Taking a Differentiated View of Intra-organizational Distributed Networks of Practice:

A Case Study Exploring Knowledge Activities, Diversity, and Communication Media Use

Eli Hustad[+], Robin Teigland*

[+]Agder University College, *Norway Stockholm School of Economics, Sweden

eli.hustad@hia.no, robin.teigland@hhs.se

Abstract: This study examines distributed networks of practice in a multinational organization in the energy and marine insurance industry. By taking a differentiated view of intra-organizational networks of practice, we identified three main categories of intra-organizational distributed networks of practice in terms of their primary knowledge activities - knowledge sharing, incremental knowledge creation, and radical knowledge creation. We then compared the networks along two dimensions: 1) the degree of diversity among network participants and 2) the communication media used by the network participants. Findings suggest that a higher degree of diversity is related to a higher degree of knowledge creation activities, but too much diversity may be restrictive when the primary activity is radical innovation. In addition, media use findings indicated an unexpected reverse relationship in which networks of practice with high task equivocality used leaner media than networks with less task equivocality. The results also indicate that the degree of diversity of a network's members may influence media use. Finally, support is found for second level media effects of media choice within the networks of practice, such as the degree to which individuals in the core of the network of practice may protect their domain.

Knowledge Creation and Networks of Practice in Multinationals

To achieve competitive advantage, multinational organizations must continuously create knowledge at a rapid pace while simultaneously transferring and exploiting it throughout their global operations (Bartlett & Ghoshal 1989). According to the knowledge-based view of the firm the challenge of a multinational is not to divide a given task into activities to be performed efficiently by different subsidiaries but to position the company so that "separate knowledge pieces" from across the organization may be combined to initiate new tasks (Hedlund 1994). The ability to create a sustainable competitive advantage is then based on a firm's combinative capability, or the ability to generate new applications through the combination and recombination of existing knowledge (Kogut & Zander, 1992). However, as many multinationals continue to expand their operations and thereby increase the number of geographically dispersed locations, employees, functions, and external partners, the task of effectively making use of knowledge within the firm becomes more difficult. Both the complexity of the multi-unit organizational structure and the differences in language and local culture may lead to significant challenges. More recent research on multinationals is finding indications that *relationships of a more informal nature* are playing an increasingly significant role in the above knowledge activities (Hansen 1996, Tsai 2002), and this research provides tentative support for a positive relationship between participation in informal intra-organizational knowledge sharing and organizational performance (Hansen 1996).

One body of literature that has been paying increasing attention to the informal knowledge processes of firms is that of networks of practice (e.g., Brown & Duguid 1991, 2000, Wenger 1998). The concept of networks of practice and the subset of communities of practice (Brown & Duguid 2000, 2001) describe the informal social networks that facilitate learning and knowledge sharing between individuals conducting practice-related tasks. In contrast to the use of formal controls to support knowledge exchange, such as contractual obligation, organizational hierarchies, monetary incentives, or mandated rules, networks of practice promote knowledge flows along lines of practice through informal social networks (Brown & Duguid 2000, 2001). Thus, they are to be distinguished from dispersed teams that are formally mandated and goal-oriented.[1]

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1 While network of practice relationships may emerge, that is not to say that the formal organization has no effect on their creation. For example, the formal organization may bring together individuals from across the organization. However, once the team is disbanded, individuals may continue to interact based on their own discretion due to the building of affective bonds. While this relationship originally is a formal one, it no longer falls under the "formal" category. As individuals form relationships based on biases and preferences for others, the creation of affective relationships may lead them to continue to interact regardless of formally defined structures (Stevenson & Gilly 1993). As a result, the position on networks of practice in this article falls between that of the formal organization entirely dictating interactions and that of relationships being truly emergent since the formal structure is argued

Within an organization, networks of practice typically consist of weaker ties linking individuals who are dispersed across an organization yet who are working on similar tasks using a similar base of knowledge. To date, there is a considerable number of empirical studies on communities of practice, a subset of networks of practice (e.g., Gherardi & Nicolini 2002, Lave & Wenger 1991, Wenger 1998) as well as a growing number of studies on electronic networks of practice (e.g. Nonnecke & Preece 2000, Wasko & Faraj 2000, 2004, Wasko, Faraj & Teigland, 2004), yet with the exception of a few studies (e.g., Hildreth, Kimble & Wright 2000, Lesser & Storck 2001), there is little research focuses specifically on the knowledge sharing and creation activities of *networks of practice whose members are distributed across an organization*.

With the above research gaps in mind, we performed an explorative case study in a small multinational firm operating in the marine and energy industry. Through a series of seventeen open-ended interviews in three European locations, we were able to build a rich picture of the firm's efforts to promote knowledge sharing and creation through intra-organizational distributed networks of practice. The study examines intra-organizational distributed networks of practice by investigating their *primary knowledge activities*, the degree of *diversity* of network participants, and the *communication media used* by the participants.

Such inquiry makes two important contributions. First, this research empirically takes a differentiated view of networks of practice rather than a unitary one, resulting in identification of three categories of intra-organizational distributed networks of practice; 1) those whose primary activity is to *share critical knowledge* to support problem-solving in daily ongoing business activities, and those whose primary activity is to *create new strategic knowledge* through 2) incremental innovation or 3) radical innovation. Second, this research contributes to the literature on media choice and use since interesting findings indicate an unexpected reverse relationship between *the primary activity* of the networks of practice and the networks' *communication media use*.

The paper is organized as follows. In the following section, we briefly review the relevant knowledge-based view of the firm and intra-organizational network of practice and ICT literatures. These literatures provide the foundation for the development of two research questions. Section three describes the research methodology and provides a description of the research site. Section four reports the results of the empirical study while the last section provides a discussion of the results and the implications of this research for theory and practice as well as suggestions for future research.

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to bias the shapes of networks of practice (Teigland 2003).

Theoretical Background and Development of the Research Questions

The knowledge-based view of the firm places considerable emphasis on taking a micro view of the organization with a particular focus on the individual (e.g., Nonaka 1994), and according to Grant (1996a, 1996b), competitive advantage results from how effective firms are in integrating the specialized knowledge of their members. Turning to multinational firms, one of the key issues underlying the knowledge-based view is to understand how knowledge is integrated across geographically dispersed units to create organizational capability (Hansen 1996).

Grant's theory of knowledge integration, however, represents a paradox: a focus on the efficiency of knowledge integration may hinder flexibility and the ability to create new knowledge and innovations. Network of practice and community of practice interactions may provide little additional knowledge over what an individual already knows. This may impede the ability to develop new and creative ideas (Granovetter 1973, 1983), thus resulting in core rigidities and competency traps – inappropriate knowledge sets that preserve the status quo and limit new insights. In addition, the knowledge in a tightly knit community of practice may be largely redundant. For example, Granovetter (1973, 1983) argues that closely-knit clusters in which individuals are well-acquainted and interact often are characterized by knowledge that is redundant. However, weak ties characterized by a relatively low involvement of time, emotional intensity, intimacy, and reciprocity, are instrumental to the diffusion of new knowledge.

Networks of Practice

Within the network of practice concept, Brown & Duguid incorporate Lave & Wenger's (1991) original work on communities of practice, describing this particular network of practice as consisting of "relatively tight-knit groups of people who know each other and work together directly…typically face to face communities that continually negotiate with, communicate with, and coordinate with each other directly in the course of their work" (Brown & Duguid 2000: 143). A central debate in the network of practice literature revolves around the knowledge sharing and creation activities performed by the various networks of practice. In some of the first literature, communities of practice have been positively linked to the creation of new knowledge through incremental improvements in local work practices in response to new problems (Brown & Duguid 1991). However, recent work has also noted that while communities of practice encourage knowledge sharing and incremental knowledge creation within communities, they may limit knowledge flows across communities and as such may place constraints on more radical knowledge creation and innovation in the wider organization (Brown & Duguid 2001, Swan, Scarbrough & Robertson

2002). For example, some researchers argue that more radical innovation occurs at the interstices between established groups and work activities since these interstices disrupt or fundamentally alter current work practices (Blackler 1995).

Boland and Tenkasi (1995) discuss innovation in their work on communities of knowing, which are similar to communities of practice, yet are found in knowledge-intensive firms. They argue that it is through dynamic interactions between communities that new configurations of knowledge really emerge. Organizations such as Ericsson, the telecommunications multinational, are trying to incorporate networks of practice and communities of knowing in their knowledge strategies (Hustad 2004, Hustad & Munkvold 2005), and are even focusing on promoting interaction between distinct communities, e.g., developing boundary practices (Carlile 2002, Wenger 1998) and hosting cross-community communication forums (Boland and Tensaki 1995).

Individuals who participate to a high degree in intra-organizational distributed networks of practice generally serve as brokers (Wenger 1998). These individuals act as bridges between local communities of practice and serve to transfer and translate knowledge between them. Due to the physically distributed nature of networks of practice, members are generally linked together through weak ties. Intra-organizational distributed networks of practice will have less redundant knowledge due to the weaker nature of the ties in these networks and thus may facilitate a higher degree of new knowledge creation.

Research Question 1. Knowledge Activities and Diversity

Knowledge sharing is not sufficient for creating a sustainable competitive advantage; firms must focus on knowledge creation through knowledge integration and the combination and recombination of firm-specific knowledge that is physically dispersed across the organization. Intra-organizational distributed networks of practice have a more extensive network of both internal and external contacts than local communities of practice. Individuals in other organizational units are more likely than co-located coworkers to have important knowledge that is non-redundant, generating access to sources of new ideas and innovations located across intra-firm boundaries (Granovetter 1973). Previous research has provided tentative support for the above since individuals participating in intra-organizational electronic networks of practice to a higher degree rated themselves as more creative compared to individuals participating to a higher degree in local communities of practice (Teigland & Wasko 2003).

Yet the limited previous research on intra-organizational distributed networks of practice has tended to focus on the dynamics of knowledge sharing as opposed to knowledge creation, thus leaving us with only a partial understanding of these important knowledge activities. One reason for this focus may be that most communities and networks of practice under study tend to be comprised of homogeneous as opposed to diverse members. This is no surprise since previous

research in various fields such as social psychology, network theory, and diversity theory has found support for the principle of homophily, or the phenomenon that people develop relations with similar others (Homans 1950), thus suggesting that intra-organizational networks of practice emerge between like-minded individuals. However, networks of practice consisting of more homogeneous members are argued to be less likely to engage in knowledge creation and innovative activities (Justesen 2004).

Building on the above, for our first research question, we are interested in investigating the different knowledge activities within intra-organizational distributed networks of practice as well as whether there is a relationship between the kind of knowledge activity and the degree of diversity within the network of practice. Thus, our first research question is two-pronged and becomes the following:

Research Question 1*: What kinds of knowledge activities, e.g., knowledge sharing vs. knowledge creation, do intra-organizational distributed networks of practice conduct and what is the relationship between these knowledge activities and the degree of diversity of the network of practice's members?*

Information and Communication Technologies

Members of intra-organizational distributed networks of practice are highly reliant on information and communication technologies (ICT) such as intranets and groupware to communicate due to their dispersed nature (Vaast 2004). Ellis, Gibbs, and Rein (1991) define groupware as "computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment" (p. 40). There is a growing body of research in the IS literature that investigates dispersed teams and knowledge creation and sharing within them, e.g., the use of information technology to enable group processes in the context of virtual organizations and virtual teams (e.g. Orlikowski, 1992, Sproull & Kiesler 1991, Munkvold 2003). These synchronous (e.g., video and telephone conferences) and asynchronous (e.g., e-mail) technologies facilitate the interaction and knowledge activities between network members across geographical sites in a multinational with the company intranet as a common organizational junction and entrance to different types of collaboration technologies (Munkvold 2003).

Within the field of communication research, researchers have paid considerable attention to the choice and use of communication media by individuals. One of the most widely known and used theories is media richness theory. Media richness theory argues that communication media vary in their level of richness, or the ability of a medium to facilitate shared meaning or convey information and to reduce equivocality (Daft & Lengel 1986), i.e., the existence of multiple and conflicting interpretations (Weick 1979).[2] The original

[2] It should be noted that equivocality is not the same as uncertainty. Equivocality means not knowing which

media richness studies found that the managers observed based their choice of communication media on the equivocality of their managerial tasks at hand (Daft et al. 1987). Media richness theory suggests that individuals will be more efficient and effective when richer media are used for more equivocal tasks while leaner media are used for less equivocal tasks (Kahai & Cooper 2003).

However, the theory pays no attention to the social context of individuals making media choices since it assumes that media have fixed properties (or that individuals have the same perceptions of media richness), individuals make choices independently of the people around them, and choice-making is purely cognitive (Fulk, Schmitz & Steinfield 1990). As a result, a broad range of alternative explanations has been developed, including critical mass theory (Markus 1990), the social influence model (Fulk, Schmitz & Steinfield 1990, Lee 1994), the emergent network perspective (Contractor & Eisenberg 1990), the genre theory (Yates & Orlikowski 1992), interactivity (Zack 1993), channel expansion theory (Carlson & Zmud 1994), and critical social theory (Ngwenyama & Lee 1997). While these theories all take a somewhat different perspective, they do share the same underlying assumption that communication richness is not an intrinsic, objective property of the communication medium alone. Rather, the same medium could support rich communication among some users in some organizational contexts, while only supporting lean communication among other users in other contexts. Along these lines then, the best medium for communication is not the decision of a single person since it emerges from the organizational context and from the interactions among people in the context using the medium over time (Lee 1994).

Research Question 2. Knowledge Activities and Communication Media Use

Based on the seminal work of Wenger (1998), organizational co-location is a significant factor in the development of communities of practice (Sole & Edmondson 2002), and these networks have been found to reduce equivocality through patterns of exchange and communication through the rich communication medium of face-to-face interactions (Schenkel 2002). The primary processes of communities of practice involve mutual engagement, collaboration, and narration, not merely the performance of the same kinds of task (Brown & Duguid 1991). These are the processes that lead to a shared repertoire and as such, they depend on frequent interaction in which members share experiences and recount stories often in unexpected encounters or informal situations. With respect to intra-organizational distributed networks of practice, we would expect that based on media richness theory, this type of network of practice would tend to use richer media over leaner media since they are involved in knowledge activities with a high degree of equivocality similar to those of communities of practice.

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questions to ask while uncertainty means not having the data required to answer a particular question. It has often been argued that people in lower organizational levels are more often faced with situations of uncertainty while upper managers are faced with equivocal situations (Rudy 1996).

Within a distributed network of practice, the geographical dispersion of individuals is likely to hinder the ability of individuals to spontaneously and frequently interact (Kiesler & Cummings 2002) and thus the ability to develop to the same degree a body of communal knowledge. The development of a sense of mutual accountability to the group may also be hindered since the dispersed nature may affect the group's ability to develop the necessary degree of trust, commitment, and respect (Orlikowski 2002). Finally, research on the problem-solving ability of communities of practice has found that when the use of richer media such as face-to-face and telephone negatively was impeded, the community of practice's ability to reduce equivocality and solve problems was negatively affected (Schenkel 2002).

Thus, the choice and use of communication media are particularly important for the ability of intra-organizational distributed networks of practice to reduce equivocality in their knowledge activities, and we would expect that they would tend to use richer media over leaner media to communicate. Additionally, knowledge activities that are more focused on knowledge creation than knowledge sharing involve a higher degree of equivocality, and the emergence of trust is necessary for knowledge creation and innovation to emerge (Fonseca 2002). Thus, we would further expect that networks of practice involved to a higher degree in knowledge creation activities would communicate to a higher degree through richer media than networks of practice involved in knowledge sharing activities. This leads us to our second research question:

Research Question 2: *What is the relationship between the primary knowledge activities, e.g., knowledge sharing vs. creation, and the use of communication media by intra-organizational distributed networks of practice?*

Research Site and Methods

In order to investigate the two research questions above, we chose to undertake this research in a single firm, Insure (pseudonym). While the objective in the future is to broaden the investigation to other firms, it makes sense to begin in a single case and then to re-evaluate on the basis of the findings from that study. We chose a case study because of the importance of studying network of practice knowledge activities in their real-life context (Yin 1989). This approach was particularly important given our emphasis on studying what *actual* intra-organizational distributed networks of practice existed, rather than the ones that top management assumed existed. A second reason for choosing a case study approach was that we felt the existing body of literature did not adequately describe the phenomenon under investigation (Eisenhardt 1989). Finally, a case study provides a more comprehensive in-depth study in one organization in which all the specificities that are unique for the organization are investigated more carefully.

The selection criteria were based on a number of factors: 1) globally dispersed operations, 2) participating in a highly knowledge intensive, fast-paced industry, 3) a networked organization with a high degree of two-way communication both vertically between headquarters and subsidiaries as well as laterally between subsidiaries, and 4) an explicit and active knowledge management strategy focusing on the transfer and utilization of organizational knowledge across functionalities and geographical locations. Finally, due to practical reasons, we were interested in choosing an organization with the majority of its operations located in Europe. Thus, for this study we chose a marine insurance multinational headquartered in Northern Europe.

Company Description

Insure is a multinational firm in the marine insurance and underwriting industry. The firm dates back to 1907 when a mutual protection and indemnity (P&I) association division was formed in Norway to provide marine liability insurance for regional sailing ships. Today Insure has three different product divisions (Protection & Indemnity, Marine, and Energy) and business areas comprising claims handling and underwriting activities. Insure has a 12% global market share and around two-thirds of the firm's members are domiciled in European and Nordic countries while the balance represents major industrial shipping interests in Asia and the Americas. In addition to insuring marine vessels of all types, Insure provides insurance in the oil and gas industry as well as conducts underwriting activities in the hull and machinery market. It is important to note that Insure is well known in the industry due to its ability to develop innovative insurance covers. With offices in nine different locations worldwide, Insure has approximately 330 employees comprising 27 nationalities and a number of knowledge disciplines, e.g., lawyers, maritime experts, experienced mariners, engineers and financial experts.

Data Collection and Analysis

We chose three organizational sites - Norway, England, and Finland, and collected data through interviews and secondary material. We chose interviewees to cover a range of hierarchical levels (from operational to top management), business operations, functions, and knowledge disciplines (lawyers with different legal competencies, mariners, engineers, financial experts, ICT, and knowledge management). We conducted seventeen interviews, each lasting approximately two hours. The structure of the interviews went from completely open-ended in the start to a more structured format. The interviews were taped and transcribed verbatim. The main source of secondary material was the Insure intranet, and this included internal reports, publications, presentation materials, workshop reports,

and meeting agendas and minutes. This provided important contextual information of the company's knowledge management strategies, their day-to-day events, policies, and practices. Additionally, we were provided access to the email discussions in one of the identified networks of practice. This gave us a broader understanding of the complex knowledge activities performed and the participants' behavior in the interaction and knowledge activities within a particular network. The process of data collection and analysis proceeded iteratively, allowing themes to emerge and then to be examined more deeply as relevant.

Findings

Through our investigation, we found that Insure consisted of numerous distributed networks of practice 'spun' throughout the organization, and in particular we identified eleven intra-organizational networks of practice in our data. We identified these based on our definition of networks of practice, i.e., self-organizing and emergent, self-selecting and not defined by the organization's hierarchical structure, and responsible for establishing their own agendas and leadership (Wenger & Snyder 2000).[3] Members of these networks of practice were from different types of divisions, functional areas, product lines, professional specialties, and project teams. Thus, these networks of practice interwove and interacted with each other across various boundaries, and members often participated in several networks of practice. The following quotations illustrate some of these typical characteristics in networks of practice in Insure.

> People can start to be proactive themselves, to show initiative, ask questions about things, come with ideas, and in that way show that here is a person who we really need [in the network] .. So everyone is the master of his own fate...(Senior underwriter)

> People decide themselves, on a voluntary basis, they know when they don't make contributions any longer …(Senior vice president)

Research Question 1: Knowledge Activities and Diversity

We investigated the eleven identified networks of practice on the two dimensions discussed above: primary knowledge activity and diversity (table 1). We first analyzed the networks of practice according to their primary knowledge activity. While we found a natural divide - knowledge sharing and knowledge creation, further investigation revealed that the knowledge creation networks of practice could be divided further into more incremental innovation and more radical innovation. We discuss this in more detail below. The next step was to investigate the diversity of the members in each of these networks, and the

[3] Additional networks of practice are likely to exist since our investigation covered only three out of nine locations.

following diversity categories emerged from the data: geographic location, nationality, business division and area, and knowledge discipline.

Network of Practice	**Number of Locations, Partici-pants, Natio-nalities**	**Business Divisions and Areas**	**Knowledge disciplines**	**Primary Knowledge Activities**	**Primary Communi-cation Channel**
1. Contract consultancy	4, 8-10, 6	P & I, Marine, Energy, claims, underwriting, defense	Lawyers with different legal expertise	Knowledge sharing Complex contracts questions from clients, requests from underwriters to legal expert group, problem solving, discussion, training and learning	e-mail Intranet - documents
1. Marine underwriting	6, 13-15, 4	Marine, underwriting	Underwriters	Knowledge sharing Underwriting guidelines, world market rumors and trends, fresh updates on market dynamics, updating new clients, discussions, assessing risk acceptance, news, administration information	Videoconfe-rencing e-mail
1. P & I underwriting	2, 12-14, 3	P & I, underwriting	Lawyers, underwriters	Knowledge sharing Same as above	Videoconfe-rencing e-mail
1. Defense claims network	3, 5, 4	Defense, claims	Lawyers	Knowledge sharing Sharing information regarding complex claims	Videoconfe-rencing e-mail
2. P & I claims management network	6, 6, 4	P & I, claims	Managers	Knowledge creation Plans for new business establishments, discussion of complex and new claims, loss prevention-, cover- and underwriting issues, and exchange of legal experiences and expertise with the goal of creating improvements	Telephone conference e-mail Intranet - documents
2. Underwritin g network	4, 6-10, 4	P & I, Marine, Energy, claims, underwriting	Managers, under-writers, lawyers, specialists, different professional backgrounds	Knowledge creation Plans for new business establishments, discussion of underwriting structures and quality management guidelines with the goal of creating improvements	Telephone conference e-mail Intranet - documents
2. Finance, underwriting network	4, 5-10, 4	P & I, Marine, Energy, claims, underwriting	Managers, lawyers, financial specialists, economists, different professional backgrounds	Knowledge creation Brainstorming and discussion of how to improve underwriting control systems, management decisions methods across business divisions, strategic discussions, management styles and philosophies	Telephone conference e-mail Intranet - documents
3. Working group 1	2, 7, 4	P & I, defense, underwriting	Lawyers	Knowledge creation Development of new products, refinements and further development of existing products,	Workshops e-mail Intranet - documents
3. Working group 2	2, 8, 4	P & I, claim, underwriting, defense	Marine biologist, lawyers, mariners, underwriters	Knowledge creation Same as above	Same as above
3. Working group 3	2, 7, 3	P & I, claim	Lawyers, ex mariners	Knowledge creation Same as above	Same as above
3. Working group 4	2, 8, 4	P & I, claim, underwriting, defense	Lawyers, managers, ex mariners	Knowledge creation Same as above	Same as above

Table 1. Intra-organizational Distributed Networks of Practice in Insure.

Our next step was to create a 'picture' of the identified networks of practice in Insure. We plotted their primary knowledge activity - to share knowledge or to create knowledge (the x-axis) against the degree of network member diversity (the y-axis) (figure 1). The figure shows the total diversity for each network based on the characteristics of the network's members: locations, nationalities, business divisions/areas, and knowledge disciplines. In order to ensure a consistent comparison between the networks of practice, we performed a relative comparison of them by weighting them according to the number of members within each. For example, to compare a network with five participants in three locations with another network with ten participants in the same number of locations, we divided the number of locations with the number of participants to get a relative comparable distribution of diversity parameters. Results indicate clearly that the middle group in figure 1 representing incremental innovation has the highest degree of diversity.

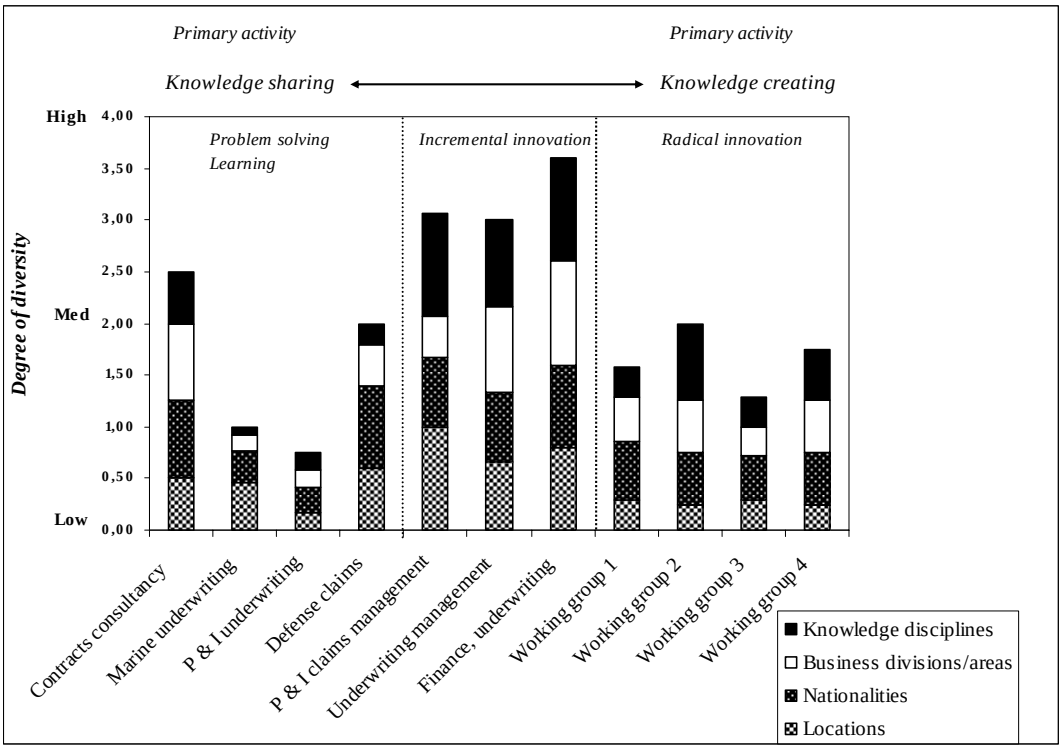

Figure 1. Knowledge Activity and Diversity in Insure's Intra-organizational Networks of Practice.

The first category of networks (left on x-axis in figure 1) whose primary activity is knowledge sharing and daily problem solving between locations has a low to medium degree of diversity. Two networks in this category have members belonging to the same business division and knowledge discipline (see also table 1); the other two networks in this category have a medium degree of diversity,

where the network of contract consultancy has a slightly higher diversity than the network of defense claims.

The category of knowledge creation – radical innovation (right on the x-axis, figure 1) has a medium degree of diversity, and these networks have a nearly even degree of total diversity. Below are results for each of the three knowledge activity groups.

1. Knowledge Sharing: Problem-Solving and Learning

Four networks conducting knowledge sharing activities were identified: Contract consultancy, Marine underwriting, P&I underwriting, and Defense claims. The function of these networks is mainly to *share knowledge* and expertise with other employees but also to get feedback and support to deal with complex business questions from Insure's clients. The members also discuss environmental changes such as new market trends and internal questions like working procedures, methods, and guidelines. One of the interviewees emphasized the importance of daily discussions with his colleagues in the following quotation:

> We discuss all kinds of daily things…but we hold a fixed agenda about what is actually going on, let's say global marine info. When my colleagues are presenting to their clients in America or Asia, they are dealing with the same thing all the time - how the competitors are reacting, what the market is feeling, how prices are rising. So daily, I think that we are the best team in the whole world. We know exactly what is going on in the marine underwriting in the world, and it's the real info, it's not one month old or one week old, it's daily. (Senior underwriter).

We found that the identified knowledge sharing networks are more homogenous than the knowledge creation networks since in the former, members often belong to the same business division (e.g. Marine underwriting network, category 1). However, they do have a high degree of nationality and location diversity. The members of the networks in this category were more stable than the incremental innovation network in terms of participation and long-time membership.

2. Knowledge Creation: Incremental Innovation

In this group, we identified three networks, and the primary activity of these was incremental innovation, e.g., improving business and quality management processes as well as particular management styles and strategies. These networks have a higher degree of diversity in all categories. We also found that some core members participated over a longer period of time while other more volatile members participated only for a certain amount of time depending on the topics of interest. For example, when a shift occurred in a topic focus, new participants replaced old ones, depending on the participant's expertise. However, consistent with the community of practice concept (Wenger 1998), changing status from a core member to a more peripheral member or an 'outsider', or non-participant, was jointly determined, since it was the result of both voluntary action by the member as well as actions by existing members, e.g., being asked to join based on

expertise. The following quotation illustrates the diversity in knowledge disciplines among the members:

> In the underwriting business, for example, one colleague and I have arranged a group that crosses departments [areas] and business divisions, we see who the relevant participants are and who will contribute to discussions around underwriting structures. We have made an email list and we meet every week in telephone conferences. (Senior vice president).

3. Knowledge Creation: Radical Innovation

We identified four networks involved in knowledge creation with a more radical innovation focus. (These networks of practice had labeled themselves 'working groups'.) These differed from the above incremental innovation networks since their primary activity was to develop a new type of insurance product as opposed to improving a process. Additionally, they transferred the knowledge and competence related to the new products they developed across the organization through such means as workshops and the distribution of electronic documents and product concepts on the intranet. These networks of practice exhibited diversity across all the categories; however, their degree of diversity was lower than that of the incremental innovation networks, particularly in terms of knowledge disciplines and geographical locations. This need for diversity in these networks was described in the following manner:

> We always try to get someone from each side, so it is a goal to try to have the three product areas represented; another goal is to try to get more distribution across the offices. (Senior underwriter)

> By having different people participate, for instance, someone who is participating on the cargos cover also deals with pollution claims [in the network] and gets something out of that…because otherwise it is a bit of a problem that people are becoming increasingly specialized, the expertise is becoming more and more narrow. (Lawyer)

Interestingly, we also found that these networks have been through a development process, moving from being completely informal, unstructured networks with ad hoc meetings to more formalized, structured, established networks with more fixed meetings and allocated resources and time to participate from management. In all the networks, the same two participants were co-located in the head office and were responsible for the coordination and administration of the networks as well as acted as catalysts to ensure continuous discussion and interaction between participants. Thus, these two individuals had core participant status while other members in other locations participated on a less frequent basis and thus had a more peripheral participant status. A core participant of one of these networks described one of these networks in the following manner:

> You see the purpose is to investigate new areas where we need to either expand an existing cover or to develop a new [insurance] cover…And first it was very informal, and individual claims handlers could either discuss it within, you know, their own working area, with other claim handlers or with their supervisor….But now, with this working group structure, at least if a claims handler wants to take up something in a proper forum, it exists…so instead of

having two people dealing with a cover question locally, now we are 5 or 6 people who could deal with this. (Lawyer).

Research Question 2: Knowledge Activities and Communication Media

The communication media used in the identified networks of practice are listed in table 1. We find that while all the networks used email to a very high degree for more daily, informal interactions, the three categories of networks of practice did vary in terms of the primary means of synchronous interaction. With respect to media richness theory, we expected that the radical innovation network would use regular synchronous interaction through face-to-face meetings or videoconferencing due to the high degree of equivocality in their knowledge activities. However, the leaner medium of e-mail was used in these networks, and face-to-face interactions where both core and peripheral members participated occurred only a couple of times each year. Neither was it expected that the knowledge sharing networks of practice would primarily use videoconferencing and the incremental innovation networks would primarily use telephone conferencing. Thus, there does not seem to be a direct relationship between knowledge activity and media use as predicted by media richness theory.

We then explored the relationship between diversity and communication media and found some interesting results. We expected that the most diverse network would use the richest medium of face-to-face interactions since communication might be impeded due to differences in languages, cultural behaviors, etc. However, we found that that the most diverse networks - incremental innovation networks, used the leaner medium of telephone conferencing over video and face-to-face. Additionally, we found that the most diverse network within the knowledge sharing networks - the Contract consultancy network, used the leaner media of email and document exchange as opposed to any form of synchronous media, be it face-to-face, video, or telephone, despite the more complex nature of the problems solved. Interviews revealed that this network was formed in order to increase the *efficiency* in handling difficult contract questions as well as to distribute complex questions that required a high degree of knowledge expertise and that were time consuming to handle. A second reason was related to learning: especially new, inexperienced lawyers could be trained while participating in this network. Members indicated that the reason they used email over richer media was due to efficiency considerations, e.g., to perform telephone or video conference meetings would require a lot preparation from the participants beforehand.

In the category of knowledge creation – incremental innovation, the participants preferred telephone conferences over video conferences, and one interviewee emphasized the ‘any time anywhere’ argument in favor of the telephone.

> I don't really see the big value-added with video conferencing…you're more dependent on having a meeting room in each office that has the necessary video equipment so you have to have that room booked. There usually is a little bit of technology "clutter", you usually lose 15 minutes in the beginning each time…And there are also so many of us who travel a lot. So, for example if I book a video meeting in two weeks, then I have to be there right at that time. But if I have a telephone meeting, then I could just as well be here, at home, at an airport, anywhere. Also, a lot of the underwriters travel a lot, so if you need to use the videoconference, does that mean that you can't participate? In the groups that I work with, the culture is that if you are out traveling then this is not an excuse to not participate. You participate no matter where one is. (Senior vice president)

As mentioned above, the identified radical innovation networks used mostly e-mail discussions to communicate. Interestingly, no synchronous communication media were used to discuss with the peripheral members from the branch offices (only email discussions) despite the availability of video conferencing equipment in all the locations and the members' ability to use the equipment. One interviewee described this in the following quotation:

> We have videoconferencing in two of our meeting rooms, so of course it is there. We have been thinking of using it, but so far we have not. It is easy to talk 'in the corner' on a more ad hoc basis…the problem could be to motivate the participants from the branch offices... they could feel kind of isolated…but they do participate by email, and when they participate, their contributions are of high quality. (Lawyer)

Discussion

Knowledge has difficulty crossing boundaries of practice even within an organization (Wenger, McDermott & Snyder 2002); however, interacting in intra-organizational distributed networks of practice enables individuals to take a fresh look at their own assumptions while facilitating knowledge recombination and integration. According to Boland & Tenkasi (1995) it is through dynamic interactions between communities that new configurations of knowledge really emerge. In Insure, we took a differentiated view of intra-organizational distributed networks of practice and found not only two, but three categories of networks of practice based on their primary knowledge activity: knowledge sharing, incremental knowledge creation, and radical knowledge creation. This finding could be expected when we consider the innovation literature that commonly makes the distinction between incremental and radical innovation (Dewar & Dutton 1986, Pennings 1988).

However, a surprising finding is that the incremental innovation networks have a relatively *higher degree* of diversity than the radical innovation networks. This is in contrast to former empirical studies on networks where high diversity is important to ensure radical innovation. Having ties to diverse parts of a broader social context will yield non-redundant information to a given node (Granovetter 1973), and networks of practice that have a diverse composition can utilize a

broader external contact area. Why then are the radical innovation networks not more diverse than the incremental innovation networks? One explanation could be that the complexity of problems to be solved is very high in the radical innovation networks, and introducing a high degree of diversity in knowledge disciplines and cultural differences further complicates the innovation process. For example, Carlile (2002) proposes that knowledge is localized, embedded, and invested in practice and has observed that knowledge is both a barrier as well as a source of innovation in a product development setting. Additionally, former empirical findings have suggested that activities of a more radical innovative nature require a relatively lower degree of diversity than those of a more incremental nature (Justesen 2004, Katz & Lazer 2004).

When we investigated media usage by the various networks of practice, we found a reverse relationship rather than support for media richness theory, i.e., the knowledge sharing networks used a richer medium (videoconferencing) than the incremental and radical innovation networks, which used telephone and e-mail respectively. In addition, it was quite unexpected that we would find that the diversity of network members appears to have a relationship with the media used - the most diverse networks used leaner communication media, and the radical innovation networks that were less diverse, but with the highest degree of task equivocality, used the leanest medium. However, equivocality arises not only due to the nature of the task, but also because people attach meanings to situations and these meanings are not objective and singular, rather they are subjective, socially constructed, and multiple (Berger & Luckman 1966, Weick 1979). Communities of practice reduce equivocality through a series of iterative cycles in which members communicate around the problem at large, improving their communal understanding with each iteration (Schenkel 2002). Thus, it would be expected that *ceteris paribus* the more diverse a network is, the higher the level of equivocality since individuals come with a more diverse set of meanings and understandings to attach to situations. Our findings, however, tentatively suggest that leaner media are better at reducing equivocality arising from member diversity. One explanation may be that leaner media, such as email, are more flexible because the information processed, transferred, and shared is not required to be formalized (Hanseth & Braa 2000). With email, individuals may spend more time to understand the meanings attached by others to situations since they may reflect and reread messages. Additionally, telephone conferencing may be used over video conferencing due to its flexibility as described above by one interviewee. Another explanation may be that individuals may concentrate more on the content of the message as opposed to being distracted by body language. These findings further support alternative theories to media richness theory as well.

Our findings also have relevance for research on media effects, i.e., what effects different media have once they have been selected for a message. Sproull

& Kiesler (1991) have suggested that media effects (of computer-mediated communication) can be divided into first and second level effects. First level effects are efficiency related and relatively easy to foresee, such as information overload, while second level effects are more difficult to foresee since they are concerned with the social impacts on groups and organizations, e.g., equalization and social presence. Our research provides tentative support that the choice and use of technology has a second level effect on participation in the network of practice. For example, videoconferencing as it is used by the knowledge sharing networks requires members to be located in an office with video conferencing equipment and of course to be physically available at the arranged meeting. By using this type of technology, a network's core members may exclude participants who are not in one of the organization's offices most of their time, thus restricting their ability to move from the periphery to the core of the network.

In addition to the above, our findings also have implications for management. One issue is the degree of formality that is appropriate for the various networks of practice. At Insure, it is interesting to note that some of the networks of practice have become more formalized over time; however, this has not been an explicit intention or strategy by management, rather it has been quite a discrete and careful process. One of the initiators of the increased formalization of the radical innovation networks explained the rationale in the following manner:

> Of course it is very risky to be dependent on only one or two people [to drive the network], so after a while we realized that we needed to make things a bit more formal. It's not that things didn't work on an informal basis before, but we realized that this was a bottleneck… (Senior underwriter)

However, this formalization process has not always been that successful as seen in the following quotation:

> And we have tried other types of [networks of practice], which have not worked, and I think it was because we tried to formalize them, and it worked better when they were these unstructured, informal networks… (Lawyer)

The above is reflected in the Daphne dilemma as discussed by Van Aken & Weggeman (2000) that deals with the problem of finding the right balance between intent and spontaneity when approaching an elusive phenomenon. Striving for more exploitation of an informal innovation network may improve productivity while too much effort may destroy the informal character and so undermine the potential of a network of practice.

A second issue is achieving the right degree of diversity in networks of practice. While our findings suggest that diversity is related to both radical and incremental innovation in networks of practice, this diversity may be difficult to obtain since intra-organizational distributed networks of practice tend to emerge as 'similar' employees within the same interest field and knowledge discipline practice make 'homophilous ties' spanning multiple networks (Ibarra 1992). At the same time, our findings tentatively suggest that the type of network diversity is related to the primary activity of the network, thus creating an additional issue,

i.e., will a high degree of diversity along knowledge disciplines or cultural differences increase the complexity in the context of the networks itself and thus inhibit creativity?

Conclusions, Limitations, and Future Research

In conclusion, we have investigated intra-organizational distributed networks of practice along two dimensions: primary knowledge activity and member diversity. Thus, these findings further support taking a *differentiated* view of networks of practice over a unitary one (Teigland 2003). Imposing one view on networks of practice masks possible heterogeneity that may be more important in explaining outcomes than a unitary one. Furthermore, we find tentative support that a higher degree of diversity is related to a higher degree of knowledge creation activities; however, too much diversity may be restrictive when the primary activity is radical innovation. Additionally, we find that the diversity of network members may influence media use by the intra-organizational distributed network of practice, but media richness theory is less supported in this study. Furthermore, tentative support is found for second level media effects within the networks of practice, such as the degree to which individuals may participate in a network.

Our research was exploratory and as such clearly has a number of limitations, thus providing for possibilities for future research. First, we have only looked at a limited number of intra-organizational distributed networks of practice within one firm. It would be interesting to see if our findings are generalizable to other firms as well as what the differences are between intra-organizational and *inter*-organizational networks of practice. Second, we have not explored any relationship between diversity, media usage, and the performance of the network of practice. Another interesting area for research is to further investigate the differences between the different kinds of networks of practice. For example, intra-organizational distributed network of practice members are not physically in the presence of each other, thus the nature of their interactions sharply contrasts with the ephemeral, typically private conversations between a limited numbers of individuals that occur in face-to–face communication in communities of practice. As a result, norms are not likely to be as dominating in intra-organizational distributed networks of practice as in communities of practice, allowing for more individual freedom in action (Squire & Johnson 2000).

A fourth area regards the knowledge itself that is shared within these different networks. As described by Wenger (1998), much of the learning and acquisition of knowledge by individuals in communities of practice occurs through an implicit mode. This is in line with Reber (1993) who argues that the acquisition of tacit knowledge occurs largely independently of conscious attempts to learn and largely in the absence of explicit knowledge about what was acquired. The

acquisition by an individual of a community of practice's tacit knowledge implies frequent interaction through word of mouth and everyday "looking and seeing" (Gherardi & Nicolini 2002), thus making it difficult to achieve in the non-face-to-face settings that are typical of intra-organizational distributed networks of practice. Finally, one area of research could investigate the ability of networks of practice to be constructed and managed by firm management, a challenge reflected in the Daphne dilemma (Van Aken & Weggeman 2000) - striving for more exploitation of an informal innovation network may improve productivity while too much effort may destroy the informal character and so undermine potential.

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