on industrial topics such as the problems of foremen (Whyte and Gardner 1945), growth and technological change at IBM (Richardson and Walker 1949), incentive systems (Whyte 1948), strikes (Whyte 1951), technological change and leadership patterns (Sayles 1952) and job satisfaction (Roy 1959-1960). A persistent element of these early studies of industry is a critique of the 'doctrine of individualism', that is, the shared tendency of economic and psychological analysis to neglect social context (Chapple 1953; Arensberg 1978; Holzberg and Giovanni 1981; Whyte 1991).

The research at Hawthorne at the subsequent human relations school made important inroads in describing the complexity of informal organization but due in part to limits of the functional perspective failed to develop beyond a certain point (Holzberg and Giovanni 1981; Baba 1986; Wright 1994). Although the shop-floor seemed to provide a kind of microcosm which might yield to anthropological research, a focus on internal equilibrium proved mostly unproductive. It seems that one of the main results of this research was to initiate a number of theoretical perspectives that have then subsequently been developed by these and other researchers (Burrell and Morgan 1979) This includes but is certainly not restricted to pioneering work on informal organization and network analysis (Whyte 1943). Interest in microlevel social networks apparently stems from Radcliffe-Brown and was also passed on via Gluckman to the Manchester school and applied in the Manchester shop-floor studies. In accordance with Gluckman's emphasis on conflict and power as integral parts of any social system researchers at Manchester were less interested in ideas of equilibrium on the group level and had tended to be more aware of individual strategies and complex negotiation. A small group of researchers developed highly innovative directions of analysis. Elizabeth Bott for instance, demonstrated that a key component in understanding the segregation of gender roles lies in the network structure of the

spouse's external contacts (Bott 1957). The key insight that social roles are linked to structures of microlevel interaction has yet to be fully appreciated.

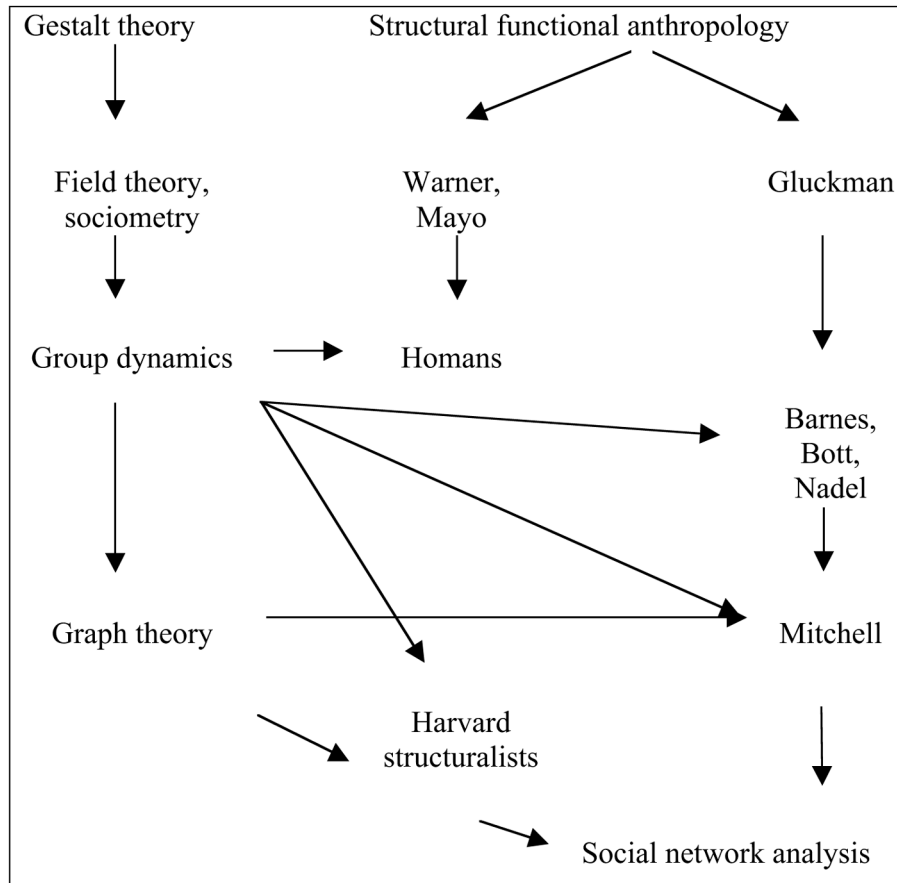


Figure 1 *The lineage of social network analysis* (Scott 2000)

The Manchester studies maintain a notion of complex social interaction and widened the scope of analysis to include important aspects of political and cultural settings in which the work takes place. Studies in this vein drew attention to the mutual articulation of processes internal and external to the businesses. (Mitchell 1969; Kapferer 1972). Kapferer, for instance, is concerned with how different groups in factory showed different levels of preparedness for militant conflict with management and how the processes develop toward a united strike. But moreover he is concerned with the extent to which these events emerge as result of interaction in the factory or as result of the participant's wider relations with the Zambian political context. In other words, the question is one of how properties of social interaction in the firm emerge and culminate in a collective strike.

Kapferer's formulation of the research approach captures the essentials of a grounded approach to the study of economic embeddedness.

Individuals are never treated as actors independent of the actions of others. Individual behaviour is framed and moulded in a social matrix of reciprocal influence and interaction which is not confined to activity on the shop floor but extends to the world outside (Kapferer 1972)

Unfortunately, this strand of anthropological endeavor largely fades from the disciplinary mainstream. According to Scott (Scott 2000) this is due to that social networks became identified with a kind of residual once other aspects of social structure had been dealt with, rather than a key element of structure. The declining interest in anthropology is probably also connected with the rise of Marxist approaches and a more interpretative bent. Ironically, this declining interest in network analysis and in the anthropology of business happens at about the same time as landmark studies, using derivative techniques appear in economic sociology (Granovetter 1974) and in the study of technology transfer (Allen 1978).

In anthropology, the relation between informal and formal organization, often using tools from exchange theory, did continue to be of interest. This is reflected primarily in studies of clientelism and corruption. An extensive body of literature exists on how personal networks shape interaction in the ostensibly impersonal functioning of bureaucracies (Roniger and Eisenstadt 1980). There is an important theoretical impetus in this study emphasizing social networks as central to anthropological theory. Jeremy Boissevain goes so far as to consider networks the 'atoms' of social science (Boissevain 1968). However, it is to be admitted that research in the field of clientelism, corruption and mafia also seem to be fueled by the 'otherness' of these forms of organization. A driving force seems to have been to show that the organizational reality was highly different from the ideal bureaucracy (in Weber's sense). In fact, an extraordinarily broad spectrum of comparative work showed personal networks to be almost ubiquitous (Roniger and Günes-Ayata 1994). This very fact probably led to a declining interest in the subject.

Ernest Gellner begins a major book on the subject by discussing this aspect of interest in clientelism.

The kind of patronage which does concern us is a form of power. In part, it intrigues us because we disapprove of it. Why? It offends both our egalitarianism and our universalism. Patrons and clients are generally unequal. Patronage relations are highly specific. They fail to illustrate the principle that like cases should be treated alike.

Of course, we may be in error when we disapprove of it. Patronage may have its merits. We should keep an open mind when approaching the problem. But all the same, we may as well admit that subject appeals to our political voyeurism. (Gellner and Waterbury 1977).

The very fact that personal networks in fact seemed to be not so exotic undercut some of the interest in this field. The theoretical thrust of this work also came upon difficulties. As Steve Sampson (Sampson 1983) points out the same kind of personal networks that allow corruption and clientelism also seem to be the ones that make positive aspects such as flexible adaptation possible. The problem as such is not that personal networks are important but what differentiates situations where personal networks are beneficial for the functioning of the organization from those where they

are detrimental. In other words, too little was known about what kinds of social 'atoms' combine to make interesting compounds.

While the anthropology of business declines during a period, similar kinds of approaches were applied in the study of ethnic economies or studies of economies in non-western settings. Research in this field is concentrated to a much greater extent, on the beneficial or enabling aspects of networks. Networks provide trust, enable critical brokering functions, access to capital and means of mobilizing essential resources (Light 1972; Bonacich and Modell 1980; Light 1994; Bonacich, Chin et al. 2000). In short, this work focuses on how relational factors affect economic exchange. Paralleling the development of studies on clientelism there has been a gradually rising awareness that personal networks, far from being exotic, might be equally important at home (Portes and Sensenbrenner 1993). In contrast to studies of clientelism the realization that personal networks in economic interaction are important generally has led to greatly increasing interest in studies of economic embeddedness, spearheaded by economic sociology. The problem of distinguishing beneficial from less beneficial networks still remains. Much of the literature on the benefits of personal network structures has taken its starting point in formal analysis of structures. Unfortunately formal analysis has often become detached from actual practice.

A recent anthropological contribution to the study of business concentrates not on networks but fluid communities and their impact on informal problem solving. An important impetus into this field of research is a work-place ethnography of Julian Orr (Orr 1996). Orr's ethnography of technicians at Xerox, shows, amongst other things how knowledge is pooled and develops in social interactions between technicians. Through storytelling, positioning and sharing of experience the technicians bring this stock of social knowledge to bear on different specific problems. Orr particularly highlighted the social character of knowledge, an aspect overlooked in individualistic notions of knowledge and human capital. Several authors extrapolating on Orr's work have sought to define a general concept of how informal problem solving in firms actually enable smooth functioning and development. The suggestion is that 'communities of practice' provide a central ingredient in the development of firms (Brown and Duguid 1991; Wenger 1998; Fontaine, Slusher et al. 2000). An interesting aspect of this approach is its emphasis on ethnography as a means of identifying communities of practice. There seems to be an aversion to the use structural network analysis in this approach (Wenger 1998). Communities of practice are held to be fluid, problem-centered and more akin to what Goffman calls focused gatherings (Goffman 1983; Mangrum, Fairley et al. 2001). Structural analysis, naturally, tends to predefine groups in which networks are studied or overemphasize the stability of networks for solving different kinds of problems. However, the incompatibility should not be overstated. Focused gatherings seem quite similar in many respects to Boissevain's idea of action sets (Boissevain 1974). Nonetheless, there is an important methodological point in that structural analysis of networks, in order to be useful, should be practice-centered and start from particular kinds of problems.

This brief discussion of anthropological studies of business is not intended as an exhaustive overview but only as an orientation and introduction to some central

themes in this research tradition. The discussion of anthropological studies in business has particularly sought to highlight a struggle to understand socio-economic processes as a result of both individual strategy and emergent properties of social interaction. This has been expressed in these studies as a critique of 'the doctrine of individualism' but also a critique of functionalist overemphasis on stability in social groups or in social structures. This focus spawned the development of social network analysis. Recent works also point to limitations of network analysis, the need to capture the right networks and important emergent properties of social organization.

Research on embeddedness

As mentioned in the previous sections social network analysis has been developed and applied extensively outside of anthropology. One influential strain of this work has come to be known as embeddedness research.

The notion of economic embeddedness originally derives from the work of Karl Polanyi (Polanyi 1957). Polanyi argued that actual, substantive, economic processes were deeply intermeshed with wider societal institutions. Polanyi's work became a starting point for the direction in economic anthropology subsequently known as substantivism. Substantivists generally strove toward the creating a whole new basis for understanding economic interaction and denied the validity of formal economics. However, the current use of the term embeddedness is quite different. Rather than wholesale denial of the validity of formal economic approaches embeddedness research seeks to create a common framework for understanding socio-economic process. The cornerstone of the embeddedness approach is Mark Granovetter's seminal article *Economic Action and Social Structure: the Problem of Embeddedness* (Granovetter 1985). His argument is that ongoing systems of social relations give rise to properties of interaction, such as trust, that importantly shape economic interaction. The emphasis in Granovetter's approach is that both social systems and individual strategy need to be taken into account.

Actors do not behave as or decide as atoms outside a social context, nor do they adhere slavishly to a script written for them by the particular intersection of social categories that they happen to occupy. Their attempts at purposive action are instead embedded in concrete, ongoing systems of social relations. (Granovetter 1985)

The argument Granovetter puts forward is highly reminiscent of the approach outlined by Kapferer that was cited earlier. However, Granovetter applies his attention to central concerns of economic interaction such as inter-firm relations, rather than strikes in Zambia. This article provided a rallying point for research in a wide range of disciplines⁴.

⁴ For an attempt at overview see Dacin, T. M., M. J. Ventresca, et al. (1999). "The Embeddedness of Organizations: Dialogue and Directions." *Journal of Management* 25(3): 317-356.

One part of Granovetter's contribution is that he indicated an historical academic development which has overdrawn the distinction of the social and economic. On the one hand an oversocialized view of the individual which treats the individual actor merely as an aspect of structure. Or on the other hand an atomized, undersocialized view of individual actors that entirely neglects social structure. The distinction can be seen as forming a traditional dividing line between the social sciences and economics. Both extreme positions share in common, however, that they efface individual perspectives, focusing on general mechanisms in broad populations (Parker 1999). An approach to the study of economic behavior as embedded requires returning focus on individual's strategies in a fine-grained understanding of social context.

Another part of Granovetter's contribution would seem to be the close connection that he maintains with network analysis and attention to microsocial settings. This has provided inroads to the study of embedded relations from diverse perspectives and in different settings. Particularly this has reinvigorated social science interest in the study of business and economic processes.

Embeddedness research emphasizes how systems of inter-personal and inter-firm relations are important for the creation of trust as well as the quality and speed of information transfer. Thus, individuals, firms or regions may be systematically advantaged or disadvantaged economically as result of the social systems in which interaction takes place.

According to the embeddedness perspective the development of individual career paths, firms and even regions are shaped importantly by socio-economic systems. Thus individuals may find better prospects (Granovetter 1973; Burt 1992; Coleman 1994). Firms can find themselves in a more a more or less advantageous position in competition (Uzzi 1996; McEvily and Zaheer 1999) or develop their strategic knowledge to different extents (Nahapiet and Goshal 1998; Lesser 2000). Both personal networks and inter-firm networks are important for technology transfer and development (Allen 1978; Katz and Tushman 1979; Andersson, Forsgren et al. 2001). Regional development can also be shaped both in direction and degree by the character of social systems (Pyke, Beccattini et al. 1990; Johannisson, Alexandersson et al. 1994; Saxenian 1994; Saxenian 2000).

An important impetus of the embeddedness research lies in the increased availability of tools for structural analysis developed in what may be called the Harvard school of network analysis (Scott 2000). The Harvard development represented an increased formalization of earlier network analyses and brought structural analysis to a wide range of different topics. Researchers in this tradition developed powerful mathematical tools for analyzing and graphically representing complex network structures.

The very power of these network approaches naturally invites emphasis on structure rather than social process linking individual strategy and structure. Formal analyses of structures on a large scale also tend to downplay that quite different types of networks may be important for different issues. It has also become evident that the effects of network structure will vary with aspects of context not captured in the networks themselves like gender (Burt 1998), other aspects of roles and power (Podolny

1994; Burt 2000; Erickson 2001). Formal network analysis provides a powerful tool for the study of socio-economic process but an ethnographic approach is important both to capture relevant aspects of the social context and make sure that the right networks have been captured.

Research questions and aims of the dissertation

Understanding socio-economic interaction has long been a key interest of anthropology. This has been particularly evident in the anthropology of business but also pertains to other classic areas of anthropological study such as understanding strategic exchange. A key point of this effort has been to find a means of studying social process that does not neglect individuals and their strategies and designs nor on the other hand ignores the importance of relations and emergent properties of social systems.

Business has often provided a site for these studies of socio-economic process. This is because business is an important site of social organization in industrialized societies, and because it is a domain of interaction in which the ideal of rational, individualized action still dominates. This provides a particularly fertile ground for researchers coming from disciplines dominated by structural approaches.

Recent developments in the embeddedness approach have created a widespread interest in the issue of socio-economic interaction. This provides an opportunity for constructive dialogue between anthropology and related fields. Anthropology may have contributions to make by combining in-depth qualitative research with an understanding of social network analysis. Moreover, the use of network techniques allow different kinds of questions to be addressed.

Social network analysis provides a means of studying microlevel structure that may shape individual perceptions and actions. Consider Bott's analysis of conjugal roles. Bott argues that the relative segregation of roles is determined by the density of social networks in relations outside the marriage (Bott 1957). This is a finding that would not be possible to achieve through solely qualitative research. Nonetheless, microlevel networks provide us with an understanding of qualitative differences in relations. Furthermore, network analysis provides an important means of understanding the interrelation of different cultural forms.

The argument that seemingly elusive networks may be important can be taken a step further when it comes to the development of social organization. Anthropologists are inclined to study close knit interactions in groups, preferably also where there are specific sites in which this interaction can be observed. But it is quite possible that the development of this close-knit community is determined not only by the structure of its internal relations. The structure of its loose disparate connections may perhaps be of equal importance (Granovetter 1973; Burt 1992). For instance most people have several somewhat separate domains of interaction such as that of family, friends and work. It may be that important relations of an individual in these

different domains never interact directly. Using only traditional anthropological methods such as participant observation do not allow us to study these different relations in a meaningful way. Yet it is feasible that it is the specific manner in which different domains are interconnected, rather than interaction in them, that constitutes the most important aspect of social structure.

The present research explores the particular situation of small manufacturing firms in southern Sweden. It approaches the firm both as a form of social organization with important economic elements. The research is concerned with exploring the social embeddedness of these firms, that is, the extent and manner in which sets of interpersonal relations shape firm development. The site, small manufacturing firms in southern Sweden, is not chosen because it is any sense atypical. It is interesting primarily because it is a site in which it is *not* expected that personal networks would be important. The social fabric in this geographic area is not particularly dense with personal ties, nor is the line of industry in which the firms operate particularly clustered (Nilsson, Svensson-Henning et al. 2002). None of the firms in the study have a strong element of family involvement and generally speaking, Swedish society is known for its highly developed formal institutions (Lash and Urry 1987). In several respects, these firms therefore provide an interesting site for testing the value of an embeddedness approach. If personal networks shape economic exchange in these interactions, then a strong case can be made for their more general relevance.

The first question that the research seeks to address is therefore: Are personal networks important in the development of these businesses? And if they are, develop an understanding of how and why personal networks shape firm development. The second question is: Are there structural aspects of these networks that would allow us to differentiate beneficial from less beneficial ones in terms of firm development? Thirdly, the research seeks to uncover some of the specific mechanisms by which personal networks develop in this particular industry and region.

By means of this exploration of personal networks in business, the research seeks to contribute to anthropological understanding of socio-economic processes and hopefully to a renewed interest in the anthropology of business. However, the research has also been guided by concerns of informants who sought a practical means of understanding the dynamics of informal organization. As with most exploratory research I hope to provide some answers but also provoke more questions.

Although the study of personal networks in small business may seem a narrow field of interest it is a field that has both a long history and touches upon very large methodological issues. I have not been able to sufficiently cover all of the relevant issues or possible perspectives. It is fair to say that the research has been guided by a material-centered approach. It makes use of theory to the extent it is necessary to explain the observed phenomena while leaving aside many issues or other possible perspectives. Even listing the number of perspectives not taken into account seems an arduous task. To pick one of many possibilities it may be relevant to point out that a gender perspective is notably lacking. This is so largely because the studied environments are largely male and I am primarily concerned with internal contrasts in the material.

I must point out that this is not a study of culture. It is likely that the kinds of networks studied have specific cultural traits and they are certainly a cultural phenomenon. However, the focus of the dissertation is on the kind of elusive informal organization that stretches across firm, industry and other social boundaries. Yet I will argue it is an important element of both individual and firm development. This kind of microsocial organization has no particular sites and is not particularly bounded. A concept of culture, conceptualized as shared orientations and norms in a group, therefore already seems somewhat inappropriate. Moreover, there is no reason to expect that the collection of individuals being studied share particular norms and values distinctive to the group (i.e. not shared by others). Or that these shared orientations, if they exist, are particularly important for understanding what goes on in the networks. This is a context in which different and more interesting questions have to be asked relating to how diverse activities are actually coordinated (Morey and Luthans 1991). Readers expecting an in depth description of how a group of people think or act will therefore be disappointed. While the thesis argues that certain aspects of firm 'atmosphere' can be linked to the prevalence of particular network structures the primary focus is on social organization rather than cultural forms.

Although economic effects of personal networks are often studied under the epithet of social capital, I avoid the term in the dissertation. There are several reasons for this: The term social capital adds nothing in precision. The concept has been used in a wide variety of ways that are sometimes conflicting (Portes 2000). While there may be a developing consensus that social capital should refer to the increased returns to an individual due to his or her social relations (Cook, Burt et al. 2001), I am not sure that the term is still not convinced that the term social capital is useful. Why not refer to the operational mechanisms involved such as brokerage and control if this is what it is about? Moreover, individual returns are not my primary interest. I focus more on how personal relations affect business outcomes and on the mechanisms shaping different sets of relations. Finally, the concept of capital seems to imply a degree of individual calculativeness and control over social relations that is unwarranted.

Finally, I must point out that this is not an in-depth qualitative analysis of how people perceive their own or other's networks. The main focus of the research is on how networks can be analyzed and network dynamics explained rather than an in-depth exploration of perceptions. This should not be taken to imply that I consider this topic unimportant. It is simply a matter of having to start, and stop, somewhere.

Structure of the thesis

The dissertation has the following structure:

- Chapter two outlines the methods used in research.
- Chapters three and four are the result of qualitative research, exploring the nature and role of personal networks between firms. From this exploration a number of

propositions are brought forth that are subsequently explored in social network analysis

- Chapter five explores the significance of inter-organizational networks, that is, relations between firms and particularly the relation of the focal firm to its customers. The position of a firm in relation to its customers is found to have an important impact on the firm's development.
- Chapters six and seven explore the significance of personal network structures using techniques of graph analysis starting from the findings in chapters three and four. Chapter six deals with how networks affect the individual's role in the firm, particularly their willingness and ability to contribute to problem solving in the firm. Chapter seven brings together important findings of previous chapters and explores the firm level effects of different network structures. Particularly, how the structure of personal networks in the firm affects knowledge development and firm growth.
- Chapter eight is a discussion of how networks develop in firms and what kind of strategies can be used to promote the development of beneficial network structures. It is argued that informal organization can provide an important means of aligning individual and firm interest.
- Chapter nine concludes the research.

CHAPTER 2

Method

This chapter provides a brief introduction and background of the research method. More detailed descriptions of the methods are provided as needed in the empirical chapters.

There exists a body of literature that suggests that personal networks may be important for trust and information transfer in business. However, research that includes a role for personal networks is predominantly concerned with either atypical regions for instance intense clusters of firms such as in industrial districts or non-western settings or atypical firms such as those involved in high-tech development work. Quite often, the literature also treats the actual dynamics of networks in a sweeping and general way, that is, research asserts the importance of networks but refrains from exploring their dynamics. The present research studies a group of small firms in a low-tech industry. The firms are not particularly clustered. Furthermore the firms operate in an environment of well developed institutions, so there is little reason to expect that personal networks are needed as an alternate means of regulating interaction. Existing research gives us little guidance as to what to expect about the role of personal networks in these cases. If anything the assumption seems to be that these firms should adhere to the standard business model of impersonal markets and impersonal bureaucracy. The lack of knowledge in this field makes an exploratory approach appropriate.

A challenge presented by the particular research focus is related to the ideological content of different models. The notion of markets as impersonal forums of interaction seems to reign supreme in much of research and certainly in folk models of business. It seems that this notion of an impersonal market appeals to a sense of egalitarianism and individualism. In theory, a market allows equal access for all parties. As individuals we make our own decisions and bear the fruits of our labor. By implication the returns that accrue to individuals or firms are also objectively justified. They have been won in fair competition. In contrast, personal networks are patently not the same for everyone. The notion that personal networks may be important suggests to some therefore that competition is skewed and that rewards may be illicit. To suggest, for instance that the success of a firm may be due to its personal networks is most likely to be perceived as an affront. While the emotional appeal of certain types of models has no theoretical implications, it does have implications for methods of research. A certain care has to be taken in the exploration of personal networks in

order to achieve a better understanding of processes presently glossed over by notions of impersonal markets and bureaucracies.

A further difficulty in exploring the role of personal networks in business relates to the exploration of network structures. In order to map a structure of a personal network it is necessary that the participants name those others that he or she cooperates with and this implicitly excludes yet others. This kind of information is sensitive and individuals may perceive a risk in disclosing it. Collecting material on personal network structures therefore requires establishing trust with informants.

The lack of knowledge about the nature of personal networks in this kind of business and the difficulties associated with collecting materials suggest that initial research should be conducted in an exploratory and qualitative approach which provides a fine-grained understanding of actual processes.

A first phase of research

A problem for qualitative research in this field is that personal networks lack obvious sites. Collecting material would be much easier if limited to a particular firm. However, this delimitation seems artificial in terms of actual dynamics of the networks. There is every reason to expect that contacts spanning firm boundaries are every bit as important as those within a firm. The difficulties presented by lack of an obvious site are exacerbated by aspects of timing and media. Important contacts may be taken in a sporadic manner, as the need arises. These contacts can take place by physical meeting but at least as often people will contact each other by phone or email. This obviously presents some difficulties when it comes to observing networks dynamics directly.

To cope with these difficulties the initial phase of qualitative and explorative research makes use primarily of interviews. Interviews take their starting point in critical incidents such as the development of new products, processes or other evident aspects of business development. These incidents provided focal topics on which different informants gave their perspectives and discussed their understanding. These different perspectives are used to piece together, reconstruct, an understanding of social process. The choice of critical incidents perhaps tended to bias beneficial aspects of personal networks but also provided a means of exploring their extent and dynamics.

The approach of the first phase of research, presented primarily in chapters three and four, is typical of ethnographic research. Differing perspectives on events are used to piece together a composite understanding of a particular social setting. A famous analogy likens this process to the work of constructing a map from the different perspectives of individuals in different parts of a landscape (Mannheim and Kettler 1982). Different individuals may view a landscape from different perspectives, much as individuals have different perspectives on a given social setting. The task of exploratory research is to construct a coherent picture, a map of the landscape, which encompasses and explains the variations in perspectives. The quality of the resulting

map, or analysis of social structure, depends on the extent that it explains different perspectives and the detail with which different perspectives are captured. Similarly, in exploring a social process it is necessary to construct a composite understanding that links up with and at the same time explains the perspectives of the participants.

The qualitative exploration of personal networks in the first phase of research makes use of different perspectives on developments in the firms. To capture such perspectives different poles in key relations were interviewed such as customers, suppliers and different levels of management in the focal firm. The technique was one of snowballing, i.e. using contacts to generate more contacts. The research began with a contact in the focal firm. After interviews with them on their business relations the connected firms were contacted. Since most of the firms were reasonably local it was possible to conduct interviews on site with a fair amount of regularity. Periods of interviewing were governed mostly by research, that is, when the old data had been analyzed and new questions cropped up, then it was time to return to the field.

Repeated interviews were conducted to progressively increase detail and correct misunderstandings. Moreover repeated interviews serve to establish a relation. This is necessary to gain a certain amount of trust and make it possible to discuss issues in a more fine-grained manner because the interviewed now knows something of what I know. The interview process was conducted simultaneously starting from four focal firms. It was possible to follow developments in the networks surrounding these firms over a period of two years (1999-2000). This made it possible to follow and assess the success of different strategies and further an understanding of important dynamics.

The four focal firms were similar with respect to their being small, low-tech manufacturing firms, using similar kinds of production techniques and operating in the same region (Scania). Comparing processes or business development in the different focal firms provides a relevant illustration of potential variability while keeping some factors constant. This provides a basis for asking more insightful questions. To a certain extent the focal firms had overlapping networks and this provided the occasional opportunity also to compare firms from the perspective of a supplier or a customer.

All in all 22 firms were involved in the first phase of research. Some of these firms were more important for the focal firms than others and consequently given more attention. Approximately 70 interviews were conducted in this first phase of research. Interviews varied in length, some but not all were transcribed. At times, particularly in initial interviews a tape recorder was unwanted. At other times interviews were conducted in an informal manner and included walking around in different parts of the plant, partaking in impromptu meetings and discussions and in these cases recording the interviews was either difficult or inappropriate. Although in retrospect it seems that it would have been advantageous to record each encounter, I am convinced that the informal exchanges were at least as important in forming an understanding.

In general the process of selecting interviews followed a up to down strategy. In other words interviews and contacts were first made with owners and/or managers. Sometimes interviews would take place with at team of managers at once. After the initial interviews it was possible to be more specific. Calling an initial contact and broaching a certain topic I would then be directed to an individual or set of individ-

uals. "you need to talk to X". Access increases over time as the relation evolves. In focal firms I have had the opportunity to interview at all levels although admittedly some firms were easier to cooperate with than others. In general the firms were very generous with their time and open to answering questions. In one firm with which a particularly close relation was established I had the opportunity to ask about this openness. The owner/manager responded: "it's good that you come here every now and then and ask questions. We seldom have the time to look at things like that." Questions on informal or even formal organization were seldom clear cut and sometimes required considerable reflection on the part of managers and other employees.

While the methods of the first phase of research are typically qualitative, the method of presenting research results may not be typical. There are several reasons for this. As previously noted the studied networks are not confined to a particular site. Thus an in-depth description of some particular site is beside the point. Moreover the study is conducted against an implicit backdrop of impersonal market interaction. What is of interest is to demonstrate important mechanisms of interaction that in some sense stand out against this backdrop. In other words description is limited to those cases that alternate mechanisms are important in explaining business outcomes.

The first phase of research resulted in the identification of some important mechanisms of personal networks for firm development. However, it was still difficult to assess the overall impact of these mechanisms on firm development. It was also difficult to present the differences between networks in different firms in ways that could be easily understood. These factors, combined with a desire to engage in constructive dialog with structural analysis of networks motivated the second phase of research.

A second phase of research

A second phase of research was conducted in the latter part of 2000 and beginnings of 2001 to further explore the findings of the initial qualitative approach, and to set findings of the first phase in relation to formal network analysis. The second phase of research also sought to provide a more encompassing picture of the central production networks in the firms so that structural aspects of these networks could be set in relation to other overall aspects of the firm's development. This was intended to remove a weakness of the initial phase of research which provided insights into mechanisms but at best a fragmented understanding of the situation in the firm as a whole

In the second phase of research the basis was expanded to include eight focal firms, all in the mold-injection industry. This was deemed to provide a kind of minimum basis for statistical treatment. To map network structures in these firms a short formal survey was conducted and a snowballing technique was used to find respondents. Starting from identified key roles in production, each person was asked to name a number of persons most important for their development of production related know-how. The contacts named by the original interviewees were then asked the

same questions in a snowballing procedure⁵. This provides a map of exchanges of information and knowledge in and between firms.

Starting from a hypothetical person (A) the resulting network might look as in the figure below.

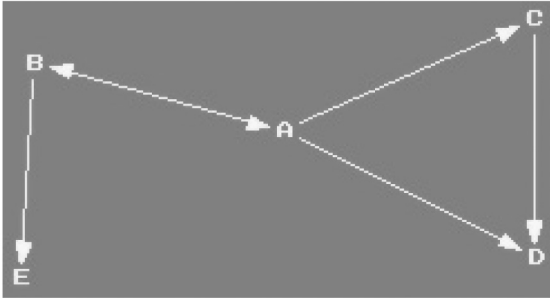


Figure 2 A hypothetical network

Each person that took part in the survey was also interviewed. This was motivated in part by the need to establish trust and to guarantee a high level of response necessary to provide a realistic picture of network structure. However, the formal exploration of personal networks also provided access to an interesting set of relations with unexpected components. In these semi-structured interviews a few themes were particularly explored such as the creation and regulation of contacts in a person's network. The interviews also solicited the person's point of view with respect to the situation of the firm as a whole and their own position within it. Answers to these questions provided a valuable impetus in the interpretation of network graphs. The methods used in mapping and analysis of the networks are detailed in chapters six and seven where the second phase of research is reported.

The social network analysis in the second phase of research provided an interesting opportunity to explore network dynamics. The mapping and analysis of complex microsocial situations would be hard to achieve by solely qualitative methods. The graphs themselves also provide a relatively intuitive imagery for presenting a complex social situation and can be used to highlight the differences between firms. Graphs of the firms studied in the second phase of research are presented in chapter 6. Network analysis was conducted using UCINET 5.0 software (Borgatti, Everett et al. 1999) and graphs were constructed using Krackplot 3.0.

5 The ambition was not fulfilled for secondary contacts due mostly to that some persons did not wish to partake and others were hard to find.

Anonymity

In the research both firms and individuals are treated anonymously. It would be preferable for several reasons to be able to discuss which firms were studied openly. This would have made it possible for others to assess the data more easily and perhaps provide alternate perspectives. However, particularly given the focus on personal networks it seemed wise to grant anonymity at the outset. I believe it would have been difficult to build a good working relation without this guarantee. Both firms and individuals sometimes requested a high level of confidentiality. Although many of the firms and persons no doubt would acquiesce to disclosing information after viewing the study as a whole, this is not true of everyone. Therefore the data, as a whole has been treated so as to protect the identities of the partaking.

Mixed methods

The research focuses on an important but elusive form of social organization. The relevant networks are not readily observable; there are no collective effects of these networks. Nonetheless it is to be expected that these networks have important systemic effects. These effects are only possible to grasp by paying close attention both to the qualities of the material and a person's position within the context of relevant others. The overall research strategy employed in the dissertation may be described as a mixed methods exploratory approach (Creswell, Clark et al. 2003). The first phase is wholly qualitative while the second phase combines both formal network analysis and the collecting of qualitative materials. The initial in-depth exploration of the social context with careful attention to the quality of material was necessary given the lack of knowledge in this field and the sensitivity of the research focus.

Moreover qualitative research made it possible to identify recurrent problems in the production of the firms and key roles involved in solving these problems. This provides a means of situating the subsequent social network analysis so that relevant networks are studied.

Using formal network analysis in a subsequent phase of research provided an opportunity to test the relations between network structure and other aspects of firm development. It also provided a means of making the findings more concise and transferable. Finally, formal network analysis provided an excellent means of obtaining wider access and further exploring issues in a qualitative manner.

A mixed methods approach thus offered considerable advantages; however, there are also weaknesses. In retrospect there are several aspects that I would have wished develop more, both in terms of exploring different facets of social interaction through qualitative means and quantitative testing of the understandings developed in the dissertation. There are a number of leads that could have been followed up if I had known at the start what I knew in the end. This is perhaps a quality of all exploratory research but I think it is particularly evident in mixed methods approaches of this kind.

CHAPTER 3

Embedded relations and coordination between firms

Introduction

The embeddedness approach holds that economic relations should be understood as part of a wider matrix of relations. This wider matrix of relations is important in understanding, for instance, the development of firms. While there are strong arguments in support of the notion that structures of economic and personal networks matter, and despite the fact that many practitioners recognize special relations and contacts as important, there are relatively few studies that develop both an understanding of the social dynamics and overall effects on firm development.

An important exception is the work of Brian Uzzi (Uzzi 1996; Uzzi 1997; Uzzi 1997). Uzzi shows how economic relations between firms that also have a social component are important in creating trust, facilitating fine-grained information transfer and affecting the willingness to find mutually beneficial solutions. However, business relations with a social component are also argued to have detrimental affects. When social embeddedness increases beyond a certain point firms run an increased risk of lock-in, the structure of interaction becomes overly fixed and inflexible. The most beneficial strategy therefore combines both types of relations. In this way the firm reaps rewards of better information and coordination with certain partners while avoiding becoming entangled in specific relations when not productive. Uzzi finds that an appropriate level of embeddedness significantly and positively affects firm performance. These are highly interesting findings, both elucidating the effect of social embeddedness and demonstrating their effect. However, the articles state little about how social aspects of inter-firm relations develop except that referrals seem important.

In a later article in *Administrative Science Quarterly* Uzzi develops a series of general propositions as to when embedded relations are likely to be important. These propositions are intriguing but also problematic in that they are squarely functional. In other words the arguments have the form that need for embedded relation explains their existence. When there is a need for fine-grained information transfer, trust and mutual problem solving there will also be an important ingredient of personal networks in business interaction. Ironically, one of the best arguments against these propositions is Uzzi's own work. If functional explanations were adequate there could be no explaining how certain firms apparently have too much or too little social interaction in their relations. Yet it is this variability that is the basis for the claim that an appropriate level of embeddedness is linked to firm performance. The problem thus remains; there are strong empirical and theoretical reasons to expect that personal relations are important in shaping business development but far too little is known about how these personal networks actually develop.

The present chapter begins an exploration of the role of personal networks in inter-firm relations. The aim is to uncover the role (functions) of embedded relations in this setting and begin to explore some of the contextual factors that determine their development.

The study takes its starting point in small manufacturing firms in Southern Sweden. The research strategy is one of comparative case study of relations of four focal firms. Managers at different levels in each of the firms have been interviewed about relations with suppliers, customers and other kinds of cooperative relations. Particular attention was paid to those inter-firm relations that managers of the focal firm considered important. Thereafter these firms were contacted and interviewed about their relations, including the one with the focal firm. The focal firm and each of the more central firms were interviewed on several occasions.

Studying different networks simultaneously provided insights and contrasts that were the basis of further interviews. The firm networks overlapped to some extent which provided a further means of enriching an understanding of the differences between the focal firms as this facilitated juxtaposing and discussing different types of interaction. Even when business networks did not overlap there was often an element of personal knowledge about reputations, and occasionally histories of past interactions. The interviews focused on issues of coordination between firms in relation to ongoing developments in the firm.

Coordinating production between firms

The following discussion on the role of personal networks relates to small manufacturing firms involved in a production technique known as injection-molding. It is helpful to have at least some notion of the production technique as this provides an important element of technological context. It is fair to say that the production tech-

nology itself constitutes an important aspect of macro-structure, outside the control of any small firm. The leeway of the small producing firms lies in the mixing of materials, the use of machines and the combination of inputs into specific products.

Simply stated the injection molding technique, is based on injecting thermoplastics into a quality steel mold at high pressure. The plastic is cooled in the mold and subsequently ejected in order to make room for the next in the series. An enormous range of products are produced in this manner. Unless a significant effort has been made by the reader it is very likely that there are several such products in the immediate vicinity i.e. pens, casings of electronic appliances, key covers, light switches, clocks and so forth. Generally speaking, any given plastic product corresponds to a unique mold. Any substantial modification of a product requires the production of new mold. The design and construction of a mold is quite complex and is usually the largest single investment with respect to the production of a particular plastic item.

Any particular item to be produced by mold-injection therefore needs to pass through the following stages: product design, mold design, mold manufacture and then injection molding production. In the cases treated here these stages are each conducted in separate firms and the coordination between these firms will be a focus of our attention⁶.

The relations between different firms in this chain can be considered as vertically linked in the sense that the customer purchases a product from the injection molding firm, who in turn negotiates a deal with the mold manufacturer⁷, who buys technical specifications from mold designer (see Figure 3).

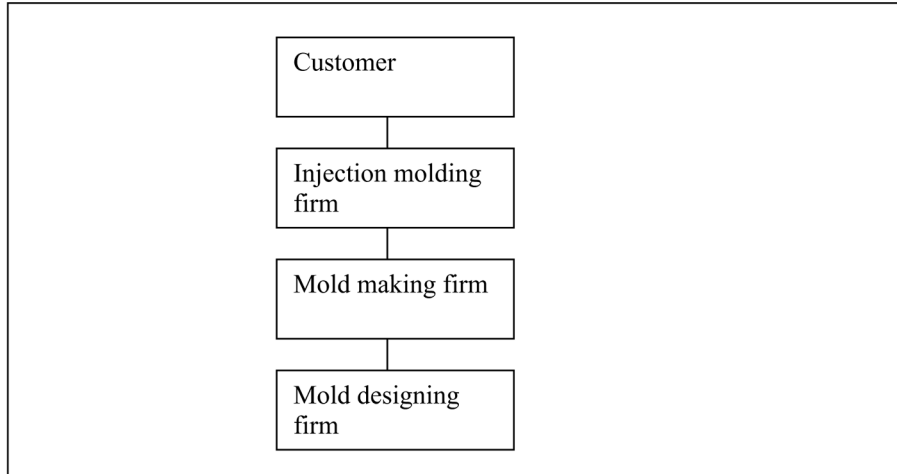


Figure 3 *Part of the value chain for injection molding*

6 Different degrees of vertical integration do exist in the process. For instance some injection molding firm maintain some capacity for making molds and some mold manufacturers maintain a capacity for design.

7 Formally the customer buys the mold and owns it but it is most often kept at the mold injection firm and is rarely moved to a different producer. The price of the mold is stated in the original offer made by the mold-injection firm to the customer.

The relation between the firms is hierarchical in the sense that each tier primarily has contact with the one immediately below but presumes the existence and coordination of levels further down. This hierarchy is most evident in the case of a fully specified product. In more complex cases where design of the product is still being discussed, plastic firms, mold manufacturers, customers and product designers may meet in order to find the best possible solution from the point of view of production and customer wants. It seems reasonable to begin this exploration with the simple case of making a bid for a fully specified product.

Making a bid for production

In theory, the process of making a bid for production by a mold injection firm would be simple. It would be a process where a fair number of different mold making firms are asked to make bids for the necessary mold. These mold makers in turn should contact a number of potential designers to make the necessary designs. When the appropriate calculations have been weighed the mold injection firm can then add the cost of producing a mold to its own costs as a basis for its bid.

While this straightforward model makes intuitive sense, in actual fact, the process is not conducted in this manner. There are good reasons to expect that acting as this model of interaction suggests would make the process costly, time consuming and uncertain. The reasons for this are not difficult to grasp. If relevant qualities of a product or service cannot be accurately described beforehand and if there is a lack of similar products or services to choose from then both price and contractual control quickly lose relevance as means of coordinating activities. The simple model of interaction that was described above for making a bid presupposes that prices and contracts are sufficient. It is not difficult to imagine situations where conditions are not met for this kind of interaction but what relevance does this possibly have for modern, small manufacturing firms in a mature industry?

To sum up, in order to make a viable bid the mold injection firm must naturally take into account its own capacity and costs but also the substantial costs of producing a mold, including the service of the designer that makes the specifications for the mold. While this process may seem simple it entails a considerable degree of uncertainty. To illustrate this and how the firms deal with these issues, it will be useful to consider each element that needs to be taken into account successively, that is, firstly the relation of the mold injection firm to the mold manufacturer and then subsequently the mold manufacturer and the mold designer. Finally, we will return to the relation of the mold injection firm and this firm's relation with customers.

Looking more closely at what goes in to making a bid will show how personal networks form an integral part of coordination between the firms. These personal networks are a key to being able to place a viable bid and thus they are central to the business as a whole.

Mold injection firm and mold manufacturer

Once a particular product is specified for production, the first step the mold injection firm must take is to contact a mold manufacturer who is known to be skilful at producing the particular kind of mold needed. The making of a mold usually requires a considerable level of craftsmanship and different firms vary extensively with respect to the tools, particular skills and capacity which they can bring to bear on the production of a mold. Their relative skill and capacity will determine price, the time needed and quality of the end product. The mold injection firm will usually have a limited knowledge of the intricacies involved in the design of particular mold and the implications of different designs for production. Since each mold is unique the purchasing of a mold is marked by uncertainty in several respects. The mold-injection firm not only risks buying an inferior mold at a high price but also risks sabotaging relations with its customers in turn if unable to deliver on time or meet the quality standards demanded.

The uncertainty in the relation between mold injection firm and mold maker is mutual. Making an estimate on the production of a mold often requires a substantial investment in time, as it requires working through how the mold could be designed and the production times and costs for a unique and complex product. Making such an estimate is unpaid work; it is part of a bid for production and will be reimbursed only if the mold injection firm accepts the bid and is in turn rewarded the production of the plastic item. Mold manufacturers will naturally be wary of making this kind of investment in time and effort if they are unsure of the sincerity of the firm asking for an estimate. The image conveyed is one of highly specific lines of trust. General mistrust is the rule unless there are specific reasons for believing otherwise. A manager of a mold making firm expressed this belief that most mold-injection firms behave opportunistically in anecdotal form. 'They might ask for bids from 50 mold making firms, in the hopes that someone will make a mistake in his calculations and be stuck with too low a price'. This kind of behavior is doubly unethical, it would cost many mold manufacturers to spend unnecessary time and effort and it preys on understandable mistakes in the estimate of a complex product. This kind of behavior represents a transgression of trust and lack of cooperation. Whether this kind of behavior actually takes place is uncertain. What is important is the message which was also spelled out by the manager: 'you have to know the people you are working for'. In this manager's view, relying on a formal market system of evaluating different offers is understandably not considered ethical behavior.

A strategy of dealing with mutual uncertainty in the relation of mold injection firm and mold manufacturer is to cultivate relations with specific partners. Recurring interaction allows a growth of specific knowledge and trust in the relation. By developing a set of supplier-partners that have somewhat differing competencies the mold injection firm can also evaluate the particular skills and capacities of these firms. When this structure is well developed it provides necessary knowledge for minimal

effort. This explains the strategy of choosing a supplier as expressed by one firm manager:

We put out contracts for the production of a particular mold and send it out to three or four, but sometimes we see that this suits that particular firm and we won't send the contract out so widely, because we know that it suits them and that their prices are good. We know this.

The dynamics of the relations between mold injection firm and mold manufacturer are more apparent before the structures are fully developed. For instance, one of the mold injection firms has looser relations with its suppliers of molds than the other mold-injection firms. This situation derives in part from expansiveness of the firm and limits of capacity among its suppliers. In part the more distanced relation between the firm and its suppliers of molds also seems to be due to the fact that the mold injection firm has a high level of internal competence with respect to the construction of molds which facilitates different contacts. Nonetheless choosing between different potential mold making firms is still an uncertain process:

We have ten or so different mold manufacturers whom we work with. You might say they specialize in different areas. When we put out a contract we won't ask all ten but maybe just two or three what they think the price might be for constructing a particular mold, and these are the ones that we know historically to be especially skilled at this particular kind of task. If it is a different type of work then we go to someone else...rotating, hinging... different mechanisms of expulsion... these require somewhat different techniques and one can readily see if they are good at this kind of construction. It shows in the prices they ask, if they are not so good at it then right away the price shoots up because they think: this is difficult...then again you might come across someone else who states a very low price. You have to watch out there because they probably haven't understood the problem. The best people are in the middle somewhere, they probably know what they are talking about.

The quote illustrates interesting mechanisms of these relations. What the manager is saying is that if prior contacts have not yielded information about which possible firms are best suited for the particular production then a first indication is in the price. Generally a higher level of skill corresponds to a lower price. However, if little is known about the mold maker, price should be in the middle range as this would tend to indicate neither over or underestimating the difficulties involved. If quality is already assured through prior contacts, lower prices are of course welcome. What this suggests is that the relations between these firms is a complex mix of different important dimensions such as quality, price and punctuality, which, when projecting on to the one dimensional scale of price should be somewhere in the middle. However, if previous contacts already insure a known quality and trust then there is the possibility of lowering cost of production.

In controlling aspects of uncertainty such as deadlines, coordination through personal networks and mutual knowledge also seems to be preferred. For instance the mold making firms in this study are generally quite small ranging from a few individuals up to about 12 and therefore often have a quite limited capacity. Yet time considerations are often important in the production of a particular mold. For this reason mold injection firms and the mold manufacturers keep in touch frequently in

monitoring the development of a particular mold. Occasionally the mold injection firms will operate under conditions where monetary sanctions are imposed for delays. This is the case particularly for large customers with whom other forms of direct relations do not exist. A critical factor in meeting production deadlines for a new product is the time needed to produce and test the mold. However formal sanctions for delays are never passed on to mold making firms. The mold makers generally state that they had never worked under such conditions. Recurring interaction between key persons in the firms contributes to the development of a certain ethic of interaction which is personal. In discussing the possibility of delays and lapses with one mold manufacturer stated that sanctions were not necessary because: "*We trust each other, so there is no need but if we should lapse that would be a highly embarrassing transgression*" Of course delays do occur, as to do other faults in production but this is then signaled at an early stage and resolved cooperatively between the firms.

Important aspects of coordination between the firms are thus solved by personal networks. This explains why when a manager of a mold injection firm is asked about the particular constellation of mold making firms that they work with, he replied:

It is because of our long personal contact, we have worked with them for many years. Both my companion and I have been employed at different firms in the region earlier so we know them. In the end a close cooperation crystallizes, we are like friends. Sometimes we even get together in our spare time.

This by no means implies that friendliness is the dominant characteristic of these networks, or that that they are free from pressures. The personal character of the relations connecting firms seems to derive from important role in coordinating firm activities that mutual knowledge and ethics between the key personnel provides. These qualities of interaction do not seem to transfer easily to the organizational level. Several instances were reported by mold manufacturers where key people have left a customer firm, even a larger plastic firm, and the business relation with this firm has then ceased. This may simply be because the new personnel have a good set of contacts elsewhere.

Mold manufacturer and mold designer

The relation of mold manufacturer and mold designer adds further complexity to the relationship between the firms involved in producing a new item. Although the relations between these mold manufacturing firms and mold designers are seldom taken into account directly by the mold-injection firm this external relation of the mold manufacturer is still crucial for the bid as a whole to be viable in terms of time, price and quality.

The designer's role is to make technical specifications for the mold and usually also codes for the operation of numerically controlled machines of the mold manufacturer. The technical design of a mold embodies several key considerations with respect to production of a specified item. These considerations impact primarily on production of the mold but also on the subsequent production of the plastic item. A good solution in the design of a particular mold is not only a matter of having expertise in a particular field of mold design, it often entails being able to tailor a solution to the specific situation in which the mold and final product are going to be produced.

In order for the overall production process to be efficient the designer needs to take into account that his specifications suit the particular craftsmanship, tools and capacity of the mold producing firm. In other words the design needs to be such that bottlenecks in the mold making firm's production can be minimized and this clearly depends on the particular character of available work-force and their machines. Considerations may include for instance whether to try and economize on raw materials or machine capacity in a particular instance, or simply designing in such a manner that minimizes slow and/or redundant component tasks if the extra machine capacity is not available. Had the mold making firm been larger it might have been able to adjust more easily to different requirements on machines and personnel. Because the firms are small, and inflexible in this respect, this must be compensated for by the quality of communication between firms, allowing adjustments so that each can work at their potential.

In this case the designer must know the particular constellation producing the mold beforehand and have an excellent communication with the mold makers. The representative of the mold making firm, in order to state his offer for a production, must already have a fairly good idea of how he wants to have the mold designed, as well as who will work on what. He must be able to discuss this 3-dimensional and complex tool, including mobile pieces, cooling and ejection mechanisms with the designer without the aid of a technical drawing. In other words there needs to be a very high quality of communication between the parties.

Because of the importance of the quality of relation between mold manufacturer and designer, it was expected that there would be a close work cooperation between the firms. It was therefore intriguing when both mold manufacturers and designers stated that this was not necessarily the case. However, while this relation does not require intensive interaction it still has to be one in which fine-grained communication is possible. For this reason it is common practice to keep long term relations between the designers and mold manufacturers. The latter sometimes make exclusive use of a single designer over extended periods. Probing this issue one manager of a mold making firm stated, "well, it's like this, we have worked together for 25 years so we know exactly what the other person means when he says something."

Relations between mold manufacturers and mold designers are often based on almost exclusive interaction over long periods. The quality and communication and ethics of interaction is based on a store of mutual knowledge and interdependence. There is clearly a personal element in the relations between the firms. Often the different persons have previously been colleagues or known each other well in a different

role in different firms. One of the designers interviewed stated frankly: 'I work for my friends'.

Despite the limited range of interaction between mold manufacturers and different designers it is not uncommon to hear managers make statements like "this company with which we work is one of the best in Sweden" For instance, a particular mold-maker extolled the skill of the mold designer he consulted, stating that this designer had achieved a level of proficiency that enabled him to make the same design specifications and technical drawings in a fraction of the time, and thus at a fraction of the price, of other designers. Pursuing this issue one manager said that one occasion he had compared the technical drawings of two very similar molds:

I saw a particular technical drawing for a mold that this designer had drafted and for which he had charged 10 000 SEK, another designer had charged 60 000 SEK for the same work.

The example demonstrates an interesting logic that was also apparent in some of the relations between mold injection firms and mold manufacturers. It is apparent that the mold-maker in this case values the skill of this designer but the costs of his personal skill, which is difficult to replicate, is not passed on to the mold-maker. His increased skill instead allows him to produce technical specifications at fraction of the time and cost of others. In other words the price of the designers work is not set by an impersonal market but rather by an ethical model of costs in socio-economic relations. This reflects the embedded character of the interaction. Because they respect each other's skills, share an ethics of interaction and have a high quality of communication both parties understand that the other is a unique and valuable partner in a recurring interaction. Because prices are set in accordance with standards to maintain this relation it enables a lowering of costs in this particular value chain and contributes to the overall viability of the bid for production.

Plastic firms and customers

Thus far the discussion has concerned the coordination of mold injection firms, mold manufacturers and mold designers in making a bid for production. Relations between customers and mold-injection firms also have a role in making a bid viable. It does not seem that embedded relations are less significant to business dynamics on this end, but the character is somewhat different. For one thing the firms are more dynamic in their customer relations than other links of the chain that have been considered previously. The firms need to be alert and find new customers and new applications that might suit their production. Due in part to the particular production technology competition between firms is largely focused on being able to secure new productions. It is much more seldom that an ongoing production of a particular item is moved.

One advantage personal networks confer in relation to customers has to do with that plastic is such a versatile material. The diversity of opportunities and the continual expansion of the industry along many different dimensions make it highly beneficial to be well informed and well trusted in wide range of areas. Acquiring timely information about new opportunities makes a necessity of having a good network. It is essential to make use of prior contacts and to create new ones. One manager, of a highly expansive firm, described the firm's approach to finding new customers in the following manner:

We are constantly chasing new customers. The traditional methods are advertising and partaking in exhibitions, we don't believe much in this, we believe in a personal marketing strategy. We've been around long enough to know which companies need plastics and so we call them...

The strategy builds not simply on knowing which firms to call but to know specifically who to call and moreover to be recognized by this person. Once again, the character of this interaction is more evident in examples where relations are not yet fully established. The same manager discussed an active approach to making new contacts with customers by partaking in consultations on the development of new products. The idea was to provide input and get involved in the early stages of design specification.

The process of producing a prototype and making bids on contracts can be onerous. Sometimes we can collect on work done in this phase if we end up getting the contract, in which case the costs are specified separately otherwise we have to put it down to marketing costs, it's 50/50. We never pay for the prototypes, the customer does that, but we have to be there with them and discuss different issues at perhaps two or three different meetings. We do a lot of free marketing by working with consultants or sending out bids for contracts that we put a lot of effort into and then there is no result. We can't ask them to pay us for this, but we feel that the characteristics of interaction and the prospects on our part will become clear reasonably shortly when one builds a person-person contact. In this personal marketing the customer doesn't dare..(here the interviewee breaks off, pauses then resumes)...we have had very extensive and good discussions with two relatively large firms. Despite the depth and length of discussion we haven't been paid for anything yet. Sooner or later though there will be a contract and we will be rewarded for the effort.

The quote illustrates an interesting mechanism. On the one hand the relations with customers are motivated on instrumental grounds usually to obtain a certain position or contract.. On the other hand the strategy of the firm is one of seeking to create personal embedded relations. The interpersonal link is actively sought as a means of reducing unnecessary costs by improving the quality of information that they receive especially with respect to the prospects of attaining contracts. Some of the firms seem quite refined and explicit in their techniques of creating this personal element. This is done, for instance, by trying to create multiplex relations by interactions in different domains. However, it seems that for the most part relations seemed to grow slowly and were heavily dependent on contacts established through prior work-related activities in different roles.

The image emerging of business interaction even in this end often seems surprisingly dissimilar to common notions of a market. One manager of a mold injection

firm, but not one in the focal firms, recounted a recently conducted inventory of how the firm had come in contact with its customers⁸. The inventory is strikingly contrary to the most common image of how marketing and business transactions in modern economy are conducted. At that time present customers of the firm were met in the following ways:

- 15 customers had come in contact with the firm by means of recommendation by previous business contacts.
- 15 customers had originally been established via personal contacts of other kinds.
- 2 customers had been found by way of exhibits and trade fairs but one of these was also an old school friend of the owner.
- 2 customers had come in contact with the firm by means of distributed information on new products and ads.
- The rest, approximately 15 were unaccounted for being small or very old customers.

In this inventory somewhere in the range of 90-95% of the accounted for customers have come to the firm through personal contacts. Some of these contacts were the product of business related activities such as referrals and meeting at trade fairs others were simply due to having diverse contacts in different fields of endeavor outside the immediate business. In these relations the main advantage seems to be informational although an element of basic trust, that the parties do not exploit each others lack of knowledge also contributes to their importance.

Effects of proximity

In addition to considerations of quality of communication, trust and informational aspects of relations between the firms there is also an issue of proximity. Proximity may additionally contribute to the quality of communication, and thus provide gains in time and cuts in costs. For instance, it is not uncommon that the original specification of the plastic item is made by a non specialist, so that it may contain unnecessarily high tolerance requirements which would substantially raise the cost of production. Or it may be that the mold maker, by seeing where the piece of plastic is to be used, can discern which measurements need to be exact and which need not be as precise. In either case deviance is likely to be small, sometimes down to the thousandth of a millimeter, but nonetheless there are always issues of where errors can be displaced in the mold as a whole. These issues can usually be resolved best by discussion on site or at least in discussions person to person. Physical proximity is also im-

⁸ The firm was founded in the 1950s, is family owned and has approximately 20 employees.

portant in the trial runs of the mold when adjustments need to be made so that the final product meets the specifications of the customer. For obvious reasons there are advantages to having these adjustments being conducted as close by as possible. The importance of proximity naturally further limits the different possible alternative producers the mold injection firm might employ and thereby puts even more pressure on the need for specific relations to work well.

General aspects of specific relations

For the mold-injection firms in this study placing a bid for the production of a fully specified item turns out to be not so simple a process. In order to place a viable bid in terms of quality, costs and time numerous considerations have to be weighed. But key decisions are made in different firms in the chain of production. Different possible designs of a mold, for instance, will also have different implications both for production of the mold but also for the subsequent production of the plastic item. The aim of the mold injection firm is of course to quickly and cheaply acquire a mold that will work smoothly in production. However, since each mold is complex and unique a total quality of a mold is difficult to define, particularly before actual production has started. For these reasons market mechanisms do not emerge in a way that allows price to be a sufficient indicator of relevant qualities⁹. Even for firms that are expert in the role of purchasing molds price provides only a slight indication of quality and the logic is alien to market dynamics. Generally, high levels of skill in making the molds leads to lower prices but prices that are too low may indicate a lack of quality. The case of the relation between mold manufacturers and mold designers is perhaps even less regulated by price. It is highly unusual to be able to compare prices for specific mold designs. The rare case where this is possible reveals market far from equilibrium. Because price is an insufficient mechanism to regulate relations other mechanisms must be used to insure gainful coordination between firms.

To deal with uncertainties in coordination, the firms make use of developed personal networks. These relations serve as an assurance that the parties can count on each other's competence and trust each other in their exchange despite lacking knowledge. Personal relations also serve the important function of allowing a high quality of communication. For instance, the mold injection firm must make use of a specific mold manufacturer that they know to be skilled in this particular kind of mold and who is also efficient and punctual. Their dealings will not end with delivery of a particular mold but continue until the mold is functional. The cooperative, mutual problem solving requires both trust and quality of communication. The mold pro-

⁹ The enumerated factors would seem to be necessary but not sufficient for the emergence of market like coordination where price may be a sufficient index of relevant qualities. For instance the willingness of firms to partake in competition on measurable aspects of products cannot be taken for granted.

ducers, in turn, rely on extraordinarily high quality communications with their sub-contracted designers in making an optimal design. In each step, the quality of relation between the firms is essential to making the process as a whole efficient. Thus even such a mundane task as predicting costs and times of production in these firms is predicated on an extensive social infrastructure. The need for a well functioning social infrastructure is increased by advantages of proximity. The advantages of having customers and suppliers close by makes good working relations with specific partners even more important. The mold injection firm's personal networks are instrumental in establishing the basic exchange of information in different areas so that new opportunities can be identified.

From a certain perspective the need for a social infrastructure, might seem debilitating for the firms and particularly for the mold injection firms. The argument would be that this constrains their maneuverability in their choice of subcontractor and their ability to find customers. For the firms in this study at least, important relations are so laden with uncertainty that, it seems, only a well developed social infrastructure in personal networks allows for an efficient use of resources to take place. It is these networks that have allowed their rapid increase in volumes not hindered their growth.

Personal networks in this case seem to solve a dual problem of trust and access to other's specific and expert knowledge. This dual aspect of the coordination problem is very important. Solving only the control aspect, is not helpful.

Establishing specific control by ownership for instance would be likely to exacerbate the problems. Mold-injection firms could own mold making firms. However, this would be likely to limit the development of both. In order for mold making firms to specialize in a particular area they need a range of different customers. The mold-injection firms when dealing with different customers need to access specialized expertise in mold making to make a viable bid. Ownership would allow control along specific relations but would limit the diversity of sources of specialized knowledge.

Similarly, the development of institutions that would allow general trust in interaction does not sufficiently solve the problem of coordination of these firms. It is by establishing specific lines of coordination that costs and lead times can be held to a minimum. This coordination must include specific knowledge of the other firm's expertise. General trust, in the sense of lack of guile, is not enough.

Elaborating contractual forms that would promote joint problem solving might be a viable route for formal arrangements (Berggren, Söderlund et al. 2001). While this may promote better coordination between firms it is unlikely to obviate the need for personal networks. High quality communication is a trait of personal relations. A high quality of communication is pivotal for flexible solutions to problems as they arise and in finding solutions that are mutually beneficial. Trust in the ethics and competence of the other persons sets a basis for mutual problem solving which is important in minimizing wasteful processes in the whole chain of firms.

There seems to be reason to expect the observed situation that personal network relations forward and backward in the production chain have extensive implications for coordination between the firms. Nonetheless the development of a social infra-

structure which makes gainful coordination possible is not an automatic process. It does not arise automatically from business interaction. In the cases that have been discussed the social infrastructure is a historic product of interaction between the key people in these firms over a number of years and often in different roles and representing different firms. It was not uncommon for a manager to state that a certain person in another firm had been known for a long time even though he assumed his present key role only a short time ago. The fact that a person is known from different roles seems to be an important part of creating depth in a relation. Past interactions form a backdrop for crystallizing understandings of how business should be conducted and sets a stage for trust¹⁰. In order to underscore that the social infrastructure cannot be taken for granted it will be useful to consider an example where it seems to be lacking.

Lacking social infrastructure

One of the firms in the study has a young and creative manager and presently employs twelve persons in the mechanical engineering business. A large portion of their turnover came from supplying a very large Swedish firm with a product which facilitated the transportation of some of the larger firm's components. As most mechanical engineering companies in the area, this firm was presently unspecialized, covering a wide range of different services, and was to a significant extent reactive to the needs of local industry. This means catering to their special needs to be performed on site, and making acute repairs. A portion of the firm was involved in the manufacture of components or products in the firm's workshop but most often tailored to a particular customer and the portion varied with the intensity of other more acute needs in responding to local industry. Despite this the firm had secured two more defined types of products, with large present and potential orders. In both cases however the production was floundering and failed to yield the positive effects it might have for this firm. The reason for this may be understood against a background of lacking social infrastructure in two respects: vertically, in relation the larger firm, and horizontally in relation to other local firms.

In the case of the transportation equipment there is a poor quality of communications with the much larger firm, there is also a lack of horizontal social infrastructure that would have allowed the coordination of production of these products on a larger scale. What happens is that the large customer makes specifications which later turn out to be deficient or even wrong because those making the specifications have too little knowledge of the actual practice of how these components are used. The small

¹⁰ Getting to know a person in different contexts and roles is an important part of triangulating an understanding of the other. Multiplex relations in a network and are often considered to be stronger than single stranded relations.

firm representatives was therefore obliged to go to the site and investigate how the component is to be designed, and often also adjust finished products. While this process might be necessary it was the impression of the manager that communication could vastly be improved. For instance he was convinced that there existed technical means of conveying essential information such as how the robots used for loading and unloading actually conducted the work. This would have been a substantial help in their production. The manager felt assured that if the large company would help them in setting up a system for the transfer of this information, or at least give assurances that they would use such a system if the firm set one up, then the investment in effort and technology would be worthwhile. The firm could bear the costs of setting up such a system because the simulation service could be sold widely to other mechanical engineering companies with similar needs. However, no such assurances were offered and thus the communication between the firms continues to cause unnecessary costs in time and effort.

At present the engineering firm received orders from the large firm for its product which greatly exceeded its own capacity to produce them. The lion's share of the work was therefore subcontracted out to large foreign firms while they maintained only the role of final adjustments. Had cooperation existed among the smaller regional mechanical engineering firms then some of the production could have been kept internally and financed upgrading of production facilities for other products. However, the problem here lies in that other mechanical engineering firms, just as this one, are diverse, unspecialized and largely reactive in their customer relations. This means that it would be very difficult to coordinate a joint production in terms of assuring punctuality and quality.

...take this product for instance. It is actually quite a big thing. Components are produced in Poland, the Czech Republic and Germany then it is sent here for adjustments. It is the same situation as with the plastic molds, nobody in Sweden can take care of large orders, we are too small. If we were to take care of the production in-house, we would have to work full time on it for two years...but we (similar firms) are not coordinated well enough on the production side to be able to say that we can produce this together. I have brought up the idea but I don't think it would work.

Interviewer: Are the firms too dissimilar?

Rather too similar, each would want the best and biggest part for themselves but there is no one that could govern it, coordinate it. Everyone has to keep their set delivery times and if they get a different job then well.... and I can't possibly employ another twenty people here, in this workshop...

The problem this firm is encountering therefore depends on a deficient communication with a much larger customer. This lacking quality in communication entails difficulties in planning of production and investment. However this situation might have been alleviated if a horizontal coordination of similar firms had been possible. If such a cooperation had existed the firms might have been able to handle larger orders and also divide production between them allowing for a mutual specialization. Lack of coordination in each case makes development difficult. The example serves to demonstrate that a beneficial social infrastructure cannot be taken for granted, nor

is the development of such infrastructure merely a byproduct of commercial transactions.

Conclusions

The chapter has sought to explore coordination between firms. The interaction between firms is different from what would be expected from a model of impersonal market. A closer examination of the interaction between the firms makes it evident that there are good reasons to expect that the price mechanism is insufficient as a means of coordination and that making a viable bid, for instance, requires other forms. For these firms a social 'infrastructure' of personal networks provides an essential ingredient of coordination. Embedded relations turn out to be central to productive efficiency.

Several different mechanisms were noted by which personal networks contribute to coordination between firms: personal networks express and facilitate trust both in the sense of ethics of interaction and trust in the others competence. Personal networks also express and enable the build-up of quality of communication which is important both for joint problem solving and simply for acquiring adequate information about opportunities.

The important role of personal networks limits transparency and exchangeability or relations. This has not however entailed that the businesses in question are less dynamic or economically viable, quite the opposite seems to be true. The dynamism of these firms is possible largely because of the existence of non-market regulatory mechanisms, particularly a certain ethics of business interactions, and non-market transfer of information and conceptual development.

In many respects the findings are reminiscent of Uzzi's work on firms in the N.Y. apparel industry (Uzzi 1996; Uzzi 1997; Uzzi 1997). The interpretation of the role of personal networks in business relations in this chapter is somewhat different though. I have argued simply that personal networks are a pivotal factor in integrating different areas of expertise. My interpretation of how these networks develop is also less functionally oriented. Productive networks do not arise only because a need exists.

The current exploration of the role of personal networks has sought to add something to our understanding of the dynamics of embedded relations. For these firms the most important relations are a product of prior interactions in business rather than deriving from exogenous sources the development. However, advantageous social infrastructure is by no means a simple effect of prior transactions. In the relations between mold injection firms, mold manufacturers and designers personal networks developed through previous contacts, often in different roles over a stretch of many years. In other words mobility within related industries in the region provided a base for persons to 'triangulate' and provides depth of interaction. It seems that the devel-

opment of these networks is a process that takes considerable time. In fact, given the length of time that seems to be needed to create a beneficial personal network, and the ongoing significance of these networks for business interactions, it could be said that the dynamism of these firms largely expresses the quality of the networks in which they are enmeshed.

Of course this initial exploration leaves a number of important questions unanswered. Clearly, there is a great deal more to be said about network development. It is apparent that more precision is needed in differentiating qualities of personal networks relations. Are there ways to assess the firm's situation in coordination with other firms? How do embedded relations shape the development of the firms?

CHAPTER 4

Embedded relations and business development

Introduction

This chapter continues the exploration of embedded relations in the small firm networks introduced in chapter three. The focus of exploration shifts from ongoing business coordination to an exploration of business development, that is, the way the firms come to produce new products, use new processes or simply expand their customer base.

The material in the study is structured in a dual theoretical perspective. It begins by focusing on functional aspects of embedded relations for firm development. This provides a basis for understanding why people spend time and effort in creating and maintaining their networks. However, there are certain limitations to this approach that are inherent in functional explanations more generally. While they provide an understanding of the usefulness of certain kinds of network relations, they do not provide an understanding of how these relations are actually created. The focus on functional aspects though, allows a means of exploring mechanisms of network development.

The chapter begins by a discussion of relations in the business networks. The development of each focal firm and particularly the significance of personal networks for these developments are presented for each of the four cases separately. The differences and similarities of these cases then provide grounds for the formulation of several hypotheses concerning the functional value and development of embedded relations.

Background

Each of the focal firms in the four networks began as a dependent subcontractor to much larger firms, and have, to differing extents, worked themselves out of this un-

favorable situation. Dependence on larger customers was perceived by all of these firms as a circumstance that constrained their development, offering neither security nor prospects. Extensive efforts have been exerted over a number of years by each of the firms to establish more diverse vertical and horizontal links in order to increase their prospects for development. Personal networks provide an important component of these strategies and shape the trajectories of firm development.

Since personal networks will provide an important element of the exploration it is worth noting again something of the social context in which these firms operate. The small business networks that form the empirical basis of this study are not located in an area known to house particular industrial clusters, nor is it an area in which the social fabric can be said to be particularly dense with personal ties in other respects, although this may vary somewhat locally. Furthermore none of the firms in the networks have contacts that have been mediated by family ties, only one firm of twenty has an element of family ownership and none have a substantial component of family interaction within the firm. In other words there is little exogenous supporting social infrastructure which the firms could draw on for information transfer, assuring quality and timing of business transactions, or mutual support in terms of expertise, machinery or finance.

There is a sense though, in which three of the four central firms, and many of their closest business relations, can be said to be loosely connected by personal ties, namely by long term engagement regionally in a rather select group of producers within their line of business. This has led to a rather large possible range of prior personal contacts. Since the plastics industry has also undergone radical changes in the last twenty years there has been a considerable mobility. An extent of former collegiality contributes, at times, to solidifying particular business relations. Both individuals and firms actively seek to create beneficial networks but the relations themselves of course can never be the instrumental design of single individuals or firms. However, it becomes evident in interpreting the material that the strategies of the four central firms draw upon and invest differently in embedded relations. The nature of this investment has important implications for understanding firm development.

Functional aspects of embedded relations in business development

In chapter three it was argued that personal networks provide an important means of coordination between firms. It is to be expected that personal networks should also have a role in business development. Informational advantages, trust and quality of communication are likely to be at least as important in development as in ongoing business. However, before turning to a discussion of the situation of the different firms it may be useful to briefly exemplify these mechanisms in the context of business development.

Trust

Personal ties have advantages that cannot be replaced easily by generalized processes of coordination. For instance small firms do not generally have the means to make their capacities and skills widely known by developing a brand name. Instead they may rely on building good but specific relations in which their qualities are recognized. These relations are banked upon when important customers in turn may pass on a recommendation to others or by increased volumes of trade in specific relations. These kinds of networks embodying trust, in the sense of both awareness of the others ethical traits and knowledge of their competence, link firms in a complex tiered manner. It is not unusual to find small, low profile firms involved in aspects of large high prestige projects. For instance, a small mold making firm in this study remains pretty much technologically unchanged since the firm started in the 70's and still has basically the same staff. Judging only by visible attributes there is nothing that would lead a person to expect that the firm was working on a component for the latest model of Mercedes Benz. This is possible only because the orders traveled through different subsidiaries along lines of personal connections of trust and mutual confidence. These highly indirect connections provide a basis for development of both new products and improvement of existing techniques.

As noted in chapter three the important aspects of trust in this context is not general trust in the sense of Fukuyama (Fukuyama 1995). It is specific yet multiple lines of coordination with different firms that allows gainful access to knowledge inputs at a reasonable price. Trust in business relations have been extensively studied (Powell 1996; Cook 2001; Kramer and Cook 2004). Several authors develop a notion of trust that includes both aspects of lack of guile and confidence in the other's skill that fit this need (Ben-Porath 1980; Boone and Holmes 1991; Morgan and Hunt 1994; Menning 1997). Trust may exist in relations between organizations as well as between persons. The two aspects are probably not always entirely distinct. In this case of course the primary interest is on trust as created through personal relations.

Information gathering

Another important aspect of external personal contacts is that they serve as sources of information. This may be highly valuable because the information most useful to these businesses is often of highly specific nature and would be difficult to obtain through generalized means even if it did exist in this form. For instance, managers of small firms need information on the plans of firm X, what kinds of technology are being used at Y, what new products exist and so forth. Although at any given time the exchange of small bits of information relevant to each others' business may not be of large economic value, the overall effect can be substantial. Exchanging information may be a matter of small amounts of time and effort, simply helping each other out. Building up such a range of good relations is a process over time that requires extensive trial and error. Such networks are highly evident in relation to several

of the network firms and represent a valuable resource. For instance one of the network firms, PDC, specializes in product development. This means coordinating the process of design of a product so that it meets the technical specifications and aesthetic needs of the customer while at the same time making the product suited for production, given the particular constraints of the production technique. To complete the design of a particular product requires drawing on diverse sources of small bits of simple, but critical information, such as what kind of screw or spring would be best to use in this product? Work at PDC therefore requires bits of expertise from a very wide range of sub-suppliers to be able to fulfill their work effectively but they do not themselves purchase quantities of such items. So help from a wide range of subcontractors is not remunerated in the short term. During the years of work they have come in contact with a great many such suppliers who help them and in turn are helped by being recommended by PDC to their customers who apparently need exactly something which they can supply. The exchange of information between PDC and its suppliers is based on helping each other out in small ways which may reap large rewards but also may not. The information gathering itself though is a vital part of PDC's work. The arguments are in line with extensive research on personal networks (Granovetter 1973; Allen 1978; Geertz, Geertz et al. 1979; Burt 1992)

Quality of communication

Personal networks are also important in limiting other types of uncertainty. There are interactions that critically depend on inherent qualities of the relation. In such cases embedded relations provide the only viable means of coordination. This is something that is perhaps most evident in developmental projects, where personal commitment and quality of communication are essential. The customer relations of PDC provide an illustrative example:

Customers often arrive with an idea but when they realize how difficult it is to work out the specifications of the product this often proves to be a stumbling block. We had a company here recently from a major science park, highly competent people, but when they realized how difficult it was to specify the qualities they needed we didn't hear from them in several weeks... they have submitted a specification now though. Interestingly this process is often easier for small firms. For instance VLC was here and they were asked to make a specification... that was a while ago and I don't expect we'll ever hear from them about this again. There has to be a person behind the orders. It just isn't possible to conduct this kind of business on a purely formal basis. Even if it is formally perfect, things won't work out very well if there isn't someone driving the process onward. We have to have understanding in both directions; in fact, the customers we haven't been able to co-operate well with have been dropped.

The quote articulates an important insight concerning quality of communication namely that it is an active process requiring mutual and personal effort. Without this personal connection conceptual development such as in the specification of a new product is unlikely to succeed. Quality of communication depends on personal connections.

In sum there are domains in which embedded relations provides functions in the development of small firms which cannot be achieved by more general mechanisms. This may be due to costs of making oneself known or retrieving highly specific information. It may also be due to qualities inherent in the transaction, such as the personal involvement necessary of product development. Personal networks fills these needs both in strong specific relations linking firms in customer-producer relations, but also in a wide range of weak ties that are essential for information gathering. The following sections are concerned with exploring when and how these networks will be important.

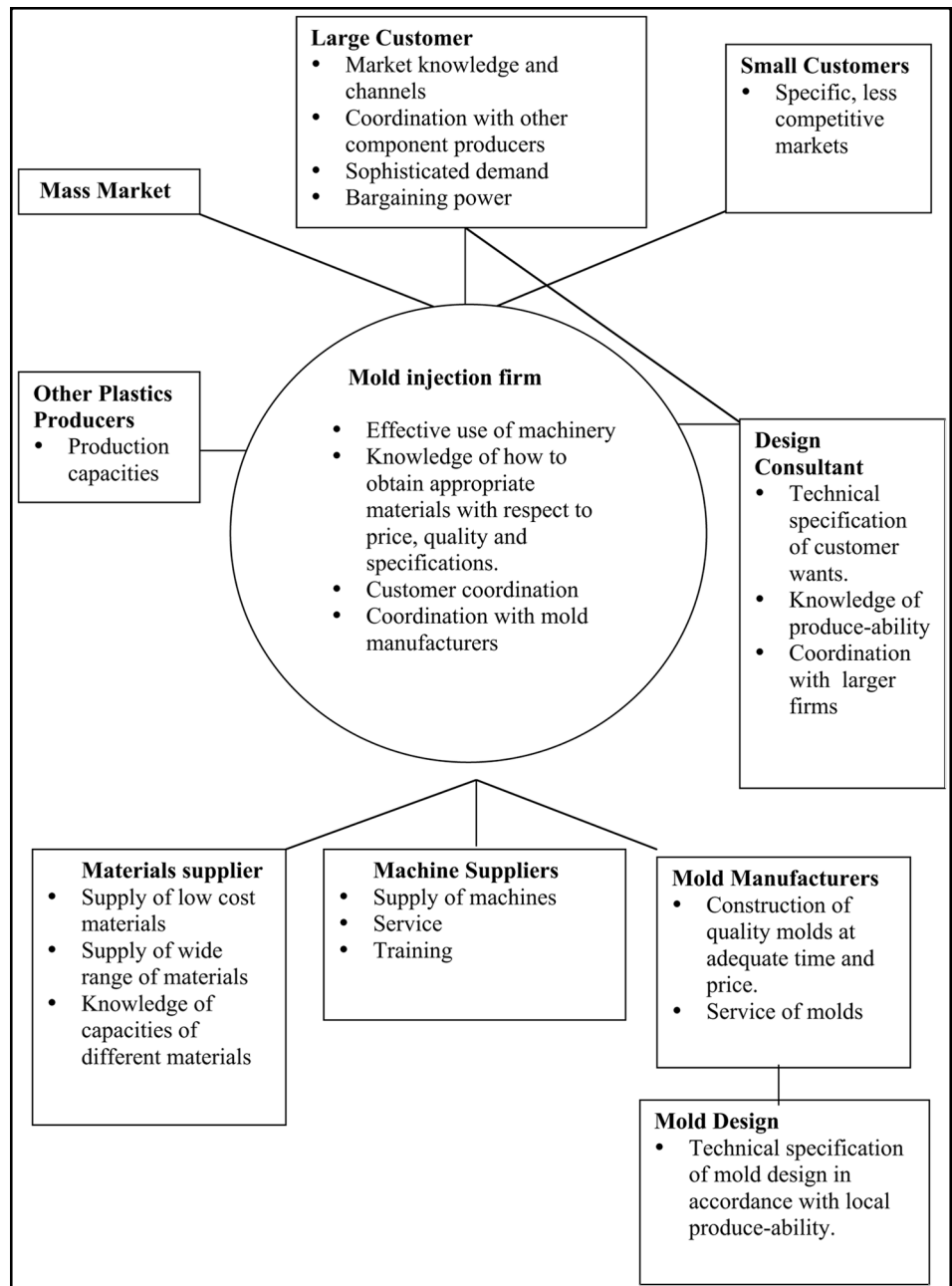


Figure 4 Example of resources in the network of a mold injecting firm as seen from the firm's perspective

Product and business development in four small business networks

In the following section four small businesses are described (Alpha to Delta). These firm's relations with customers and other firms are discussed. Differences between the firms are used as means of exploring the role of embedded relations in different firm strategies.

Alpha

The firm was bought a few years ago and is now run by a new set of owner-managers, who have led it in an exponential growth. In part this success has been due to high level of skill in production and of being able to assess good deals. They have, for instance, been buying up products formerly produced by others and realizing excellent returns. There are several respects however, in which the astounding growth of the firm cannot be understood without taking into consideration the constitution of the networks in which they partake.

When Alpha was purchased its sales was dominated by a single large, local customer. The purchase was preceded by negotiations with the larger firm to assure that the change of ownership would not entail a termination of the previous purchasing practices. Similar negotiations were held with suppliers. The new managers also began a process of building new relations so as decrease dependency on specific firms. The basic configuration of firms on the supplier side though has remained relatively stable. The new managers also marginally increased personnel through the addition of an old colleague of one of the managers. The most significant change however was that the managers brought with them a substantial set of contacts. These contacts had been built up during many years of work in the same line of business, but in different well-positioned roles, and mostly in the region.

The most substantial contribution of their previous contacts is on the customer side. Bringing in new products has been an integral part of the dramatic increase in turnover of the firm. The growth rate of the firm at the time of the takeover was – 18%. But by the first year the firm had turned around and achieved a growth of 60%, the subsequent year growth was 100% and the year after that roughly 50%. The owner-managers describe their strategy of finding new customers in the following manner:

Our strategy could be called personal marketing, since we have good contacts across a wide range of fields; this makes it possible to get orders for components. There is no a priori reason why our customers should be local, this is a result of our prior contacts... but it is advantageous as well that the technicians can meet on short notice.

In the quote the manager argues initially that there is no (functional) reason for customers to be local, but then adds, as an afterthought, the importance of being able

to meet at short notice. The products of Alpha are not particularly technically challenging so the assessment of the manager seems quite reasonable. It is the social space not the technical one per se that is of interest in understanding the extent of local interaction.

Good contacts will probably continue to boost Alpha's turnover for some years. However, in a sense this is cashing in on prior investments and not per se a generative strategy. The firm's attempts to open new channels have been frustrating.

By and large the customers have come to us, yes that's right, I don't think we have managed to bring in a single new customer by outward (impersonal) marketing.

The firm also experiments with developing consumer products. However, the time and effort needed to build new channels of distribution was underestimated. One manager thus exclaimed in response to a question about product development: 'Develop new products? don't ever do it, it doesn't pay off'. This is not an indication of conservatism; the same firm has ambitious plans to establish itself in a major science park and is actively seeking partners for major product as well as a process innovation. What the quote represents is rather respect for the costs involved in building up a wider distribution network for the produced product: meeting people, convincing them, and establishing credibility, integrating their product into delivery systems and so forth. In Alpha's situation these investments do not seem attractive at present.

A more successful strategy has included using former contacts to acquire timely information of emerging business opportunities, particularly products being sold off from other firms. Alpha has bought up these products and realized generous returns. Alpha's largest product for instance was acquired in this manner. According to the managers of Alpha the previous owner had 'done all the hard work of creating distribution channels, all we had to do was produce'.

Alpha does have a generative strategy of sorts for developing its business relations. The idea is to develop strong network ties in specific types of external relations such as complementary services needed for more complex products. In this way they hope to come into contact with new customers. Thus Alpha took an active part in stimulating the growth of the product development center PDC and has close contacts also with manufacturers of prototypes. Potentially there are returns in such cooperation for both parties.

Alpha has often referred customers to PDC and this was particularly important in critical phases of PDC's establishment. Alpha also acts as a consultant in meetings and discussions with customers that come to PDC by other channels. There are never any contractual bonds between Alpha and PDC and there is no reimbursement for this consultancy in monetary terms. The close interaction of PDC and Alpha contributes expertise to the product development process. In order to understand the gains that Alpha gains from this arrangement it is necessary to take into account the customer relations of PDC.

Product development is always a process that requires good coordination and trust. The quality of PDC's services can only be estimated post-hoc and even then this may be difficult for the non-expert. Not even the price of PDC's service is given

in advance since the process itself contains considerable uncertainty. Alpha's consultancy, though not directly reimbursed, in turn creates an advantageous position for them via the trust conferred on PDC by the customers. This may happen through recommendation, which must be clearly ethical or run the risk of alienating future business from the customer. It may also be that interactions themselves create a basis for mutual build up of knowledge, possibilities of trust but also possibilities, for instance, for Alpha to prepare making a bid on the subsequent production. Thirdly, there is never one single manner in which a product can be designed, different equivalent solutions may be chosen to offer an advantage in produceability specifically at Alpha. For instance, there may be choice of design which can be adapted to fit also a certain park of machines or a material may be chosen which is already being used in large quantities and therefore allow a more competitive bid in production. The informal relations of the firms do not disadvantage the customer. On the contrary when there is an ethical relation the arrangement provides reductions in uncertainty, time and costs of production. The situation is in many respects similar to that of the plastics manufacturer and mold makers examined in chapter three. The ethics of interaction is upheld in part because PDC can not afford to compromise its image in the eyes of its customers and does not wish to appear partial to a particular producer of goods. The firm can reach its widest possible range by not being officially associated with any particular producer. Alpha in turn gains important advantages of establishing relations with potential new customers, the same slice of customers that would avoid directly contacting a producer at least in this particular errand but who consider their knowledge valuable. The strategy depends on achieving both trust and separation to achieve a better division of knowledge and to create a greater diversity of customer contacts. It is a strategy that hinges critically upon specific personal relations.

Beta

Beta is a firm slightly larger and more established than Alpha. The firm is a spin-off from a larger firm located close by. Starting up in the middle of a recession the firm initially had difficulties but is now growing strongly if not quite so dramatically as Alpha. Beta's process of growth has focused more on internal accumulation of expertise than Alpha's. The firm has good relations with a number of large customers, this enables planning and partnership in developmental projects. Beta also has an extensive network of contacts with suppliers. These factors are used in a mutually strengthening strategy.

Good contacts on the material supply side have been important for Beta. This has been developed consciously over a number of years. Occasionally the firm has been the first European firm to use certain materials, which is remarkable considering Beta's size and the scale of the industry. The process of searching for materials is described by the manager:

We are always on the lookout for new materials and testing them out. In practical terms this means consulting our first suppliers, they in turn chase their channels and in this way we expand our contacts. Where can we find someone who can do this? Sooner or later the answers come back, it might take six months but it will come. The process gets faster and faster. One has to have a good connection with the suppliers, we know each other and the person understands what it is we're looking for. A personal chemistry is important, that way people will help out to a greater extent. Many large firms have the tendency to shift their purchasing of personnel precisely so that this personal element doesn't arise. They don't find it is productive. I am of a different opinion.

What the manager is describing is how Beta contributes to driving the development of a network of material suppliers. The development of this network is the reason for the process becoming increasingly efficient. Beta uses this knowledge resource to negotiate a better relation with its, often much larger, customers. This strategy has been an important and effective means of developing relations. However a less successful project provides an interesting illustration both of the functioning and limits of embedded relations.

Searching for interesting materials led Beta to stumble across a radically different material. The advantage of this material was that it was classified by EU standards as wood, and it had the feel of wood but could be produced in an injection molding process. The drawbacks of the material were that it was very dense and tended to dissolve in water. This material seemed to offer potential interest in several areas but there were also clearly limits to its usefulness. One customer initiated cooperation with Beta to develop the use of this material for wooden toys.

It turned out that the material was difficult to work with in several respects as it contained a great deal of water. This created extraordinary pressures in the mold injection process and caused extensive corrosion. Beta developed its production processes in order to be able to produce the material itself, and produce with it, on a large scale. This process development led to important channels of communication with their large customer, a deepening of the quality of communication and personal ties on levels which otherwise would be difficult to achieve for a small firm such as Beta.

Despite initial enthusiasm and funding for this development however, the people in the customer firm supporting the project lost out in an internal struggle. A shift in priorities lessened interest in cooperation. However, since the customer firm had already committed to an extent it was agreed that there should be a trial run for products using this material. The customer firm's choice of original test production using this material was a small toy boat. As the manager of Beta said: "the first thing the kids will do is put it in the bathtub, it will sink and dissolve": The project as a whole developed along similar lines.

The example serves to highlight an interesting breakdown in coordination between the firms. Extensive personal contacts are not enough to ensure coordination. At least, this is the case if the contacts lack sufficient clout in internal decision making.

While a diverse external network of suppliers is of key importance for Beta, many other aspects of development are essentially kept in-house. This is a result of a par-

ticular customer structure and a strategy of trying to negotiate relations with much larger customers rather than diversifying relations. In order to negotiate these relations it is necessary in some respects to vertically integrate so as to become a relevant counterpart. For instance Beta is considering acquiring essential capacities of product design/development. The reason for this is that some of their large customers have internal design capacity and Beta is thus forced into a reactive position in relation to these designs which may or may not be well suited for production and particularly not for production at Beta.

In principle we have been a kind of discussion partner with their designers so I have had a lot to do with their people both locally and nationally. They make their designs in a special program... and that is where we think we might be able to come in with a designer of our own. We could solve the problems at home and send the technical drawings and say: this is what we think it should look like. In this way it would be easier for us also to sell this part. We know it should look like this, it should have this form and we can present a complete suggestion. That way they wouldn't have to make these designs themselves, that is where we want to be.

The contrast of Beta's strategy and that of Alpha/PDC is striking. In the Alpha and PDC example it was argued that the division of labor between design and production, when coupled with strong informal ties, was beneficial for both parties. Why then cannot a similar mutually beneficial situation be achieved here?

One reason for this is that Beta customers are very large firms. The customer mentioned in the example (VLC) has a unique computer aided design system that requires specialized procedures and technical apparatus and thus specialized adaptation of the supplier. Such idiosyncratic procedures are an artifact of large integrated firms that necessitate similar responses among their suppliers. But there is also a more fundamental issue. The existence of an idiosyncratic set of procedures in VLC is may be seen as an expression of maintaining internal control of design and a certain lack of interest in dialogue with other parties. Translation among different CAD/CAM systems would not be insurmountable for a product development firm such as PDC. The real issue is in what forum the discussion is to take place.

In the Alpha/PDC case discussion of design was already externalized by the customer firm, it was conducted in a forum where they certainly have a large say but which is free from vested interests internal to the firm. In contrast the technical dialog shaping the product to be produced at Beta is conducted at VLC and on its terms. Beta, at this point is not a relevant actor in the shaping of product design in the same way as PDC is for their customers. Beta cannot recommend an external designer or bring one in for tripartite discussions. Successful negotiation of relations in production thus requires a countervailing integration of design capacity. This entails that the dialog of VLC and Beta must remain very specific and somewhat curtailed with respect to knowledge inputs¹¹.

11 The argument that vertical integration inhibits diversification and dynamic growth of related fields has been put forth by several authors treating regional development cf. (Saxenian 1994) (Scott 1998) and (Berggren 2002)

Gamma

Gamma is a family owned firm that has been in the business a relatively long time. The present owner/managers have run the firm since the late 1980s. When these managers took over they had little experience of the industry. Initially the production was focused on a small set of products and was heavily dependent on a single customer. The relationship with this customer was perceived by the owner-managers to be exploitive. During the 90s the firm's production was gradually switched to a different process and a new niche carved out for the company. These were hard times financially and the firm survived because local bank contacts showed a great deal of confidence in the firm. Since the owner-managers did not have an extensive set of industry contacts, the firm chose to 'go with a product' and found a specialized mass-production market in which they could undercut prices. The reason they were able to break into this market is not, according to the manager, price per se, but that the small number of firms in the same field either inadvertently or directly had fixed their prices. This became obvious when the others could follow suit and lower their prices. Even though mass production of this type entails substantially less in terms of personal contacts and investment this behavior of upping the prices was perceived as a breach of ethical behavior that propelled a substantial portion of the customers to switch suppliers.

In this business there weren't so many actors at that time, in reality only two and this is too little for competition to get under way. I don't know if they had some arrangement on prices but the prices went down substantially when we entered the market. The best way to help a new company on the market is to ask too high a price. One of our oldest customers still talks about having to pay 3 SEK for a product that was only worth about 1.70. He will never forget it. In fact our competitor X has been our best sales manager because he doesn't understand customer relations.

Among the competitive arguments in its favor Gamma considers good relations with their customers. They are neither the cheapest nor of the highest quality but rank somewhere in between on both scales. The production process itself is somewhat monotonous and requires large volumes. The firm is presently expanding at good rate in terms of turnover. In terms of its network and expertise though, the current development entails a substantial long term risk. With respect to vertical contacts the customer structure of Gamma is quite distributed, in the sense that it has many customers. However customers are not diverse, that is, the customer portfolio largely carries the same kind of risk. The niche character of the business combined with a need for large scale production has led to relatively monotonous relations on the supplier side. A single mold manufacturer has stood for the greater part of work over the past fifteen years. Large volumes and tight schedules have also led to a situation where Gamma pretty much exclusively uses a single material and hardly experiment with others. Both the purchasing of materials and design are the responsibility of a single manager at Gamma, who also takes care of a great deal of other administrative duties.

Since customers each account for relatively small portion of sales, product development becomes difficult. Because the customer structure is fragmented it is difficult

to obtain relevant information on what kinds of needs or wants exist in the group. Gamma has to mantle the uncertainty for any such development. Similarly customers are unlikely to play an active role in what they see to be a mass produced item. The situation becomes a reactive one and which the impetus for development is unlikely to stem directly from customers. Any given customer lacks the relevance to provide an impetus for development.

What about unexpected ideas from customers? Well, if one is seeking new products at any cost one might try to satisfy a customer even though it won't be economical. If there is only one customer that buys... Perhaps he only uses say 10 000 products...but if the firm has enough to do already then well...(the manager gestures showing that nothing can be done) This is wrong of course, it is risky to just live in the present... but if the customer only uses 10 000 sets then I guess he has himself to blame.

The development of Gamma may be understood largely as a product of network relations. Lacking initial good contacts they were put in a disadvantaged position in relation to a larger customer. The firm successfully pulled through a change, with technical assistance from a local university, good financial contacts and a restricting of their own wages. However the mass production of a, per se, reasonably successful product leaves them once again in a vulnerable situation. While they no longer are dependent on the whims of dominant customers. The current production does not lead to new impetuses for development. Nor do established relations provide the coordination for a concerted development of new products.

Delta

This is a smallish firm, in the mechanical engineering industry. The development of this firm has already been treated to some extent in chapter one where it exemplified lacking social infrastructure. The firm was established in the later part of eighties by a young creative manager who still runs it. The firm has gradually grown over the years but remains highly unspecialized in its activities, this is considered a problem because the scale of activities remains limited in each area and reactive to local external needs. In other words, proximity and to a lesser extent local contacts built up over the years have been the source of competitive advantage. A single large firm is responsible for a major portion of sales which is also felt to pose a problem because there is uncertainty as to the future of this company, whether it will retain its production locally or move it abroad. Communicative relations with this large firm are poor which means that planning for future investments is almost impossible. For instance the firm desires a more extensive use of simulation and technical programs which would greatly facilitate production and made it possible to subcontract more efficiently. (See chapter one) This technical aspect of communication with the larger firm however depends on improving communication and coordination between the firms on more fundamental levels. The present situation is characterized by the manager as follows:

In the best of cases a technical drawing is included... or I will visit the customer on site and check what needs to be done, if it is even worth proceeding to calculations... if we really understand what they want. Because nine times out of ten when they see the product they asked for... or try to use it they suddenly realize, damn! we have to unload this thing,...or they might discover that this particular piece won't fit... this is unbelievably common. We have to interrogate them first then work together.

The quality of communication both in specific transactions and in terms of the overall relation are poor. This effectively blocks Delta's ability to plan and invest in developments..

There is no shortage of saleable products or developmental ideas in Delta. However, there is a lack of marketing channels and a lack of quality subcontracting relations that would allow the spreading of risk and enable keeping a better portion of large orders. Instead Delta actually subcontracts to several much larger firms abroad and maintains only work on final fitting and adjustments. This utilizes only the advantage of proximity and does not contribute to the firm's long term development prospects. Basically Delta's manager perceives a need to move away from a service orientation toward specialized manufacture. This requires the building of a good vertical network quite different from the existing one. The present line of work has not generated the kind of contacts necessary though and so they too find themselves in a kind of an impasse in terms of development.

Embedded relations and customer structures

Each of the focal firms began as dependent subcontractors to much larger firms. Each has also over a number of years actively sought to change this situation such as to lessen dependence and provide better security and developmental prospects. The strategies of these firms have drawn on and invest differently in the development of embedded relations which in turn yields different outcomes and development trajectories.

The contrasts between these strategies provide a basis for uncovering some aspects of embedded relations and thereby also the function and development of personal networks. The personal networks being discussed are of a rather particular kind, that is, ones that have a direct bearing on business practice of the persons involved. It is useful to separate analytically inter-firm relations from personal networks even though the two are clearly intertwined in embedded relations.

Personal network structures

It has been argued that personal networks can contribute to firm development in several ways. Firstly it seems evident that diverse ties can be important. A diverse set

of contacts, each with their own sources, may provide valuable information from a wide range of related fields. The material suppliers of Beta, the different contacts of PDC that help them with small pieces of information necessary for product design, or the contacts of Alpha that provide a range of different potential customers serve as excellent examples of this. Diversity can be conceived of as a structural aspect of networks (Burt 1992). The idea is simply that people need different contacts and that these contacts in turn should tap different sources.

A second aspect of the personal networks studied is reciprocity. Reciprocity entails that the relation is mutual in the sense that the parties help each other out despite uncertainty as to whether this effort will be rewarded or not. Instead the parties rely on the other to return the favor at some other time if the opportunity arises. At least there would seem to be a feeling that the other would do this if they could. There is a personally based recognition of the other's competence and ethics. In the words of Beta's manager 'there has to be a certain chemistry between persons' this is what drives the system. Reciprocal relations can be weak as in the case of supplier contacts for Beta or strong as in the case of customer relations of both Beta and PDC. The distinction of weak and strong refers to the extent in which the personal contacts work to curb uncertainty in the relation. In offering a little extra help on occasion individuals are not banking heavily on personal trust, this would be a weak tie. Strong ties become important in developmental projects where the parties are mutually dependent and outcomes uncertain. At PDC costs for designing a product are never specified in advance, there are so many contingencies in the design process so that making accurate calculations beforehand becomes impossible. Since designing a product can be costly and it will be almost impossible for the customer to determine the correctness of this price, there has to be a real trust in the ethics and competence of the people in charge of the project. The situation is quite similar for instance in the developmental projects at Beta. The efforts of both customers and of Beta certainly rely on estimates and discussions of the potential new products but it also hinges critically on a mutual knowledge development and trust in the other party. Reciprocal ties are characterized by trust and quality of communication.

It seems possible to identify important functional aspects of personal networks with certain types of structures particularly diverse and reciprocal relations. However, important questions are still unanswered. It seems perfectly possible to have strong reciprocal relations with others without this necessarily conferring advantage in terms of development. The contrary might even be true if reciprocal relations are not also coupled with a dynamic input from diverse sources. There are indications in the material of both mold making firms and mold designers being locked into specific relations. The high level of trust and quality of communication needed for effective interaction reduces the potential development of the firms. Conversely, diverse networks in themselves do not offer benefits unless the informational advantages offered can be meaningfully integrated and put to use. The reason that Beta's diverse networks on the material supply side are important is because they also have strong reciprocal ties with customers. Similarly the reason PDC needs a diverse set of contacts about different types of component products is that this information can be put to

use, integrated in the development work, based on strong relations with customers. Strong reciprocal relations augment the need for diverse complementary networks and vice versa in a mutually strengthening manner. At least it might be expected that the personal contact networks will be particularly important for the development of firms when they exhibit both diversity and (strong) reciprocity. The argument seems to make intuitive sense in that information itself is not valuable; it is valuable in relation to others that can appreciate it. This is likely to be the case where relations are characterized by mutual orientations, trust and quality of communication. These are qualities that are associated with (strong) reciprocal relations. Conversely, the value of strong relations depends on tapping complementary sources of information.

The argument might therefore raise questions as to the long term cooperation of Alpha and PDC. The managers of Alpha have brought customers to PDC and PDC has brought new customers to Alpha. The relationship between the firms requires trust but it is questionable to what extent their networks are sufficiently complementary. It is their access to different sources of relevant information that provides an interest maintaining trust and quality of communication. For both Alpha and Beta personal networks provide a pivotal component of business development.

The line of reasoning on personal networks can be summed up in the following hypothesis:

- 4.1 A combination of diverse and reciprocal (work-related) personal networks provides the most beneficial situation for firm development.

Customer structures

Each of the firms studied has a history of seeking to escape a situation of dependence on large dominant customers. For firms such as Gamma relations with a single larger firm were antagonistic and exploitive. For other firms such as Delta the issue is not so much one of inequality as lacking communication resulting in considerable uncertainty. Delta continues to live with a considerable uncertainty about needs of its customers and a lacking coordination to mobilize even for specific developments.

Gamma successfully achieved a transformation from being dependent on a single large customer to being a mass producer of standardized goods. This is a considerable achievement. The manager's personal investment in the firm and confidence of a local bank provided a basis for the transformation. Since the owner-managers lacked contacts with other potential customers, being new to the industry, the alternative of going with a product rather than developing specific relations seemed the only possible alternative. While the present production of the firm provides a level of security the development of the firm seems in several respects inherently limited. The firm's activities do not lead to new impetuses from either suppliers or customers. Development becomes a reactive monitoring of competitors.

From a developmental perspective the present situation of Delta mirrors that of Gamma. In both cases the firms find themselves in a situation where there is a con-

siderable uncertainty about the needs of customers and a lacking coordination that would allow the firms to mobilize on identified needs. Both the concentrated customer structure of Delta and the fragmented customer structure of Gamma seem to lead to a poor quality of communication in forward links. This seems difficult to offset by means of personal networks. In Gamma's case a focus on keeping down costs leads to a streamlined relation with suppliers of materials and molds and a limited relevance of customer contact. This in turn, depletes internal networks in the firm. Single individuals are responsible for most aspects of firm development. For Delta there seems to be very little likelihood of establishing contacts with relevant decision making levels of the customer firm.

For Alpha and Beta developments have been quite different. Beta focuses on in depth relations with larger customers and banks on a good set of contacts with suppliers. This strategy has been successful for the most part. Initial contacts with customers have been built up progressively. The firm has built up an internal competence respected in particular customer relations that often have had an evident reciprocal character.

In Alpha finally, the rainmaker managers have brought in a great deal of new products and customers in a way that is reflected in the impressive growth of the firm. However, the diversity of contacts with potential customers has not been matched by the development of strong reciprocal relations. A large part of their internal efforts have been focused on managing variations in volumes rather than being a part in development. While the customer structure of the firm has become more diverse, coordination in forward linkages seems less productive than in Beta. The firm seems to be cashing in on diverse personal networks but the long term prospects of this position are not clear. Alpha seems not to have created strong reciprocal ties with other parties or perhaps sufficiently complementary other partners.

The cases provide a set of interesting contrasts. It seems that personal networks can have an important effect on the development of customer structures. But customer structures also in themselves impact on the development of beneficial personal networks. Both dominance of single customers and a fragmented customer structure seem to lead to decreased quality of coordination in forward links. This constrains development of the small firm and tends to deplete the value of personal networks. A middle ground of having a reasonable set of diverse customers but with whom it is possible to develop more in-depth communication and complementary specialization seems to be most positive situation in terms of firm development and puts a premium on network development. The argument can be summarized in the following hypotheses:

- 4.2a Both increasing dependency and increasing fragmentation of the customer structure leads to a decreasing quality of coordination with customers.
- 4.2b A middle ground in customer structure, where customers are individually relevant, but diverse as a group, provides a situation in which coordination by personal networks is particularly beneficial.

Limitations of personal networks

In several of the firm's relations, particularly with larger customers, there have been examples of lacking coordination. This was evident for instance in the example of Beta and its large customer in developing production with a new material, or in the case of Delta and its much larger customer. Breakdowns in coordination between firms are commonplace but there are aspects of these examples that warrant closer attention in order to highlight the limitations and dynamics of personal networks. Particularly the examples might seem to show that personal networks are important for the coordination of small firms but that coordination with larger firms is not achieved on this basis. This interpretation is probably not completely correct. There is little reason to believe that the significance of personal networks in large firms is less important, after all trust, information gathering and quality of communication are likely to be just as important in the development of large firms. Formal coordination is not a substitute when diverse expertise has to be brought together.

The difference between small and large firms in this respect may simply be the level on which the important networks exist. It is quite possible that a small supplier to a large firm may never be able to get access to the networks central to decision making in the customer firm. Thus in the case of Delta, it seems likely that this firm has a solution that would be beneficial for its customer to invest in, but it is very difficult to make it known and relevant enough to the key actors. In this case personal network ties will be of limited use in coordinating activities of the firms. The situation was quite similar in Beta despite the personal networks connecting the firms there was insufficient real clout in Beta's ties to bring their development project to a more interesting conclusion.

The real issue in terms of understanding the significance of networks, and their limitations, is perhaps not one of size of the firms but rather on the extent which the contacts have a sufficient capacity to act. Beta's ties with its customer seemed excellent but these persons lacked sufficient internal ability to act. The fact that this was realized quite late in the process is probably best understood as a result of problems of internal coordination in the customer firm. This is quite similar to the problems experienced by PDC in relation to some of its customers. A lack of internal coordination in customer firms becomes problematic because product development requires weighing different considerations. In short, personal networks, in order to be an interesting means of coordination, have to connect relevant people in both firms. In highly hierarchical firms this might effectively limit relevant networks to a handful of persons. However, even large firms that have a supple internal coordination can make extensive use of personal networks as a means of external coordination. In accordance with previous arguments on information and communicative quality it is expected that supple internal coordination in firms will take place through certain structures of personal networks. The argument can be summed up as hypothesis of structural relations such that:

- 4.3a The informational benefits of external personal networks for a firm depend on their being anchored in relevant internal personal networks.
- 4.3b The value of inter-firm coordination through personal networks depends on their including relevant actors in both firms.

Conclusions

This chapter has explored the significance of embedded relations for business development. It is argued that personal networks in business affect both the extent and direction of business development in the studied firms.

Embedded relations seem to be important because they provide a domain of interaction sheltered from short term rationality; they provide trust, quality of communication, informational advantages and willingness to help even when returns may be uncertain. These are at times vital to firm development.

People in these firms spend time and effort in seeking to create and maintain beneficial networks. In fact, these networks may be understood as a result of substantial costs. They are maintained or allowed to become dormant to the extent that they have a perceived significance. The benefits, in a developmental perspective, that accrue through personal networks are linked to certain types of network structures. Two such structures are identified in the material. Firstly a simple form of reciprocity entailing mutual recognition, willingness to trust in the other's competence and ethics. In weak forms this might consist simply in occasionally helping each other out. Stronger forms are necessary in developmental projects where there is considerable uncertainty and the results depend to an extent on personal qualities of the other. Secondly diversity of contacts seems important in obtaining informational advantages, for instance in finding new customers or suppliers. However there seems to be wider structural issues determining the question of when and how personal networks will be important.

In order to explore these structural aspects of embedded relations an analytical distinction was made between inter-firm relations and work-related personal networks. Although it should be clear that the two affect each other in important respects. The distinction allows us to explore questions of each domain separately and to phrase the relation between them as hypotheses.

Interpretation of the material led to the suggestion that personal networks might also have an internal logic. It is to be expected that the benefits of diverse networks will be realized best where there is reciprocity in relations. And that the value of strong reciprocal relations embodying trust, mutual orientation and quality of communication would be most valuable where there also is complementary diversity in personal networks.

The internal logic of personal networks can then be set in relation to inter-firm structures particularly the relations between the focal firms and their customers.

A concentrated customer structure, dominated by single customers has not been perceived by any of the firms as a beneficial situation. Each has used strategies to seek to lessen its dependency on particular customers. The argument is that dominance of single customers in itself creates a situation where coordination and communication between the parties is unlikely to have a quality that provides prospects for development. Greater diversity provides increasing benefits in terms of a wider range of informational inputs and better prospects of leveraging accumulated knowledge in relation to some particular customer. However, the effect diminishes with an increasing number of relations beyond a certain point. With widely diverse customer structures coherent information once again becomes more difficult to collect and coordination with relevant parties for development becomes less likely. Thus concentration and fragmentation of the customer structure both seem to decrease the quality of coordination in forward links of the firms.

In these more constrained environments there is little room for experimentation or serendipitous recombination of elements that create small scale innovations. The situation simply provides less scope for creating and capitalizing on knowledge development. Individuals are therefore less likely to invest time and effort in exploring alternatives that might be beneficial to firm development.

A final theme that arose in interpreting the material concerns the limitations of personal networks as a means of providing coordination between firms and benefits to firm development. This argument is that the benefits of external personal networks are contingent on supple internal coordination of the firms. This seems intuitive and explains several aspects of the material. However, the proposition also implies a need for a more comprehensive approach to understanding the significance of personal networks in the firms that takes into account both external and internal coordination.

Customer structure

Introduction

In the previous chapter it was suggested structures of customer relations could affect the development of a business by either enabling or constraining coordination. The purpose of the present chapter is to explore this relationship.

The term customer structure refers to breakdown of a firm's total sales in relation to each of the firm's primary customers. This provides a kind of heuristic device, often employed to assess a firm's developmental situation¹². In interviews managers could readily supply answers to questions on customer structure. They seemed to find this of obvious interest and agreed on basics of interpretation. At its most basic customer structure reflects risk in a business. If a single customer dominates the firm's sales this puts the firm in a vulnerable position. Moreover, having several large customers reflects something of the 'objective' value of the firm. In this chapter the aim is to formalize aspects of this heuristic and draw out its implications.

The idea that structures of inter-firm relations may be an important factor for firm development has been extensively developed in research using tools of network analysis (Burt 1992; Granovetter 1992; Uzzi 1996; Gulati 1999; Gulati, Nohria et al. 2000; Rowley, Behrens et al. 2000). A particularly influential piece of work is that of Ronald Burt (Burt 1992; McEvily and Zaheer 1999). This argument states basically that diverse customer structures provide bargaining advantages for firms and also informational advantages and thus provide a better opportunity for development.

The chapter explores customer structure as a level of analysis to see if it can provide clues to understanding firm development. The qualitative exploration suggested that this should be the case. However, the findings of chapter four are not completely congruent with the suggestions of Burt's theory. In particular, it was argued that both dependency and fragmentation of the customer structure hindered development. This is not an outcome suggested by Burt's approach and the discrepancy warrants further exploration. In this chapter I attempt to draw out the implications of customer structure that may be of interest in these firms but perhaps also more widely.

¹² Customer structure is often referred to as customer portfolio. Perhaps this term may have been used instead. However, it is particularly the structural rather than content aspects that are of interest in this analysis.

This chapter also introduces the second phase of the research. This entails a shift from a purely qualitative study of relations between firms to a more formal means of probing and analyzing the findings of the previous chapters. Formal analysis provides interesting means of deepening our understanding but also imposes a structure on the development of arguments. It becomes necessary to carefully study one element of the argument at a time. For instance, the overarching aim of this thesis is in exploring the role of personal networks for firm development but the present chapter is concerned only with the role of customer structure. Nonetheless this is a necessary step in moving the argument on personal networks forward.

In this second stage of research the material is collected from eight small mold-injection firms, all located in Scania. This is a somewhat wider but still limited empirical basis that enables in-depth knowledge of each firm's situation but also allows for some forms of statistical analysis.

Dependency and constraint

In chapter four it was suggested that the structure of customer relations might in itself affect the quality of coordination in forward links. This not always going to be the case, there are many factors that might affect the quality of coordination between firms including cultural and organizational differences, histories of past interaction and the quality of personal networks. However, the argument is that the structure of customer relations might impact on the quality of coordination with customers and therefore on firm development. For instance, if a firm is highly dependent on a particular customer this is likely to affect coordination adversely in the firm's perspective. It has been common to argue that small firms risk becoming overly dependent on single customers and this impedes prospects for firm and even regional development (Capecchi 1989; Perrow 1992; Storey 1994).

Burt argues that there are two important aspects in understanding a firm's situation in a network of self-interested actors. Firstly, there is an informational aspect. The question is one of access to information. Relevant information is hard to come by. It may be highly specific and timing may be critical. For this reason valuable information often travels through networks of interaction rather than being accessed by generally available channels (Burt 1992). Clearly information does not travel only along pre-existing network channels, or there could be no development. But at the same time it is a reasonable argument that developed channels of communication provide an important index of an actor's situation in terms of access to relevant information. For the firms in this study this kind of relevant information might concern inputs to develop production in some direction or being informed about emerging business opportunities.

The second aspect Burt argues is relevant in understanding an actor's position in a network is related to bargaining. Basically an actor's bargaining position in a specific relation depends on the extent that the actor has attractive alternatives. If a firm

has a set of good alternatives to a particular customer relation for instance, then this is a better situation than if the firm's alternatives are unattractive. In an unfavorable situation, the firm might be forced to make concessions in ways that it would not have accepted if its bargaining position was better. A dominant customer can dictate terms of interaction in a manner that provides little leeway for the producing firm. Bargaining, in this case, should not be understood to relate only to price but also to other aspects of coordination between the firms such as the manner in which discussions are carried out, forms for quality assurance, delivery and so forth. The lack of alternative customers for a firm constrains its ability to negotiate a gainful mutual adaptation. There is also a lack of alternative customers that may appreciate developments the firm has already achieved.

Being dependent on a single customer implies a disadvantageous situation both in terms of informational flows (access to market information) and in terms of bargaining power. Burt terms the combined informational and bargaining effects *constraint*. Constraint is the lack of maneuverability and lack of developmental potential imposed by limited information and limited ability to make one's position heard. This leads to the hypothesis that: Constraint in the customer structure should be negatively correlated with firm development.

Burt's argument on constraint seems reasonable, and there are certainly aspects of the material that seem to be explained by constraint. For instance, the perceptions that being dependent on single customers was both risky and lacking in developmental prospects. The situation of Delta could perhaps in several respects be explained by means of a concept of constraint. However, in its present form the argument on constraint implies that a more finely subdivided customer structure, where each customer account represents only a small fraction of total sales is always better than one that is less finely divided. This does not fit well with the previous findings where having numerous small customers also poses problems of access to relevant information and coordination. Before developing the argument on fragmentation though, it seems appropriate to view how much of the variation in firm development that can be accounted for by constraint.

Exploring the effect of dependency on growth

Data on customer structure was collected by means of a short questionnaire presented to the head of marketing in each mold-injection firm. The short survey asks for a breakdown in terms of total sales in relation to each of the five largest customers. The cutoff point, using the five largest firms, rather than say the four or seven largest is theoretically arbitrary. However, using some such cutoff point seems reasonable. Firstly, sales fluctuate. Small orders come and go. The customer structure thus becomes less and less stable as smaller and smaller customers are considered. For one firm in particular even noting the five largest seemed rather irrelevant. For most however this was a question

they immediately understood and could answer although most also checked the statistics to be exact. This brings us to a second reason for using a cutoff point. In exploring an heuristic it seems reasonable to maintain a close connection with how it is used in practice. The managers themselves find it most relevant to list the four of five largest customers as rough index of a firm's situation. Finally, the data provides us with a reasonable notion of the rest of the customer structure. It is clear that sales unaccounted for by the five largest customers, are conducted with customers smaller than the fifth largest. This point will be developed subsequently but suffice it to say that the data provides an indication of important aspects of customer structure.

The customer structure for the firms that partook in this study is shown in Table 1 below. Numbers indicate the part of total sales which each customer stands for. Thus firm A's largest customer (C1) buys 20% of what A sells. The five largest customers account for 52% of A's total sales (residual of 48%).

Firm	C1	C2	C3	C4	C5	Residual
A	0.20	0.15	0.10	0.05	0.02	0.48
B	0.34	0.23	0.14	0.11	0.11	0.07
C	0.12	0.12	0.13	0.13	0.12	0.38
D	0.25	0.17	0.16	0.10	0.10	0.22
E	0.42	0.13	0.10	0.03	0.02	0.31
F	0.20	0.12	0.12	0.08	0.08	0.40
G	0.08	0.08	0.08	0.07	0.07	0.62
H	0.30	0.15	0.10	0.08	0.08	0.29

Table 1 *Customer structures*

Calculating constraint

The concept of network constraint has been developed and extensively discussed by Burt (Burt 1992). A full treatment of this concept would take a great deal of technical discussion. However, the customer structures that will be analyzed in this chapter are extremely simple in network terms. Because customers of a particular firm are not connected it is not necessary to take into account how potentially complex interconnections affect information and bargaining. The only interesting aspect about a customer structure is the relative weights of different customer relations.

For customer structures of these firms constraint is a product of dependency in an informational sense (access to market information) and dependency in a bargaining sense. Both aspects of constraint in relation to a particular customer are indicated in the customer's proportion of total sales. The argument is that the proportion of sales for a certain customer provides us with an index of the total effort and time that is devoted to this relation. This is rough measure but remember that coordinating on-going production is by far the most important activity of the firms. As in the case of

Gamma in chapter four, ongoing production may easily overshadow all other interests. Relations of ongoing production therefore provide an important element of a firm's informational and bargaining situation.

To calculate constraint in customer relations of these firms the proportion of sales for each customer is squared (dependency in information multiplied by dependency in bargaining) and then summed across the five largest customers. The results are presented in Table 2.

Firm	C1	C2	C3	C4	C5	Total Constraint
A	0,2	0,15	0,1	0,05	0,02	0,0754
B	0,34	0,23	0,14	0,11	0,11	0,2123
C	0,12	0,12	0,13	0,13	0,12	0,077
D	0,25	0,17	0,16	0,1	0,1	0,137
E	0,42	0,13	0,1	0,03	0,02	0,2046
F	0,2	0,12	0,12	0,08	0,08	0,0816
G	0,08	0,08	0,08	0,07	0,07	0,029
H	0,3	0,15	0,1	0,08	0,08	0,1353

Table 2 *Total constraint in firm customer structures*

Effects of constraint on growth

Having calculated a value for constraint, it becomes possible to set this in relation to other measures of firm development. The concept of development, as the term has been used here, is intended to capture a firm's capacity to successfully develop its products and processes, but also develop knowledge in other respects such as finding new markets. One important measure of this is the firm's organic growth, that is, the increase in turnover relative to the previous year¹³. Growth represents the continued appreciation of the firm's activities by customers, management and owners. Growth rates for the firms, in percent of total turnover, and values for constraint are presented in Table 3 below.

13 Data on turnover has been taken from the database Affärsdata. www.ad.se. The material on customer and personal network structures was collected at the end of 2000 and the beginning of 2001. For each of the firms increase in turnover is given in the subsequent fiscal report. I was fortunate in collecting this material in that the firms neither purchased or sold significant parts of their production. One firm has divided itself into two legal entities one for sales of end consumer products and the other for industrial products. However both firms rely solely on the same production and personnel. Calculations concerning increase in turnover have therefore been combined for the two entities.

Firm	Total Constraint	Growth (%)
A	0,0754	-7.14
B	0,2123	32.81
C	0,077	7.26
D	0,137	14.98
E	0,2046	-0.19
F	0,0816	17.44
G	0,029	-6.33
H	0,1353	17.62

Table 3 Firm growth

Applying a straightforward analysis it is expected that constraint will correlate negatively with growth. The results however do not corroborate this. Not only does constraint not negatively correlate with growth but the correlation indicated is positive¹⁴. In other words increasing constraint seems to be a good thing in terms of growth of these firms. Although somewhat surprising a positive but weaker correlation of constraint and growth has been reported by Mark Freel in his extensive study of small and medium sized manufacturing firms in a region of England (Freel 2000).

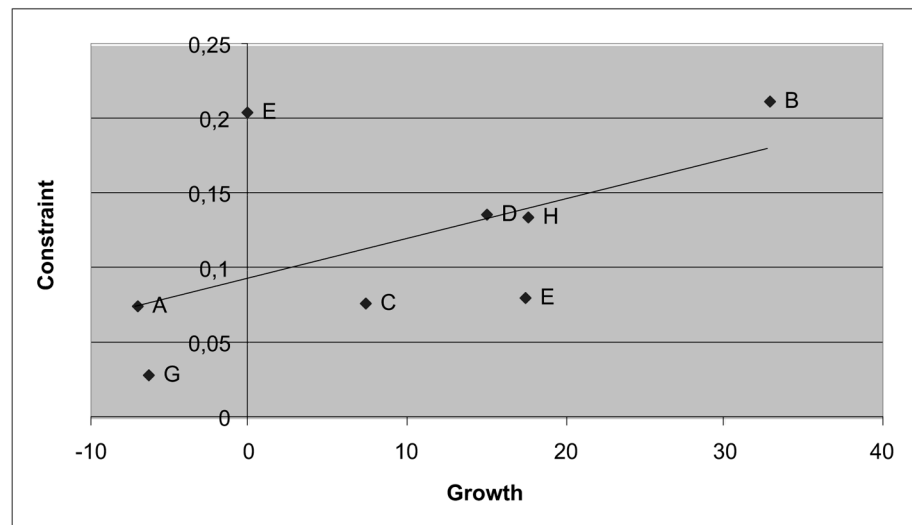


Diagram 1 Constraint and growth

There are several possible interpretations of the observed relation of constraint and growth. However, based on the qualitative findings the probable explanation is that the model underestimates the difficulties of coordination, both in terms of information and of bargaining, that come with increasing fragmentation of the customer

¹⁴ A two-tailed Spearman rank-order correlation between constraint and growth yields a value of 0,667 this is not significant when employing a five percent threshold.

structure. This may simply be a matter of taking into account that coordinating activities with other firms, collecting information, bargaining and so forth are themselves costly activities. In Burt's model of constraint this dimension of cost is not taken into account.

Fragmentation of customer structures

Information gathering and bargaining are costly activities, requiring considerable time and effort. Now, if each customer has unique information and a unique bargaining position, then this would mean that that cost of coordination varies in a simple linear way with the number of customers. Coordination with a myriad of different but small customers would perhaps be a brilliant starting point for a firm to develop some types of knowledge, but in terms of costs this would be impossible. Not only would cost be exorbitant, the value of developing coordination with a specific customer also diminishes as the customer becomes relatively smaller and the structure of customer relations becomes more finely divided.

In actual fact any organization is forced to opt for strategies that standardize interactions, thereby treating customers as more uniform and sacrificing potential informational and bargaining benefits. The situation approaches the case of Gamma. The firm has a number of small customers and a poor overall situation in terms of knowledge development. Standardization of production and relations with customers has meant that they pretty much use a single mold manufacturer, a single material and rely on a single person for the development of design. This led to the suggestion that fragmentation of the customer structure should also be considered to decrease the quality of coordination in forward links. This might be a more important factor than overt constraint in customer structures.

In terms of the model of constraint, the introduction of a notion of coordination cost implies that there is a point where further diversifying the customer structure no longer provides sufficient advantages in terms of information or bargaining position. Lessening constraint must be weighed against increasing coordination costs.

A first approximation of fragmentation is provided by the residual category in the customer structures (see Table 1). The residual category simply states the portion of sales not accounted for by the five largest firms. As the residual rises the customer structure can be said to be more and more fragmented. Alternately it might be possible to gauge fragmentation as the residual divided by the proportion of sales that the fifth largest customer accounts for. Both measures seek to capture the extent that a firm has to coordinate an important portion of its sales with small customers.

Setting these measures against growth provide support for the notion that a factor like fragmentation is important. Both initial measures of fragmentation are significantly and negatively correlated with firm growth¹⁵.

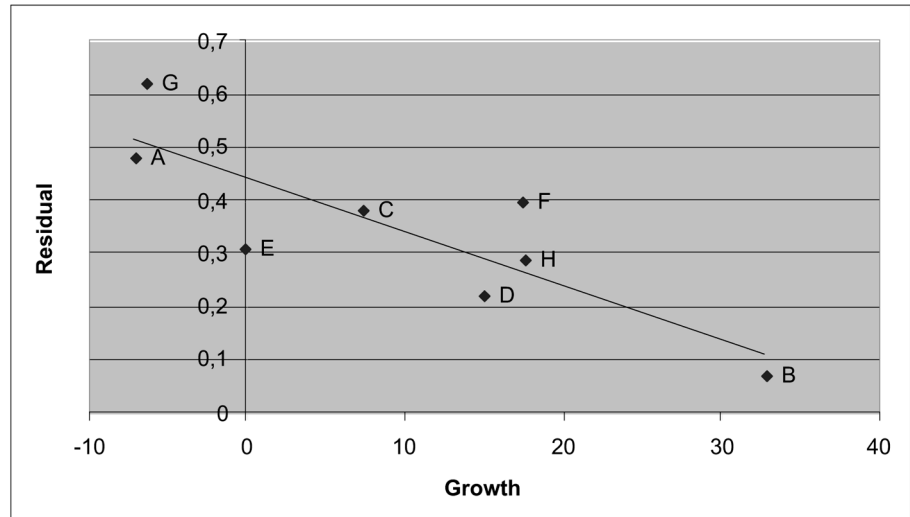


Diagram 2 *A first exploration of fragmentation and growth*

For these firms increasing subdivision of the customer structure is not a situation conducive to firm development. Although the residual category in the customer structure might serve as an index of fragmentation there is reason to treat fragmentation as related to both dimensions of information gathering and coordination. A better measure of fragmentation would be to treat the residual in a manner analogous to that of individual customers in calculating burttian constraint. This means that the proportion of sales should be squared. This is done because the variable is intended to capture not costs of coordination but effects of these costs on forward coordination in both informational and bargaining aspects. The factor *fragmentation* is therefore obtained by squaring the proportion of sales not accounted for in the five largest firms. See table 4.

Firm	C1	C2	C3	C4	C5	Residual	Fragmentation	Growth
A	0,2	0,15	0,1	0,05	0,02	0,48	0,2304	-7,14
B	0,34	0,23	0,14	0,11	0,11	0,07	0,0049	32,81
C	0,12	0,12	0,13	0,13	0,12	0,38	0,1444	7,26
D	0,25	0,17	0,16	0,1	0,1	0,22	0,0484	14,98
E	0,42	0,13	0,1	0,03	0,02	0,31	0,0961	-0,19
F	0,2	0,12	0,12	0,08	0,08	0,4	0,16	17,44
G	0,08	0,08	0,08	0,07	0,07	0,62	0,3844	-6,33
H	0,3	0,15	0,1	0,08	0,08	0,29	0,0841	17,62

Table 4 *Fragmentation in customer structures*

¹⁵ Two-tailed spearman rank-order correlation values of -0,762* and -0,786*.

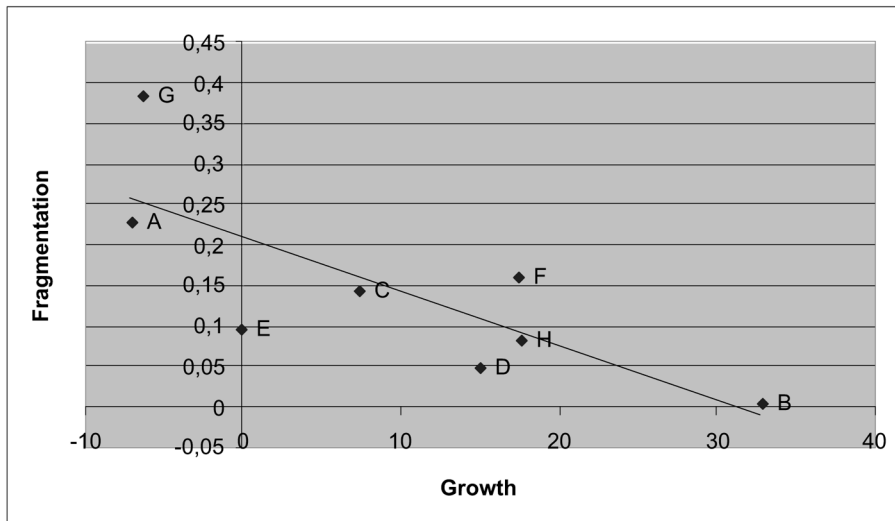


Diagram 3 *Fragmentation and growth*

A spearman rank-order correlation (two-tailed) setting firm growth against fragmentation yields a significant correlation $-0,762^*$ using a five-percent threshold.

Combined constraint and plural customer structures

The effects of fragmentation are fairly evident then in terms of growth of the firms. Firms that have a fragmented customer structure also tend to be growing more slowly. However, there is not reason to abandon the concept of constraint. The fact that fragmentation is more important in this particular set of firms does not invalidate the proposition that constraint may be important in others. Furthermore it is conceivable that both effects are present in a sample of firms or even in a particular firm. Consider for instance the customer structure of firm E (see Table 4). This firm has a large part of its sales tied to a specific customer but also a large part of its sales in the residual category. Its situation can therefore be described as both constrained and fragmented. The firm contends both with a dominance of a particular customer and the problems of coping with a myriad of smaller customers in a meaningful way. There is every reason to expect that the effects of both constraint and fragmentation should be taken into account.

To explore this possibility requires constructing a model that includes both constraint and effects of fragmentation. This poses no particular difficulty since they are in fact constructed in the same way. The simplest possible measure of combined constraint, as the variable will be called, is obtained by adding the unweighted values of

constraint and fragmentation. Combined constraint is thus lack of maneuverability due to dependency plus lack of maneuverability due to fragmentation. The variable combined constraint is therefore derived by summing the variables of constraint and fragmentation.

The model implied by the notion of combined constraint is that a firm's developmental situation is improved with increasing diversity of its customer structure up until a breakpoint. Thereafter increasing diversity decreases relevant impulses to develop and lessens the firm's ability to capitalize on its developments.

Testing for correlation of combined constraint and growth yields a strong result of $-0,786^*$ in a (two-tailed) spearman rank-order correlation.

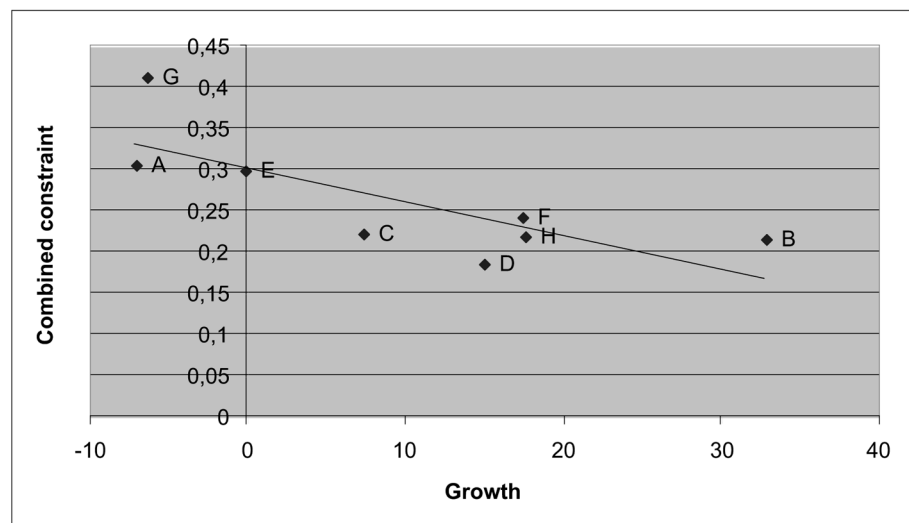


Diagram 4 *Combined constraint and growth*

The correlation for the variable combined constraint is exactly as strong as that for fragmentation alone. However, the correlation has fewer outliers. Furthermore Pearson partial correlation tests for constraint and fragmentation in relation to growth, while holding the other constant seems to suggest that both factors may be important¹⁶. It would seem that both effects of constraint and fragmentation exist and affect the development of the firm by decreasing its ability to coordinate activities in forward linkages with adverse affects on its development.

The notion of combined constraint also fits well with aspects of the qualitative material. For instance a large conglomerate in the mold-injection business in Sweden has an explicit strategy of developing this kind of customer structure. The strategy aims to create in-depth relations with large customer firms. In realizing this strategy the conglomerate has purchased a number of small firms and restructured them. This restructuring has, in some cases at least, entailed that a large number of small cus-

¹⁶ The correlation of constraint and growth, while controlling for fragmentation, is not significant but in the right direction. A Pearson partial correlation test yields a coefficient of $-0,258$.

tomers have been dropped or helped to find other suppliers. This is explicitly part of creating a beneficial customer structure which they think enables them to deepen relations with specific customers. Marketing strategies in the conglomerate therefore aim at creating in-depth relations rather than a widening the customer structure.

Conclusions

The argument on constraint has a heavy theoretical backing. The argument on fragmentation however is novel. The point that coordination between firms entails costs is rather obvious. The problem is to find an adequate means of combining analysis of inter-firm networks with this notion of cost. The model proposed in this chapter has the advantage of simplicity and in addition it seems intuitive and somewhat anchored in the practice of the managers. Nonetheless the specific breakpoint introduced in the model, where increasing diversity of the customer structure ceases to be advantageous, is theoretically arbitrary. In other words there are reasons to expect that such a breakpoint exists but no basis for proposing it to be at a specific point. The analysis was guided by following an heuristic device employed by managers. Conceivably, this breakpoint should vary with the specific type of production in the firms. In this sample, analysis is relatively robust even if the specific breakpoint is shifted somewhat. Thus using the four largest customers instead of the five largest as a basis for calculating constraint provides highly similar results and the values for constraint and fragmentation move in the expected directions.

This chapter has explored the effects of customer structure and has developed the arguments of chapter four that both dependency and fragmentation in the customer structure affect forward coordination negatively. The chapter developed a concept of combined constraint to account for this and offers a first operationalization of the concept. The model implied by the concept of combined constraint is strongly supported in the data. However, the exploration has only dealt with affects on growth. While this is certainly important the proposition in chapter four is that customer structure affects firm development more generally and also with respect to knowledge development in the firm.

In the next two chapters the focus will be on knowledge development in the firms. This is trickier to measure. The analysis proceeds via an in-depth study of personal networks in and between firms. Chapter six focuses on individual level effects of personal networks. Chapter seven elaborates effects on the firm level.

CHAPTER 6

Problem solvers and their networks

Background

In the case studies of mold injection firms, I was often struck by differences with respect to the 'atmosphere' the firms afforded. Although it is difficult to accurately express these kinds of differences they will probably be familiar to most. Some organizations house confident open interaction and in others the atmosphere is heavy and difficult. It seems that an important component of these differences lie in informal organization, the quality and dynamism in communication in the firms. These underlying differences were expressed in different propensities of the firms to experiment with new materials, and products, in the diversity of their suppliers and customers, the significance they attached to developing external contacts and the extent they made use of external education.

While the differences in 'atmosphere' seem elusive and difficult to pin down they also seem to be a central part of a firm's development. For instance Beta's development of a deep relationship to its customer depended on the diversity of embedded ties with a number of different suppliers of materials. This is only possible given a healthy communication between different key persons in the firm for instance those responsible for customer contacts, those responsible for supplies and numerous persons that partake in assessing and adapting production. While this might seem obvious it certainly can not be taken for granted. Similarly, cashing in on the network of contacts of Alpha's managers depends on an organization capable of meeting different kinds of demands and substantial variations in quantity. For this to be possible there has to be a good coordination between key actors in the firm such that bottlenecks can be avoided and error minimized.

Most managers in the firms attributed a great deal of importance to informal organization. The CEO of a firm with 70 employees emphasized the importance of informal organization to the extent that he felt a need to explain why the firm retained a formal organization at all.

Informal organization is what matters, we have to develop an atmosphere which enables people to turn to the best person rather than whoever might be in charge... We still retain a formal organization because in the final instance we need to be able to hold somebody accountable, but it is the informal problem solving that really matters. (CEO firm D).

This ready understanding of the importance of informal organization is perhaps related to the small size of the firm. In small firms it is often evident that organization is built primarily on individuals rather than roles. But more importantly, the firms find themselves in a dynamic environment where ability to adapt and use changing circumstances is an essential aspect of business. The question is: what characterizes a dynamic informal organization? Are there particular analyzable characteristics? And if so, what drives the development of a beneficial informal organization?

This chapter seeks to develop a vocabulary and try to pinpoint those aspects of informal organization that seem to shape the firm's ability to solve problems and capitalize on developments. The issue is intimately intertwined with a topic raised in chapter four where it was suggested that the informational benefits of external personal networks for a firm depend on their being anchored in relevant internal personal networks.

Personal networks and knowledge development

Formal organization is, in the best of cases, tailored to suit typical challenges an organization meets. Informal organizations have a beneficial role to the extent that they enable the handling of dynamic situations, for handling the unexpected both on an everyday basis and also in terms of larger changes (Brown and Duguid 1991).

Informal organization has long been recognized to be important for technological development. For instance, Thomas Allen's classic work on communication networks in aerospace projects in the late 1960s demonstrated how personal lines of communication were critical for problem solving and general success in these projects (Allen 1978). Allen's argument was concerned with technical knowledge. He argues that this knowledge exists primarily in people's heads and embodied in products. Documentation is at best an auxiliary process. Allen argued further that personal interaction is necessary for the transfer of this knowledge. Thus to a very large extent technical knowledge is stored in and developed through personal networks. Allen also noted that communication was unevenly distributed in organizations. Certain persons, gatekeepers or boundary spanners, provided essential bridges, bringing together different areas of expertise.

Allen's work holds open the possibility that being a gatekeeper is both a role, given by a social situation, and a product of individual capability. Perhaps because of the emphasis in this research on information and 'sources of ideas' there is surprisingly

little interest in other aspects of communication networks that could influence the extent to which information or potentially good solutions are actually put to use.

Recent writing on knowledge development in firms has emphasized the interplay of individual knowledge and social context (Nahapiet and Goshal 1998). This kind of approach acknowledges that there is a social aspect of knowledge. This may be related to structures of personal networks or qualities distributed within a group such as useful routines, beneficial codes of interaction such as ethics, quality of communication, sets of narratives that encapsulate key knowledge and so forth. These aspects of knowledge in an organization are collective and cannot be meaningfully captured on an individual level. From a strongly collective perspective individuals are uninteresting except as expression of collective knowledge.

A modern strain of writing that emphasizes social aspects of knowledge development and problem solving draws on the notion of *community of practice*. This is a theoretical development based on occupational ethnography, particularly the work of Julian Orr (Brown and Duguid 1991; Orr 1996; Wenger 1998). These authors emphasize understanding learning and development in close relation to actual practice, that is, how people actually 'get the job done'. This perspective avoids treating knowledge as thing but sees it instead as aspect of social process. The notion of a community of practice seeks to capture the importance of collegial exchanges in developing a shared repertoire of understandings based on the actual practice in which these people are involved. Orr provides an oft-cited example of how technicians at Xerox draw on these shared narratives in order to construct and deal with practical problems that fall outside the scope of formal directives (Orr 1996). This kind of exchange which entails both social construction and problem solving becomes a source of cohesion and the building of a common practice. In a sense the 'communities of practice' approach is the polar opposite of Allen's. Knowledge is social and brought to bear on specific problems by different constellations of individuals. For Allen solutions to problems exist in particular individuals and flow from one to the other.

While the concept of a community of practice is a highly useful metaphor and while the approach is important for its emphasis on connecting with actual practice, the concept of a community is analytically frustrating and elusive. Attempts to formalize the concept as a structural relation introduce boundary problems and tend to lose the connection with practice (Schenkel 2002)¹⁷. In the worst case the approach becomes one of testing whether a preconceived notion of a group corresponds to preconceived theoretical notion of what communication should be like.

It is not my intent to overdraw the differences between these research traditions. The contrast is relevant simply to bring to the surface a familiar dividing line, namely between approaches that emphasize the individual or the collective as a basis of explanation of social interaction. In actual interaction however, both aspects are likely to be important. A reasonable approach, seeking a kind of middle ground, would be to start from an individual level and try to build upwards toward an understanding of what constitutes an organization's ability to thrive in a dynamic environment

17 Similar problems appear for instance in trying to implement approaches to social capital based on Coleman's conception of this notion (Coleman 1988).

(Teigland 2000). This kind of analysis should take its starting point in particular problems or recurring types of problems and the people involved in finding solutions rather than at the outset delimit a group supposed to be relevant. Network analysis could provide an interesting tool but should be sensitive to the fact that aspects of social interaction not captured in the network graphs may affect significance of network structure. A situational approach might expand the usefulness of network approaches rather than be seen as a limitation. This kind of approach would study how general mechanisms play in specific social contexts (Erickson 2001).

This chapter explores aspects of problem solving and development in the firms focusing particularly on the role of personal networks structures. The exploration is guided by the understanding that informal organization forms an important part of the firm's ability to deal with the flux of everyday problems as well as successfully cope with a dynamic environment. The exploration takes its starting point in the qualitative findings of the preceding chapters and probes these findings by using a combination of interviews and network analysis. The empirical basis for the study consists of the eight mold-injection firms that form the basis of the second phase of research.

Mapping networks of problem solving and knowledge development in production

To understand problem solving and knowledge development in the firms it is necessary to have a view of the wider networks that the individuals partake in both within the firm and in relation to outside contacts. The mesh of interpersonal relations should hold important clues to knowledge development and problem solving in the firms, if the right networks can be captured. No organization can be captured in its entirety, it is necessary to take up a particular perspective from which to view it.

The idea in this case was to try and construct map of network structure anchored in a specific types of recurring problems in the firms. A modified and scaled down version of Allen's methodology of tracking sources of solutions is then used to begin the process of uncovering the relevant networks.

The perspective chosen in this study is that of problem solving and development of production. Production seemed a good starting point for identifying important networks for the firms. Other functions of the firm will enter into the networks only to the extent that they connect with production. However, the focus seems warranted in these firms because production provides a critical link between customers and suppliers. Coordinating production processes with customers and suppliers can be seen as a central recurring problem of the firms. Much of what is essential to the firm finds its way in one way or the other to production. Although it is hoped that this perspective captures relevant aspects of the firm's situation it obviously excludes other justifiable perspectives.

A first step in the mapping process was to identify individuals who fulfilled certain key functions in coordinating production. These functions may or may not be recognized in formal organization. The functions were specified as follows:

- Persons with an overall responsibility for production
- Persons who do purchasing for production
- Persons that have technical discussions with customers

These individuals were identified with the help of management in the firm. People fitting these roles provided the starting points for mapping the informal organization. The underlying assumption is that these individuals are central in the activity of coordinating production with suppliers and customers. The number of persons thus identified varied from firm to firm, in some firms all of these roles were filled by a single individual in others two, three or four. These persons formed the basis of the first wave of interviews.

The next step in the mapping process entailed interviewing the identified key personnel and asking them to identify the contacts most relevant for *their* problem solving and development of production know-how. This was done by means of standardized questionnaire filled out in my presence. The key questions on which the maps of the informal organization are built are the following:

1. With whom do you preferably discuss technical solutions, problems, work organization or discuss ideas related to production?
2. Assess the importance of each of the contacts identified in question one on a scale of one to five with respect to their importance for your development of production know-how (five being 'very important' and one being 'less important').

The questions are intended to elicit the essential contacts of a key person with respect to the development of their production know-how and problem solving capacity. The question is open ended enough to allow the participants to relate it specifically to their practice. The aim is to identify a group of persons that are relevant for actually getting the job done as these individuals experience it. The interview situation provided an opportunity to discuss what was meant by the question and to follow up on answers. Information about how contacts were developed as well as the character of contacts was discussed in the interviews.

The mapping process itself can be considered exploratory, starting only from certain given roles then seeking the relevant group or community of persons that partake in the way key individuals get their job done. In this case 'the job' is to coordinate production internally and in relation to suppliers and customers.

In eliciting important contacts, a maximum of six persons was set. In other words the respondents were asked to list a maximum of six contacts. This limit is motivated

by several considerations but particularly to focus the question¹⁸. This is an approach that has both pros and cons (Holland and Leinhardt 1973).

Responses to the first question, identifying important contacts, provided a basis for further exploration of the networks. The persons identified in response to this question formed the body of a second wave of interviews. The same questions were given to each of the persons in the second wave, in effect snowballing on key persons in different aspects of production know-how. Second wave persons may be in the same firm but often were not. The assumption underlying this approach of starting with identified key personnel is that these persons should be in a position to identify the important actors with respect to production related know-how and thus snowballing on their contacts should provide an adequate representation of the key persons contributing to production know-how in the firm with respect to our particular focus.

The networks are not restricted by any prior bounding. They include customers, suppliers, technical consultants, marketing personnel, banks, relatives, former colleagues and people in similar roles in other firms. Most persons in the second wave were interviewed in manner identical to those in the first wave. In some cases it was not practical to do this and in these cases these contacts were simply sent the questionnaire and introductory letter.

The mapping of personal networks in these firms thus used a simple procedure. However, I think that issues of response rate and quality of response made it a necessity to personally conduct this mapping. Naming important personal contacts can be a sensitive issue. It is necessary to establish a certain amount of trust in order for people to be willing to partake.

18 The cut-off point of six contacts is arbitrary. A cut-off point was motivated by the need to maximize the relevance of responses. If the number of possible responses is too limited this introduces distortion in the network data (cf Holland and Leinhardt 1973). However, the alternative would have been to use a free choice approach where individuals could state as many contacts as they deemed appropriate. However, using a free choice model introduces ambiguity in the question. Certainly a question eliciting the 3 most important contacts in some field would yield results of a different *quality* than a question eliciting the 100 most important contacts. If this is the case, and we can also assume that different individuals will have different preconceptions of an appropriate number to list, then a free choice model will invite error not precision. Responses will vary in quality as a result of uncontrolled interpretation. Providing some limit on the number of contacts focuses on the most significant relations which therefore are likely to pertain to a reasonably well delineated focus. Astute positivists may argue that the problem is one of making the question unequivocal. This would require making the question completely unambiguous. Even if this were possible it is not likely to be productive. It should not be the researcher's role to define beforehand exactly what kinds of interaction should be considered important, especially if the aim is to map the actual complexity of an organizational context. So, in using this kind of tool to probe networks, a compromise has to be struck between different considerations of data quality. Distorting the networks by using fixed choice approaches is undesirable but so is unconstrained interpretation of free choice alternatives. Care in specifying questions may limit the variation in interpretation but the more precisely defined the questions are, the less we can find out about what practitioners really find to be important in their interactions. This would result probably in a less accurate map of the territory to be explored.

Characteristics of personal networks in the firms

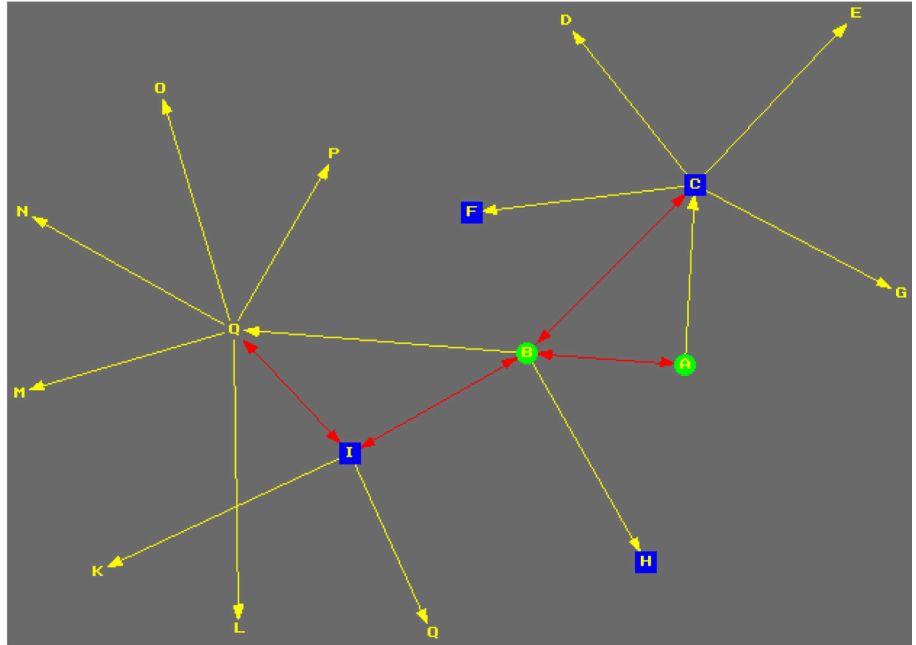
The results of mapping informal networks of problem solving and development of production know-how can be shown graphically in network diagrams. These diagrams provide an initial means of approaching the structural aspects of informal organization in and between firms. The networks of each of the eight firms are shown below.

These network diagrams provide us with a rough indication of the lay of the land when it comes to problem solving and development in the firm's production. It provides a kind of rough image of which persons are central for problem solving in the firms and what kinds of resources, in terms of informal contacts that they in turn can draw upon. A key for interpreting the graphs is given in the Table 5 below. Note that for sake of clarity the contacts of contacts are included only when they connect back to the networks of key persons in the firm. In other cases these have been left out.

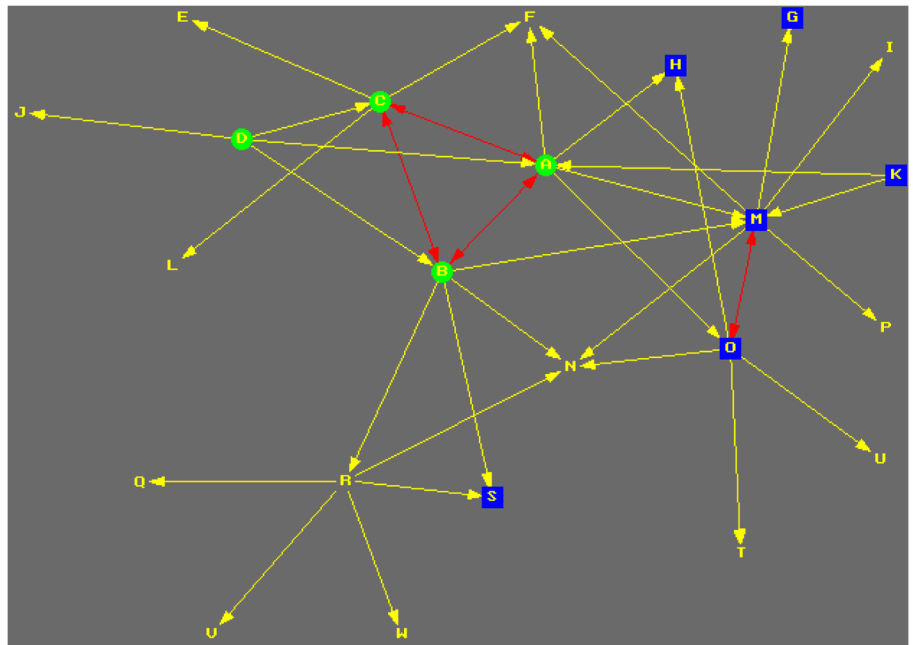
Symbol	Meaning
Nodes A,B,C etc	Persons in the production network
Round node	Employee of the focal firm and part of the first wave of interviews
Square nodes	Other employee of the focal firm
Unmarked nodes	Contact external to the focal firm
Arrow from A to B	A has identified B as an important contact
Red two-way arrow	Highlights a reciprocal relation

Table 5 *A key to the network graphs*

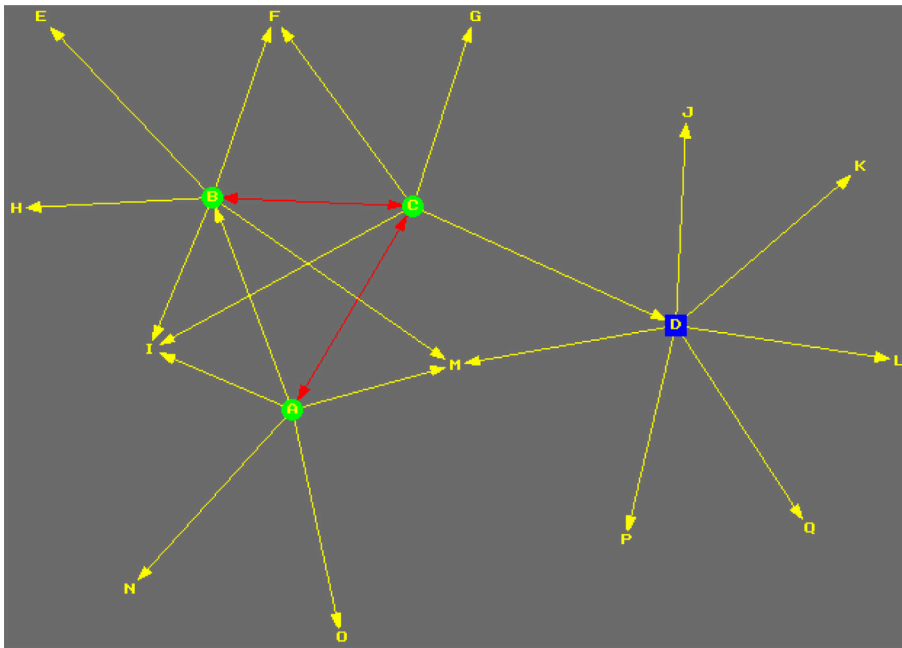
Graphs of firm networks



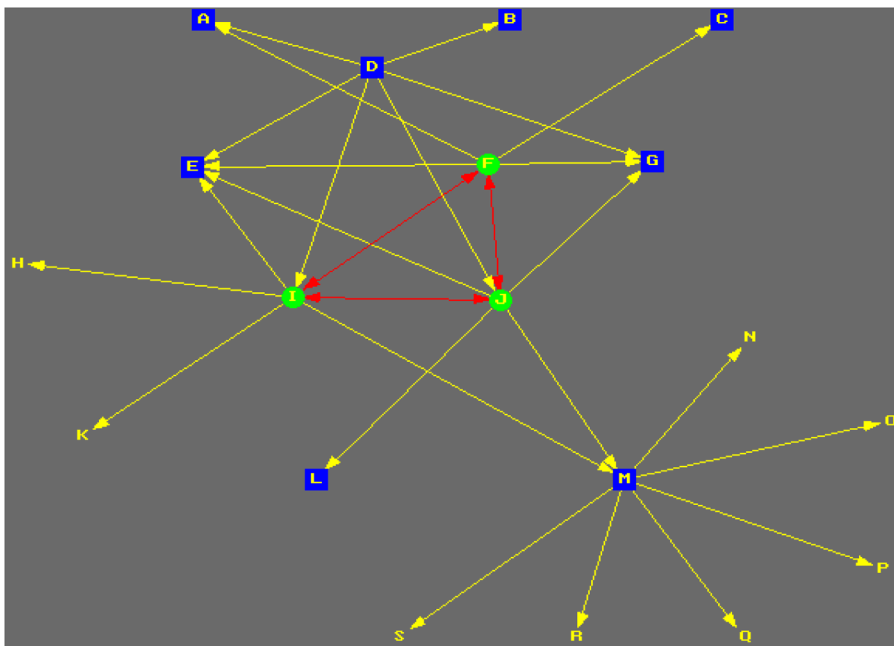
Firm A



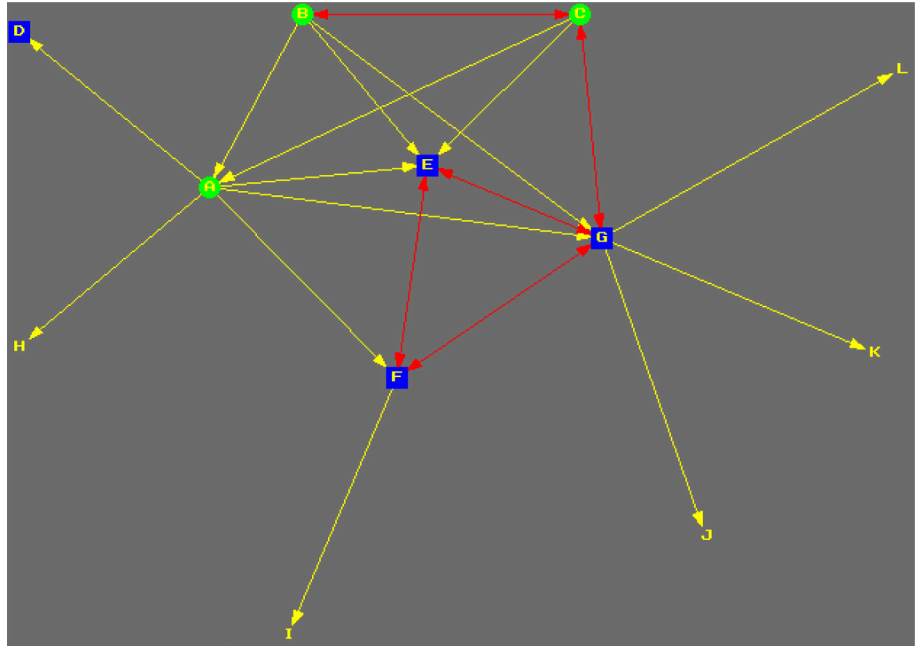
Firm B



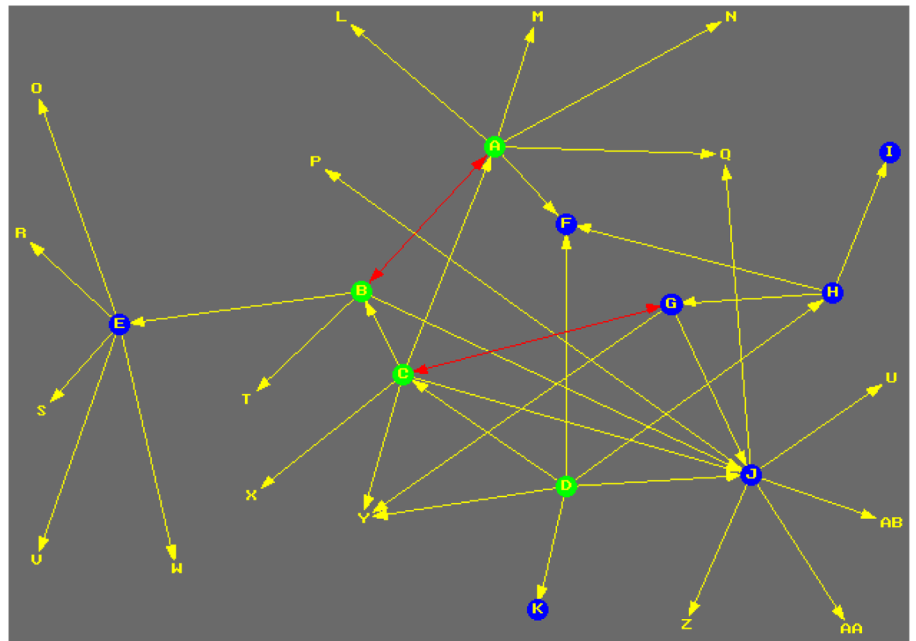
Firm C



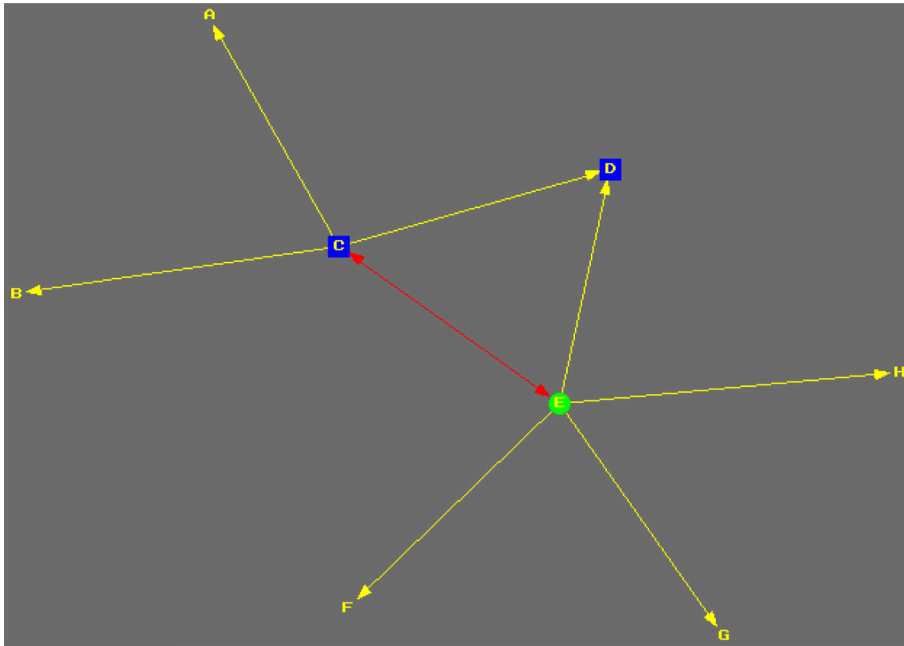
Firm D



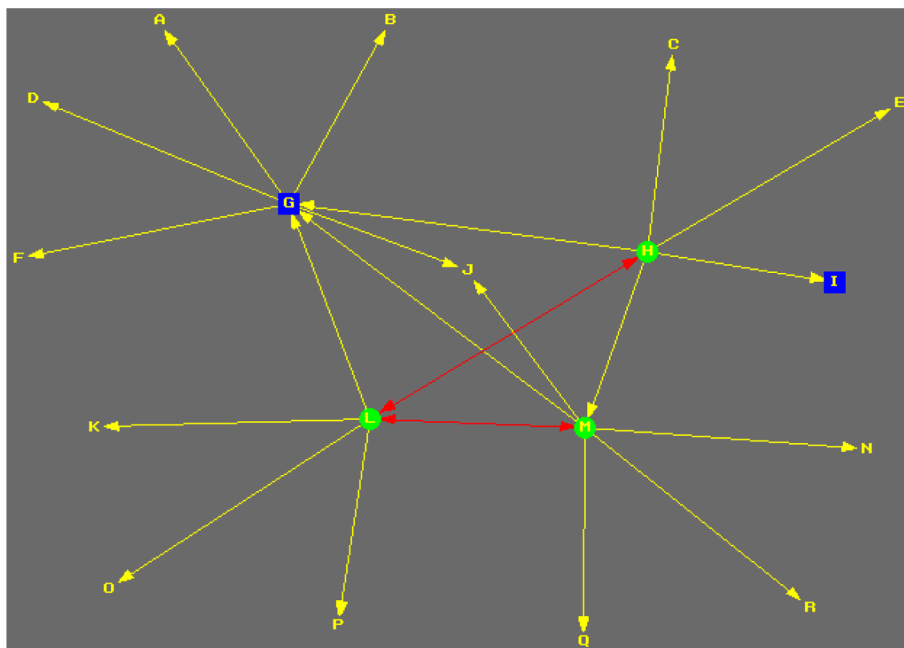
Firm E



Firm F



Firm G



Firm H

There are marked differences between the networks in the firms even at first glance. Perhaps most evidently, the networks differ in size, that is, the number of people that can be called upon to resolve issues in production or in the development of production. This is not a result of the size of the firms. The firms all have between 19 and 25 employees except E that has slightly more than 40 and D that has slightly more than 70. There is no simple correlation of network size and number of employees.

Another notable aspect of the network diagrams is that different individuals clearly partake to different extents in the process of know-how development in the firm. Some individuals are quite central in this respect while others are peripheral. This is to be expected. However, it may seem even at first glance that the distribution of importance varies. In other words some networks display a high level of centralization while in others problem solving and knowledge development is more distributed. In extreme cases of centralization the entire firm hinges on specific individuals (see firm A person B, firm C person C, and firm G person E)

At first glance it seems that firm boundaries are less important than might be expected. No less than 67 of 124 (54%) contacts identified as key sources of knowledge development were external to the firms. This figure however refers only the *number* of persons contacted inside or external to the firm and thus is highly proximate indication of significance. Suffice it to say that external sources of knowledge development and problem solving are important.

A further aspect of these personal networks, not evident in the graphs, is their local character. Of 124 contacts only 4 were outside Sweden. In each of these cases the persons had previously been in direct personal contact either as colleagues or as supplier and customer. Of the contacts in Sweden all but 4 were located in the southern regions that is, south of Stockholm. The overwhelming majority were highly local. This local character is easily explained in accordance to Allen's findings that persons have to be in direct contact in order for the transfer of (technical) knowledge to take place. That the contact networks for problem solving and development of production related know-how are local is congruent with the notion that the transfer and build-up of knowledge may be a key part of understanding regional dynamics (Malmberg 1998).

The type of contacts that people name is also interesting. The personal networks of these firms were dominated by contacts on the supplier side. Although there were marked differences between the firms, in general, the largest number of contacts is with mold manufacturers, machine suppliers and technical consultants and thereafter with material suppliers and contacts in other mold-injection firms. Persons in customer firms played a small role in the problem solving and knowledge development in the firms. The situation in the firms seems to be one in which the development of production know-how is considered largely a technical issue. Forward linkages with customers, although critical for firm development, are less important as a direct source of knowledge development. Only three of the firms consider persons in customer firms to be important contacts and only in one of these (H) is this connection reasonably strong. The network data reinforce a suspicion that there is a knowledge gap between mold-injection firms and their customers that is probably detrimental for the development of the firms.

There are several aspects of the networks that seem pertinent to understanding knowledge development and problem solving. However, moving the analysis further requires a choice of approach. As indicated earlier there are reasons to believe that a structural analysis of these networks could provide clues as to what makes up a dynamic atmosphere and provides for fruitful basis for solving production related problems. The rest of this chapter explores this possibility.

Problem solvers

One way of approaching an understanding of the social interaction of personal networks is to start by contrasting different roles in the production networks. Starting from an individual level it may be possible to build an understanding of what components enter into an adaptable production network.

The approach opted for here follows in Allen's footsteps and seeks to uncover if there are factors that determine a person's ability and willingness to partake in problem solving and firm development. The networks showed that different individuals partake to a greater or lesser extent in knowledge development in the firm. In other words certain persons are named often as important sources of knowledge. It is possible to ask, for instance, why in firm B person A (BA) seems to be an important source of knowledge while in firm G person E (GE) seems to be more less important as a source of know-how development? The answer may of course lie in differences between BA and GE as persons, their level of education, experience or other personal characteristics. Such differences certainly exist but there seems to be more to it than that. A high level of individual skill does not necessarily entail contributing to others knowledge development. So, are the other factors determining why GE is less important as a problem solver than BA?

In a given group facing collective problems there will be persons that take on a more central role. Having expertise in a relevant field is probably necessary but being a problem solver in some social context is also a role or position. It entails, among other things, that others recognize the person's expertise and are willing to cede a certain amount of control. The distribution of people that are given this recognition and confidence seems to be an important component of firm atmosphere and general problem solving ability of the firm.

In order to begin to unravel the question of why certain persons are more able and willing to partake in firm problem solving it is necessary to define a few measures. A simple way of measuring an individual's contribution to problem solving in the network data is provided by the extent that a person is indicated as an important contact. For analytical purposes a person's *significance as a problem solver* in firm production may be measured by summing the values for the relations where the person is indicated. For instance, if three persons (and only three) identify X as an important contact and each of these persons value this contact highly (four on a five-degree

scale) then the measure for this person's *significance as a problem solver* (SPS) is $3 \times 4 = 12$. This value is clearly a rough indication of a person's significance as a problem solver in a firm but it does provide a simple metric for relative evaluations of different roles. It provides some idea of the contours of the microsocial landscape in each firm and makes comparisons across firms possible¹⁹.

The measure 'significance as a problem solver' has been calculated for each of the persons in the first wave of interviews, that is, those 23 persons that were identified as having key roles in production. The results are presented in Table 6 below.

Firm	Individual	Significance as problem solver (SPS)
A	A	2
A	B	11
B	A	13
B	B	14
B	C	7
B	D	0
C	A	5
C	B	10
C	C	8
D	F	7
D	I	10
D	J	8
E	A	7
E	B	3
E	C	3
F	A	6
F	B	7
F	C	7
F	D	0
G	E	4
H	H	3
H	L	7
H	M	6

Table 6 *Key persons' significance as problem solvers*

It is important to remember that the variable SPS pertains to a certain domain of interaction namely production related know-how. Had the questions used for creating the networks been related to a different area, for instance solving computer related problems, the results would probably be quite different. Nonetheless, there seem to be certain general characteristics of people at the top of the list. These people seem to be those that have expertise in a field, have developed networks from working in different related firms and are good communicators. Although it seems hard to exemplify a problem solver role, it seems nonetheless that these roles are often recog-

¹⁹ The notion of problem solvers is strongly reminiscent of Allen's gatekeepers (Allen 1979).

nized. Most people will probably have a hunch as to which people fill this role in the organizations they work in or are otherwise familiar with.

Experience

It is often assumed that education is an important element in individual ability to take part in knowledge development in the firms. It might therefore be reasonable to suggest that education would be factor to consider as an explanation of high SPS. However the coupling of the mold-injection industry with formal education is low, that is the skills needed for getting the job done in this industry have next to nothing to do with formal education. There are other kinds of specialized training provided by machine suppliers, consulting firms and training institutes but this kind of training is difficult to express in a meaningful quantity. Since skills were developed much more 'on the job' it seemed more likely that years of experience in the field might provide a more interesting individual level variable. Length of experience on the job was sometimes used as kind of short-hand for skill by the individuals involved. A lengthy experience provides a basis for developing expertise and contacts.

Information on the number of years of related business experience an individual has been collected in interviews. The variable *years of experience* was defined as the number of years a person has worked within some part of the plastics industry. This may include experience working for suppliers, or in purchasing from mold-injection firms. A first means of approaching an understanding of what determines a persons significance as a problem solver was to set years of experience in relation to SPS. However, experience by itself shows little correlation with the person's significance as a problem solver.

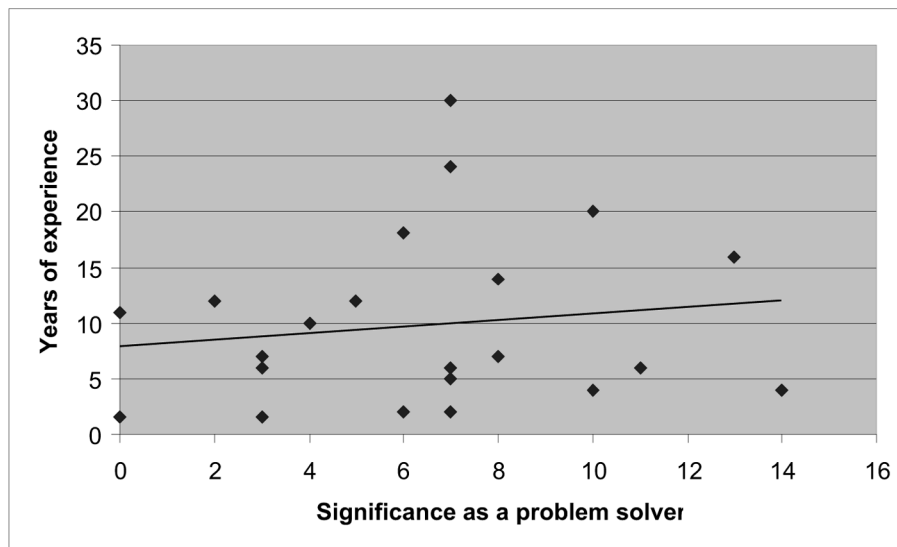


Diagram 5 *Significance as a problem solver vs. years of experience*

A test of significance using a one-tailed Spearman rank order correlation yields a positive but insignificant correlation (0.134). Years of experience in related fields clearly does not provide an interesting explanation. Although this may seem surprising given the common propensity to merit experience, it does seem to make a kind of intuitive sense. As a colleague of mine once noted; "Experience means nothing. The bus driver on the bus I rode this morning had 30 years of driving experience. He was, however, not a good driver". Experience per se does not generate either expertise or beneficial networks. It is necessary to look further for understanding of why some people come to take part in problem solving in an important way while others do not.

It seems feasible to ask if there might be other factors in the environment that provide differing inducements to partake in problem solving and development. Perhaps these aspects may provide a better explanation of differing roles in the production networks. To explore these kinds of hypotheses it is necessary to clarify functional and structural aspects of networks.

Functional aspects of personal networks

There are important aspects of communication in an organization intrinsically related to personal networks of particular importance for problem solving and development of new ideas. The role of personal networks has thus far been discussed primarily in the light of following three aspects: trust, quality of communication and informational advantages.

Firstly, personal networks remain important for communication and knowledge development because they enable *trust*. If there is no trust between parties this makes communication almost impossible. The concept of trust is used here to indicate two intertwined aspects of a relation. Firstly, trust in the other's goodwill (Boone and Holmes 1991; Hosmer 1995). Secondly, that the other has the needed competence and know-how. The amount of trust a person has in another person's sincerity and competence often determines the effort that we are ready to put into understanding what they have to say (Nahapiet *et al.*, 1998). For instance, developing a revolutionary idea for a product is only a very small part of the process of transforming this new concept into a viable, accepted product. The really critical effort is in convincing different parties to realize the advantages of it. The inventor has little way of knowing beforehand what kinds of effort will be needed and if there will be any return for this effort. The producers and customers of the potential product, in turn, have little way of knowing beforehand if it is worth their time and effort to really understand the new product. The uncertainty involved in the transfer and development of knowledge can be lessened to the extent that interaction is usefully guided by existing concepts and existing relations.

Secondly, personal networks may provide *quality of communication* which minimizes the effort needed to coordinate activities. Communication is predicated on

that the parties share context which means both shared orientations and cues (Sperber and Wilson, 1995). Particularly when it comes to specialized work, quality of communication may hinge on having similar lines of work, sharing an educational background or having other social, historical and physical contexts in common. However, in the final instance such common sets of cues do not in themselves guarantee communicative quality. It is only the combination of shared cues and mutual orientations that can form the basis for the transfer and development of tacit or underconceptualized knowledge. Michael Polanyi (Polanyi, 1998) has pointed out how personal interaction was a necessary part of the transfer even of scientific know-how, a field is sometimes considered epitomize formal impersonal knowledge. What holds true for scientific practice is even more evident in other fields of endeavor (Allen 1978). Perhaps the most commonly recognized field in which 'tacit' knowledge is of key importance is that of craftsmanship. The notion of craft seems almost to be defined by an area of skill which must be learned by the practice and apprenticeship or at least close interaction with those more skilled. Both the problems set to the apprentice craftsman and the solutions to it that he or she may learn are 'phrased' to a large extent in the context of the physical media in which work is conducted. Underconceptualized knowledge is neither rare nor mystical, nor even a distinct thing. It is just that the development and stabilization of concepts in a wider social environment requires a huge effort. Personal networks make it possible to build a more refined, if specific, context and allow a more finely honed negotiation of appropriate focus. They thus provide a higher quality of communication and a higher extent to which underconceptualized knowledge can be conveyed. This in an important aspect of why Allen finds that people have to be in direct contact with each other in order to understand each other and transfer knowledge.

Thirdly, although some information is essentially easily expressed, and thus transportable, both persons and organizations often need timely and highly specific information. Timely information about job or business opportunities, about market or technological developments may be of great value. Similarly, highly specific knowledge about who can repair a certain machine on short notice, or what kinds of changes are taking place in competitor firms, customers or suppliers can be highly significant. But these kinds of information are not available by general, impersonal means. The specific and time bound nature of the information of interest makes the development of impersonal channels unlikely. Valuable information of this kind flows through the conduits of personal networks. Some parties are systematically favored in such flows, that is, have *informational advantages* due to better personal networks (Burt 1992).

From these three aspects of personal networks follows a fourth quality which is important for understanding their development. In discussing quality of communication, trust and informational advantages the emphasis has been on an individual's ability to acquire information and knowledge but very little has been said about motivations for passing on knowledge. Yet this is clearly an important aspect of understanding how personal networks develop (Portes 1988). The personal networks in this study can be understood as exchanges. The object of exchange is information and

knowledge necessary to successfully navigate the wider business environment. Thus the networks are separate from but important for business activities. The individual's ability to partake in the exchange of information and knowledge in these networks rests not only on acquiring relevant information and knowledge but also having channels in which this can be passed along and exchanged. From an individual perspective the same kind of network relations that provide ability to acquire knowledge and information also provide motivation and incentive to pass on relevant knowledge. These individuals have an advantageous social infrastructure for exchange of information. For instance, developing trust in a relationship provides an improved means of communication but it also provides an obligation to pass on knowledge relevant to the other, to look out for the other's interests. This is an important part of maintaining a good relation. Complementary sources of information provide an improved ability to pick up information relevant to the other and therefore increased ability to partake in information exchange. In other words the individual is in a good position to broker information (Burt 1992).

The important point is that personal networks have a role in the creating *ability and willingness* to take part in knowledge development. The structure of an individual's personal network is a key to understanding if he or she is likely to have anything to gain in one form or another from gathering information, reworking it and passing it on to other relevant parties. Persons that have a high quality of communication and trust with their contacts and enjoy informational advantages have the best opportunities to contribute to knowledge development in a way that earns recognition. These persons have developed channels of acquiring and passing on relevant knowledge. This argument can be summarized in the following proposition:

- 6.1 Individuals who have networks that provide trust, quality of communication and informational advantages will be most able and willing to take part in the firm's problem solving and knowledge development.

While the interrelation of different functions of network relations may seem a complex mesh, the difficulties need not be insurmountable. It seems that these four relevant functions of networks, trust, quality of communication, informational advantages and motivation coincide to a great extent with two basic aspects of network structure namely *reciprocity* and *network diversity*.

Structural aspects of networks

The analysis of structure is a means of simplifying complex interaction. Structural analysis focuses on the implications of patterns of interaction rather than the content of interaction. Clearly there are limits to how far this can be taken but in cases where interaction is basically similar it provides an interesting means of capturing impor-

tant systemic effects. There are two structural aspects of an individual's network that will be considered here namely; the number of reciprocal relations in the network and network diversity. These structures will be used as indices of important functions of personal networks.

Measuring reciprocity

Reciprocity refers to mutual interdependence created through ongoing exchange or multiple exchanges over time. The mutual orientation created in reciprocal exchange is important in establishing trust, ethics of interaction and a better quality of communication. Reciprocity is a notable aspect of relations both internally in the firm and in external networks.

In external relations reciprocity is important where business involves complex under-specified products. In these instances trust both in the sense of the other's sincerity and competence is vital for the exchange to happen at all. Recurring exchange provides mutual constraint which itself can be a basis for trust. This is simply to say that when the parties know they will be dependent on each other in the future they more likely to try to establish a good relation in the present. Moreover, reciprocity also allows for development of the relation itself. Since the relation is valuable *in itself* this allows openness with respect to the *content* of the relation. A mutual orientation provides room to renegotiate the relations so that they are most beneficial to both parties. As discussed in chapter three it is common that mold manufacturers establish long term relations with particular mold-designers and use them almost exclusively. The reason for this is not only risk aversion but value creating. In making choices about how a mold is to be designed the parties have to communicate about a highly complex and not yet specified product (the mold), so that this can be designed in the best possible way both in terms of its production and the product to ultimately to be produced in it.

Reciprocal relations are important at different levels of the firm and provide important bridges of communication. In one instance a quality officer in one of the mold-injection firms developed an excellent communication with the logistics manager in a customer firm (firm H). This relation evolved despite changing roles of the individuals. The customer firm, now the largest customer, is still a strong source of development for this firm and dissemination of new knowledge takes place largely via the former quality officer.

Firm-internal reciprocity is less evident in its effects but probably not less important. For instance in one case two young employees started work (at firm B) during the same period. They helped each other meet challenges of starting out in a new organization. As these individuals advanced they kept up their good relation and now form an important bridge between technical aspects of production and marketing which is critical for the kind of industrial marketing of high quality products that the firm is involved in.

A problem in creating a measure for reciprocity is that its importance is probably greatest when it is least noticed that is in providing a taken for granted gainful coordination between different individuals. This is something that seems to be associated with an atmosphere of mutual recognition and a certain confidence that things will get done. The situation recounted in chapter four of the interaction between mold manufacturer and designer may serve as an illustration. The mold manufacturer was aware of the extraordinary importance of his connection with a specific designer of molds but noted that interaction was not very intense. Having worked together for a long time they simply knew exactly what the other meant.

Nonetheless, one aspect of reciprocity should be captured in the network graphs. It seems reasonable that if two persons each indicate each other as a source of knowledge development then this is hardly a simple instrumental relationship. The mutual orientation indicates openness in the relation and degree of freedom and mutual responsibility characteristic of reciprocal relations. It is to be expected that these relations are characterized by mutual orientation, efforts to maintain communicative quality and trust.

A first measure of (strong) reciprocity may therefore be to note those situations where two persons indicate each other as important contacts. For instance in Firm A persons A and B have this kind of dyadic reciprocity. This kind of dyadic reciprocity has widely been held to be important for trust motivation to mutual help eg (Granovetter 1982; Krackhardt 1992; Burt and Knez 1996)

In the analysis of personal networks in these firms reciprocity is gauged by noting the number of dyadic two-way relations in which a person partakes. The variable counting the *number of dyadic relations* in which a person partakes will be called NDR. Having several strong ties of this kind has been noted by several authors as a means of getting the job done efficiently and solving work-related problems (Morey and Luthans 1991; Wenger 1998) but also for instance as an important element of clientelistic politics (Landé 1977). While NDR is undoubtedly a rough measure it should capture some essential dynamics practical problem solving in firms.

Interview material also offers some support for the indicator NDR. The examples cited earlier of reciprocity at different levels in the firm were for instance indicated both in interviews and in the network graphs. Although this cannot be systematically demonstrated there seemed to be the qualitative characteristics of reciprocal relations where they were expected. The notion of a team was for instance often invoked in interviews to describe pairs or small groups of individuals with a high NDR. Values for NDR for the persons in the first wave of interviews are provided in the table below:

Firm	Individual	NDR	Significance as problem solver
A	A	1	2
A	B	3	11
B	A	2	13
B	B	2	14
B	C	2	7
B	D	0	0
C	A	1	5
C	B	1	10
C	C	2	8
D	F	2	7
D	I	2	10
D	J	2	8
E	A	0	7
E	B	1	3
E	C	2	3
F	A	1	6
F	B	1	7
F	C	1	7
F	D	0	0
G	E	1	4
H	H	1	3
H	L	2	7
H	M	1	6

Table 7 *Values of NDR for key persons*

Setting reciprocity against a person's significance in firm problem solving yields a discernable positive trend although with certain outliers.

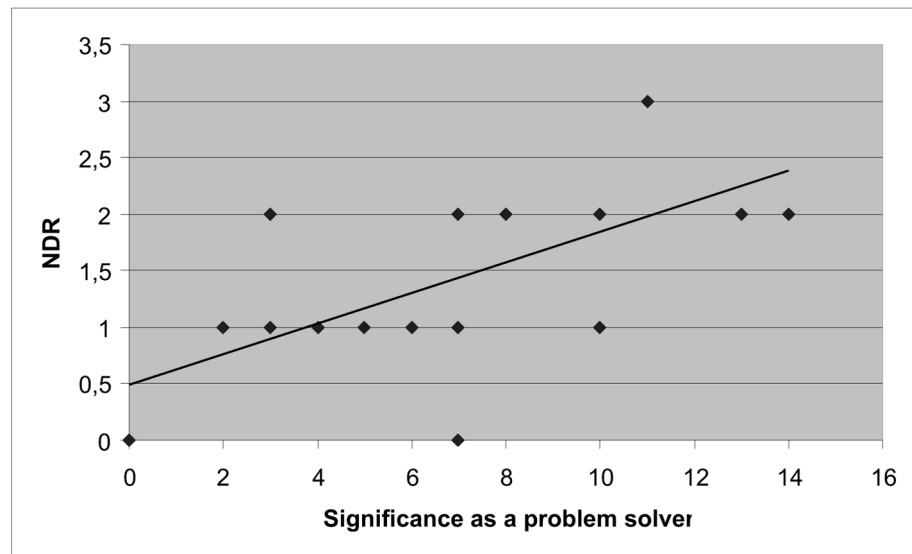


Diagram 6 *Significance as a problem solver vs. network reciprocity*

Generally speaking reciprocity in an individual's network also increases the person's propensity to partake in the development of know-how in the firm. A one-tailed spearman rank order correlation yields a value of 0.658** which is significant using a 1% threshold.

The finding supports the notion that the two measures are linked. However a certain amount of care has to be taken in interpreting the results. Care is warranted because the variables are not completely separated.

Measuring informational advantages

Personal networks are also important for obtaining informational advantages for instance in terms of finding potential customers or suppliers of particular kinds of materials or simply being prepared for organizational changes in good time. As Burt has argued it would seem reasonable that informational advantages accrue primarily when persons have diverse networks, that is, they effectively tap different sources of information (Burt 1992). Having a diverse set of contacts is an asset that is quite unevenly distributed in the firms.

The diversity of an individual's network is measured in accordance with Burt's (Burt 1992) measure of effective network size (ENS). The measure can be understood as having two components. First it takes into account how many contacts an individual has. This includes both the contacts that he or she indicates and also relations created by others indicating the individual. The underlying assumption is that

information will flow to an extent across these relations regardless of their primary direction.

The next step in calculating diversity of a network is to subtract from the number of contacts a value for redundancy. Redundancy arises because contacts also have direct contact with each other and thus lose their uniqueness as sources of information. For instance, if a person A has contacts with B and C this would yield an effective network size of A of two. However, if B and C have direct contact with each other the network diversity or effective network size falls below two due to redundancy.

The exact value of network diversity depends on the strength of the specific relations between A, B and C²⁰.

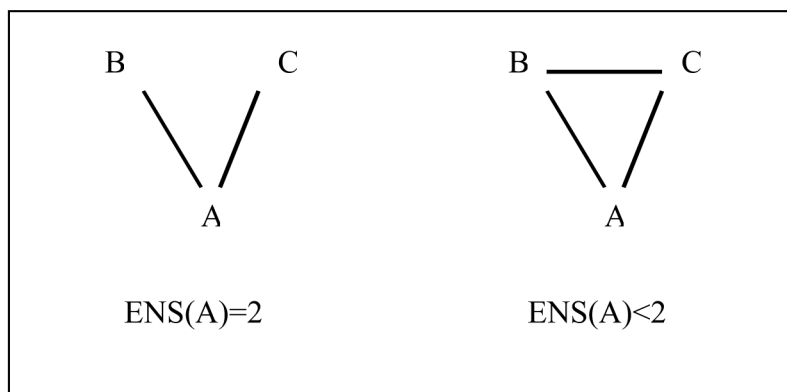


Figure 5 *Effective network size*

The concept of network diversity seeks to capture the extent that an individual has unique information in relation to his or her different contacts. If B and C have direct contact with each other, then A not only may get redundant information he also has a less unique position as middleman brokering information flows between B and C.

Burt's operationalization takes into account relations between individuals in direct contacts, and does not consider the effects of secondary contacts. However, this still provides a rough measure of general network diversity, that is, the extent that a particular person draws together different sources of information. Effective network size for different individuals in the networks was calculated using UCINET 5.0 software (Borgatti et al. 1999).

20 Effective network size is calculated in the following equation:

$$ENS = \sum_j (1 - \sum_q P_{iq} M_{jq}) \quad q \neq i, j \text{ and } P_{ij} > 0$$

P_{iq} : is the normalized weight of the relation between i and q

M_{jq} : is a measure of the intensity of the contact between j and q calculated by dividing the weight of the relation by the weight of j 's strongest contact.

The values for network diversity for each of the persons in the first wave of interviews are given in the table below.

Firm	Individual	NDR	Network Diversity (ENS)	Significance as problem solver
A	A	1	1,0	2
A	B	3	4,7	11
B	A	2	6,4	13
B	B	2	5,6	14
B	C	2	4,5	7
B	D	0	2,4	0
C	A	1	4,8	5
C	B	1	5,8	10
C	C	2	4,7	8
D	F	2	4,7	7
D	I	2	4,8	10
D	J	2	4,7	8
E	A	0	5,3	7
E	B	1	1,8	3
E	C	2	1,7	3
F	A	1	6,8	6
F	B	1	4,5	7
F	C	1	5,5	7
F	D	0	5,3	0
G	E	1	3,5	4
H	H	1	4,8	3
H	L	2	5,2	7
H	M	1	6,0	6

Table 8 Values of network diversity for key persons

A test of the relationship of network diversity and significance as a problem solver yields a significant correlation, though somewhat less strong than in the case of reciprocity. A one-tailed Spearman rank order correlation yields a value of 0.438* which is significant at a 5% threshold. Once again care has to be exercised in interpreting the results as an extent of overlap exists in the independent variables.

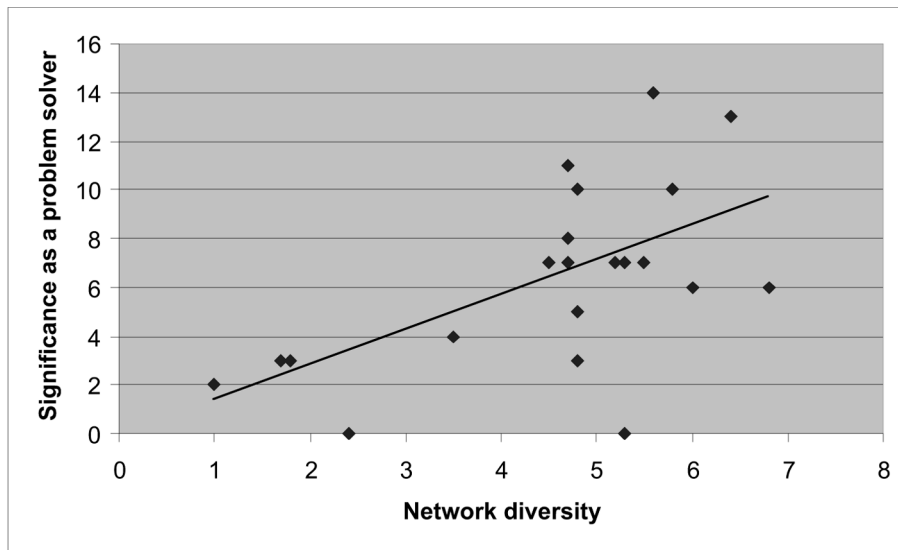


Diagram 7 *Significance as a problem solver vs. network diversity*

Combined effects of reciprocity and diversity

In the preceding it was argued that NDR and network diversity should be positively related to a person's significance as a problem solver, that is, the extent that a person contributes to problem solving and knowledge development in the production network. It was also suggested that NDR and network diversity provide indications of complementary aspects of knowledge development. It is to be expected that there will be a high *quality of communication* where there is reciprocity and a high *value of information* where individuals have diverse, boundary spanning networks.

It might also be possible to add the variables NDR and network diversity. The construction *combined reciprocity and diversity* (CRD) assumes that it is meaningful to add effective network size and the number of reciprocal relations. While this is not intuitively obvious the combined variable could be interpreted analogously to Burt's 'effective network size' (Burt 1992). Effective network size is not a measure of number of actual relations but a measure of a person's informational situation. Burt's argument is that interconnections between a person's contacts makes his or her situation less advantageous therefore decreasing the value of network diversity (ENS). In combining the NDR with network diversity the argument is that a person's informational situation improves when his or her contact relations are reciprocal.

A variable to measure these combined effects of network position CRD can be derived by adding the standardized²¹ values of NDR and network diversity.

21 Standardization serves to transform values in a series into numbers between 0 and 1. Standardization is performed by dividing all the values in series by the largest value in that series.

Firm	Individual	Standardized NDR	Standardized Network diversity	CRD
A	A	0,33	0,15	0,48
A	B	1,00	0,69	1,69
B	A	0,67	0,94	1,61
B	B	0,67	0,82	1,49
B	C	0,67	0,66	1,33
B	D	0,00	0,35	0,35
C	A	0,33	0,71	1,04
C	B	0,33	0,85	1,19
C	C	0,67	0,69	1,36
D	F	0,67	0,69	1,36
D	I	0,67	0,71	1,37
D	J	0,67	0,69	1,36
E	A	0,00	0,78	0,78
E	B	0,33	0,26	0,60
E	C	0,67	0,25	0,92
F	A	0,33	1,00	1,33
F	B	0,33	0,66	1,00
F	C	0,33	0,81	1,14
F	D	0,00	0,78	0,78
G	E	0,33	0,51	0,85
H	H	0,33	0,71	1,04
H	L	0,67	0,76	1,43
H	M	0,33	0,88	1,22

Table 9 Values of combined network reciprocity and diversity

Testing the combined variable CRD, using standardized values for reciprocity and diversity yields a strong correlation with SPS (0,839**). As a first indication this is encouraging. It seems that the combined measure of network position is extraordinarily strongly associated with the significance a person has as a problem solver in the firm. If so, then this measure provides an excellent means of uncovering discussing important aspects of informal organization. However, these results may be too optimistic. There is an issue of overlap between dependent and independent variables which will be treated presently.

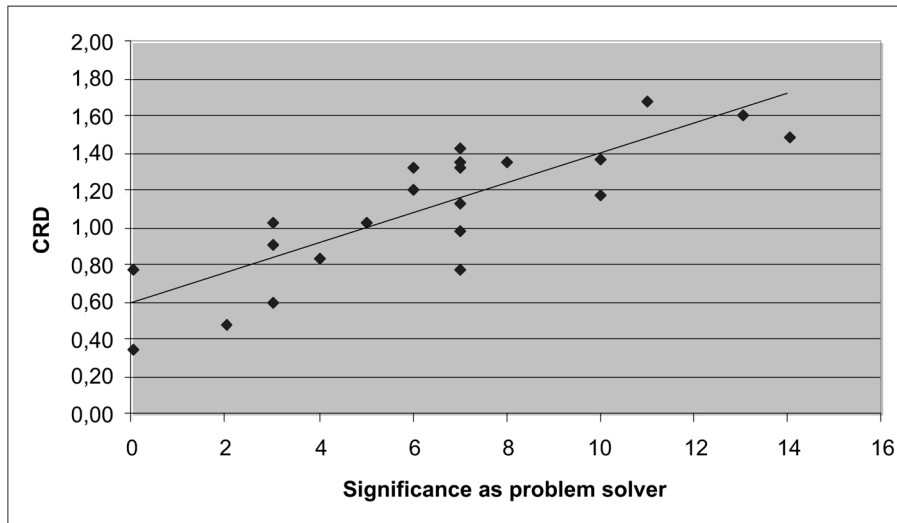


Diagram 8 *Significance as a problem solver vs. combined reciprocity and diversity*

Controlling for indegree

In each of the statistical tests there has been a problem of separating network variables. For instance a person that partakes in a large number of dyadic reciprocal relations, high NDR, is expected to have a higher SPS. This may be due to qualities that have been argued to exist in reciprocal relations. However, it might also be that this correlation is due to that this person has been pinpointed by a number of others as a significant source of knowledge. The argument will become clearer by introducing the concept of indegree.

Indegree, in this case, denotes the number of persons that have indicated a certain person as a source of knowledge development. Thus if three persons all indicate person X as a significant source of their knowledge development then X has an indegree of three. The problem referred to earlier is that the variable NDR overlaps with indegree. It is impossible to have a dyadic reciprocal relation unless the person is contacted by others. The variable SPS also captures aspects of indegree. It is impossible for a person to have a high significance as a problem solver unless others indicate this person as important for their knowledge development. Thus it is possible that the correlation of reciprocity and SPS is actually the effect of indegree in both variables. The correlation would then reflect an overlap rather than a relation between two distinct variables. If indegree varies as an effect of some unknown factor then the correlation of NDR and SPS would be spurious.

Similar problems exist in testing the correlations of network diversity and significance as a problem solver. The measure of a person's network diversity is increased by an increasing number of others that indicate this person as a valuable contact, that

is, increasing indegree. Therefore the correlation between diversity and SPS could also be understood to be a measure of overlap rather than a correlation of distinct variables. This provided, once again, that there is some exogenous factor determining indegree.

It is possible to control for indegree and thereby remove the overlap between independent and dependent variables. However, this procedure is likely to strongly understate the correlation of the proposed variables. In effect the procedure will test the extent to which reciprocity and network diversity increase the value of *given* relations but will not allow for relations to be created or maintained as an effect of diversity or reciprocity. So a certain amount of care is required in interpreting these results as well. The earlier results may overestimate correlation the present test however will be too conservative.

Testing the relationship between NDR and SPS while controlling for indegree in a Pearson partial correlation test yields an insignificant correlation coefficient of 0,18. A similar test of Network Diversity and SPS however yields a stronger correlation than when indegree is not controlled for. The correlation coefficient 0,524** is significant using a 1% threshold. The model treating the network factors in a combined variable CRD, yields a correlation coefficient of 0,587**. This is significant using a 1% threshold.

I interpret these results in the following way: Controlling for indegree is a rather severe way of separating the network variables. The method should understate the correlations. The stronger correlation coefficient for network diversity when controlling for indegree is somewhat surprising but probably indicates that the network diversity variable insufficiently distinguishes directionality in networks²². In any case, the effect of diversity on an individual's significance as a problem solver is strong. The relationship is not spurious.

It is possible that the results should be interpreted to the effect that reciprocity is in fact unimportant. However, I am disinclined to take this position even though the statistics indicate that the relationship may be spurious. The qualitative material presented in chapters three and four seems to point strongly toward the effects of reciprocity. It is quite possible, of course, that the proposed variable NDR is too blunt or misses aspects of reciprocity as noted in the discussion in measuring reciprocity. As long as there are no better explanations of how indegree varies I propose that NDR be retained as an interesting factor. The statistical data does after all provide some support for this measure. The variable CRD that combines NDR and network diversity has a stronger correlation with SPS than diversity alone. This is true even when controlling for indegree.

Finally, there is a very strong correlation of the combined network variable (CRD) and a person's significance as problem solver. This indicates that network position

²² The variable 'effective network size' averages incoming and outgoing relations. This might not be wholly appropriate as it equates a strong relation from A to B with a strong relation from B to A. It is to be expected that these different situations affect A's contribution to knowledge development and problem solving differently. Controlling for indegree in effect introduces directionality into the measure of ENS and this seems, in this case, to be advantageous.

is highly important factor in the determining the ability and willingness of a person to partake in firm problem solving. The relationship is not spurious. This confirms the proposition (6.1) that persons with networks which provide trust, quality of communication and informational advantages will be more able and willing to take part in problem solving and knowledge development in the firm. Moreover, there is good reason to expect that a network graph can quickly afford an understanding of when such networks exist.

Conclusions

This chapter has explored the effects of personal networks on an individual's willingness and ability to contribute to problem solving and knowledge development in the firm. Formal network analysis supports the idea that individuals who display qualities of problem solvers and are essential to the know-how development in the firm to great extent also have specific kinds of networks.

The social qualities of interaction that have been argued to be important in knowledge development and problem solving such as trust, quality of communication and the ability to recombine knowledge in productive ways are not independent of individual efforts and behavior yet, at the same time by no means reducible to individual properties.

To put the argument in stronger terms, the data seems to point toward the importance of network position rather than the aspects of the person when it comes to determining a person's significance as a problem solver i.e. the extent that a person is able and willing to contribute to problem solving in the firm. However, the thrust of the argument in this chapter has been to avoid the dichotomy of person and position or individual and social. There is reason to believe that the role of problem solver in an organization is a result of both structure and individual effort. The causality is probably a mutual one such that beneficial network structures create ability and motivation to take up the role of problem solver in the firm but also that individual properties and effort are necessary for creating and maintaining a position in these personal networks. This middle ground, emphasizing both individual and social follows in the tradition of anthropology of business.

Clearly, this study has a limited scope; the small size of the group of firms has allowed a detail in follow up necessary for this kind of conceptual experimentation. The results are encouraging though, because the components of the construction of problem solvers are well anchored in research on networks and informal organization. The mechanisms for both reciprocity and network diversity have been shown to have a much wider relevance. Combining the aspects of communicative quality with informational value seems intuitively sensible. It also provides a strongly supported explanation of observed differences in the extent that individual's contributes to the development of production related know-how in a firm.

The findings should have implications for the way that knowledge in organizations is analyzed and possibly promoted. It is to be expected that even an individual's contribution to problem solving in a firm is less individual and more social than normally assumed. Nonetheless creating an environment where people are able and willing to partake in the gainful exchange of know-how naturally requires attention to both individual and social factors.

It should be pointed out that emphasis on structural or positional aspects of personal networks does not in anyway imply that this is a zero-sum game. The networks analyzed here are not predefined and limited. It is perfectly possible for either no one or many individuals in an organization to have networks characterized by high levels of diversity and reciprocity. However, it is to be expected that an organization displaying network structures rich in both reciprocity and diversity would be one where coordination between key actors is of high quality and one in which the individuals have highly complementary information and skills. This might be an important component of the answer to the question posed initially as to how informal organization shapes the atmosphere of a firm and its ability to navigate a dynamic environment.

We may still lack an adequate terminology for discussing these issues but certain inroads have been made if we can speak about the informal organization in terms of its diversity and reciprocity and thereby capture aspects of a firm's ability to tap different sources of information and integrate them meaningfully in its activities. The next chapter attempts to bring together the firm level analysis of personal networks.

CHAPTER 7

Firm problem solving capacity

Introduction

The previous chapter explored the role of personal network structures and how these shape an individual's ability and willingness to contribute to problem solving and knowledge development in the firms. The chapter ended with a suggestion that it should be possible to understand dynamics of problem solving and knowledge development in a firm in terms of structures of personal networks among key actors in the firm's central production network. The upshot is that if this network is characterized by a high extent of diversity and reciprocity then it is to be expected that the firm affords a dynamic atmosphere of interaction. It should be a firm that can tap a wide set of different inputs and integrate them meaningfully in its production. The present chapter explores this idea. An important part of the exploration is to construct a firm level variable for problem solving and knowledge development. In doing so it becomes possible to bring together several strands of arguments from previous chapters.

Firm problem solving capacity

Firms demonstrate different propensities to develop production know-how. The firms in this study experimented to different extents with new materials and new products. The atmosphere of work in the firms also seemed to differ substantially. In some firms there were indications of sediment conflicts. Others seemed fragmented with different persons doing their own thing but there were also different constellations in the firms that clearly perceived themselves as teams. In the present study these differences are interesting to the extent that they relate to what may be called *firm problem solving capacity*. By firm problem solving capacity is intended the firm's

ability to adapt and develop its production. The notion seeks to capture both the extent that the firm is able to handle changes in production on daily basis and also the ability to stay abreast and develop in gainful way, i.e. both static and dynamic flexibility. Both types of flexibility require problem solving in production, finding adequate solutions to unique sets of problems.

The firm Beta, discussed in chapter four, uses set of good relations with suppliers to develop in new products with customers. Beta seems to demonstrate what seems to be a high level of firm problem solving capacity. The strategy requires both a valuable set of external contacts and internal coordination between purchasing, sales and production. In contrast the firm Gamma seemed to have a lesser problem solving capacity. Gamma is dependent on a mass production of a small number or related products and demands of volume limits its capacity both for fluctuations in quantity and its ability to develop new products. However, it would be advantageous to approach this abstract quality of firms in more systematic matter. This may be possible based on the findings of chapter 6.

A starting point in approaching firm level problem solving is, once again, the persons identified in the first wave of interviews. These persons were identified because they filled certain central roles in coordinating production with customers and suppliers. This group consists of production managers, people responsible for purchasing and people in charge of technical customer contacts. Since for these firms production can be seen as the central link between customers and suppliers, central aspects of firm development take place through the network mapped by starting from these individuals. The selection of a certain set of roles as a starting point by no means diminishes the importance of other aspects of firm activities such as marketing but the effects are measured indirectly through the contacts affecting the central production network. Actually it is not critical that the 'firm problem solving capacity' captures every aspect of firm production. The essential point is that an important network is captured and that comparisons can be made across the firms with respect to qualities of these networks.

In chapter six it was shown that a person's ability and willingness to contribute to problem solving and knowledge development in the firm varied with structural aspects of his or her personal network. A diverse network with strong element of reciprocity provides ability and incentive to partake in productive exchange of know-how and collective problem solving. In attempting to create a measure for firm problem solving capacity the ability and willingness of key persons to contribute to problem solving seems highly important. Building a firm level variable from an individual level one is advantageous in that the analysis remains firmly anchored in individual interaction. However the shift in perspective from how social networks affect individuals to how the social networks of individuals affect the social system is fraught with possible pitfalls. The simplest approach is one of directly aggregating. In this line of argument firm problem solving capacity can be understood as the sum of individual level ability and willingness to take part in problem solving.

In fact a simple approximation of *firm problem solving capacity* (FPSC1) can be derived by aggregating the relevant network values for key persons in the production

network. This should capture important aspects of flexibility and developmental capacity in central production network of the firms. Thus:

FPSC1 = the sum of values for CRD across key actors in the firm's production network

For example in Firm A (see chapter six table 9) there are two person that have key roles in the production network (B and A). These persons have highly different network positions. Their values for combined reciprocity and diversity (CRD) are 1.69 and 0.48 respectively. The measure of the A's firm problem solving capacity (FPSC1) is therefore $1.69 + 0.48 = 2.17$.

There are some specific advantages to the suggested measure of FPSC1. Firstly, the measure starts from the networks relevant to the actual task of coordinating and developing production as defined by the actors themselves. Secondly, the measure of FPSC1 is squarely based on the notion of individual problem solvers and therefore strongly linked to problem solving and knowledge development in the firms. The construction in effect allows further probing of the findings of the previous chapter. Particularly it becomes possible to test to some extent whether or not problem solvers and their contributions to knowledge development in the firms also result in other more tangible overall differences in firm development.

A different way of approaching knowledge development in the firms would be to gauge the total extent of learning going on in the firm networks. The suggested variable FPSC2 has two components. Learning *by* key persons in the production network and learning *through* key persons in the production network. The first part of the variable (*by*) can be determined by simply adding the evaluations that actors in the central production network attribute to their contacts in terms of problem solving and knowledge development. The argument is that if key actors have an extensive set of important contacts then this is more favorable for firm problem solving than if they have few relatively unimportant sources to draw expertise from (regardless of structure). Thus for instance, if a production manager states four important contacts and rates them as moderately important as sources of learning (three on a five degree scale), then this would yield a value of 12 (4×3). A similar value is calculated for each of the key persons in a firm and aggregated. This represents the value of learning by key persons in the firm's production network. A higher value of outward contacts should indicate a more valuable network.

The next step is to calculate a value for the learning that happens *through* each of the key persons, measured by the extent that these persons are seen as important sources of knowledge and problem solving i.e. inward contacts. This is in fact the same value as for significance as a problem solver (SPS). These two components (*learning by and through*) are summed to provide an estimate of the learning in the central production network that takes place by and through the key actors. The variable seeks to capture learning in the central production network from a slightly different perspective than that of FPSC1. The latter determines the extent that the structure of personal networks is conducive to problem solving and development

while FPSC2 is an attempt to quantify the results of communication networks for the individuals involved²³.

FPSC2= the sum of values for outward contacts of key persons and the summed values of inward contacts for key persons (SPS).

Combined constraint

It was argued in chapter four and five that the customer structures of these firms set limits on their forward coordination with customers. Highly dominant customers introduce constraint, a too limited window of communication with the market and too limited bargaining ability of the firm. A constrained situation in relation to customers thus provides little room for firm development of know-how, either in the sense of access to information or in being able to leverage developed know-how. Similarly, and more importantly for these firms, a fragmentation of the customer structure also limits forward coordination. In a fragmented situation the firm once again lacks relevant information and bargaining capacity in its forward linkages. It is not that information does not exist nor that bargaining power in relation to particular customers is weak but simply that effort needed to use these advantages exceeds the benefits. Customers are too small and too many for it to be possible to coordinate activities. The worsening of forward coordination is measured in the variable combined constraint, as developed in chapter five. As it was demonstrated in that chapter combined constraint has significantly detrimental effects on firm growth. It is to be expected that the effects of combined constraint will be evident also in other measures of firm development.

Firms with both constrained and fragmented customer structures may be expected to gravitate toward hierarchical organization where a highly limited number of individuals control contacts with important suppliers and customers. One reason for this is an economy of scale of sorts. It makes short term sense that the same persons maintain contact with the large customer and/or make decisions about how to relate to customers. It will entail extra efforts and possible loss of time and coordination to introduce more people into these processes. In any case since customers are few or treated as part of broad customer types it becomes possible for a few individuals to control the critical nodes in the network. Monopolizing critical links is also of course an element of power. Whatever the reasons for setting up a hierarchical organization it limits the distribution of know-how development in the firm. It limits by definition the number of people that can meaningfully partake in this process. Moreover it creates status differences which will undermine communication and reciprocal exchange (Allen 1978). By extension it undermines the extent that the firm will benefit from the network diversity of individuals and the extent that it will be advantageous

²³ FPSC2 correlates with FPSC1 0,833** in a Spearman rank order correlation test.

for them to develop such networks, at least in relation to firm production. This leads to the proposition that combined constraint should be detrimental to development in the firm not only in terms of growth, as demonstrated in chapter five, but also in the sense of the firm's problem solving capacity and development of know-how.

Number of persons in key roles

Clearly the variable firm problem solving capacity (both varieties) will be affected by the number of persons identified in key roles. As noted earlier this number varies from firm to firm. As this may have an important effect, the variable will be tracked. The *number of persons in key roles* will be denoted by the variable NPKR.

Finally, the extent of growth in the firms is included, as in chapter five, as a measure of firm development. Values for each of the variables are given in Table 10 below.

Firm	FPSC1	FPSC2	Combined Constraint	Growth	NPKR
A	2,17	37	0,31	-7,14	2
B	4,78	106	0,22	32,81	4
C	3,58	100	0,22	7,26	1
D	4,09	97	0,19	14,98	3
E	2,29	68	0,30	-0,19	3
F	4,25	94	0,24	17,44	4
G	0,85	22	0,41	-6,33	1
H	3,69	81	0,22	17,62	3

Table 10 *Values of firm problem solving capacity, combined constraint, growth and number of persons in key roles.*

Combined constraint and knowledge development

The arguments in the preceding chapters have led to expectation that in these firms, combined constraint should be negatively related to knowledge development in the firms. To test this proposition, the two variables of knowledge development can be set against combined constraint.

As expected the variables are negatively correlated. Testing against combined constraint in a one-tailed Spearman rank order correlation yields the following coefficients:

FPSC1 -0,810**

FPSC2 -0,833**

The correlations are both significant using a 1% threshold of significance.

The strength of correlations is extraordinary. The findings are interpreted as a strong support the argument that combined constraint reflects adverse conditions for information retrieval and knowledge development in the firms. This also confirms the concept of combined constraint. The effects of this factor can be understood to operate by largely the same mechanisms as Burt proposes for the notion of constraint (Burt 1992)²⁴.

Testing for correlation between NPKR and combined constraint provides some further indication of the mechanisms by which combined constraint operates. It seems that the correlation between combined constraint and firm level variables of knowledge development take place in part by a limiting of the number of persons involved in key roles, that is, those identified as important for coordinating production with customers and suppliers. The correlation between combined constraint and NPKR is not significant but still noteworthy (-0,507).

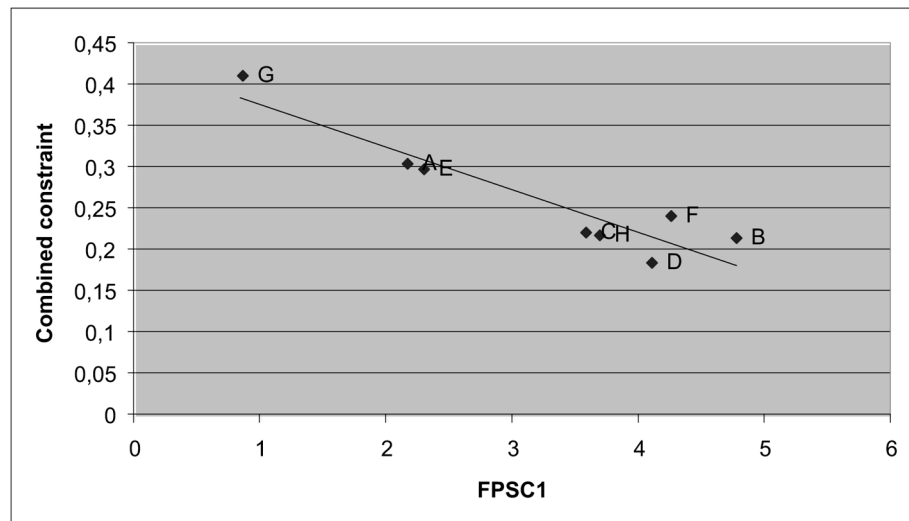


Diagram 9 Firm problem solving capacity and combined constraint

Knowledge development and growth

A firm's problem solving capacity should be related to its growth. The concept of problem solving capacity seeks to capture the ability to successfully adapt and devel-

²⁴ Just as in chapter five fragmentation of the customer structure is found to be more important for these firms. The relation of FPSC1 and constraint is positive 0,690 which does not support the expected result.. Fragmentation and FPSC1 have a negative correlation of -0,738* which confirms an expected relation. Both correlations are weaker than for combined constraint and FPSC1 that yields a correlation coefficient of -0.810*.

op production. This is a critical feature of firm development. Just as previously with customer structures, it is possible to test different aspects of problem solving capacity against growth rates of the firms in order to expose something of the mechanisms.

Testing the variables of FPSC1, FPSC2 and NPKR against growth in a one-tailed Spearman rank order correlation yields the following coefficients:

FPSC1	0.905**
FPSC2	0.738*
NPKR	0.741*

These findings provide strong support for the arguments that the structure of informal organization in and between firms is an important component of firm growth. These networks allow for supple coordination and informational advantages and thus are a central resource for the firms.

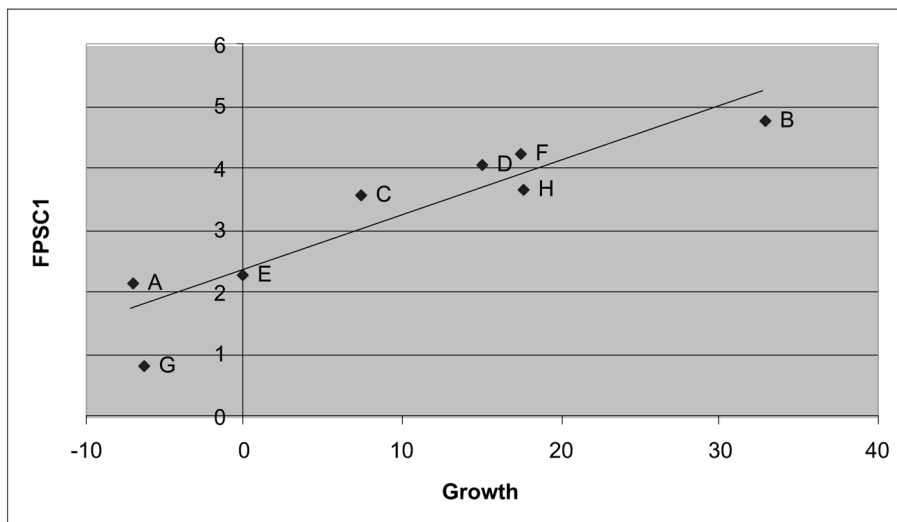


Diagram 10 *Firm problem solving capacity and firm growth*

Further probing the relationships

The findings both support previous arguments and provide some interesting clues for further investigation. To make the subsequent arguments clearer it will be useful to summarize the relations between key variables. In this further discussion the variable FPSC1 will be used as measure of a firm's ability to adapt and develop its production.

This variable is chosen as it provides the best theoretical and empirical fit with the model²⁵. The main findings with respect to FPSC1 thus far are summarized in Figure 6.

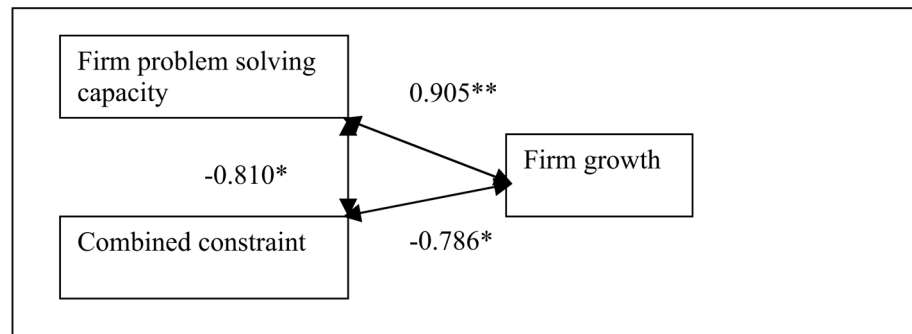


Figure 6 A model of firm problem solving, combined constraint and growth

The argument has been that combined constraint in a customer structure tends to close access to relevant sources of information, restricting the development of knowledge in the firm and possibilities of gainful coordination through personal networks. The argument, in effect, suggests that the effect of customer structure on growth takes place *via* personal networks. It is possible to test this hypothesis by partial correlation tests.

Controlling for combined constraint in the correlation between firm problem solving capacity and growth leaves it almost unchanged. A Pearson partial correlation test results in a coefficient of 0,873**. However, controlling for FPSC1 in the correlation of combined constraint and growth reduces the correlation to 0,619 which is still noteworthy but not significant in the present small sample. Thus the partial correlation tests seem to support the argument that a plural customer structure provides opportunity for the creation of beneficial networks and provides some benefits for leveraging existing problem solving capacity in the firm. Beneficial personal network structure though is the key ingredient of growth.

At least one more factor seems worth probing. It is reasonable to ask how sensitive the analysis of firm problem solving capacity is with respect to identifying the right number of persons from which to start the analysis. In other words, we would like to know to what extent the correlations depend on the identification process rather than network structures of the persons identified. In any case the findings and interpretation may remain unaffected. Delegating responsibility is a part of creating a beneficial informal organization. Nonetheless if the number of persons in key roles (NPKR) by itself is significant, as it is in tests against growth then this might suggest that the emphasis on network structure is somewhat misplaced. Once again this pos-

25 The choice of FPSC1 over FPSC2 is based on its clearer connection with the individual level variable 'significance as a problem solver' and also on empirical grounds. Firstly, the data for FPSC1 is better. Moreover, a Pearson partial correlation tests show that FPSC1 is a more relevant indicator of firm growth.

sibility can be tested using (one-tailed) Pearson partial correlation tests. Controlling for FPSC1 in the correlation of NPKR and growth yields a coefficient of 0.339. This is perhaps noteworthy but not significant. On the other hand controlling for NPKR in the correlation of FPSC1 and growth yields a strong correlation coefficient of 0.827*. The interpretation is therefore that identifying the right persons in each firm is important but that the method is probably reasonably robust in terms of errors in this initial phase. The important factor is the structure of networks.

A note on direction of causality

Statistical correlation of course in no way implies causality. However, I have sought to make it plausible that there is causality and particularly in the direction that growth is an outcome of beneficial personal networks and low combined constraint. This argument does not exclude the possibility of mutual causality; it simply proposes a primary direction on the basis that arguments for causality in the other direction are weaker. In other words it seems less likely that causal relations from growth to personal networks and customer structure explains the observed correlations.

It is possible that (exogenous) growth opens up opportunity and thus provides better returns for individuals who develop personal networks. A wider set of opportunities makes it possible to leverage these contacts with better results. This would give us reason to expect that growth might cause a general increase in networking. While this may be the case, it is not obvious why a wider span of opportunity would lead to an increase in the total value of contacts for knowledge development and problem solving as found in this study. If things are in flux then individuals might have less interest in developing specialized knowledge and high quality relations for solving similar kinds of problems. Thus the argument that growth leads to increased networks fails to explain the observed connection with knowledge development and problem solving.

The position that growth leads to particular kinds of customer structure also seems difficult to hold. Perhaps one could argue that growing firms have the opportunity to select their customers and thus tend to optimize their customer structures. However, it is unclear what motives underlie a firm's restructuring so as to create low combined constraint. The only reasonable explanation of the correlation would seem to be that this is an advantageous position in terms of development.

Finally, it would seem very difficult to argue that personal networks created for personal advancement in a situation of growth could lead to customer structure of low combined constraint.

In sum, the argument does not preclude a mutual causality, i.e. that these processes may be understood as structural transformations rather than simple causality. However, it seems most reasonable to assert primary causality in the directions noted previously: Beneficial customer structure leads to better business opportunity and better knowledge development. Knowledge development is the key element driving firm growth.

Conclusions

The chapter has sought to bring together different strands of our analysis of the situation of the eight mold-injection firms that have been the focus of our attention in the second phase of research. It also concludes this second phase.

The second phase of research was based on qualitative findings that embedded relations are important both for efficiency in ongoing production and for firm development. In chapter four it was argued that certain customer structures make it difficult to achieve gainful coordination with customers and that this also affects firm development. The findings of the present chapter indicate that this is the case and that the effect takes place largely via effects on personal networks. Plural customer structures, that is, ones that have a reasonably diverse set of important customers, provide an opportunity for the development of beneficial personal networks. Critical relations for the firm are less likely to be monopolized and therefore there is a possibility of a more distributed development of know-how in the firm. Maintaining a plural customer structure (low combined constraint) probably also requires a high level of firm problem solving capacity.

In chapter six an understanding of what drives the development of knowledge in the firm was explored by starting from an individual level. Comparing the situation of different individuals in key roles in production it was found that those most indicated as providing impetus for solving problems and developing know-how in production were those individuals that have personal networks characterized by reciprocity and diversity. These kinds of networks are the hallmarks of problem solvers in production.

In this chapter a notion of firm problem solving capacity was developed. The concept seeks to capture the ability of the firm to handle fluctuations and develop its production in response to a dynamic environment. The concept of firm problem solving capacity builds squarely on the findings of the individual level. It measures to what extent the firm's central production network is characterized by reciprocity and diversity. When this is the case the central production network is able to adapt and develop in response to changing environment.

In the studied cases firm problem solving capacity is linked by a singularly strong correlation with firm growth. Thus the findings strongly support a know-how oriented perspective on firms and where this know-how is understood to be lodged both in individuals and in networks of interpersonal relations. Personal networks provide a means of filling the gaps in coordination both in formal organization and in market contracts which is an essential part of being able to cope with a dynamic environment.

The second phase of research has broadly supported the findings of the qualitative research of the first phase. A formal approach in the research has also allowed us to test key factors against each other as a means of further probing the relevant mechanisms. The formal approach has also been advantageous for reasons related to the transferability of results. Firstly, it has made it necessary to make the arguments more precise. Secondly, it provides a condensed means of presenting the results. Finally, it provides a method that with relative ease can be used to probe the role of personal networks in other situations.

CHAPTER 8

The development of personal networks

Introduction

The main focus of our discussion in the previous chapters has been to elucidate the functional role of personal networks from a firm perspective. The question of how network structures evolve has been touched upon several times in the course of previous chapters but not developed systematically. Nonetheless the issue is of interest for an understanding of business as a social process and also for managers who wish to promote development in the firm. It would therefore feel incomplete to conclude this study without at least outlining some aspects of this issue. The chapter will try to relate issues of individual propensity to develop networks with structural aspects determining the opportunity for them to do so. This understanding of personal networks may tentatively be linked to how people perceive their work situation. The approach serves to make the issues of network development more tangible in terms of actual practice and also provides a means of exploring these issues further. The chapter has a somewhat speculative character, extrapolating on previous findings and connecting this with examples from the material.

The previous chapters have emphasized the role of know-how as a basis for firm development. However, it would be wrong to give the impression that the work situation in the mold-injection firms always puts a premium on the development of skills. The initial phases of finding and defining a product certainly require developed skills and the work is recognized as such. However other types of work are much more routine and there is seemingly much less scope for individual contributions. Management is often hard pressed to find means of promoting employee involvement and a sense of responsibility. The issue is particularly evident in an interview with the production manager of firm B. The manager and I had been discussing different aspects of work organization and he recounted a number of measures the firm had undertaken in recent years to delegate responsibility, moving decision-making out to the people most affected by these decisions. This was something the firm

worked actively with, based on the idea that if the employees plan and promise to deliver it is much easier for them to also assume responsibility for the results. We discussed various aspects of this. I voiced my interest in the relationship with development of know-how in the firm whereupon the production manager replied: "*that's interesting, we haven't thought of it in those terms but only in terms of making a boring job more interesting*". In this case the primary concern of management was not then in creating know-how but to create a sense of involvement and responsibility. It was less about know-how than care-what. Although this issue does not directly pertain to the employees that have been designated as having key roles and who have been the focus of our attention thus far, the notions of involvement and responsibility and how this is distributed in the firm may still provide some clues on informal organization and its development. Particularly, it seems that the issue of involvement and responsibility is related to what has been called ability and willingness to partake in the exchange and development of production know-how.

Difficulties delegating

The need to promote employee responsibility and autonomy as well as spread knowledge in the firm were themes often brought up in the interviews with managers. The issues were closely related to the pervasive need to achieve more flexible production and meet rising quality demands. Employee autonomy and responsibility are key ingredients of a flexible and well tuned organization (Trilia 1995).

Most managers expressed an understanding that individual lack of involvement and sense of responsibility was an organizational problem rather than an individual one. Like firm B above they sought measures that would create a more beneficial situation and where the individual could find development at work meaningful. In many cases, however, creating this kind of environment proved difficult. The CEO of firm A noted:

The most important and difficult thing is to get people to start to think, reflect on what they are doing. They have to be aware and involved, but how does one bring that about?

The situation in firm A is of particular interest because management had been trying to bring about change for several years but the firm still carried the imprint of strong hierarchy that had previously characterized the firm. The former CEO had been singularly autocratic in his leadership. Decision making was highly concentrated and production organized in discrete divisions of responsibility. These clear demarcations of responsibility provided both a means of specifying obligations and holding people accountable but also provided a line defense of the employees. Formal roles defined exactly what was expected, there was no reward but sizeable risk in going beyond these boundaries. The system demonstrated such an astounding lack of ability to

adapt to changes that when the former CEO was away for several weeks the whole production came to a halt and could not be restarted until he returned. Even though management has since been replaced, and despite that the firm is small, ingrained ways of doing things have been difficult to change. The present CEO explained how production was still characterized by distinct responsibilities and the difficulties this entails:

The system used to be one in which one person was responsible for six machines. In this system it happened that one person would be struggling with an overwhelming workload and his colleague working on the neighboring machines had nothing to do. We can't have it like that. I tried to bring about a change in this but it was met by resistance and slow downs in production....

What the new management was asking its employees to do was to redefine their roles and responsibilities, leaving clearly defined responsibilities for a much vaguer role defined in relation to overarching functions and aims in the firm. Taking into account the atmosphere in the firm under the previous management it is easy to understand an unwillingness to accept this kind of redefinition. Furthermore, this kind of change entails both a redefinition of relations with management but also with other colleagues. Resistance to the new management's plans was so strong that the measures had to be withdrawn. Subsequently, a compromise has been struck in which responsibilities remain distinct but also includes rotation of personnel. This allows somewhat more flexibility and starts the process of building a common ground for the employees.

The situation of firm A seems extreme but the issue of transforming attitudes and perceptions of work was an issue in most firms. For instance, in firm H the key account manager complained: 'If the production stops for some reason I have to be able to talk to the people there. If I ask them what's wrong I need something more than "I don't know as an answer". The manager is asking that employees should feel involved in production. This should be expressed in an attitude where they find it worth their while to develop their skills and deploy them in such a way as to alleviate problems even if these do fall outside of formal responsibility. In an interesting reflection the manager went on to discuss how his own perceptions of work had come to change over time and that he expected the new employees to go through the same development. He explained:

I like to work independently, to be self-driven and report my results on a weekly basis. As long as I have this kind of freedom and responsibility...I think I work best under these conditions. Previously, when I was working with the machines in production I would never hesitate. When the car left (the owner-manager of the firm left on some errand) then it was time for a coffee break...now, I have a coffee whenever I feel like it, but I don't put my feet on the table, I work much more now. The newer employees will also learn this. (Firm H person i).

The point of view of this manager is that taking up responsibility can be rewarding and that others will come to see this in time. This is so even though the manager by his own assessment works more than he did previously, it is still worthwhile. Clearly, there are benefits that flow from a responsible attitude such as achieving recognition,

a certain autonomy and probably better pay. But this does not explain why the calculation of pros and cons is so clearly different for different persons in the firm and why there was such an evident hierarchical dimension. Certain job situations seem to induce lack of involvement, create defensive attitudes of formal roles, and require direct control. Other job situations seem to create a more natural alignment of personal involvement and firm needs. The situation becomes easier to understand if responsibility is understood from a social perspective.

Responsibility as a role and product of microsocial negotiation

The notion of responsibility as it is employed here is clearly different from a formal division of different tasks. The issue of interest is the process by which an individual feels personal commitment to a certain field or type of work. This personal involvement is expressed in the willingness to take up an active and constructive role in the organization's problem solving even if this falls outside of formal definitions work. Following Johansson (Johansson 1998) responsibility is understood as something that emerges from a social negotiation of roles in the specific context. In this view, responsibility is constructed largely from the individual perceiving a need to be *able to respond* to different parties that have a stake in one's work such as co-workers, contacts and managers. An active sense of responsibility springs from wanting to maintain and develop the quality of these relations. The form and extent that different individuals feel responsible for work will therefore be expected to vary with aspects of the informal organization.

What is being proposed is simply that individuals seek some recognition for their efforts. When these efforts are not adequately captured in formal divisions of work or output measures, which they probably seldom are, then personally based recognition of an individual's sincerity and competence will become important. This personally based recognition explains why different individuals in an organization have different positions when it comes to obtaining knowledge and skills that are likely to be recognized. Different positions in the informal organization shape opportunity, ability and willingness to assume responsibility.

Before pursuing wherein these differences lie it seems reasonable to ask why any employee would seek recognition and responsibility. One important reason seems to be that informal organization may provide somewhat intangible but nonetheless important rewards. By taking up a role in the ongoing problem solving of the firm the individual improves their situation in terms of information. A well connected employee has a valuable resource when it comes to navigating an insecure situation. From his or her networks the person learns what is valuable to learn and gains privileged access to information about assessing future prospects. Being well connected

helps to decrease insecurity and develop in a career. As the material has demonstrated, the significance of these personal networks may continue long after particular organizational affiliations have changed.

In a previous chapter it was argued that persons whose networks are diverse and in which there is an element of reciprocity are well positioned to acquire knowledge and gain recognition or reward for having it. These individuals have incentive to partake in the exchange and development of know-how. This is because they have low costs and higher rewards for obtaining relevant know-how. As shown in chapter six and seven, these kinds of networks are strongly linked with firm development. At least in some phases of career development there seems to be fairly good alignment between networks that benefit the individual employee and those that benefit organizational development. This alignment of individual interests mediated through informal organization, with overarching aims of the organization provides an understanding of why informal organization may spontaneously develop in a highly efficient manner. Allen noted for instance in his extensive study of R&D laboratories that the informal communication channels provided a system for distributing information that could hardly have been designed better by careful planning (Allen 1978). Nonetheless there are probably things that can be done to increase the partaking of different individuals and in the development of a beneficial informal organization. There seem to be three important problems that management could tackle: increasing participation of peripheral persons, removing bottlenecks and creating an environment conducive to knowledge development.

Increasing participation of peripheral persons

The main problem of developing a beneficial informal organization may be that the advantages of partaking in a problem solving network only become apparent once the individual already partakes. In other words ability and willingness to partake depends on already having certain types of networks. Measures can probably be taken to bootstrap participation for those who inevitably are peripheral for instance persons in initial phases of their career. It may be possible by means of relatively simple measures to create an opportunity and ability to partake in these kinds of networks and thus initiate a process of self-regulating development associated with assuming responsibility.

The key point is that assuming responsibility should be understood as an active social process rather than something that springs from a stable contractual relation. Thus an important component of the transformation involved in moving from external control to being 'self-driven' and moving from perceiving a job description as vague or providing freedom hinges upon a the character of informal organization.

Efforts to form beneficial network structures in the organization should spring from a continual policy of trying to delegate, breaking up unnecessary hierarchy and

creating opportunities for people to take up responsibility. However, delegating is not enough, there must also be a sense that taking up responsibility can be rewarding. For newer employees the issue of obtaining know-how that can be used as a basis of recognition is not a simple matter, particularly since the type of know-how that is of interest is stored in individuals and their personal networks. Observing others and trial and error provide ways of learning. However, if the individual learns mainly from others in the organization in which he or she is working this provides little room for establishing a position in the informal network. After all there are already persons in the organization that are apparently more skilled. Individuals in the beginning of their careers are unlikely to be willing to identify and take up a role of dealing with a complex, changing situation if someone else around already knows better. Know-how acquired in the organization does not provide the individual with a proprietary sense of knowledge, that he or she has a unique contribution to make. This is well expressed in one manager's views on the use of external training:

In terms of what they learn, I am sure we could train them just as well internally. But there are two additional values of external training. Firstly, it boosts the individual's confidence with respect to a certain area of knowledge and; secondly, they meet people from other firms.

This approach to training attributes a high value to developing external contacts, but more subtly it recognizes that internal training would not have the same effect, as knowledge acquired could hardly be felt to be proprietary. A sense of having a unique contribution to make is a basis for partaking in the exchange of information and know-how. Courses may boost confidence and willingness to make commitments to a certain area of expertise, if intelligently deployed. In the long run however, the structure and content of a person's contact network, particularly its network diversity, will determine the extent to which he or she can develop proprietary knowledge in the course of everyday activities. For persons in initial phases of their career contacts are most likely to be in the firm. It is possible that management can devise a scheme where these persons come into contact with a range of persons in the firm and thus stimulate the growth of internal contacts. This kind of scheme should include the creation of multiplex relations, that is, contain interaction in different roles such that the involved persons become more evident as persons. Being able to triangulate the other seems to be an important part of creating a personal contact.

A person's entrance into informal organization may also start from reciprocal relations. Reciprocal personal networks may evolve simply from being in the same situation as someone else and pooling resources. For instance people of the same age or similar background may interpret their situation in similar terms and this provides an initial base for trust and mutual assistance. There were examples of these kinds of naturally evolving teams in several of the firms, particularly where the staff was younger. As the persons develop in their work and acquire different roles, initial relations can also provide bridging ties across different functions. It was mentioned previously how this kind of relation evolved and became an important link between marketing and production in one of the studied firms. Using the fact that these per-

sons could communicate well provides a basis for both better external and internal coordination.

Other strategies for catapulting peripheral persons into the informal organization include the use of mentorship. Using mentors may provide a means of lifting a person into a network of exchange relations and provide strong inducements to partake in knowledge development. The formerly peripheral person in effect borrows status of the mentor to partake in exchanges on his or her behalf and is thus brought into exchanges that otherwise would not be possible (Burt 1998).

Thus, including peripheral persons in informal exchange is something that probably can be achieved by small means. Slowly but consistently working to break up unnecessary hierarchy and create opportunities to take up responsibility is important. Beyond this management can actively stimulate a sense of proprietary knowledge and willingness to exchange by using education or mentorship in an intelligent manner. Once the process is started, individuals feel that they are able to take up a role in this exchange and see the benefits of doing so then these measures are no longer needed.

Removing bottlenecks

The flipside of including peripheral persons is to dislodge those that have become too central but to do this in a productive way. The problem seems to be simply this: once a person becomes entrenched and secure in their roles the value of partaking in informal problem solving decreases, that is, the rewards accruing through personal networks are less important. Local networks no longer provide the kind of advantages in developing know-how and navigating the environment that the individual needs and thus no longer provide sufficient reward and development. In a sense the individual has outgrown the firm. Highly proficient individuals may therefore contribute less to informal problem solving. This is evident in decreasing (strong) reciprocity within the firm and possibly also decreasing diversity. These persons may remain critical sources of expertise but willingness to take part in the networks changes. In this situation management can once again play an important role in promoting a beneficial development. There are several possible measures that can be taken both to promote the development of reciprocity and diversity in these cases.

One approach is to actively create situations to promote reciprocal exchange. For instance in firm F there were two persons holding somewhat expert roles (nodes A and B) but the production manager (node C) felt that know-how was not sufficiently integrated and put to use in the firm. One measure to promote exchange and development was to send key persons off on external generalist training. The point is simply to provide insight into what others did or did not know, acquire some knowledge of the other's fields and provide an arena of interaction outside routine. The strategy was complemented by practical activity. The in-house designer, materials specialist

and key production personnel now regularly get together to predict the outcome and problems of a new production run. Testing in production is often a lengthy process and skilful prognoses are highly valuable. Demanding collective predictions provides a challenge in firm F and demonstrates the need for knowledge exchange and integration.

A difficult but effective strategy of using experts to promote knowledge development is to create mentor roles. Mentorship can create an active interest in cultivating knowledge of a person that would not otherwise be a source of information or know-how. The mentor thereby relieves him or herself of certain aspects of his or her work load. In some cases, such as in firm H, the owner-manager clearly has a mentor role. He actively drives the development of networks in the first tier of key personnel in production. The sustained effort of this manager to 'make himself dispensable' is possible in part by his being an owner of the firm. However a similar beneficial mentor role was achieved in firm D by different means. The expert employee of firm D is employed part time (50%) and is an external consultant in his remaining time. This construction has proved a useful way of securing mentorship. The expert/consultant does not supply solutions for the central problem solvers of the firm, there is no time for this, but he does provide helpful insight, guidelines and suggestions. The firm has thereby been able to maintain a high level of expertise and yet opened up areas for knowledge development. The consultant/expert is in turn, developing further knowledge based on firm-external contacts. Similar cases of employees outgrowing their firms but remaining important sources of knowledge development are evident in the other firms.

In some cases key persons left the firm starting businesses on their own. Although this was certainly not planned by the mother-firm and may have been inconvenient, in some cases it evidently has had beneficial effects in terms of knowledge development. For instance around one of the larger plastics firms a history of fission has provided a concentration, on a microscale, of plastics firms and mold manufactures with a dense weave of cross-cutting personal network ties. The production manager of one firm for instance lists the CEO of the firm across the street as one of his most important contacts. The firms also help each other out in peaks of production and drive the development of local complementary service. This kind of regional dynamic has often been suggested as key component of regional development (Scott 1988; Saxenian 1994; Berggren C 1998; Dahlgren and Parker 2001; Berggren 2002). As in the case of Alpha and PDC discussed in chapter four, a key component of this kind of beneficial development is the combination of complementary services and personal network ties.

Management can have an important role in creating an environment conducive to development by taking measures so that the best possible use is made of expert know-how. This entails creating willingness to take part in the development of local networks which no longer happens as a natural effect of the individuals need to navigate the environment. By becoming mentors opportunities are opened for others to take responsibility while know-how is retained. Mentorship can be combined with moving the expert partially or wholly out of the firm in such a way that personal net-

work relations are retained. This may be for instance, by supporting the growth of complementary services.

Creating an environment conducive to knowledge development

Making efforts to include peripheral persons in the exchange of know-how and creating constructive mentorship are measures undertaken in relation to specific persons. Apart from such specific measures there are also general aspects of the environment that have an important impact on the development of beneficial informal organization.

An extent of mobility can become important mechanism for the development of networks. Contacts established in the daily activities of the firm may come to bridge important boundaries when individuals move to new roles. These new roles can connect different firm activities or span firm boundaries. Information trading between key persons in different firms exists in the studied firms (Hippel 1988). Judging by the significance attached to these kinds of contacts they would seem to play an important role in firm development. Mobility may be difficult to plan for small firms it may come down to question of location, that is being located in a region that supports mobility or a question of the age distribution in the firm.

An important means of creating a beneficial environment for knowledge development is also to strive toward a plural customer structure, that is, one that is neither dependent nor fragmented. There is a strong link between plural customer structures in the firms and the development of beneficial network personal networks. This relation seems to arise because plural customer structure imposes a need for more supple internal coordination and also provides a better position in terms of capitalizing on developed knowledge. A plural customer structure opens up a space in which knowledge development can be advantageous. The need to differentiate customers and produce different types of goods tends to break up a simple firm hierarchy and has a profound effect on the development of a beneficial informal organization. The need for different kinds of know-how combined with variations in production volume will make a necessity of a distributed system of knowledge. In a plural customer structure it becomes difficult for an individual to monopolize an area of expertise, at least without incurring evident bottlenecks in production. It also becomes necessary to be able to meaningfully integrate information from a wider array of relevant sources. In contrast, firms with runs of similar products have a tendency to locate key knowledge in a small number of persons which is a result of an economy of scale of sorts. It makes sense that similar kinds of tasks be performed by the same people but this has a detrimental effect on the development of networks in the firm.

A plural customer structure also allows greater specificity to be brought to bargaining by both customer and producer. The customer has a position to exert meaningful influence on the producer but this firm also has alternatives. Greater specificity in bargaining entails that a wider range of knowledge may become valuable for the producer. Know-how can be valuable both in the sense of being able to meet customer demands but also that there is a reasonable chance to make the value of internally developed know-how recognized and therefore be able to capitalize on it. The role of key account manager is in itself an interesting indication of this kind of process. Assigning people to managing key accounts, a natural response to situations where large customers have varying needs, is a useful method of providing network development in two ways. Firstly, it may develop a close contact with customers, which is essential to development of production. Secondly, by being tightly integrated with production this allows for further specialization of other production managers. In depth customer relations mediated by personal contacts not only provides a means of transferring knowledge across firm boundaries, it also creates internal organization forms that promotes knowledge development per se.

Summary: the development of a beneficial informal organization

The previous chapters have argued that know-how in the firm can be understood to be lodged in individuals and their personal networks. Structures of informal organization are therefore an important part of firm development. Developing a beneficial informal organization requires an understanding of the social processes whereby it becomes meaningful for individuals to create and uphold a role in these networks. The argument has been that the informal organization itself provides much of the means and rewards of exchanging and developing know-how. From the networks the individual gains a resource for navigating his or her environment. From the networks the individual can learn what is valuable to learn and where future prospects for development lie. Recognition in personal networks also provides an important basis for future collaboration. In specific phases of career development, notably for problem solvers, there is an alignment between individual interest and firm interest. However, specific measures of management, in promoting a beneficial development, would seem to be important when the alignment of interest is less strong.

It has been argued that an important part of promoting beneficial networks is to create meaningful opportunity to assume responsibility. There are both specific measures directed at individuals and general firm level measures that can be undertaken. Specific measures include bootstrapping peripheral persons into the informal exchange.

In initial phases of an employee's career he or she will usually have a peripheral role in the exchange of information and know-how. Moving from this kind of role toward full participation is not an easy task. It requires a sense that the individual has a unique contribution to make in the particular situation, a proprietary sense of knowledge. If the individual feels they have a contribution to make they can take initial steps of engaging in know-how exchange and development. This kind of situation can be brought about by the constructive use of external education and by subtle use of internal mobility. Management should also be aware of spontaneously arising teams. In several of the firms a younger generation of employees formed tight networks in which they seemed to pool their resources to be able to cope with the challenges in the organization. Cultivating increasingly complementary roles of such natural alliances helps to create both diversity and further internal coordination. Once the individual has developed a certain level of know-how and partakes actively in problem solving and development in the firm, the process of network development becomes more self-regulating and mutually beneficial for individual and firm.

Including peripheral persons is closely linked to actually utilizing expert knowledge in the best possible way. At a certain point however, an individual may have developed a level of expertise such that there is no real use for further development in the local networks the firm provides. The individual in a sense outgrows the firm. This seems to be a situation with several possible detrimental outcomes. It is possible that the individual will leave and no longer be in need of his or her outgrown contacts. It is also quite possible that the person may stagnate in their role and defend it by blocking others i.e. monopolizing contacts and an area of expertise. Since willingness to develop local networks no longer springs from informal organization itself, management again can play an important role by means of specific measures. The case studies offer some examples of ways in which this situation is constructively resolved, although none seem simple to bring about. One strategy deals with creating a better basis for communication and active participation in focused exchanges, that is, bringing together different experts to solve particular problems. Other strategies are concerned with transforming an expert into a mentor. This means creating a situation where the expert functions as an internal consultant and 'purchaser' of internal expertise. Alternately, the expert should be encouraged to develop complementary services in such a way that network relations of the firm remain useful.

In short, specific management measures to promote the development of beneficial networks are aimed at actively creating ability and willingness for persons not yet fully participating in the firm problem solving and for those who have achieved expert roles. Management also has at its disposal tools that can be deployed at a general level to create a dynamic environment in the organization. One such tool draws on awareness of the effects of customer structures. Plural customer structures provide an important impetus for the development of know-how by demanding variations in quality in the firm and improving the firm's chances of being able to capitalize on its developed knowledge. Management therefore acquires a powerful tool; it is possible to pursue a plural customer structure as an active strategy in order to create an environment conducive to development.

CHAPTER 9

Conclusions

This research has sought to contribute to an understanding of how economic processes are socially embedded, that is, how economic interaction is affected by social relations and vice versa. The topic is a classical one, dating back to foundational works of anthropology and anthropologically influenced works in organization theory. It is possible to trace both methods and approaches used in the present research via work on embeddedness and the transactionalists back to the Hawthorne studies and Malinowski's pioneering work on social exchange.

A lengthy series of research has contributed toward the ongoing development of a model of socio-economic interaction. The central contention of this research tradition is that economic models that strip individuals of social relations are inadequate, but so are overly structural models that leave no room for individual strategy. An adequate understanding of socio-economic process requires taking into account both actor strategy and social context. Network analysis has had a pivotal role in the development of this tradition. Network analysis provides a means of grasping complex social structure and presenting it in a graphic and relatively intuitive way. Moreover, formal analysis of networks provides a basis for assessing the extent that structural factors shape individual strategy.

Despite a long history of research on socio-economic systems the findings have been quite fragmented. Different authors in widely disparate fields have taken up the threads and developed them in different directions. It is only recently, with the rising popularity of the embeddedness approach that findings have become somewhat more integrated.

In anthropology the transactionalist tradition sought to bring together individual strategy and social context by paying attention to strategies of both economic and social exchange. The approach also sought to clarify how systems of relations can give rise to emergent properties (Kapferer 1972). The present research has to large extent shared these starting points. It also draws upon similar methodology, combining qualitative work with formal network analysis. Combining these methods makes it possible to explore both the meaning of different actor strategies and the complex context of different personal networks.

The research has undertaken to study the role of personal networks in small manufacturing firms in southern Sweden. This is an interesting site of research mainly be-

cause business is still thought of as a field particularly characterized by self-interested atomistic interaction. Existing research gives us little reason to expect anything other than impersonal market or bureaucratic interaction. Although many people seem to have a notion that networks matter the issue is elusive. There is lack of understanding as to how they matter and a corresponding lack of vocabulary for discussing different aspects of networks. To elucidate this issue the research has addressed three questions:

- Are personal networks important for firm development? And if so, how do personal networks shape firm development?
- Are there structural aspects of personal networks that allow us to differentiate beneficial networks from less beneficial ones?
- How do personal networks develop in this particular industry and region?

The research was conducted with a small set of firms. The size of this set of firms was chosen so that it enabled both in depth study of individual firms and small scale statistical testing across firms. This allows for a kind of conceptual experimentation and development. The purpose is to develop an understanding of socio-economic process in the studied firms and clarify mechanisms that may be important for understanding other contexts as well.

Combining qualitative and quantitative methods in exploratory research has both advantages and disadvantages. It is a strategy that will undoubtedly be subject to critique by adherents of both schools of method. Researchers that prefer qualitative methodology may question why mechanisms of social interaction were not further explored and if the quantitative measures suggested adequately capture the full complexity of interaction. Quantitatively oriented researchers may be skeptical of the limited data set and selection of cases. It is also reasonable to critique the statistical tests for using such a limited set of possible explanatory factors. However, there are also advantages of using a mixed methods approach. These advantages are actually quite closely related to the disadvantages just discussed. The research is interesting as an exploration of a field precisely because it can relatively easily be developed, or falsified by both qualitative and quantitative research. The main contribution of this kind of research will be to suggest conceptual developments and propose initial operationalizations.

Are personal networks important?

The suggestion that personal networks may have a role in coordinating business relations is not novel. In fact arguments that personal networks provide informational advantages and trust have been well developed in previous research (Geertz, Geertz et al. 1979; Ben-Porath 1980; Uzzi 1996; Menning 1997). However, these findings

pertain to seemingly exceptional situations. The interpretation of these results has also been that networks are important in these cases in *contradistinction* to the 'normal' situation of impersonal interaction.

The firms in this study however come close to epitomizing run-of-the-mill business. It is true, the firms are small and that the personal element might therefore be more prominent, but the firms do not otherwise belong to a group in which research has suggested personal networks to be important. The firms operate in an environment of highly developed economic institutions. They are not involved in knowledge intensive development. They are not located in a regional cluster of highly interdependent businesses. There is very little in anthropology, economics or business studies to suggest that personal networks would be particularly important for these firms. Yet the research clearly demonstrates that this is the case. Personal networks are important for both the efficiency and development of the firm. Moreover, the reasons why personal networks are important do not seem to be specific to small firms. In line with arguments of the embeddedness approach (Granovetter 1985) this finding suggests that personal networks may be an integral part of business generally. It seems that an element of social exchange in business and that this is a central determinant of economic outcomes. To understand the development of these businesses it is necessary to take into accounts both economic strategies and also relational strategies of individuals in personal networks.

The research delineated four basic functions of personal networks in business. Networks provide *trust*, both in the sense of taking each other's interests into account and also in the sense of relying on the other's skill. Networks also provide *quality of communication*, reducing the effort needed to coordinate activities. Personal networks also provide *informational advantages*. Persons with a good set of contacts have advantageous access to timely and specific information that is valuable in these contexts. Finally, personal networks provide *ability and willingness* to pass on and integrate information. Those that partake in important exchanges of information can earn recognition in these networks.

The functions of personal networks identified in the research are reminiscent of findings by other researchers. Uzzi in particular argues that personal networks provide similar advantageous functions (Uzzi 1997). In Uzzi's terminology embedded relations provide a basis for trust, fine-grained information transfer and joint problem solving arrangements. Apart from treating different kinds of firms, a difference between the present analysis of social embeddedness and Uzzi's is that the category of 'fine-grained information transfer' is divided into two separate functions: quality of communication and informational advantages. The distinction is not unimportant as it paves the way for subsequent analysis in terms of network structure. Nonetheless the findings are certainly similar.

Identifying beneficial networks

The finding that personal networks are important in these firms is interesting, but without a means of distinguishing beneficial networks and less beneficial ones, there would be little practical significance. All personal networks are certainly not beneficial in the sense of group development. Some may be distinctly detrimental. A question posed in the research was therefore: what kinds of networks are beneficial? The issue relates to the experience most people have that certain organizations afford a lively, productive exchange while in other firms even simple problems seem difficult. There are marked differences in atmosphere in different firms and this seems to be related to their ability to productively develop new knowledge or even take advantage of the knowledge that already exists in the organization.

A first step in answering this question was to map relevant personal networks in the firms. To do so necessarily involves taking up a particular perspective and identifying starting points. The focus selected was that of problem solving and knowledge development in production. Personal networks are analyzed as systems of social exchange where the object of exchange is information or knowledge of value in solving production related problems. This focus hopefully captures the central benefits of personal networks identified in the qualitative research and also relates to a central aspect of firm activity.

The next step was to identify relevant starting points for a mapping of personal networks. In this study certain key roles in coordinating production were identified in each of the firms. Using a snowballing technique for finding relevant contacts it was possible to collect data on how problem solving and knowledge development occurred in the central production networks of the firms. It was possible to use the resulting network graphs both as a means of exploring the situation of different individuals in the firms and also to compare the situations of firms as wholes.

The link from qualitative research to analysis of network structure was provided by the proposition that the four functions of personal networks previously identified are linked to two types of network structure namely; reciprocity and diversity. In fact the link to these forms of network structure is much more than a proposed correlation. The link provides a rooting in theory to what might be called social science fundamentals. The basic mechanisms involved in reciprocity are fundamental part of anthropological theory. Reciprocal exchange is a means of shaping social relations which in turn may be an end in itself i.e. status or a means to an end. In the context of the study reciprocity is argued to be important in shaping relations such that each individual can count on access to the expertise of the other. Reciprocal relations thereby provide a means of guarding against certain kinds of uncertainty. The other structure that has been shown to be important is network diversity. This is in fact a means of approaching the fundamental phenomena of brokerage. Diverse networks tap a wide range of sources and are more likely to have contacts that are in turn important for their other contacts and so are in good position to broker goods or information.

This study has focused on communicative aspects of personal networks. It has been argued that a high *quality* communication is expected where there is reciprocity and a high *value* of information where individuals have diverse networks. These network structures therefore provide complementary benefits with respect to problem solving and developing knowledge.

Empirical tests support the notion that persons with networks characterized by reciprocity and diversity are important problem solvers, persons able and willing to partake to a greater extent in the knowledge development and problem solving of the firm. Moreover, subsequent firm level analysis demonstrates that networks beneficial for the development of know-how are also closely linked with quantitative measures of firm development such as firm growth. It was shown that beneficial networks provide an increased ability of the firm to adapt production to a changing environment. In other words a greater capacity for problem solving sets the stage for firm development and growth.

Emergent properties: the division of knowledge on a microlevel

It is possible to interpret firm problem solving capacity as the fruit of interaction between individual problem solvers. In this view, firm problem solving capacity results from a firm having a set of individual problem solvers in its production network. However, it is also possible to understand the same phenomenon from a social perspective. This perspective views firm problem solving capacity as an emergent property of a social system. An explanation based on the microlevel division of knowledge lends itself easily for this purpose.

The division of knowledge is an aspect of the division of labor, a fundamental principle of socio-economic development. The beneficial effects of the division of labor in raising efficiency and promoting a dynamic development take place through the dual process of specialization and integration (Laestadius 1992). The division of labor thus consists of more than dividing up work into constituent parts; it requires a means of re-integrating these elements into a meaningful whole. Similarly, the division of knowledge consists in more than having access to complementary information. This information must also be actively reworked into meaningful concepts, understandings and even concerted action.

Since knowledge transfer and development of (technical) knowledge on the microlevel takes place largely through personal networks (Allen 1978) it is to be expected that the division of knowledge in this study should be evident in the structure of personal networks. The measure of firm problem solving capacity may be interpreted as the extent that a firm taps different complementary sources of information and integrates this in its production. Complementary specialization is measured in the net-

work diversity of its key production personnel. Reciprocal relations provide important functions in integrating knowledge particularly by promoting trust and quality of communication. Thus the level of reciprocity in the central production network provides a measure of how well complementary sources are integrated. Firms with a greater problem solving capacity may therefore be said to maintain a better division of knowledge on the microlevel and reap the benefits of this.

A re-interpretation of the findings in terms of the division of knowledge is possible but not necessary. It does however provide some advantages. Firstly, the interpretation seems to capture the firm level results in a succinct manner. Secondly, it helps us to understand the social and structural aspects of the development of personal networks. Finally, an interpretation in terms of the division of knowledge provides a connection with socio-economic fundamentals. However, it is possible that an interpretation in terms of the division of knowledge may lack in precision. Exploring these connections fully falls beyond the scope of the present dissertation. At present it is possible to say only this: An emergent property of the studied networks resembles the division of knowledge. It is unclear at present whether or not it is analytically useful to pursue explanation in these terms.

Development of personal networks

The research has sought to explore some of the specific mechanisms by which personal networks develop in this particular industry and region. This theme has been given limited attention but nonetheless there seem to be some noteworthy findings. Mobility within related industries in the region provides an important means of establishing personal networks. Networks in these firms are highly local and yet to a very large extent spanned firm boundaries. Mobility seems to be an important means of establishing extra-firm contacts in these cases. There is very little of exogenous social infrastructure that could provide a basis for such ties. Of course mobility only serves to create an opportunity of exchange. It does not make exchange viable or gainful. In other regions additional mechanisms may be important in creating networks so as to spread information and knowledge. This may have considerable regional affects. In southern Sweden for instance there is a particular region of Småland known for its high density of interconnecting regional ties (Johannisson, Alexandersson et al. 1994). These ties seem to have had extensive long term effects on the development of the plastics industry there (Dahlgren and Parker 2001).

A firm level factor that does strongly affect the viability of developing personal networks is customer structure. Straightforward constraint in the sense of dependency on other firms seems to be less of a problem for these firms. In fact, firms in this kind of situation often developed beneficial networks. It was the effects of a fragmented customer structure that were most evident. In a fragmented customer structure, it was argued, forward coordination becomes constrained as *costs* of information

gathering and coordination increase beyond their perceived benefits. Firms with a fragmented customer structure are therefore in an unfavorable position to develop knowledge and capitalize upon it in a way that parallels constraint. In both cases there are limited channels of access to relevant market information and limited scope for gainful bargaining. The research developed a concept of combined constraint to take into account both dependency and fragmentation in a firm's customer structure. It was found that combined constraint demonstrates a strong negative correlation with knowledge development in the firm. Combined constraint also correlates negatively with firm growth. The findings provide support for the argument that it is important to include a notion of coordination costs in the analysis of inter-firm networks.

Apart from environmental factors such as mobility and customer structure, specific measures taken by management can contribute to a beneficial development of personal networks in the firm. The key lies in understanding that for individuals to partake in firm problem solving it is necessary that they can develop a sense of proprietary knowledge and a possibility of gaining recognition in the informal organization. There are numerous methods by which a beneficial informal organization can be actively cultivated. The research has inventoried a number of strategies used by the firms and set this in relation to the developed understanding of personal network dynamics. The most important points are to underline the *social* dimension of knowledge development in a firm and how informal organization provides a means of aligning individual and firm interests. A well working informal organization provides benefits for both the individual and the firm.

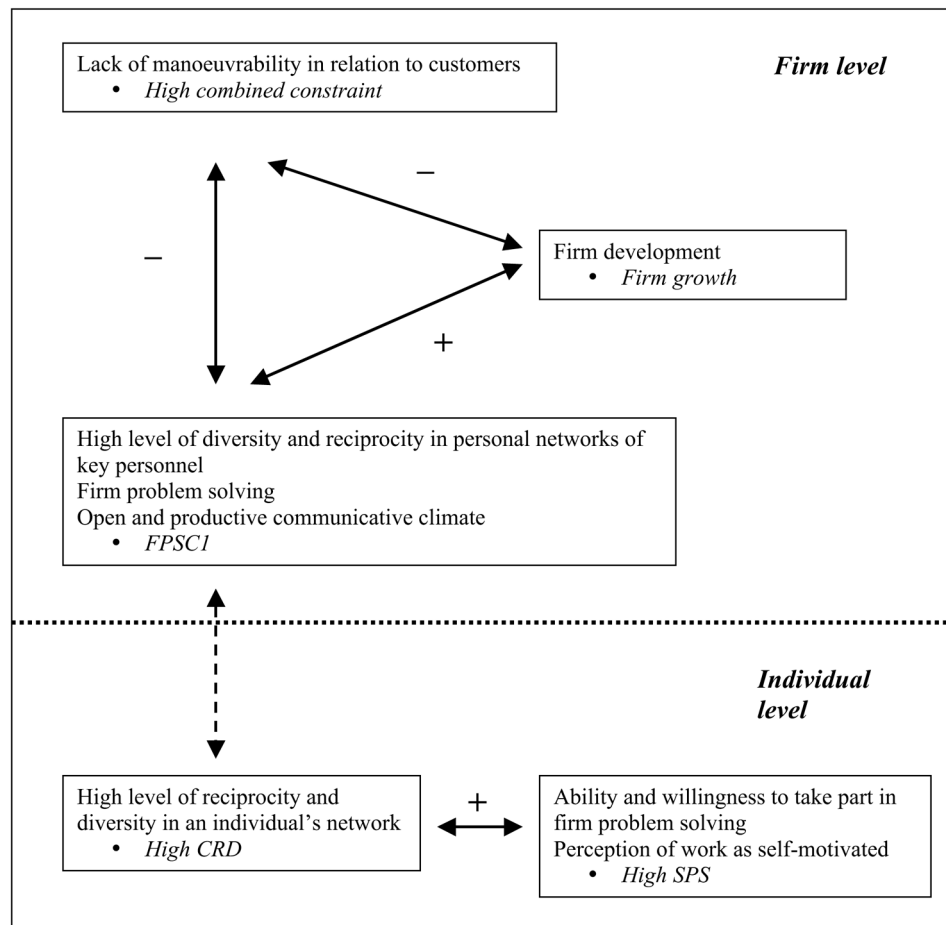


Figure 7 A summary of arguments and findings in the second phase of research

Contributions to research on social embeddedness

The research has employed a synthetic approach. It has drawn on diverse sources in anthropology, sociology, studies of business administration, technology transfer and geography to build what I hope is a clear and consistent argument on the role of personal networks in business.

The method used in identifying and analyzing relevant networks in the firm production is also something of a contribution. Although the techniques were quite simple and probably should be developed they present a novel approach. This is an approach that avoids defining relevant groups at the outset but rather takes its starting

point in recurring problem solving. It is by maintaining a close connection to recurring types of problems that it becomes useful to employ structural analysis of networks. Structural analysis needs a connection to content to be useful (Erickson 2001). When the analysis is anchored in this way it provides an interesting means of exploring how knowledge is maintained and developed in social interaction. The *situated* use of structural analysis is therefore something of a contribution.

The research has further developed qualitative distinctions concerning functions of personal networks. These developments helped to provide a bridge to structural analysis. The important functions of personal networks were argued to coincide with two forms of network structure. The role of network diversity and the operationalization of this concept has been previously extensively developed by Allen and Burt (Allen 1978; Burt 1992). The role of reciprocity is widely recognized in network research. However, the combined effect of these two factors in personal networks has not been explored previously to my knowledge. The strong links between this combined network structure and both individual level and firm level effects is therefore of wider interest.

A further contribution of the research has been the inclusion of a notion of cost in maintaining and building business relations. Although it seems obvious that relations require time and effort to maintain this is generally not considered in research on the effects of business network structure. The notion of combined constraint was developed in this research as a means of incorporating the cost dimension of coordinating firm activities. The material strongly suggests that such a factor is important in understanding the development of these firms.

Finally, the research treats individual strategy and social context in a unified framework. Using this approach the research was able to demonstrate strong correlations with clear and important output variables on both the individual and firm levels. This provides a further empirical demonstration of the value of a social embeddedness approach.

A note on the anthropology of business

The research has demonstrated that in the case of these small firms that there are important structural elements both on the individual and inter-business level that strongly affect the development of these businesses. The effects are both quantitative and qualitative, that is, the extent of knowledge development and the extent of economic growth but also the manner in which people are affected by the workplace and the trajectories of businesses development.

The starting points of neoclassical economics, treating individuals as devoid of all relations is incapable of taking these important structures into account. It is a discipline even less well equipped to treat the important qualitative aspects of these relations. In contrast, it would seem that anthropology has an extensive research tradi-

tion and tools to deal precisely with the communicative aspects of relations and even communicative strategy. There might therefore be important contributions for anthropology to make in the study of socio-economic process and particularly in business. However, the research also clearly demonstrates that the specific structure of external, loose ties may decisively affect the development of a social organization. This is a considerable challenge to approaches that emphasize corporate culture as endogenously determined or other approaches that overemphasize internal structure.

The results of this research suggest that it might be possible to treat two aspects of network structure, corresponding to basic social mechanisms, as building blocks of a communicative approach to socio-economic analysis on the microlevel. Naturally, these mechanisms need to be further explored and understood. Whether or not it turns out to be the case that the proposed mechanisms have a more general relevance, it seems to me that business anthropology can particularly contribute to an understanding of socio-economic process. A research strategy that links individual perceptions and strategies to emergent properties of interaction and uses these emergent properties as a means of explaining important events or differences seems particularly important. This is an advantageous approach not only because it provides a basis for relating to economics but also avoids problems of a priori defining groups. This does not mean of course that individuals should be treated as existing before the social.

Further research

An important aim of the research has been to develop concepts and initial operationalizations for the study of personal networks in firms. A natural step in developing the research further is to test the propositions in larger samples of firms and different types of firms. If the arguments hold then the implications for promoting firm growth are extensive. Strategies could be employed by management to create beneficial customer structures and thereby provide a strong basis for firm development. By being aware of structures of informal organization management may more effectively promote the development of beneficial interaction and thereby affect the firm's ability to stay abreast and coordinate its activities. Before making any broad assertions it is necessary to explore the proposed mechanisms in different settings.

I believe there is good reason to expect that structural analysis of personal networks can provide important clues to understanding how different types organizations develop. Personal networks seem to be important for knowledge development generally. Moreover, the mechanisms of reciprocity and network diversity are elaborated in research in quite disparate settings. The relative importance of reciprocity and diversity will be expected to vary with the type of problems that need to be solved but both components are likely to remain important. The main difficulty in transferring this analysis to other types of organizations is that it requires identifying relevant starting points and output measures. Projects or universities would be intriguing sites.

The findings of this research also offer extensive scope for further exploration of qualitative aspects of networks. For instance it was suggested that structures of informal organization should be linked with individual perceptions of work. Clearly this is a topic that warrants further exploration. Work occupies such an important place in of our lives it would be surprising if perceptions shaped in making a livelihood failed to leave a significant imprint on people's lives. A structured approach to collective communicative climate (atmosphere) would also be of interest in developing the research.

Finally, there are important topics to be researched with respect to how networks evolve. It would be interesting to study strategies of how contacts are established and broken and how people may enable or hinder others from making valuable contacts as part of their own social strategies.

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Appendix 1: A list of key concepts and variables in the dissertation

The following is a list of important concepts and related variables in the dissertation. The concepts are listed in alphabetical order. Variables are listed in relation to each concept and italicized. Note that all variables are not listed.

Combined constraint

Combined constraint refers to the lack of maneuverability that a firm experiences due to an unfavorable customer structure (portfolio). The concept of combined constraint seeks to capture the constraining effects of both dependency and fragmentation.

The concept of *fragmentation* is developed in chapter 4 and refers to a lack of maneuverability imposed on a firm having to deal with a large number of small customers. The primary discussion of customer structure, including development of the variables *constraint*, *fragmentation* and *combined constraint*, is in chapter 5.

Firm problem solving capacity

This is an abstract quality of firms. It refers to the ability of the firm to cope with fluctuations and change in production. More specifically it refers to an ability to meet requirements of static and dynamic flexibility. Static flexibility is the ability to meet fluctuation in quantity in production of a given range of goods. Dynamic flexibility refers to the ability to develop a products and processes in a gainful manner. A firm's problem solving capacity is related to the extent that it can gather information and integrate it meaningfully in production. However, problem solving capacity is also related to high quality internal coordination.

The concept of firm problem solving capacity is treated implicitly in chapters 3 and 4. The concept is a central theme of chapter 7. The variables *FPSC1* and *FPSC2* that seek to measure firm problem solving capacity are developed in chapter 7.

Informational advantages

The value of information for an individual or for the development of a business often depends on the information being timely and specific. This kind of information is less likely to be available through general channels. It is much more likely to come through highly exclusive channels such as personal networks. A person with a developed network may therefore achieve advantages in terms of gathering valuable information.

Informational advantages are exemplified and discussed in the introduction, as well as in chapters 3 and 4 (see particularly the heading information gathering in chapter 4). The variable *network diversity* seeks to measure the extent that a network affords informational advantages. The variable is discussed in chapter 6 under the heading 'measuring informational advantages'.

Problem solvers

Everyone is a problem solver, but in a given group facing collective problems there will be persons that take on a more central role. These are the persons referred to as problem solvers in the dissertation. A person may become a problem solver by having expertise in a relevant field but it is also a social role or position in that others recognize this expertise and allow them to take up the role. The concept of problem solver is closely related to the concept of gatekeeper.

A persons significance as a problem solver is measured in the variable *SPS* as defined in chapter 6 under the heading 'problem solvers'.

Quality of communication

Refers to the effort required to coordinate activities. Higher quality of communication means that less effort has to be expended in coordinating activities. High quality communication is most important when time is short and when tasks are complex.

Quality of communication is discussed and exemplified in chapters 3 and 4. The concept is treated in chapter 4 particularly under the heading 'quality of communication'. In chapter 6 the concept is treated under the heading 'functional aspects of personal networks'.

Reciprocity

Reciprocity is a fundamental social mechanism involving mutual exchange over time and where the qualities of the relation are valued. In this study, the concept of reciprocity refers to limited domain of exchange namely the exchange of information and knowledge between individuals. Reciprocity in this sense is argued to be important for the development of trust and quality of communication.

Reciprocity is discussed in chapter 4 under the heading 'personal network structures', and in chapter 6 under the heading 'measuring reciprocity'. The extent of reciprocity in an individual's network is argued to be important as an indicator of both trust and quality of communication. The variable *NDR*, as defined in chapter 6 under the heading 'measuring reciprocity', seeks to capture this.

Trust

The term trust is used to capture two highly interrelated aspects of a relation. The first aspect is the extent that a person believes the other is looking out for his or her interests. The second aspect is confidence in the other's ability. Trust, as the concept is used here, refers to both these aspects and is closely akin to the notion of reliability.

Trust is discussed and exemplified in chapters 3 and 4 (see particularly the heading trust in chapter 4). In chapter 6 there is a recapitulation of the concept under the heading 'functional aspects of personal networks'.