1. Introduction

Today's networked organizations tend to grow by mergers and acquisitions, making collaboration across distance a common experience for an increasing number of employees. A common situation occurs when two organizations merge and new groups are established with co-workers situated in different places and also within different organizational cultures. Rather than moving or shutting down departments, it appears just as sensible to establish distributed groups basing more of their interaction on mediated communication. Similarly, distributed work groups are established as a response to the need for task-solving in projects involving partners from different places and/or organizations. In such instances moving people or establishing physical departments is often too expensive and complex.

The upside of this trend is that it creates new cross-cultural groups, with a potential option for creating synergies as well as knowledge and innovation (DeSanctis and Monge 1999; Lipnack and Stamps 2000; Ackerman, Pipek and Wulf 2003; Cummings 2004). The challenge, however, is to establish groups that can function well despite a lack of physical presence or a common history. It is widely agreed that *trust* is a crucial value for the success of distributed work groups (Handy 1995; Jarvenpaa and Leidner 1999; Piccoli and Ives 2003; Zolin, Hinds, Fruchter and Levitt 2004; Panteli 2005; Johansen and Selart 2006; Wilson, Straus and McEvily 2006). As an alternative to hierarchical organizing principles, trust seems much more suitable for complex systems, with reduced opportunities for traditional control and supervision (Bradach and Eccles 1989; Powell 1996). Yet, as organizations become more distributed, and closer relations get more difficult to establish, trust is also less likely to grow. This leads to what has been called the "paradox of trust" in modern organization (Handy 1995).[1] It is a "need-to-have value" since control and observation are difficult due to the distance. But at the same time the lack of proximity makes trust increasingly difficult to develop. An essential question then is how distributed work groups can escape from this paradox. Is it possible to develop trust in highly distributed work groups?

Studies of trust in distributed and virtual work have found that distributed work groups use different strategies to deal with this paradox. One stream of research has found that distributed work groups, much like temporary teams, seem to rely on a simpler and more calculative form of trust, so-called "swift trust" (Heckscher 1994; Meyerson, Weick and Kramer 1996). Empirical studies of globally distributed teams of students have found evidence of swift trust being important for performance in such ad-hoc groups and teams (Jarvenpaa and Leidner 1999). This line of study has received support from more recent work, indicating that trust in distributed work groups often relies on quickly developed impressions or images. A lack of interaction and proximity makes people develop trustfulness on a rather weak evidence in the beginning of the collaboration, and this impression tends to keep stable over time (Zolin, Hinds et al. 2004). This suggests that early impressions may substitute for much of the lack of immediate interaction in the groups. On the other hand, research has found that trust in distributed groups has the potential of reaching the same level as co-located groups, although it takes a longer time (Wilson, Straus et al. 2006).

Thus, existing studies have tended to avoid the problem somewhat, by stating that lighter and more functional forms of trust in most cases will be sufficient, or alternatively, that more time is

[1] "The more virtual an organization becomes, the more its people need to meet in person" (Handy, 1995:46).

needed to reach the same level. This article suggests, however, that there are other options for handling the paradox of trust in distributed organizations if one focuses on the group's structural networks. Approaching the distributed work group as a *network of relations* opens for a more fine-grained understanding of the constellations of stronger and weaker ties that hold the group together. One of the central features of a social network approach to small groups is that it can provide detailed information on the relationships between the involved actors in a group (Katz, Lazer, Arrow and Contractor 2005). It can also indicate if, and how, different involved sub-units or locales are connected. As such, the network approach stands out as a unique but largely unused strategy to investigate qualities of distributed work groups.

The central research question guiding the study is "what kind of structure characterizes high-trust groups that work across distance?" While previous studies have given somewhat contradictory answers to this question, the current study will explore this in more detail on the basis of quantitative and qualitative analysis of four cases, including researchers, product developers, technical advisors and financial controllers. Focussing on central aspects of their internal networks of stronger vocational ties, preliminary findings indicate that the high-trust groups had developed a stronger core-periphery structure than the low-trust cases. In both the high-trust cases *integrating cores* seemed to stabilize the groups and enhance the development of trust and performance. The findings presented here add to a growing body of research investigating network patterns of well performing distributed groups (Ahuja and Carley 1999; Koku and Wellman 2002; Cummings and Cross 2003; Hinds and McGrath 2006). It also contributes to the rapidly growing field of studies addressing the issue of trust in distributed groups (Jarvenpaa and Leidner 1999; Aubert and Kelsey 2003; Panteli and Duncan 2004; Wilson, Straus et al. 2006).

2. Trust, networks and the new boundaries of work

2.1 Trust in network perspective

Although there are many different ways to understand and describe trust, a central feature is that it describes a relationship between two people or (in some cases) between people and abstract systems and/or objects.[2] A much used point of departure is the definition presented by Mayer and his colleagues (Mayer, Davis and Schoorman 1995). They define interpersonal trust as: "A willingness of a party to be vulnerable to actions of another party based on the expectations that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Ibid: p.3).

This definition emphasizes interpersonal trust as a particular mindset or risk-taking attitude, of a trustor toward a trustee. As most definitions, it has a clear relational fundament, denoting the quality of a relation between two persons. This definition also demonstrates the appropriateness of a social network approach as this approach in particular encompasses theories, models and applications that are expressed in terms of relational concepts or processes (Wellman 1988; Wasserman and Faust 1994; Scott 2000).

In network theories trust is usually related to particular types of *stronger ties*. As argued by Granovetter the strength of the ties is the outcome of "the combination of the amount of time, the

[2] The idea of system trust has in particular been elaborated by Luhmann and Giddens (Luhmann 1988; Giddens 1994)

emotional intensity, the intimacy (mutual confiding), and the reciprocal services that characterize the tie" (Granovetter 1973). A strong tie is usually seen as a provider of more trustful relationships than a weak one. Even though a wide spectre of research has indicated the value of having a broad network of weak ties, studies have also indicated that strong ties are important. The "strength of the strong ties" is according to Krackhardt that they help reduce risks in insecure environments and predict the behaviour of others (Krackhardt 1992). Trust may, however, be seen as a multidimensional construct that includes both rational and affective dimensions (Lewis and Weigert 1985; Rousseau, Sitkin, Burt and Camerer 1998). While affective trust is most typical for intimate and family relations, a more rational type of trust – i.e. calculative trust – is most prominent in professional relationships. From a network perspective, trust in groups may be analyzed as interconnected patterns of both affective and cognitive ties (Julsrud and Schiefloe 2007).

Following a tie-strength approach, then, trust is related to stronger reciprocal ties that build up over time.[3] Studies of trust within the field of social networks also see this as closely related to the larger network structures: Within the area of social capital, trust has usually been related to particular constellations of social networks (Coleman 1988; Nahapiet and Ghoshal 1998; Cohen and Prusak 2001; Adler and Kwon 2002). Social capital can be defined as "the sum of actual and potential resources embedded within, available through and derived from the network of relations possessed by an individual or social unit" (Nahapiet and Ghoshal 1998). As such, the concept of trust is recognized as an important resource embedded in a social network structure rather than as (only) individual perceptions about particular others. A key term here is *network closure*, i.e. networks that are closed in the sense that two persons are united by a third common acquaintance or friend (Coleman 1990; Burt 2005). A central and consistent idea within network studies has been that denser networks have other qualities than open and more sparsely connected networks. The closure sets in as soon as a dyad is growing in to a triad: Having a common connection to a third party reduces the risk of trusting others, because the third party is a "witness" of the interaction. The benefits of interconnected triads for trust and stability have been followed up in recent studies of cohesive sub-groups in intra-organizational networks (Krackhardt 1999; Krackhardt and Kilduff 2002). In larger constellations the third party effect escalates, and the reputation effect sets in as well. As the network grows denser the risk of getting a bad reputation is always present, as this will usually increase the risk of cheating. In contrast, interacting in very open networks, with few third-party connections, is usually more risky.

A network approach, then, sees trust both as a quality of a particular (dyadic) relation and as a quality of a larger network or group. It deals with trust on an interpersonal but also on a structural level, and this makes it a suitable point of departure for studies of trust in distributed workgroups.[4] If a closed network structure of three or more people tends to reinforce existing meanings and attitudes through a reputation mechanism, ensuring that people do as they are expected (Burt 2001; Burt 2005), the effect may be to generate trust and support, or to create disadvantages and negative outcomes. In an empirical study of the relationship between senior managers, Burt and Knez (1996) found evidence that third party relationships influenced

[3] Note that the gradualness involved in building up trust is a crucial point made by social exchange theories (Homans 1950; Blau 1964; Kollock 1994). Blau, for instance, argues that although a certain portion of trust is necessary to initiate a relation, relational trust will gradually be produced as a successful chain of exchanges takes hold (Blau 1964 p. 94).

[4] The appropriateness of social network theory for studying trust has recently been recognized by several studies of organizational trust. See McEvily et al (2003) and Möllering (2006).

positively on the levels of trust, as well as on the levels of distrust if they both held negative attitudes toward the third person. According to the authors, this can be explained by the actual or potential gossiping between two persons embedded in a denser network. Because two parties usually display information that is consistent with their existing attitudes, their common attitudes toward the third party tend to get amplified. They argue that direct connections affect the directional trust level held by each party toward the other, and that indirect connections in reinforcement from a mutual third-party connection amplify or exaggerate the trust intensity, whether positive or negative, consistent or inconsistent. This is an important correction to over-simplified ideas of the value of dense networks. However, these authors do not disagree that network closure is important for creating agreements and trust: their point is that *between* denser sub-units, ties of mistrust can often be enhanced.

A controversial issue in studies of trust and social networks, that should be mentioned at this point, is whether one prefers to see the network as an outcome of interaction in networks, or the other way around. On the one hand network oriented scholars have tended to argue that trust comes out of repeated interaction over time (Blau 1968; Tilly 2005) and that a rich network represents a foundation for development of relational trust. This is also the general argument made by Coleman and most subsequent studies of social capital and trust in organizations. On the other hand it has been argued that trust is an important "attitude" driving the establishment of relations and denser networks in groups and organizations (Bradach and Eccles 1989; McEvily, Perrone et al. 2003). This issue is not easily solved, and in this paper I will not go in to this complicated discussion, but recognize that trust and networks tend be closely interconnected in a relationship that may go in both directions.

2.2 The risks of boundaries

For work groups in general a dense network of "strong ties" would be optimal for developing trust. In the context of distributed groups, however, there are at least four types of boundaries that impede the development of denser structures[5]. First of all, the *geographical distance* between groups and co-workers makes it more difficult to develop social relations. While physical proximity has proved important for the development of networks and relations, distance will in general impede the development of relations and social networks (Homans 1950; Blau 1964; Feld 1981). Efficient use of communication technologies may soften some of the disadvantages related to physical distance, in particular if it is used in combination with regular face-to-face meetings (Maznevski and Chudoba 2000). Still, lack of co-presence tends to reduce options for informal communication; an issue that is usually seen as crucial for trust building (Kiesler and Cummings 2002). A second boundary that often comes together with geographical distance is *difference in time*. Time boundaries are particularly problematic for globally distributed groups located in different time zones (Walther 2002). As a result communication in real time might be difficult, limiting the available means of communication. Thirdly, *diversity in disciplines* is often common in distributed work groups. Often – but not always – distributed groups include employees with heterogeneous knowledge. Such diversity can be advantageous, yet several studies have recognized that greater vocational diversity also makes the collaboration more vulnerable for breakdown (Albert, Ashforth and Dutton 2000). And fourthly, *institutional belonging* may represent boundaries for developing social relations when collaborations involve multiple

[5] In a very general way the concept of boundaries, as used here, may be described as obstacles to the possibilities of developing social relations.

organizational units. Institutions are often important sources of trust, and conflicting norms and values can make the development of trust more difficult (Zucker 1986). Previous findings have indicated that involvement of multiple organizations and institutions is problematic for distributed groups (Cummings and Kiesler 2005). Often, however, several of the above mentioned boundaries will operate in concert in cases of distributed work. As in the case studies presented later in this paper, distance-related boundaries may coincide with boundaries related to time and institutional belonging, making the development of social relations particularly challenging. Still, the most basic boundary involved in distributed work is geographical distance, and in this paper I will focus on groups where distance boundaries were salient, although recognizing that this overlapped with institutional boundaries.

The boundary of distance represents important challenges for the development of trust in distributed groups. Trust relations usually build up more easily within boundaries, among co-located individuals, than across them, and physical proximity is a central factor in the development of social networks (Homans 1950; Blau 1964; Feld 1981; Kraut, Fussel, Brennan and Siegel 2002). As such, the risk of developing *local* cohesive sub-units and *local trust* can be expected to be high in groups that involve several locations, with reduced face-to-face interaction. Following the arguments made by Burt and Knez (1996), *distrust* might easily be generated between such local units in situations involving uncertainty and risks. Experimental studies have brought evidence that uncertainty and risks may enhance local identities and increase conflict levels between organizational units (Krackhardt and Stern 1988).

Social identification theory is often used as a theoretical foundation to explain why conflicts between local groups and units so commonly develop (Tajfel and Turner 1986; Ashforth and Mael 1989). Following this theory, individuals tend to classify themselves and others in particular social categories. In general, individuals usually put themselves in categories together with individuals that have similar characteristics as themselves (so-called "in-groups"); while dissimilar others are categorized in "out-groups". In other words, mental boundaries are constructed based on perceived similarities and differences.[6] According to faultline theories (Lau and Murnighan 1998), the *composition* of such groups affects the possibilities of developing in-groups and out-groups. Following this more recent stream of research, social categorization processes can be expected to be most disrupting when there are strong dividing lines (i.e. faultlines) that can categorize the group in sub-units. Faultlines are most significant when they divide a group in two sub-units of approximately the same size and power. It is easy to imagine that geographical boundaries may represent one important dividing line in a group, and recent studies have generated some evidence that the location of employees may create faultline mechanisms among groups of distributed workers (Polzer, Crisp, Jarvenpaa and Kim 2007).

Thus, while a dense interconnected network of stronger ties would be optimal for trust in distributed groups, boundaries related to geographical distance make such networks difficult to achieve. Physical boundaries can evolve into "mental" boundaries related to identification if no efforts are made to interconnect local units. Thus, there is a risk that boundaries of distance together with institutional differences may lead to local trustfulness, but mistrust in the larger groups per se.

[6] Note that several network studies have found evidence that networks are more easily generated between similar others (i.e. homophily mechanisms). These findings in general fit well with social identification theories. Homophily mechanisms have been studied on the basis of similarity in age, gender, education, prestige, social class, tenure and occupation (Marsden 1988; Ibarra and Andrews 1993; McPherson, Smith-Lovin and Cook 2001).

2.3 Handling the boundaries of geographical distance

As a dense network of collaboration might be difficult to achieve in a remote work group, what may the alternatives be? Network research on distributed and virtual groups has started to explore these issues. So far, however, the findings have been inconclusive: On the one hand some studies have found that distributed groups might be better off with a hierarchical and centralized structure than with traditional co-located teams (Ahuja and Carley 1999; Hinds and McGrath 2006). Ahuja & Carley (1999) analyzed the network structure of a larger virtual organizational group consisting of 66 researchers. The study looked in particular for structural properties of communication networks and the way the structure fitted with different tasks. The study found a high degree of centrality and hierarchy in the communication networks. They concluded that virtual teams might be decentralised from an authority standpoint but that from a communication standpoint they may be centralized and hierarchical. Although this study did not focus on trust per se, it still indicated that a more hierarchical interaction-based structure may be most efficient in a highly virtual setting. On the other hand, there is evidence to suggest that work groups working with non-routine tasks need more integrated structures to coordinate their work. In a more recent study of the social structures of work groups, Cummings and Cross (2003) found that centralized structures were negatively related to performance as rated by the group members. Even though these findings were based on a mix of co-located and distributed employees working within the same organization, it indicated that cohesion may be a necessary feature in many knowledge-intensive groups.

The network-oriented studies above have looked for general patterns of high-performing groups, analyzing ties of communication and coordination. Some of the ambivalence on the structural question, however, may be due to a lack of attention to the particular *constellations of distant and co-located nodes*. The findings from faultline theories suggest, however, that the constellations of co-located and remote workers may be decisive for how well distributed groups function. In the light of these studies, general measures of centrality and/or density may be insufficient to capture the differences in distributed networks of collaborators. In this explorative study, we will therefore try to go one step further and look at the structural features within the groups, as well as their particular constellations of remote and co-located nodes.

3. Methodology and research design

Although there has been a renewed interest for applying a network approach on small organizational groups, this is so far mostly done on larger samples (Bélanger 1999; Sparrowe, Liden, Waynes and Kraimer 2001; Cummings and Cross 2003). The overall methodological approach applied in this study is on the contrary a *comparative, in-depth study* of a limited number of cases. The case study approach has been applied successfully in different areas and disciplines, and it is particularly suited for exploring diversity between a limited set of cases (Eisenhardt 1989; Ragin 1994; Yin 2003). Drawing on a limited number of distributed work groups, we looked for evidence of trust within the groups, as well as potential factors that could explain variance along these dimensions. As a general strategy we grouped the cases into “successful” and “problematic” cases of distributed work, and used the categorization as a point of departure to look for similarities and differences. In this paper we will focus in particular on the way the successful cases constructed their internal networks of weaker and stronger ties across the boundaries of distance.

Multiple techniques were used to compare the cases: First, the respondents were *interviewed individually* for 30 – 40 minutes. This part of the study aimed at getting an understanding of the general patterns of collaboration in the groups, and how satisfied the employees and managers were with the collaboration. Second, a *quantitative study* was used to get an indication of well-being, performance and trust within groups. Standardized inventories for the measurement of trust and performance were used, as well as indicators for well-being and belonging. Third, a *social network study* was used to indicate structural networks based on interaction frequency and professional collaboration. A triangulation of these techniques gave us good opportunities to understand differences and similarities between the cases, in regard to trust, performance and well-being.

In this paper we will in particular highlight findings from the social network study, and we will display results that indicate structural aspects of distributed groups with high levels of trust. Starting with an overview of the differences between the networks, based on a descriptive analysis, we will move on to a closer description of how the structures were established, and how they actually worked to stabilize trust. Regarding the issue of causality, we will not anticipate certain mechanisms, but rather explore how the network structure in the high-trust groups had been established and how it could be related to general trustfulness in the group

3.1 Selection of cases

For comparisons of case studies, it is important to sample cases that are comparable in sharing membership in a meaningful, empirically defined category (Ragin, 1994; p.113). This study is based on the comparative study of four cases of distributed work groups, broadly defined as; *groups of professionals that collaborate across geographical distance assisted by information and communication technology*. There is no single way to define distributed work groups. Most authors define this in a general way, as group-based work where members are located in different cities or countries, supported by use of information and communication technology (Lipnack and Stamps 2000; Zolin and Hinds 2004).

Further, to understand variations in the structures, it is useful to have a pool of cases where there is a high level of similarities along central dimensions. In this study all four cases have employees situated in at least two different organizations. Thus, this involves distributed work groups on a relatively high level of complexity. Second, all cases had employees located in three or four different sites. These sites were in different parts of the country, and in some of the cases (Omega, Delta, and Beta) even in other countries. Third, all of the cases comprised employees involved with tasks demanding high levels of communication and interaction. The work task can be described as non-routine and knowledge-based, typical for non-bureaucratic organizations. Fourth, all groups based their interaction heavily on ICT-mediated communication (i.e. information and communications technology). In all cases e-mail, mobile phones and various conferences services (audio and video) were used on a regular basis. And finally, all groups had worked together for about one year when we conducted our study. Thus we intervened in the groups after the collaboration had been well established.

3.2 Categorizing cases

To categorize the cases into high or low-trust groups (Table 1), different tools were applied. First, an inventory of group-based trust was used, based on an instrument developed by Pearce et al., and by Schoorman et al. (Pearce, Sommers, Morris and Frideger 1992; Schoorman, Mayer and Davis 1996; Jarvenpaa and Leidner 1999). This instrument included four items: 1) “We are

usually considerate of one another's feelings"; 2) "The people in my group are friendly"; 3) "I can rely on those with whom I work in my group"; and 4) "Overall, I find the people in my group trustworthy". For all items, the respondent could indicate agreement/disagreement on a five point Likert-scale.[7] If more than 30 % of the employees in the group disagreed (strongly or weakly) with any of the statements, the group was treated as a low-trust case. If not, it was classified as a high-trust case.[8] Second, incidents of mistrust and dissatisfaction were analyzed based on the qualitative interviews. If several such incidents were reported this influenced the categorization. Such incidents were more frequently found in the low-trust cases and it was used to elaborate our understanding of the groups.

Table 1. Cases and categorizations

Name	Type	Category	Trust (mean)	Std. Error of mean	Org. units	Countries	N
Gaia	Researchers	High trust	4.417	.072	3	1	15
Omega	Product developers	High trust	4.324	.102	2	2	17
Delta	Technical advisors	Low trust	4.033	.111	2	2	15
Beta	Financial advisors	Low trust	4.071	.223	2	2	7

3.3 Measures of networks and ties

In professional groups, close affective relations are usually rare. More common is a type of cognitive trust, based on recognition of knowledge and mutual recognition of expertise and competence (McAllister 1995; Lewicki and Bunker 1996). In our cases we were interested in finding the *vocational ties,* and those where trust was salient. To capture these, two types of relations were combined. Firstly, we asked for the intensity of the interaction. The questionnaire asked: *Whom in your group are you in contact with on a daily basis?* This question does not distinguish between mediated or face-to-face interaction but includes communication of all kinds. Still, interaction alone can be misleading as an indicator of a strong tie, as it may for instance be based on a high level of individual dependency. Therefore, we also asked for the relations that were recognized as particularly important when discussing work related problems. We asked: *Whom in the group have you discussed important work related issues with during the last five weeks*? This question tried to capture the network of colleagues who were important for developing common meaning, trust and identity within the group. For both questions a "roster design" was used, where a relation could be indicated on a complete list of employees in a group. The list was distributed on an email questionnaire, and full anonymity was granted beforehand (we use pseudonyms to distinguish group members).

[7] Chronbach´s Alpha = .754 indicates an acceptable level of reliability of the applied scale.
[8] A one-way test of variance (ANOVA) rejected the hypotheses that the high and low trust groups were equal (Sig. = 0.006, F = 8.064).

For each question, we got two matrices; one for interaction (M1) and one for work discussions (M2). The two networks were then merged into a directed and valued matrix that indicated the stronger and weaker vocational ties[9] (M3). If two persons in a group had daily contact and at least one of the partners recognized this as a useful relation when discussing professional matters, it was coded as a stronger tie. If there was only daily interaction, or only professional recognition without regular interaction, it was coded as a weaker tie. Although this conception of a strong vocational tie is not as strong as an affective tie between friends or family members, it indicates a particularly important relationship between collaborators in a group.

In the network section of the study we wanted to compare structures of the four different groups along some central dimensions. The structural cohesiveness was captured by analysing network density for each group. *Density* measures the average degree to which all members are connected to other members based on the number of actual ties as a proportion of the maximum possible ties.[10] For a valued network it is the total of all values divided by the number of possible ties. To capture the degree of *centralization* we applied Freeman's network in-degree centralization index (Freeman 1979). This measure gives an indicator of how well a network fits an ideal centralized structure (i.e. a network formed as a "star" with one central person and no interconnection among the other members). A third aspect of the network that we wanted to investigate was the degree of *core-periphery structure*. A common conceptualization of a core-periphery structure is that of one integrated core of nodes surrounded by more weakly connected nodes. We will here use the measure developed by Borgatti and Everett, that captures the degree to which a network fits an ideal core-periphery structure (Borgatti and Everett 1999). As discussed above, the boundary-crossing ties are particularly important in distributed work, since such groups usually consist of employees located at different sites. To capture this important dimension we applied the *I-E Index* analysing the share of ties in a network that connects to two or more sites (Krackhardt and Stern 1988). This enabled comparison of the number of boundary-crossing ties for each of the small networks.

3.4 Qualitative network data

Prior to the main quantitative network study, semi-structured interviews were conducted with employees and managers to get a better picture of their work situation. The interviews followed an interview guide focusing on each respondent's main work tasks, social relations, and identity in groups/organizations and trust issues. The informants were not asked directly about whether or not they trusted others in the group. Trust related issues were, however, captured indirectly by asking about satisfaction by asking about collaboration patterns, satisfaction and organization of the work.

Each interview lasted 30-40 minutes. Of the 53 employees, 45 involved were interviewed.[11] In addition, interviews were conducted with a selection of individuals outside the group, including the leader's superior executive and other managers in the company. The rationale for this was to get a better understanding of the group's tasks and position in the company by including "outside perspectives". During the qualitative study, intermediate reports and preliminary analyses were

[9] That is: M3 = M1 + M2

[10] The density measure is criticized for being insufficient as regarding cohesion. For some more elaborated approaches, based on connectivity of a graph, see White and Harary (2001) and Moody and White (2003).

[11] Some employees were impeded by job shifts and sickness. Five of the interviews were conducted by telephone for practical reasons.

made. The interviews were coded as text files (using NUD*IST software) and the main issues and topics from the interviews were classified. Write-ups were made for each of the cases and cross-case comparisons were done accordingly, including findings from the network study.

4. Results

Four groups of distributed workers will be presented in the following section: Gaia, Omega, Delta and Beta. We will first give a brief description of each group and the collaboration that was going on during our period of investigation. As interaction and communication are seen as particularly important for developing trust, we will draw attention to this in the text, as well as the actions taken by the manager to enhance the trust within the group. We will then move on to present evidence on the network structures within the groups, focussing in particular on the constellations and core-periphery structures. Finally, we will discuss further the development of the relations within the cores, and how they operated to foster and sustain trust in the groups. In this part we will therefore in particular draw attention to the two high-trust cases (Gaia and Omega). Note that all while only pseudonyms are given for individuals and groups, the genders of participants are unchanged.

4.1 Case descriptions

Gaia: Gaia is a group of researchers situated at two universities (A and B), located in different regions of Norway, and one private research institution. The project included nine PhD and master students as well as one professor and five researchers. The goal of the group was to conduct behavioural research in the area of information technology services, yet the participants also had their own goals, related to their education or research.[12] The project lasted for three years and several sub-goals had to be reached during the progress of the work, including carrying out joint work tasks, publication of reports, papers, et cetera. The group organized regular meetings approximately four times a year, and in between they had meetings by videoconference or audio-meetings. In addition, informal communication by e-mail or phone was common. Gaia was established as a joint project, where the industrial partner was the one that took the initiative to establish the cooperation. Later on, however, one of the university partners took over the management of the group, based on a common agreement. Gaia had a relatively long period of establishment, where students and researchers were slowly added to the group. A central challenge for the leader of the group (Edwin) was to include and involve participants situated in different parts of the country, each with individual tasks. Many of the discussions at the early meetings revolved around the issue of establishing a common framework for the group's work. The solution reached, after approximately six months, was to split the work into some general "work streams", following parallel tracks. This seemed to work better as the project avoided the continuous discussions of researching a common framework for the research activities. In sum, however, the satisfaction with the collaboration was in general high for the participants. Words like "positive climate" and "trustfulness" were often used to describe the collaboration in the groups. The group accomplished its work at the end of 2006 and most informants described the project as a success.

[12] Note that the author of this paper was involved as a contributor to the Gaia project.

Omega. The second case is a group of 15 product developers in an ICT organization responsible for a wide range of products. The group's main objective is to coordinate and collaborate on issues related to the development of existing and new consumer technologies. After an acquisition between two companies, the group was established with a majority of the employees as well as the manager located in Norway. Five employees have their regular work places in Denmark, and two Norwegian employees are located at a local office in another city. Omega experienced a tough start after the merger of the groups, characterized by many conflicts. Disagreements about technical questions were made more complicated by a lack of organizational structure that worked across two countries. A few weeks before our interviews the group had gotten a new manager (Torhild), who decided to assign a new set of sub-unit managers responsible for particular technical areas. This seemed to help the group focus their work around particular tasks and to generate clearer goals and intentions. In the group there were meetings at the Norwegian headquarters approximately every three months. This ensured that everyone in the group had met each other face-to-face. In addition there were audio conferences approximately every fortnight.

Delta: The third case is a group of technical advisors in a company consisting of employees situated in two countries. As was the case for Omega, this group also developed in the wake of an organizational merger and involved collaboration across Norway and Denmark. Delta also experienced significant problems and conflicts during their first year of collaboration. The interaction between the two national groups after some time was minimal, and some respondents admitted that they had problems even remembering the names of their colleagues in the other country. The group had regular face-to-face meetings on a monthly basis. However, the manager (Carl) had decided to run the group meetings as mainly local happenings, involving one "guest" from the other country. The idea was to ensure some integration and overlap, but there was much dissatisfaction with this. As a consequence the manager decided to start using videoconferences much more intensively. Still, there was significant dissatisfaction with the way the group was managed. Earlier conflicts and disputes about technical issues developed into a more permanent situation of mistrust toward the manager as well as the more distant group members. A few months after we withdrew from the group Delta reorganized into more local units, partly due to the significant collaboration problems.

Beta: The last case is a small group of economic advisors working together in a large Nordic computer company. A central task for the group is investigations of irregularities in economic transactions within the firm. The group comprises seven individuals from two countries. The manager is situated in Norway, although the majority of the staff is located in Sweden. Our initial investigation of the group found that the group was performing well and there were not many open conflicts. The group had regular meetings every month, and videoconferences were used to support their weekly group meetings. However, there had been changes in the organization of the group, and a new leader (Ann) had recently been made responsible for the managerial tasks. This had turned out to be difficult, as she was not as involved in the internal relations of the group as was the former manager. The group was dependent on having a leader with good connections to different parts of the larger organization and some members of the group had doubts as to whether the new leader had sufficient experience and contacts to manage this. There was also some uncertainty about the future of the group in the company, and where the different tasks

should be located. In the interviews, several respondents expressed dissatisfaction with the new situation, even if they felt that they handled their work reasonably well.

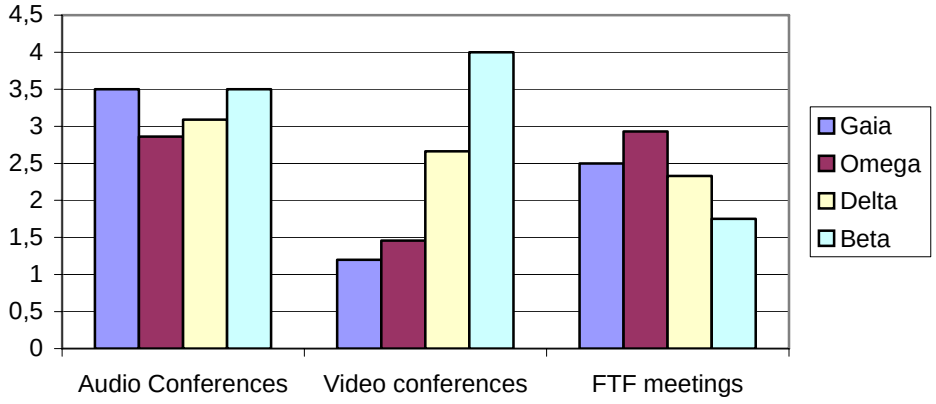


Figure 1. Intensity of mediated and face-to face interaction in the groups, showing mean values of estimated frequency among all members (1 = almost never, 2 = monthly, 3 = every fortnight, 4 = weekly)

The different communication patterns for the groups are indicated in Figure 1 by employees' registrations of the extent of use of audio-conferences, video-conferences and regular face-to face meetings. It is interesting here to note that the frequencies of videoconferences per se seemed to have little effect on the general level of trust in the groups: The most eager users of such conferences were Beta followed by Delta.[13] Face-to-face meetings, however, seemed to be more important, as the high-trust groups in general scored higher along this dimension. One reason for this was that at least in one low-trust group, the use of videoconferences had been added recently as part of a strategy to counteract dissatisfaction in the group. As such, use of videoconferences was here added as a *result* of the low-trust situation. Still, the finding suggests that advanced communication tools themselves are not sufficient to guarantee high trust in distributed groups.

4.2 Network structures

Four general structures were analyzed for each group (Table 2): in-degree centralization (maximum 1), value density (in this case with a maximum of 2), core-periphery (2 blocks) and the proportion of ties going beyond the local sites (E-I index). The high coreness values for Gaia and Omega for the vocational strong ties (ST), ranging from 0.652 to 0.669 (in bold), correlate with differences in trust. Thus, these cases had a structure more similar to an ideal core-periphery structure than Delta and Beta. The E-I index further indicated that there were no strong ties (ST) across the local sites in the low-trust cases, while there was a certain proportion of boundary-crossing strong ties in the high-trust cases. The in-degree centralization index (all ties) was strikingly lower for Beta, but did not correlate with those for strong ties (ST). Beta was also

[13] The connection between being in a group with high intensity of videoconferences (i.e. Beta and Delta) and individual trust level is actually negatively correlated a 0.01 level (r= - 0.366).

consistently highest in value density (bold), although its smaller set of nodes makes it difficult to compare it to the other cases along the indicator of density (Scott 2000 p. 97). Beta was lowest in the E-I index for all ties, and Beta and Delta for this index with strong ties (bold).

Table 2. Coreness, centralization, density and E-I indexes for the four cases.

Category	**Case**	**Coreness†**		**In-Degree Centralization‡**		**Value Density**		**E-I index**	
		All ties	*ST*	*All ties*	*ST*	*All ties*	*ST*	*All ties*	*ST*
Higher	Gaia	0.532	**0.652**	0.306	.168	0.2714	0.1238	-0.313	-0.273
trust	Omega	0.657	**0.669**	0.352	.320	0.3063	0.1471	-0.545	-0.375
Lower	Delta	0.534	0.462	0.367	.076	0.3467	0.1429	-0.429	**-1.000**
trust	Beta	0.557	0.472	**0.139**	.222	**0.8571**	**0.2857**	**-0.294**	**-1.000**

† Borgatti and Everett (1999).
‡ Wasserman and Faust (1994 p. 180, equation 5.5), computed by Pajek/Network/Degree/Input.

The structures of the Gaia and Omega networks are shown in Figures 2 and 3. Each comes in a "flat" upper figure, with cores encircled and managers labelled,[14] as contrasted with a "complex" version that shows how arcs are reciprocated (lower figure). Valued matrices for weak and strong ties are given in the Appendix along with trust ratings by individuals. Different colors for individuals in the graphs identify employees belonging to different spatially separated organizational units ("sites") within each distributed network. In the case of Gaia there are three such units within Norway, with red showing employees for one university, blue for those at another university, and black for those at a private research institution. For Omega (Figure 3) and Delta (Figure 4) the red indicates employees located at the Norwegian sites and the blue employees at the Danish sites.

Comparing cases, the two high-trust cases seemed to have managed to combine a strong core-periphery structure with a network containing stronger ties across the geographical boundaries. Gaia and Omega display two interesting cases of core-periphery structures that integrate and connect a distributed group. Table 3 gives the results of a simple, categorical core-periphery analysis for each network shows for Gaia that Tommy, Edwin and Jacob constitute a core representing all the involved local units (and institutions). Even though not every participant of the group is integrated in the strong-tie network, the core members have strong relations to central nodes in every local site. The Omega network core consists of four members; Torhild, Martin, Kari and Kai. In this case, however, the core did not include individuals from different locations and was located at one site, with different core members having strong ties to three of the four members in the Danish (blue) group. The interconnections between these peripheral members in the local Danish group were surprisingly weak, with only one weak tie and no strong ties amongst them, and thus no signs of a "rival" core in the Danish site.

[14] The old managers of Omega and Beta were working elsewhere in their organizations by the time the study began and so they do not appear in the networks.

Table 3. Members of core units for vocational strong-tie network (ST) and for networks of all ties (weak and strong), based on a Ucinet categorical center-periphery (C-P) analysis.

Category	Group	Core		Value Density in core	
		ST	**All ties**	**ST**	**All ties**
Higher Trust	Gaia (N=15)	Tommy, Edwin, Jacob	Tommy, Edwin, Jacob	1.333	1.333
	Omega (N=17)	Martin, Kari, Kai, Torhild	Martin, Kari, Kai, Torhild	1.500	1.750
Lower Trust	Delta (N=15)	David, Maria, Trygve	David, Maria, Trygve, Stein	1.333	1.500
	Beta (N=7)	Kristin, Thomas, Rita	Kristin, Thomas, Rita, Linda	1.000	1.333

For the two lower-trust cases there were no single unified core structures. The structures of the Delta and Beta networks are displayed in Figures 4 and 5. In the graph for Beta those at the Norwegian site are colored red and the Swedish employees blue. Delta had a strong basis in both the Danish and the Norwegian parts of the organization. The group had a network (C-P) core on the Norwegian side (Table 3) of approximately the same size as the less cohesive Danish group located with the manager (Carl). Beta had a similar two-core structure with no strong ties across the geographical boundaries. This group had a strong bias toward the Swedish site, however, although with the manager located in the distant Norwegian core. Note that in Delta and Beta the cores based on all ties were each enlarged with an extra member: Stein and Linda, respectively. The reason for this is that these two employees had such a rich network of weaker ties that the C-P algorithm included them in their cores. When it comes to the development and transmission of trust, however, the weak-tie members were probably less important than the members of the strong-tie cores.

Summarizing from the network analysis, at least three aspects appeared different between the high and low-trust cases: Firstly, the high-trust cases represented a densely integrated core that had *strong relations to all local sites involved*. The cores had a well developed network of weaker ties toward all peripheral participants. This was in particular the case for Omega where all but one of the Danish group members had strong ties to one or more members of the core. Alternatively, they displayed a core with representatives from each of the participating units, as in the case of Gaia. Secondly, the cores in the higher-trust groups had *no competitive core*. As can easily be seen from the maps of Delta, this group had two local cores, situated in each of the sites. This was also the case for Beta, although this group was one-sided, with the larger group at the Swedish site. And thirdly, the cores of Gaia and Omega had the *managers included in the core* of the group. As such the groups were almost working as (informal) “steering boards” where much of the work was coordinated and discussed.

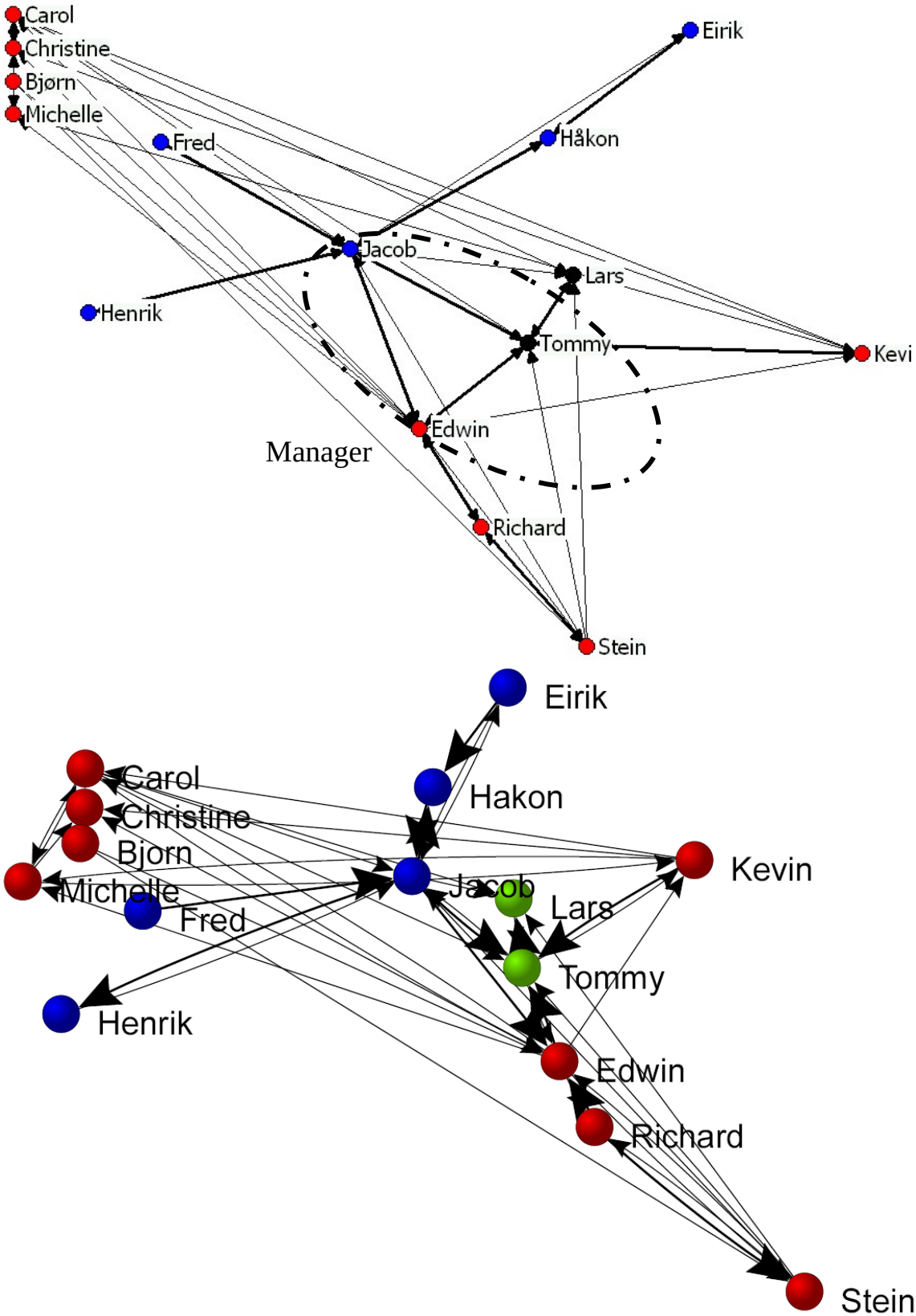
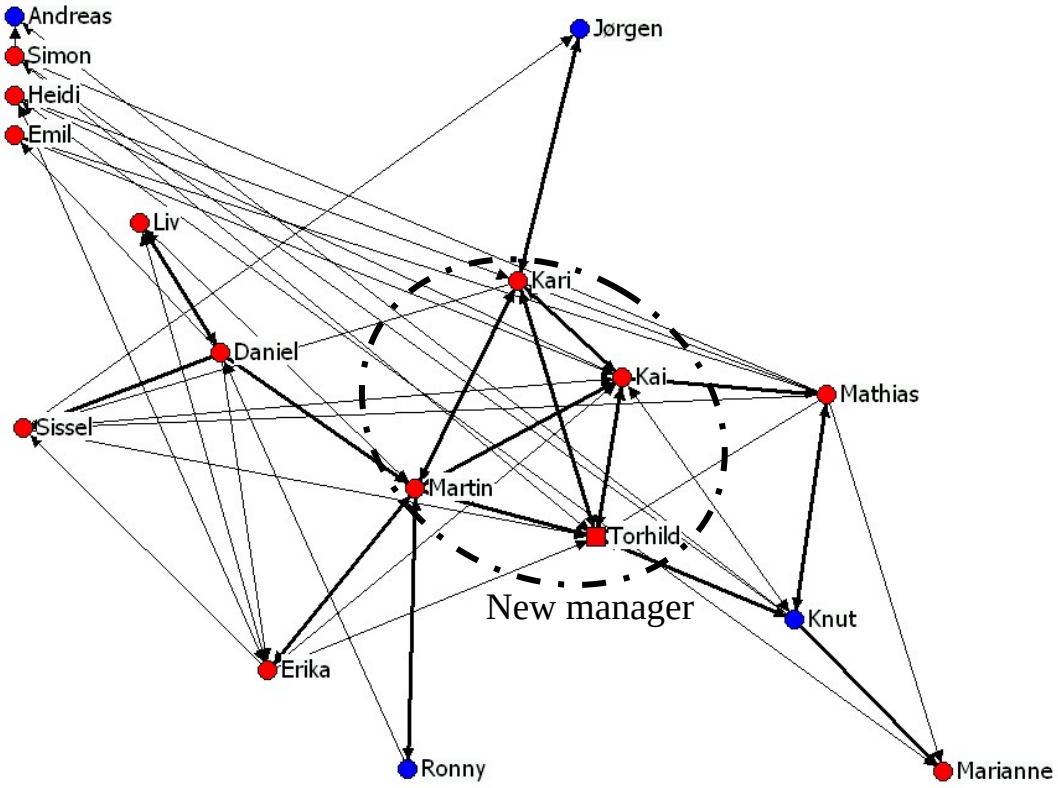


Figure 2. Vocational ties in Gaia (strong and weak), all Norwegian: Red/Blue=Universities A/B; Green=Private institution.



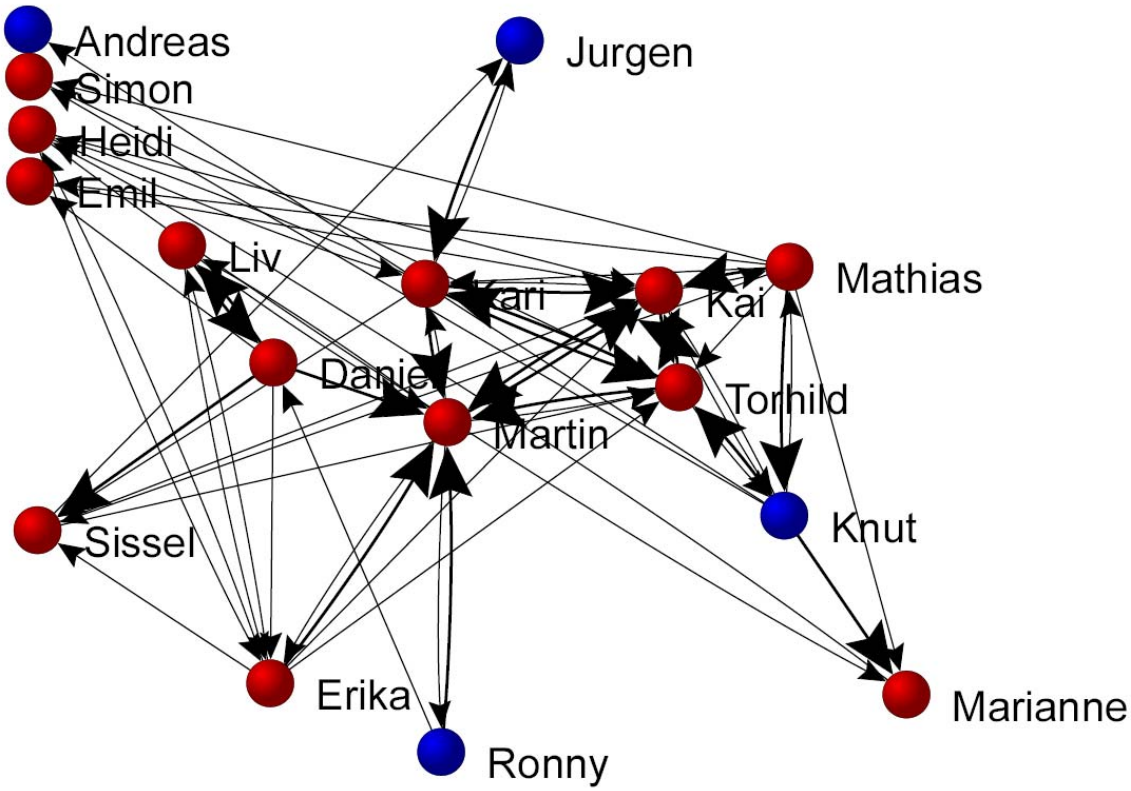


Figure 3. Vocational ties in Omega (strong and weak); Red=Norwegian, Blue=Danish

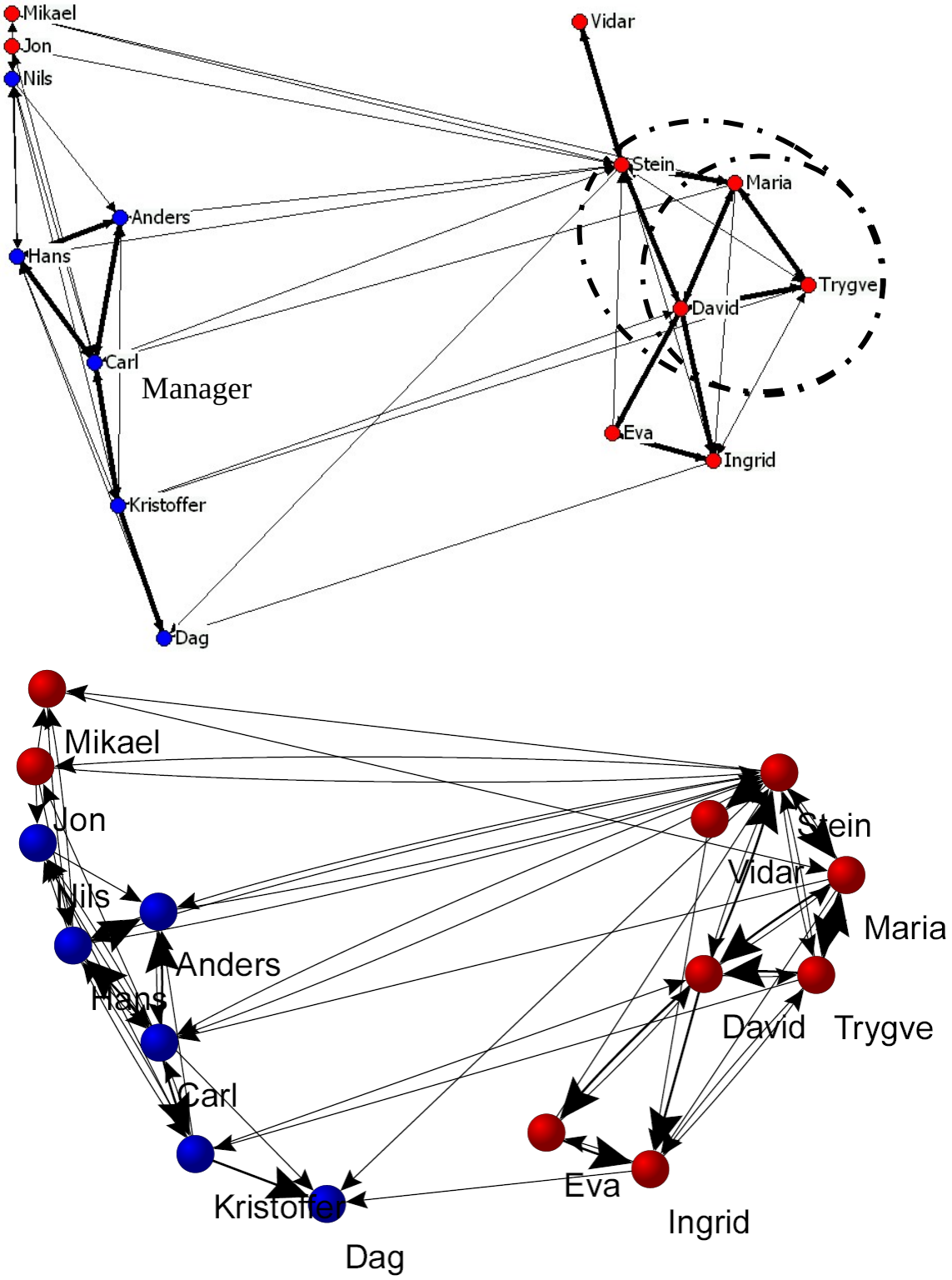


Figure 4. Vocational ties in Delta (strong and weak); Red=Norwegian, Blue=Danish

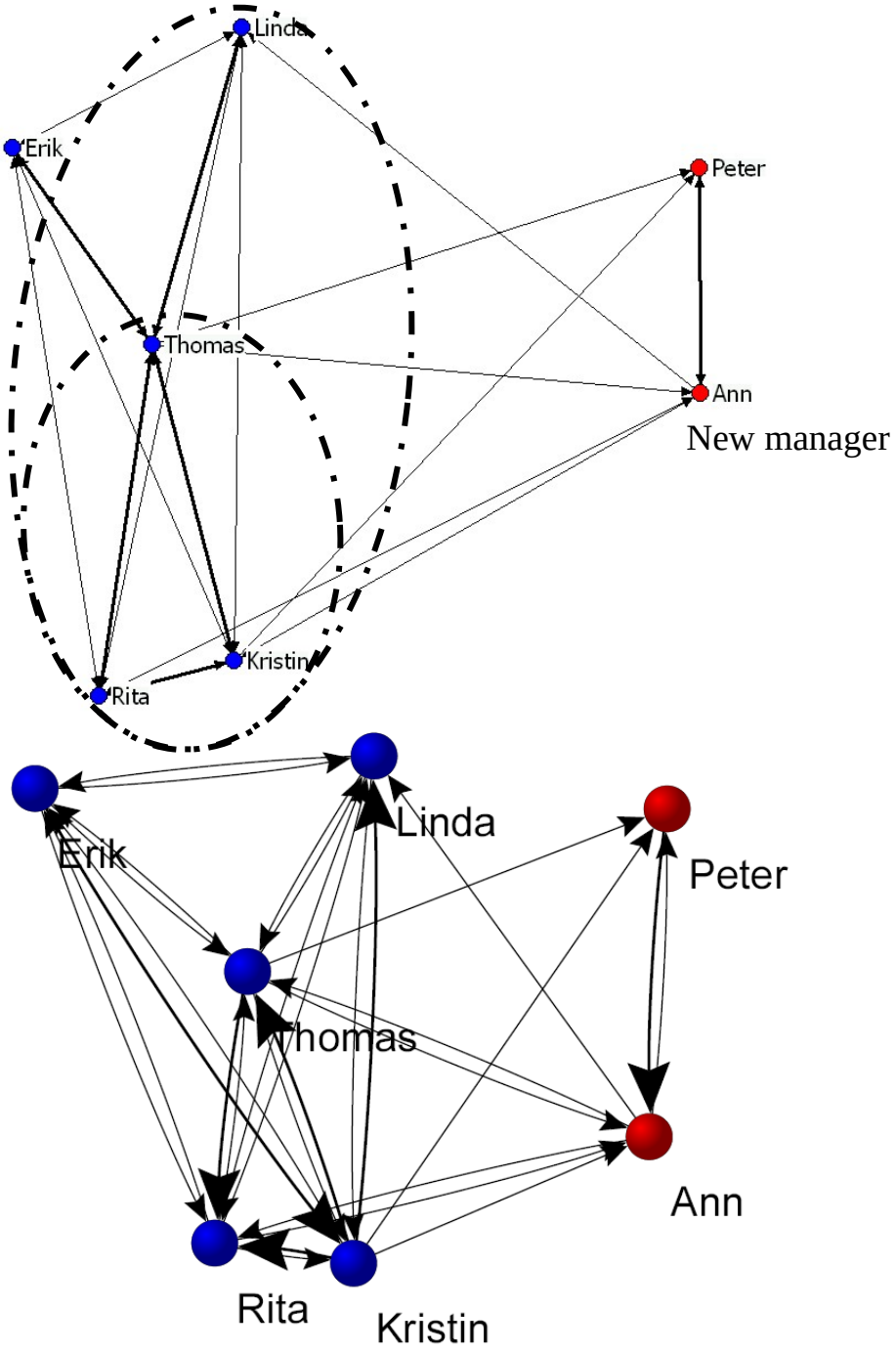


Figure 5. Vocational ties in Beta (strong and weak); Red=Norwegian, Blue=Swedish

Taken together, these structural aspects, especially those of strong ties, undivided cores, and managers within the cores, suggest qualities that were important for the development of trust and cooperativeness despite boundaries of geographical distance. In short, they had an integrating core that structured the work and held the group together across the distance boundaries. Given that these cores are important aspects of the development of trust in distributed groups, an

important question is how these cores operated to produce trust and stability. In the next section we will elaborate further on the way these cores operated to develop and enhance trust in the groups, based on our qualitative data.

4.3 Trust-building activities

4.3.1 Establishment of the integrating cores

The interviews gave us insight into the way the cores were constructed and how they operated. For Gaia, the triadic core between its three institutions, which was the point of departure for the project itself, was forged by prior relations: Lars and Edwin knew each other from earlier collaboration, and their personal relationship was important for the connections made between the private research institution and University A, while the relation to university B was similarly based on the prior acquaintance between Tommy and Jacob. The more peripheral members were, with some exceptions, students and researchers that were brought in little by little. The inner core of Omega was, in a similar way, affected by relations established earlier. Three of the members (Martin, Kari and Kai) had actually worked together for more than five years, prior to the present organizational form.

Thus, the several of the core relations in both these cases were established before the existing groups. Another important similarity was the decision to create smaller professional units operating more independently within the groups. In Gaia the manager together with Tommy and Edwin decided to divide the work in clearer "work-streams", and this seemed to help the partners involved in their collaborations. In Omega it was decided to organize the work in three technical sub-fields, and the new manager gave some employees (Kari, Knut and Martin) a new responsibility as sub-unit managers. Interestingly, in both these high-trust cases persons that were responsible for different knowledge units seemed to be represented in or strongly tied to the informal core in both groups.

Most employees in Gaia and Omega recognized that there were informal core structures operating within the group, and there were no strong objections to this. Still, there was sometimes a slightly different perception of who the members of the informal core were, so the boundaries between central and peripheral parts of the groups were fuzzy, at least in the minds of the participants. Therefore, one should probably not overstate the strength of the boundary dividing members of core and periphery.

4.3.2 Trust-building mechanisms

In what way did the cores operate to sustain trust in the groups? According to our interviews there were at least three ways that the inner cores enhanced and sustained trustfulness. First of all they conducted *immediate coordination* that was important for holding the group together. Members of the core groups in Omega and Gaia emphasized the value of immediate contact with a limited set of close collaborators:

> "The work I do here really depends on some like-minded individuals that I have a very good dialogue with. This makes things work despite the problems that sometimes occur…" (Martin, *Omega*)

> "The contact with Tommy, Edwin and Lars is important for my understanding and overview of the project. For me this is a central entry to understand every aspect of the work that we are doing [...] I feel that I have very good relations to these people, and I talk to them at least every week" (Jacob, *Gaia*).

Much of the day-to-day adjustment and problem solving in the groups was done within the group of core members, and their stronger relations ensured that this could be done briefly and sometimes also with simple media, like Instant Messaging and email interaction. Thus, the inner groups worked to coordinate the work informally, and to solve immediate problems on a day-to-day basis. This would probably not have been successful without good relations to peripheral parts of the groups. However, in both Omega and Gaia there seemed to be important links connecting the core to the local sites. For instance, a peripheral Gaia member, located at University B, stressed that he appreciated the relations that he had to Jacob, who was part of the core:

> "I feel that Jacob is doing what he can to make the work easy for us. He is my most important contact in this project and I feel that we have a good dialogue going on…" (Håkon, *Gaia*)

Thus, the immediate coordination was efficient because the core members had managed to establish good and trustful relations to the peripheral members. This ensured a common focus and also helped the group retain a clear direction and goal. As mentioned above, there were those in both Gaia and Omega who made strategic decisions to establish some professional sub-units within the groups, and this clearly helped to strengthen the core–periphery ties.

Secondly, the integrated cores were important as they assisted in *making the work visible* for all involved participants. For members of distributed groups, feelings of isolation are a continuous challenge, and face-to-face meetings are not always enough to counteract this. A core representing various parts could accomplish better contact with employees than, say, a centralized group, by having individual relations of stronger ties toward important sub-units in a distributed group. In Gaia and Omega few members complained that their work was neglected or marginalized. Core group members in Omega, like Kai, Martin and Torhild, underscored the importance of sharing information across sites:

> "There are many mails and even more telephone calls. I often call to hear how things are going, so that they shall feel that they are being followed up, and that there is interest for what they are doing. Since we cannot sit aside them and see what they are doing, we have to call them up and ask…" (Kai, *Omega*)

In contrast, in the lower-trust cases, employees often expressed that their work was neglected by the group manager. Employees' feelings of working in isolation were clearly a significant factor driving the Delta group toward distrust, rather than trust. In particular, the manager of Delta (Carl) was accused of not seeing what they were doing in the Norwegian unit:

> "He uses very little time on us, and when he is here usually has meetings with others […] He almost never sends e-mails or calls me up on the phone, and he has only vague ideas of what I am doing…" (Ingrid, *Delta* employee)

It is interesting to note here that the more intense use of videoconferences in the lower-trust groups had little effect on these matters (see Figure 1). Thus it seemed like the personal contact

between the manager and the employees was as important, for developing trust in the group, as regular group meetings.

Thirdly, the core groups seemed to *moderate conflicts* that occurred in different ways. Conflicts occurred in both of the high-trust cases, but they were solved on a local level. Episodes of conflict that had occurred in one of the university groups in Gaia were unheard of in other parts of the network. The integrating cores also helped negotiate issues before conflicts grew to intolerable levels. In Omega there were several conflicts, particularly in the first months of the collaboration. Again, a central aspect that helped to solve these conflicts was important personal relations that helped to establish trustfulness across the sites. For instance, in Omega, the peripheral member Ronny enhanced the importance of being connected to Martin:

> "Us in the little group…we have a manager that I can talk to about professional issues and everything. He is the first Norwegian I have met who really knows what he is talking about [….] The fact that he now works with us, with his professional competence, really makes me believe in this" (Ronny, *Omega*)

The quote indicates that a relation had been established across the national boundaries that could be used to "talk about everything". This statement underscores that it was not only a professional connection, but a tie involving significant levels of trust that had been established between these two collaborators (Ronny and Martin). Clearly, without such boundary crossing, stronger vocational ties conflicts might have escalated to higher levels in Omega, than they did.

4.3.3 Challenges to a core-periphery structure

The establishment of integrating cores was not without difficulties. Most threatening for Gaia was the continuous risk of disconnecting the more peripheral members. During the course of the collaboration two peripheral members decided to leave the group, and some individuals complained about being "not really part of the group". The bonds toward peripheral parts were, then, sometimes not strong enough. A second challenge was to avoid fragmentation of cores that were operating well. As for Beta, the operating core structure seemed to have broken down before we started our investigation, and at the moment of our investigation the group was in a state of fragmentation. The removal of a leader had disconnected a core that united the local units, and the new leader had not (yet) managed to establish new, stronger ties. A third, and perhaps obvious, challenge for the integrated cores is to avoid establishment of competing cores. In Delta there were two denser units located in each of the locations involved, and the group suffered from this polarization. For integrated groups like Omega and Gaia it would probably be threatening if some of the local units were disconnected, although we found no indications of such developments.

5. Toward a network-based understanding of trust in distributed groups

This article has displayed results that indicate that the distributed work groups with higher levels of trust have different network structures than the groups with lower trust. Inductive evidence from four cases suggested that well-functioning distributed groups took advantage of having a stronger core-periphery structure, and they also had some stronger ties to the involved local units. In this study we found two slightly different constellations of integrated cores: one that was mainly located in one site with strong ties to the periphery; and one with all local units involved. In both cases "integrating cores" appeared to operate in a way that moderated conflicts, enhanced

the sharing of information and enhanced immediate coordination. In contrast, the lower-trust cases seemed to move in the direction of developing a dual core-structure with few interconnecting ties between them. In this last section we will describe more closely the way these findings complement existing theories of trust-building in distributed groups, and how the findings may be followed-up in later studies.

5.1 Theoretical contributions

The aim of this paper has been to generate a better theoretical understanding of trust in distributed groups, based on a limited set of cases analyzed in detail. The argument for this is that it is a set of case studies that aim toward analytical generalization, rather than empirical generalization (Yin 2003). Therefore, although the small sample of four cases has given us insight that is useful for developing new theories in the field, they should not be used as a basis for drawing strong conclusions or to generalize to larger samples. The aim of this work has been to get a deeper understanding of how trust can be related to particular network constellations of vocational strong ties, ones cutting across geographical distance.

In the field of network theory this study adds to the literature on network structures in virtual teams. Prior contributions have found evidence of a centralized structure as most efficient for coordinating work, as well as the necessity for some level of structural cohesiveness. Against this, the present study suggests that an integrated core might be optimal as a way to balance the need for efficient coordination of tasks and integration across local units. The mechanisms related to the operation of the integrating cores provide additional hypotheses on how such groups operate, and why they succeed or not. The findings in this study seem to go together well with findings from previous experimental studies, indicating that opposing organizational units may result in higher levels of conflicts and distrust in situations of uncertainty and risk (Krackhardt and Stern 1988). This was largely the case with the two low-trust cases that experienced a “vacuum” of stronger vocational ties in between the local departments. At this point the evidence displayed in the low-trust cases could also be explained by faultline theories that predict that units with two groups having “boundaries” that divide the group into two subunits, of similar size and similar power, will tend to run into more conflicts than other constellations (Polzer, Crisp et al. 2007). Still, the more formal network methodology used here gives a much more detailed understanding of the relational structures involved, and of the roles of individuals in establishing and sustaining these structures.

This work also contributes to a dynamic, interdisciplinary field focussing on trust in distributed work groups and virtual teams (Jarvenpaa and Leidner 1999; Kanawattanachai and Yoo 2002; Panteli 2005; Wilson, Straus et al. 2006). A central hypothesis in this area has been that distributed groups can better manage with more task-oriented forms of trust, based on common understanding of roles, i.e. “swift trust” (Jarvenpaa and Leidner 1999; Kanawattanachai and Yoo 2002). To this picture, the present study adds that it is not only the quality of the relations that matters, but also the way they are interconnected. Applying a network approach to trust adds a relational dimension to studies of trust in distributed groups, and the findings here indicate that there is a connection between high-trust groups and their inner network of relations. Further, compared to most other studies of trust in distributed groups, the present study has certain methodological benefits: While most existing studies of trust in distributed work is based on field experiments with groups of students, this study has the advantage of being based on real work groups of professionals conducting knowledge-intensive collaborative work. It also has the

strength of exploiting a combination of a structural network analysis with a qualitative approach. This is a combination that manages to capture an outside perspective of the networks with an inside analysis of the social relations; a combination that has been sought after by network scholars (Kilduff and Corley 2000).

5.2 Limitations and further research

We should note, however, that this study has some clear limitations: Firstly, the study has been devoted to analyzing structural dimensions of the distributed collaboration, with a focus on core-periphery structures. Besides the factors that have been examined, others might be needed to provide a fuller explanation of the variations in trust between these groups, such as ties external to the individual groups. Such an effort would necessarily fall beyond the scope of this article. Secondly, we should also note that this work has not tested – or confirmed – any hypotheses regarding the causality of trust and network structure. The evidence brought forward here is mainly descriptive and does not propose that trust is a product of a particular structure (or the other way round). To achieve such conclusions, larger samples and other statistical tools are needed. And thirdly, the network data here is largely based on self-reported interaction data, and perceived closeness of the other participants in the group. Self-reported categorization of interactions will usually have problems of bias or reliability compared to data based on observations or technical records of interactions (Bernhardt, Killworth and Sailer 1982). Still, self-reported data have been found to be fairly reliable when it comes to the individual ranking of different activities, and useful to compare interaction patterns across different groups, as is done here (Hartley, Brecht, Pagerly, Weeks et al. 1977).

The relevance of the core-periphery structures as described here should clearly be further confirmed or confronted by additional empirical studies. Such investigations may want to apply more sophisticated techniques to detect, map and compare networks than have been used here. There are multiple ways of exploring core-periphery structures and cohesive areas within distributed collaborative networks, and it would be of interest to explore this further (Borgatti and Everett 1999; Moody and White 2003). Another option would be to explore in more detail the mechanisms involved in creating functional cores in distributed groups, through network-building mechanisms. The role of individual actors, working deliberately to build stronger relations across distance, appears as a particularly important area for further research. Existing work in the field of boundary spanning (VanSell, Brief and Schuler 1981; Friedman and Podolny 1982; Podolny and Baron 1997) and network brokering (Gould and Fernandez 1989; Gould 1991; Fernandez and Gould 1994; Burt 2005) appear as useful points of departure.

6. Conclusion

The challenge of developing trust in distributed work groups has been a much-discussed issue during the last decade. Most studies have been pessimistic about the possibilities for developing stronger forms of trust when the employees are located at a distance. This paper has suggested, however, that the establishment of relatively small distributed networks with some central relations crossing the physical boundaries can overcome much of these obstacles. These cases provide evidence that integrating cores within the distributed groups seemed to stabilize the total network and generate trust on a more general level. As such, a core-periphery structure appears as a more rational solution to the problems of developing of trust in a group of dispersed

collaborators, than simply trying to enhance trust within the group on a general level. The existence of integrating cores may therefore represent one way of dealing with "the paradox of trust" as discussed earlier in this paper: When trust can flow through a few interconnected individuals, centrally positioned in the larger network structure, trust may be enhanced for the total group.

As organizations and groups tend to move in the direction of becoming more elusive and opaque, investigating their local, structural properties appear to be increasingly relevant and interesting for researchers as well as the organizations themselves. Social network methodologies and theories are in a good position to do such analyses, as they have the capability of analyzing and visualizing the complex combination of co-located and remote connections involved. Clearly, the present study has only scratched the surface of these possibilities.

Appendices: Strong and weak ties matrices and individual trust scores

Coding:
Weak ties = 1 (daily contact or important work)
Strong ties = 2 (daily contact and important work)
Trust ratings = 1-5 (averaged per individual over four Likert scale questions)

I. Gaia

	Stein	Fred	Edwin	Richar	Kevin	Lars	Jacob	Tomm	Carol	Christi	Henrik	Bjørn	Håkon	Michel	Eirik	*Trust*
Stein	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	4.75
Fred	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4.50
Edwin	1	0	0	1	1	0	0	2	1	1	0	0	0	1	0	4.75
Richard	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4.75
Kevin	0	0	0	0	0	0	0	2	1	1	0	0	0	1	0	4.00
Lars	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4.00
Jacob	0	0	2	0	0	1	0	2	0	0	2	0	2	0	1	4.50
Tommy	0	0	1	0	1	2	1	0	0	0	0	0	0	0	0	4.25
Carol	0	0	1	0	0	1	1	1	0	1	0	0	0	1	0	4.00
Christine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.50
Henrik	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4.75
Bjørn	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4.50
Håkon	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4.50
Michelle	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	4.25
Eirik	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	4.25

II. Omega

	Sissel	Andrea	Simon	Daniel	Heidi	Torhild	Kai	Marian	Jørger	Kari	Erika	Ronny	Knut	Mathia	Emil	Liv	Martin	*Trust*
Sissel	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	4.75
Andrea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.00
Simon	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4.50
Daniel	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	2	4.00
Heidi	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	4.75
Torhild	0	0	0	0	0	0	2	0	0	2	0	0	1	0	0	0	2	4.00
Kai	0	0	0	0	0	2	0	0	0	1	0	0	1	1	0	0	2	4.00
Marian	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4.00
Jørger	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4.00
Kari	1	0	0	0	1	2	2	0	1	0	0	0	0	0	0	0	2	4.25
Erika	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2	5.00
Ronny	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	4.00
Knut	0	1	1	0	0	2	1	2	0	0	0	0	0	1	0	0	0	4.75
Mathia	1	0	1	0	0	1	2	1	0	1	0		2	0	1	0	0	5.00
Emil	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4.75
Liv	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	1	4.00
Martin	0	0	0	0	0	1	2	0	0	1	1	1	0	0	0	1	0	3.75

III. Delta

	Ingrid	David	Vidar	Mikael	Trygve	Carl	Eva	Stein	Maria	Jon	Dag	Kristoff	Nils	Hans	Anders	*Trust*
Ingrid	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	4.75
David	2	0	0	0	1	0	2	2	1	0	0	0	0	0	0	4.75
Vidar	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4.75
Mikael	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	3.50
Trygve	1	2	0	0	0	0	0	1	2	0	0	1	0	0	0	4.00
Carl	0	0	0	0	0	0	0	1	0	1	0	2	1	2	2	4.00
Eva	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	4.00
Stein	0	1	2	1	1	1	0	0	2	1	1	0	0	1	1	3.75
Maria	1	2	0	0	2	1	0	1	0	0	0	0	0	0	0	4.00
Jon	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	4.00
Dag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.50
Kristoffer	0	1	0	0	0	1	0	0	0	0	2	0	1	1	1	4.00
Nils	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3.50
Hans	0	0	0	1	0	1	0	1	0	0	1	1	1	0	2	4.25
Anders	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	3.75

IV. Beta

	Ann	Peter	Thomas	Kristin	Linda	Rita	Erik	*Trust*
Ann	0	1	0	1	1	1	0	4.00
Peter	2	0	0	0	0	0	0	4.75
Thomas	1	1	0	2	2	2	1	4.00
Kristin	1	1	1	0	1	2	1	5.00
Linda	0	0	1	1	0	1	1	3.50
Rita	1	0	1	1	1	0	1	3.75
Erik	0	0	2	1	1	1	0	3.50

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