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Knowledge sharing through virtual teams across borders and boundaries

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Abstract

This study focuses on a challenge faced by multinational corporations: how to enhance knowledge sharing across geographical and functional boundaries given the multifaceted nature of knowledge. The article demonstrates how a multinational company can create the means and spaces necessary to achieve effective knowledge sharing and learning by highlighting a viable information system that supports social networking. It also offers a virtual team structure that draws upon and strengthens employees' social ties, which can boost organization-wide management of fine-grained knowledge. This combined approach mitigates the negative effects of physical and organizational distance on the availability of support and information. The present study contributes to organizational learning and knowledge-sharing discussions by shedding light on how virtual teams that function as knowledge activists can enhance internal knowledge sharing in globally dispersed organizations.

Keywords

case study, knowledge activists, knowledge sharing, multinational company, virtual teams

Introduction

Prior research on organizational learning has analysed the key concerns in knowledge management, including the challenges of fostering knowledge sharing by enabling the interaction of different actors within an organization. Many knowledge management scholars have underscored the need for spaces or communities that enable knowledge sharing (Enberg et. al, 2006; Nonaka et al.,

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2000; Von Krogh et al., 2001; Wenger and Snyder, 2000). These studies have noted the challenges inherent in knowledge sharing that relate to the international working environment such as time differences, the lack of face-to-face interaction, inter-functional barriers, and cultural barriers (Lucas, 2006; Minbaeva, 2005). In the literature, increasing attention has been paid to both the organizational capabilities of learning, assimilating, and creating knowledge and the structures behind knowledge sharing (Jones, 2006; Zollo and Winter, 2002).

Although the extant literature has recognized the roles played by individuals and teams as change agents, knowledge activists, or facilitators of knowledge sharing (e.g. Cross et al., 2006; Jones, 2006; Von Krogh et al., 2001; Wenger, 1998), these issues have received little empirical scrutiny compared to, for instance, organizational structures. Moreover, in today's multinational and geographically dispersed organizations, virtual teams are potentially much more viable facilitators of knowledge sharing than individuals or traditional teams. In this role, virtual teams serve as knowledge activists, sharing and mediating knowledge as well as promoting learning throughout the organization. In line with Von Krogh (1998), we define the knowledge activist as an individual or group whose task is to enhance knowledge sharing.

However, previous studies have not paid sufficient attention to how virtual teams might contribute to knowledge sharing in an organization. More precisely, there is need to investigate the function of virtual teams in organizational knowledge sharing and to understand what they require to fulfil this task. Therefore, this study focuses on the following: (1) how virtual teams mitigate the barriers to knowledge sharing in an international, multicultural, and geographically dispersed organizational context; and (2) the facilitating factors that must be in place for virtual teams to enhance knowledge sharing in this context. The main research question posed in the present study is: how do virtual teams contribute to knowledge sharing in an international organization? This study aims to examine this question by focusing on virtual teams as knowledge activists that are given the task of mitigating the barriers in organization-wide knowledge sharing.

The concept of knowledge activist was chosen to focus on the role of virtual teams in promoting knowledge sharing among all knowledgeable individuals within a geographically dispersed, multinational, and multicultural organization. Specifically, this study investigates the role of virtual teams as knowledge activists across inter-functional boundaries within the organization and in organizational contexts where there is an ever-increasing need for organization-wide knowledge sharing. The need for such knowledge sharing is multi-faceted: salespeople need technical and product-related knowledge on a wide array of products and their applicability under circumstances of technological complexity. Simultaneously, product development and product line marketing specialists need market-related knowledge from salespeople on the evolution of customers' needs and competitors' offerings. This study pays special attention to the location dimension of context (see Jones, 2006). Hence, a salient contextual factor in the present study is the virtual space in which virtual teams operate. More importantly, the present study demonstrates knowledge sharing through specialized virtual teams by acknowledging the diverse nature of knowledge in specific context and by showing how virtual teams and spaces create a viable basis for organizational learning.

Virtual teams as vehicles for overcoming barriers to knowledge sharing

Several researchers have investigated the challenges related to knowledge sharing in the context of geographically dispersed organizations (e.g. Lucas, 2006; Minbaeva, 2005). Most of these studies conclude that knowledge sharing relies on face-to-face encounters, cohesive social ties, dialogic

practices, shared norms, and trust (Jarvenpaa and Majchrzak, 2008; Mooradian et al., 2006). However, the physical distance between actors reduces the number of opportunities for face-to-face interaction. The absence of face-to-face interaction generally diminishes trust and cohesion among actors and thus compromises knowledge sharing (Malhotra et al., 2007). This issue is complicated by the fact that in addition to geographical barriers, multinational companies must also overcome functional and cultural barriers to their internal knowledge sharing. The literature on globally distributed teams generally frames the impediments to coordination and collaboration in terms of communication problems due to the divergent, nationally based cultural attributes of the sites, language barriers, and limitations associated with information and communication technologies (Kankanhalli et al., 2007; Mihhailava, 2007). Because team members cannot see each others' work in the virtual setting, a shared understanding of the role and accountability of each actor involved is essential. Such a harmony between people leverages expertise, facilitates coordination, and avoids redundancy and duplication of work (Duarte and Snyder, 2001).

Virtual teams are one solution to the challenges facing knowledge sharing in multinational companies. Recent studies by Vlaar et al. (2008) and Ratcheva (2008) argue that processes that support knowledge synergy and shared understanding make virtual teams a potentially powerful new organizational form. Specific challenges in managing virtual teams and essential practices of the virtual team leader have been elaborated recently (Malhotra et al., 2007). Cascio and Shurygailo (2003) emphasize that work can now be conducted anytime, anywhere andeither in real space or through technology, thus overcoming key challenges faced by global organizations. As technology has improved and collaborative software has been developed, virtual teams, whose members are spread across diverse physical locations, have become increasingly prominent (Kirkman et al., 2002, Martins et al., 2004). Considerable attention has also focused on facilitating factors such as communication technologies, which are needed to enable virtual work (e.g. Fioland O'Connor, 2005; Malhotra and Majchrzak; 2004). Two major approaches to the support of information systems in knowledge management (Kankanhalli et al., 2003) are codification (involving transmission of knowledge via electronic knowledge repositories) and personalization (involving transmission of knowledge via electronic communication with experts). Considering that organizations use virtual teams in knowledge sharing, research is needed to increase understanding of when and how to use information systems to leverage each approach. The present study focuses on the latter approach, focusing on what organizational practices are needed and what kind of system supports virtual teams in their contribution to knowledge sharing.

Some researchers have begun to uncover the nature of virtual leadership (Kayworthan and Leidner, 2002; Malhotra et al., 2007) and strategies for virtual team leaders (Malhotra and Majchrzak, 2004). The need to empower employees to work collaboratively is well established in organizational practice (Peters and Manz, 2007). Indeed, empowerment is a key variable that also facilitates the performance of virtual teams (Kirkman et al., 2004). Creating virtual teams that are comprised of members who may reside in different time zones and countries is one example of empowered collaboration in an organization (Horwitz et al., 2006). Indeed, we contend that empowerment and collaboration are so closely intertwined that organizations accomplish their tasks through empowered virtual teams. Virtual team leaders must overcome coordination barriers associated with working across distance and time, cross-cultural and language barriers, and trust and team cohesion barriers created when team members have very limited opportunities to identify common values. Jarvenpaa et al. (1998), Liedtka (1996), and Peters and Manz (2007) emphasize that the members of virtual teams must have an open mind and willingness to listen to and trust their teammates. They should also possess the ability to respond constructively to conflicts and act supportively, rather than authoritatively, in the team environment. Moreover, Maznevski and

Chudoba (2000) show that face-to-face meetings are important early in the formation of a virtual team, especially if the team's task relates to complex strategic issues. As Jarvenpaa and Majchrzak (2008) showed in their study of transactive memory systems (TMS) such meetings improve knowledge sharing. Their findings indicate that it is important to be aware of who knows what and who knows who knows, as transactive memory can serve as a facilitator of group performance. According to the transactive memory theory (Wegner, 1986), groups whose members are aware of the knowledge and expertise of other group members perform better than groups whose members do not possess such knowledge.

The extant literature reveals many examples of virtual teams that have been created to accomplish specific tasks such as innovative problem-solving related to product innovations or design (e.g. Malhotra et al., 2007). We propose considering virtual teams as *knowledge activists* that facilitate knowledge sharing on a continuous basis. In other words, these teams are designed to encourage and promote knowledge sharing within the context of a multinational company. In that sense, accomplishing the task (i.e. improving knowledge sharing) will not make virtual teams redundant but rather legitimizes their importance in an organizational structure. In their role as knowledge activists, virtual teams promote organizational learning and mediate knowledge in the global setting. In essence, the role of knowledge activists is to bring different people and groups together (Käser and Miles, 2002; Von Krogh et al., 1997). Moreover, the role consists not only of uniting otherwise disconnected individuals but also actively creating spaces and occasions for joint actions, thus reducing barriers to knowledge sharing among functional departments or teams. In other words, they enable the use of ideas and innovations in novel settings by acting as knowledge brokers (Hargadon, 1998). Furthermore, knowledge activists coordinate knowledge sharing and operate at the interfaces between the users and producers of knowledge (e.g. Wenger 1998). Finally, knowledge activists create a vision for the future by encouraging innovative activities within working groups. By linking diverse competencies and innovative ideas from one domain to another, they enhance innovativeness (Hargadon and Sutton, 1997; Von Krogh et al., 1997, 2000).

A key challenge in organizational knowledge sharing is that knowledge is context specific (Elsbach et al., 2005) and multi-faceted by nature. Moreover, agreat amount of knowledge is subjective and is continuously recreated and reconstituted in social interactions (Nonaka et al., 2001; Tsoukas, 1996; Von Krogh, 1998). In organizational knowledge management, knowledge may be seen as a practice or communal activity created jointly in social interactions within a given context, either through shared practices (Gherardi, 1999; Newell et al., 2006) or in a community or communities of practice (Lave and Wenger, 1991; Wenger, 1998), where the locus of knowledge resides not only in individuals but in communities. In the transactive memory systems literature, the locus of knowledge emphasizes that knowledge may exist at the individual, group, organizational, and even network levels (Jarvenpaa and Majchrzak, 2008). The challenge for the virtual environment thus becomes a space for the continuous recreation and reconstitution of knowledge. In practice, effective knowledge sharing requires both extensive social interaction among the actors and responsibility of the individuals in a team to engage in developing their own TMS (see also Macdonald and Piekkari 2005, Scott and Walsham, 2005). Again, the virtual environment challenges the technologies that are expected to serve as spaces for continuous knowledge sharing and constitution in the absence of face-to-face interaction (Hinsz et al., 1997; Kirkman et al., 2002; Von Krogh et al., 2000; Wenger and Snyder, 2000).

Figure 1 summarizes this section's discussion on the possibilities of virtual teams to contribute to knowledge sharing across firm internal borders and boundaries. However, as the discussion implies, there are several potentially serious barriers to knowledge sharing that virtual teams must overcome in order to share knowledge. Thus, a firm needs to employ managerial, organizational,

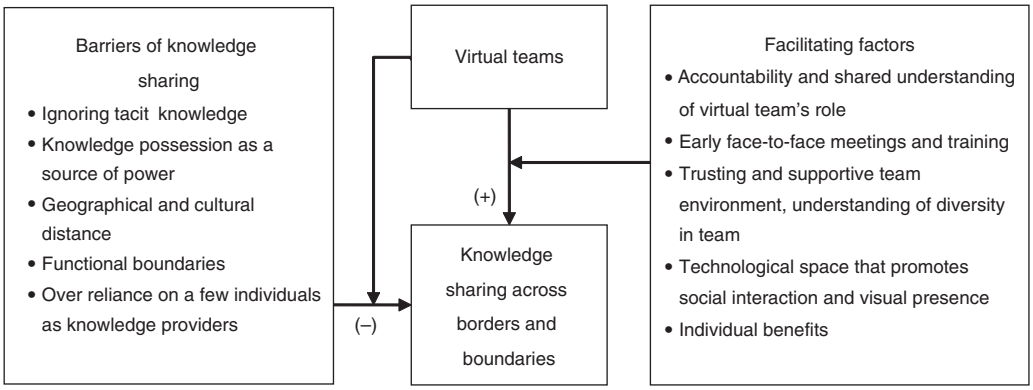

Figure 1. Conceptual model

and technological factors that facilitate the positive impacts of virtual teams—or mitigate the shortcomings of other barriers. In the following section, we first describe the case context and then present how the case firm used virtual teams to improve firm-internal knowledge sharing. Moreover, we discuss the facilitating factors that the firm employed in its attempts to support knowledge sharing through virtual teams.

Methods and data

This article reports a case study of the virtual team project in Vaisala Instruments (VI). The research process followed the realization of the actual knowledge project within the case company. In short, VI established a project team to create virtual teams to improve the firm's internal knowledge sharing. In collaboration with the authors of this article, the project team started by identifying VI's knowledge-sharing challenges and by evaluating how virtual teams could help them overcome these challenges. During the initial phase of the project, a member of the firm's project team interviewed 28 salespeople in person at international locations to determine the knowledge-sharing challenges that pertained to their work. Along with the interviews and other data collected by the researchers, the interview data were utilized in this study's analyses. The project and research teams then identified and analysed the knowledge-sharing challenges. The teams then discussed different models and means of understanding the management of knowledge and the formation of virtual teams.

Because of the complexity of the phenomenon under study, we conducted a single case study (Stake, 2000) using several data collection methods: participant observation, interviews, and a survey-based social network analysis (SNA). The case company represents a multicultural organization with a topical need to manage enterprise-wide knowledge sharing. The researchers adopted the abductive qualitative research approach in their analysis of knowledge sharing (Dubois and Gadde, 2002; Shank, 2002: 119). The rich case data provide us with both practical and theoretical implications.

SNA was used to identify the knowledge-sharing paths between the sales and product line personnel. For salespeople, the online form included the names of all people in product line marketing. By checking a box before each name, the salespeople indicated who supplied them with

Table 1. Interviews with virtual team members

Team	Number of members	Interview type
1	5	Individual interviews
2	6	Group interview
3	8	Individual interviews
4	4	Group interview

product-related information. Furthermore, after each name, a dropdown menu presented numbers from 1 (the lowest) to 3 (the highest), which the respondent used to rate the quality of knowledge provided by that person. An identical online form was presented to product line marketing people, but that version presented the names of salespeople, and the question pertained to their receipt of market- rather than product-related knowledge. A link to an online form was sent to 105 individual sales persons and product line marketing specialists. Initially, 102 (97%) people responded but after a reminder email, the remaining three individuals responded, yielding a response rate of 100. The project team then used the results of this analysis in their creation of virtual teams. One virtual team was created for each product line. Each of the four project teams was interviewed, either as a group or individually (Table 1).

We were also able to observe the virtual teams in action through the knowledge management portal created to support their operation. That is, by using a computer, we observed how virtual team members in practice interacted and communicated in the intranet knowledge-sharing space. These observations helped us to understand the pace, tone, and content of the communication. In addition to observation of the virtual teams' operation, we performed interviews to investigate the understanding of knowledge within the teams and the role of communities and knowledge activists. We also held team-specific workshops to identify different views of knowledge as well as the need for knowledge across teams.

In line with the abductive research approach (Dubois and Gadde, 2002), we analysed the data collected and compared it to the theoretical premises throughout the research process. Table 2 summarizes the analytical framework and concepts used in each phase of the research process. In reality, the concepts and theories are intertwined; for example, while the ideas about the nature of knowledge were used in each of the phases, the role they played was emphasized in Phase 1.

The concepts mentioned in the framework were studied by combining three areas of expertise: (1) concept of knowledge; (2) virtual teams and technological support in the analysis, which

Table 2. Data collection methods and conceptual issues in each phase of the empirical study

Project phase	Data collection	Conceptual issues
Identifying challenges	Interviews of key actors Discussion within the company and project team	The nature of knowledge Challenges in knowledge management Knowledge-sharing models
Establishing virtual teams for knowledge activism	Interviews SNA	Knowledge activists Social ties Existing worknets and communities of practice
Creating the virtual working environment	Interviews Observations	Virtual teams Technological support for knowledge sharing

made use of the empirical observations; and (3) prior research knowledge throughout the research process. Investigator triangulation within the research team improved the validity of the research. In addition, data triangulation and multiple analysis methods were used to improve the transparency of the research and the reliability of its findings.

Description of the case company

Vaisala Instruments is one of Vaisala Corporation's three business units. Its main concern is developing, manufacturing, and selling industrial measurement applications. Another business unit, Vaisala Measurement, focuses on meteorological measurement devices, and Vaisala Solutions provides its customers, such as road administration agencies, with environmental measurement systems. Vaisala Instruments accounts for approximately one-third of Vaisala Corporation's annual sales of 243 million euros (2008). Similarly, VI employs one-third of Vaisala Corporation's 1200 employees and generates one-third of Vaisala's operating profit of 38 million euros (2008).

Of particular interest is that 94 percent of Vaisala's sales come from outside its home country of Finland. Thus, the company has an extensive sales and service network, with 24 offices in 12 countries. Because each business unit serves different customer groups, each unit has its own dedicated staff of salespeople. In fact, Vaisala has approximately 440 salespeople scattered around the globe in 12 countries. Despite this global sales presence, most of VI's other functions and operations are based in Finland. Notably, all of VI's R&D and product line marketing functions are located in the company headquarters near Helsinki. The only significant exception is Vaisala's Boston office, which provides technical services to Vaisala's customers in North America. Otherwise, Vaisala's workforce outside of Finland consists almost exclusively of salespeople.

The business process structure of VI's organization builds on three main functions: R&D, product line marketing, and sales. First, as VI is a research-intensive organization that develops a wide range of products that are technically complex, its R&D group plays a key role in the business processes. Specifically, the problems encountered by VI's customers frequently require the attention of the firm's R&D people, since they have the expertise in measurement algorithms and other technological specifications necessary to solve such problems. For R&D, the benefit of these inquiries is that they often reveal new knowledge about products' deficiencies, which can be utilized further when improving existing products or developing new ones.

The product line marketing group acts as the commercial counterpart to R&D. The primary task of the people in product line marketing is to coordinate the activities that centre on products and product lines (product families) by providing salespeople with product-related information, representing the customer in product development, and finding new markets and application areas for the products. Finally, the VI's sales group is the firm's first line of contact with its customers. As a result, salespeople have the greatest need for product-related information. Simultaneously, they are the main sources of information about customers, markets, and product feedback. Unlike the employees in the other two main functions-who reside in Helsinki-salespeople are spread worldwide. Further, where nearly all R&D and product marketing people are Finnish, VI's salespeople come from more than 20 different countries.

Analyses and findings

Identifying the challenges of knowledge sharing prior to establishing virtual teams

> We have realized that there is a lot of knowledge in people's heads that should be put into movement. (VI HR director)

Although VI has long been among the best performers in the industry, its internal knowledge-sharing system has been viewed as needing improvement. Before establishing the virtual teams, the project team sought to understand what kind of challenges the new system needed to overcome. On the one hand, the salespeople did not always believe that they were receiving all of the product-specific knowledge they needed for customer service. On the other hand, the product marketing personnel were not completely satisfied with the quantity and quality of customer information and product feedback they received from the salespeople. VI's existing knowledge-sharing systems concentrated only on explicit knowledge and used a remarkably formal reporting format; they also lacked the means to encourage knowledge-sharing processes. Moreover, in some cases, knowledge was seen as a possession that facilitated power and thereby inhibited sharing with others (Kim and Mauborgne, 1998). For example, during the company's internal idea competition, rather than brainstorming initiatives together, employees kept their ideas to themselves so that they could use them in a later competition. Thus, employees preferred to promote their self-interest rather than work for the firm's benefit (Jarvenpaa et al., 1998; Newell et al., 2006). In addition, three important issues pertaining to VI's organizational structure complicated or impeded knowledge sharing: (1) geographical and cultural distances among the actors; (2) functional boundaries; and (3) over-reliance on a few individuals as knowledge providers.

First, geographical and cultural distances did not influence knowledge sharing between the R&D and product line marketing areas because both groups were located in the same building and members came from the same cultural background. However, when the sales function was included, the situation became completely different. In general, salespeople were not only geographically and culturally distant from the R&D and product line marketing groups, but also distant from one another. Thus, salespeople's communication was mostly constrained to relations with other salespeople in their local offices and the occasional support they received from the product line marketing specialists in Helsinki. As a salesperson from Germany described, this distance hindered customer service because it was difficult for salespeople to serve customers whose operations spanned across regions when Vaisala did not have an effective apparatus for multilateral knowledge sharing.

> We have one problem;[...] [a] global customer asked us for application and the problem was, who to address, who to ask, who is responsible in the other countries for this customer. So it's always, you have to go to Helsinki. (Salesperson)

In addition to geographical barriers, VI's knowledge-sharing organization had to deal with cultural differences and language barriers. Cultural distance was noted, especially between the employees in the western countries (Western Europe, North America, and Australia) and those in Asian countries (China and Japan). Cultural distance was coupled with language barriers and in particular employees from Asian countries reported that these differences interfered with their communication with the supporting staff at headquarters. At the instrumental level, telephoning Finland was also difficult from the Vaisala offices in Asia, Australia, and North America because of the differences in time zones. These challenges are similar to those identified in many studies focused on multinational companies (Krishna et al., 2004; Lucas, 2006; Minbaeva, 2005). VI attempted to bridge cultural barriers by promoting trust and active communication within virtual teams because these factors are likely to increase understanding among the actors.

Second, as VI's employees are organized primarily by their task function, the presence of boundaries between functions was inevitable. The benefits of functional organizing are especially significant for R&D people because the development of sophisticated instruments depends on

close collaboration among scientists and technical specialists. However, homogeneity within the functional groups accentuated the heterogeneity between the functions. In some cases, intergroup heterogeneity presented difficulties in communication and knowledge sharing, as people in different functions did not always understand concerns, priorities, or even the terminology used to discuss the issues. For example, the following remark by a product line marketing manager illustratively depicts how differences in functional focus obstructed knowledge sharing between salespeople and the product line marketing.

> A salesperson's way of thinking is often such that if a customer wants something else,and I just have this product, so I try to sell it to him or her. That is the focus. And if the customer says that this is okay, but I would actually prefer something else. Well, that message rarely reaches us, as the salesperson is happy with being able to sell the extant product anyway. Of course their interest is to sell as much as possible whereas my interest is to collect as much knowledge on the product preferences as possible. (Product line marketing manager)

According to Lave and Wenger (1991) and Horwitz et al. (2006), these kinds of problems are typically encountered in knowledge sharing between different types of communities. In addition, functional boundaries reduced face-to-face, interfunctional interaction, which limited the development of trust and understanding between people from different functions (Jarvenpaa et al., 1998; Lave and Wenger, 1991). As such, virtual teams struggled to build trust and open communication in virtual teams that were composed of individuals with different functions. Trust and open communication are elementally important since they augment virtual teams' ability to facilitate knowledge sharing.

Third, before the virtual team project, much of VI's knowledge-sharing burden rested on a few individuals who were liaisons between the salespeople and the rest of the organization. All these individuals were product line marketing people whose formal job description included mediating between commercial and technological matters. However, even among the product line marketing people, the knowledge-sharing burden in both directions tended to fall on a few employees. Consistent with the study of Jarvenpaa and Majchrzak (2008), we find that the number of individuals responsible for enhancing the group and organizational level TMS is limited. These individuals indeed acted as knowledge activists, but without the status and resources allocated for such a function. For instance, in a discussion of the changes that virtual teams were expected to bring, a product line marketing manager hoped that they would equalize the burden of knowledge sharing.

> I hope that at some point it equalizes our workload; as there are more individuals responding. (Product line marketing manager)

Importantly, an informal network of only a few individuals active in knowledge sharing included several risks and disadvantages for VI. For example, the organization's knowledge-sharing system is seriously harmed every time a key individual leaves the organization because these people possess a great deal of tacit knowledge and social capital, both of which are hard to replace. Further, the constant need to mediate large quantities of information and respond to numerous requests can cause strain and fatigue for the individuals serving in the bridging positions, thus increasing the risk that they will quit (Thomas et al., 2007). Moreover, a network relying on only a few active individuals did not facilitate the success of the knowledge activists (Käser and Miles, 2002; Von Krogh et al., 1997). For instance, most VI's knowledge sharing was repetitive, as questions and requests usually touched upon the same issues, which was frustrating

to product line marketing managers who had to spend more time and effort than they wanted to on routine coordination.

> I think it [the virtual knowledge-sharing space] will remove some of the frustration of like having this multiple places where to put information and making sure that is everyone on board on this or have I informed everyone. (Product line marketing manager)

The repetitious questions and answers only exacerbated the congestion of knowledge flow. In such contexts, knowledge sharing was found to consist merely of forwarding pieces of information rather than engaging in knowledge sharing. Therefore, the flow of knowledge was slow, reaching the intended recipients became difficult, and important requests were snowed under by simple ones. This congestion is a problem because knowledge activists cannot act in a coherent and coordinated manner if they do not have a steady, real-time flow of information about their progress and whether they are meeting expectations (Denton, 2006). From a salespeople's perspective, the problem was that obtaining necessary knowledge was sometimes slow and at other times nearly impossible, as illustrated in the following comment by a salesperson from Vaisala's Boston office.

> I would say more often than not it's a time issue, and if we don't get any e-mail response it means that one of the questions was very difficult and they need to consult many people to get the answer, or it's a time issue and they're not in the office or they're too busy with other things. (Salesperson)

Establishing virtual teams for knowledge sharing

> I noticed that when there is a rush, they call the person they know will answer quickly, and if not, they will call the person they think will provide the best answer. (Project manager)

As a first step in finding workable solutions to the challenges based on discussions among researchers and the project team, VI decided to establish global, interfunctional, virtual teams to improve knowledge sharing within the company. They wished to benefit from the internal diversity among various functions and the teams as spaces for novel interaction and bridge the differing knowledge contexts by the use of the virtual teams as knowledge brokers and knowledge activists (Hargadon, 1998; Malhotra et al., 2007; Von Krogh et al., 2000). The aim was to ensure everyone's access to all relevant knowledge, to encourage a culture that was conducive to the joint creation of new knowledge, to share openly both tacit and explicit knowledge, and not to view knowledge as a possession or as a tool of power (Newell et al., 2006; Von Krogh et al., 2000). The project team also desired to build teams based on people's social interaction rather than just creating another information system, thus perceiving knowledge as communal and as a process occurring in people's interactions (Newell et al., 2006; Nonaka et al., 2000). The main goal of the virtual teams was to replace individual project line marketing people and become the primary mediators and providers of knowledge. In other words, teams would become knowledge activists and create a joint context for knowledge sharing (Von Krogh, 1998), and in this capacity they would eventually exhort all of VI's employees to participate actively in reciprocal knowledge-sharing activities. In order to support the realization of the main goal, VI strengthened ties across functions and countries, and built a denser internal network among VI employees. This network was desirable because it increased the speed and extent of knowledge diffusion, and it improved organizational TMS by increasing the number of focal individuals in knowledge networks (Macdonald and Piekkari, 2005) as well as mitigating, over time, the negative effects of

cultural and functional differences in knowledge sharing. Moreover, the dissemination of complex product- and market-related—and even tacit knowledge—is much more likely to occur in dense rather than sparse networks (Hansen, 1999).

Before establishing the virtual teams, the project team wanted to find out where each employee turned for the information and how employees rated the quality of the knowledge they received from these sources. In other words, the aim was to identify the individual natural or organizational knowledge activist. The purpose of the social network analysis was to provide the project team with means to identify the specific individuals that were important nodes in the knowledge-sharing network. Furthermore, the analysis exposed both directions of the primary knowledge flows. That is, the sociograms depict the flows of technological and other supporting knowledge from product line marketing people to salespeople and also the flow of market knowledge that salespeople were supposed to supply to product line marketing. This identification was important since virtual teams were designed to include employees from both functions and improve knowledge sharing to both directions. Figure 2 presents a sociogram of the social network analysis of a virtual team development within one of the product lines.

In Figure 2, the nodes represent the knowledge-sharing network of individuals in one product line before the new virtual teams were established. Each connection between two nodes represents an active knowledge-sharing relationship, whereas the thickness of the line indicates the employee-rated quality of knowledge in the relationship. These kinds of sociograms were created for each of five product lines as well as for VI's organization as a whole. They were used to analyse both the centrality of individuals within the organization as well as the knowledge-sharing relationships among specific individuals in order to identify suitable candidates for the virtual teams. In addition, the organizational reach of the potential virtual team members' relationships was analysed. Sociograms were useful in selecting the team members because they illustratively depict the knowledge flows of groups under scrutiny. For example, the left side of Figure 2 exposes the actors who are active in sharing knowledge on a particular product line. The right side of the figure shows that the relationships among the members of a particular virtual team create a dense network. At the same time, it involves ties to the whole organization, and thereby helps to share knowledge also beyond the specific product line.

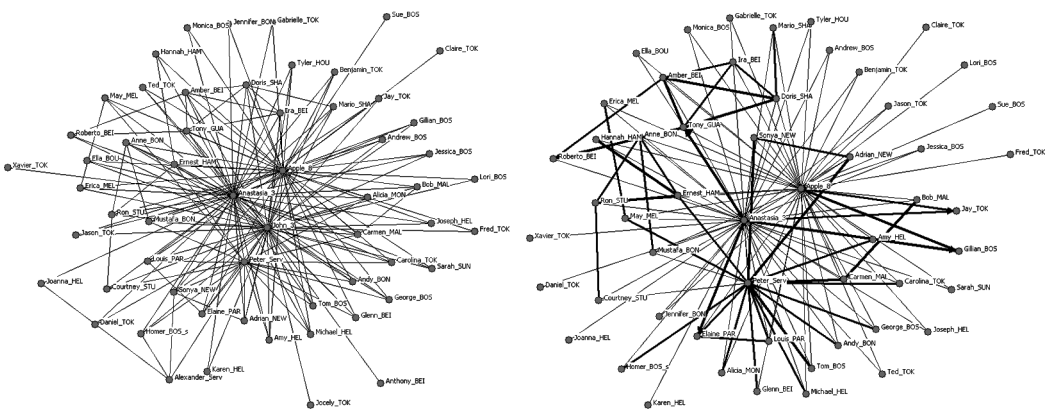

Figure 2. Development of knowledge sharing through virtual teams

> We also found surprises, like one individual who has not been in the organization for long, had unexpectedly strong ties in the sociogram. And it was very nice to learn that s/he was not as rookie as we had feared since we had considered him/her to become a team member. (Project manager)

A virtual team was established according to each of VI's product lines; thus, since the organization had five product lines, five teams were established. To populate each team, VI's project team selected the product line marketing people who were already active in sharing and mediating knowledge. Here, the purpose was to exploit the strength of the established knowledge-sharing network with which the employees were already familiar. Moreover, one or two other product line marketing people were added to each virtual team. Through this configuration, the project team aimed to balance the burden among the product line marketing people and give each of them an equal opportunity to participate in knowledge sharing.

Besides the product line marketing people, salespeople comprised the other elemental group in the virtual teams. The aim was to create specialized virtual teams that acknowledged the linked benefits (e.g. differing expertise), yet noted the challenges (e.g. multiple cultures) (Malhotra et al., 2007). In general, each team consisted of three product line marketing people, six salespeople and a person from R&D or technical services. As was the case with the product line marketing people, the salespeople were selected based on their existing ties and their activity and ability to share knowledge according to ratings by their colleagues in product line marketing.

> In Europe, we screened out a few prospective individuals based on... if we knew that they were a bit too strong-minded personalities, maybe not so much team players. (Project manager)

Moreover, because the mission of virtual teams was to promote knowledge sharing throughout the global organization, salespeople from different geographical and cultural regions were selected for teams. In this way, VI wanted to bring down the barriers resulting from cultural differences (Krishna et al., 2004; Lucas, 2006; Minbaeva, 2005). Some of the long-term goals that pertained to the involvement by salespeople with virtual teams were especially ambitious. For instance, the salespeople assigned to virtual teams were, in practice, responsible for exhorting other salespeople in their regions to adopt more active behaviour in terms of knowledge sharing. In that function, they were allocated two tasks as knowledge activists, one as a catalyst and the other as a mediator for knowledge sharing (Von Krogh et al., 2000).

Before starting their formal operations, each virtual team had an intensive week of training in Finland. The purpose of that week was to orient and educate the team members in their new roles, but more importantly, the opportunity was intended to create trust and establish social bonds among the team members. Thus, the programme designed by VI's project team included many shared social events, such as sauna evenings and cottage weekends. Special emphasis was given to the intensiveness of the teaming activities because several studies (e.g. Jarvenpaa et al., 1998; Malhotra et al., 2007; Orlikowski, 2002) have accentuated the role of face-to-face interaction in creating trust and a collective identity among the team members.

> This kind of [virtual] correspondence can never work if you don't know who is there behind the text. You've got to know the face and know the person. All that personal knowledge then supports the correspondence and knowledge sharing, when you have some kind of grasp of how the other person reacts to different things, etcetera. (Product line marketing manager)

Overall, these efforts were consistent with Rosen et al. (2006), who observed that virtual team training and team building activities are essential for the success of virtual teams. At the

end of their training week, the virtual teams were asked to organize their own future face-to-face meetings and the conduct of their virtual work in the portal. Some teams scheduled their next face-to-face meetings at the start of the training session while others chose to decide later in the virtual space. Because empowerment is positively associated with virtual team performance, by allowing this freedom, the project team empowered the virtual teams to make the decisions that pertained to their activities and working methods. However, this leeway might become a major challenge. Malhotra et al. (2007) point out the need for not only virtual team leaders to ensure regular meetings and monitoring of the team activities but also someone to be in charge to promote team activity.

> One important thing with a team is that it is self-organizing. Of course it is important that the team members get along...that we have prerequisites for this thing. And at the first kick-off meeting one specific catch is that they discuss within the team how they could keep up their work and benefit from it as much as possible. (Project manager)

System support for knowledge sharing—the need for collaboration software

> Now having a whole group answering these questions… a lot more people answer and cover these questions than just direct e-mail to one person. (Product line marketing manager)

Simultaneous with the building of the virtual teams, Open House, an intranet portal, was created as a knowledge-sharing tool in the ongoing interaction among the virtual teams. While most of the Open House portal was open to all VI employees, some areas were restricted to team members. The portal consists of a discussion space where people can exchange knowledge on products and markets. The questions, answers, and comments are thus open for review by everyone in VI. The team members and project team wrote the first questions, answers, and comments so that at the opening of the portal, VI employees would find it interesting enough to use. Moreover, ongoing discussions were believed to lower people's reluctance to ask questions or offer comments that all portal users could see. The discussion style was intended to be informal yet accurate.

In addition, there was a search function to retrieve previous discussions and comments. This function enabled easy management of explicit knowledge, which facilitated joint activities such as the awareness of new product characteristics or customer purchases and thus diminished the problems associated with differing memories (Hinsz et al., 1997) by facilitating shared practices and creating a common language and common concepts (Horwitz et al., 2006; Lave and Wenger, 1991). Furthermore, fewer questions were repeated because employees often searched the archives for answers to their questions. Prior to launching Open House, the project team ensured that current product materials, brochures, and product manuals were readily accessible through the portal.

The team members added their personal information to Open House in order to reduce barriers to social interaction in the virtual setting. By sharing such information and visual images, users built a sense of community to encourage social interaction and the establishment of deeper relationships within their virtual teams (Peters and Manz, 2007). This sense of community was vital to overcome the obstacles associated with computer-mediated communication, in which the lack of face-to-face meetings, facial expressions, and body language make communications between team members difficult to interpret and understand, especially when team members are from different cultures (Malhotra et al., 2007). Congruent with the findings of Malhotra et al. (2007), we found that such postings also helped to create competency-based trust among team members as other members could 'virtually' observe the contributions being made.

Knowledge-sharing effects of virtual teams

As soon as the intranet portal opened, the virtual teams began creating content. The team members were charged with answering the questions processed through the system, and the system displayed how long a question had been waiting for an answer. Initially, the virtual teams created comments on identified information requirements to populate the portal; these actions showed the identities and roles of the team members to all portal users. These joint efforts to create content also contributed positively to instilling a team identity and achieving cohesiveness. Rather than assignments controlled directly by upper management, these comments were shared experiences that empowered the teams and created a sense of community and trust among the members (Jarvenpaa et al., 1998; Wenger, 1998). Moreover, after the virtual teams had created content in the portal, employees from outside the teams began using it both to seek and post knowledge. Overall, the virtual knowledge-sharing space received a cautiously optimistic welcome from Vaisala's employees. For example, a sales manager from VI's office in San Jose described his experiences with collaborative virtual knowledge sharing:

> The first impression is definitely good. Yet, I have only posted a few questions and once I was just looking for information. So, I can't claim that I have used it a lot. But it worked and I got rapidly the answers that I needed, and that is great. (Sales manager)

Moreover, some individuals came to learn that the virtual knowledge-sharing space had the potential to advance their knowledge beyond the specific questions or information needs on their agenda. Owing to the open and multilateral nature of knowledge sharing, users of the Open House portal were exposed to contents in addition to their own questions and the accompanying answers. This additional knowledge was beneficial to the users of Open House, as much information pertained to their activities.

> With this Open House portal site you can look at many questions from other persons and maybe some question is what you want to know and the other question is what you couldn't imagine. (Salesperson)

From the perspective of product line marketing, knowledge sharing orchestrated by virtual teams was beneficial as other team members—or any other Open House user who happened to know the answer—also responded to salespeople's questions. As a consequence, even when a specific product line marketing specialist was unavailable, other people could respond to a salesperson's queries. This flexibility made the entire knowledge-sharing organization less dependent on individual employees and limiting the risk of what could happen to the organization's knowledge basis if, for example, a key employee quit.

> Now that we can do chat-based correspondence, it is always online everywhere. It doesn't matter if someone is at lunch, if someone is on summer vacation, on winter vacation, you don't know what email messages he or she has received... don't have to worry about those. Rather, the business just keeps running all the time. That, I think, is great about the Open House. (Product line marketing manager)

In addition to receiving support in sharing product and technology-related knowledge, a special benefit for the product line marketing was that the Open House portal stored information and made it available to all users. Furthermore, anyone in the organization could comment on the postings, questions, and answers in Open House, which helped to keep information up to date.This availability made it possible to benefit from organizational TMS rather than rely on individual level knowledge regarding whom to ask about additional information. Since all the information was

available in the portal, there was no longer a need for repetition and or worry over whether or not the salespeople had received the latest information. Rather, employees were able to obtain the knowledge they needed from Open House or to pose a question if they did not find what they were looking for.

> What I think is a good thing is building up this data base. (Product line marketing manager)

However, discussions in the portal became very task-oriented and did not include small talk or 'stories' as such, which had been present in the previous means of communication using phone calls and emails. A formal method of communication impedes tacit knowledge sharing (Nonaka et al., 2000), which is at odds with the virtual teams' objective to share tacit knowledge through Open House and create interactive knowledge processes. This conflict can be attributed to the method of interacting that was open to the other users. For example, not all employees were comfortable sharing their customer encounter experiences—especially when these experiences were negative. This discomfort is also an important reason why the discussions in the virtual knowledge-sharing space dealt with products and technologies, while very little knowledge sharing occurred on the markets or customers. In other words, it was quite easy to discuss the products and technologies as most of the knowledge related to them is explicit. However, knowledge of markets and customers is more context specific and involves a great deal of personal interpretation, which makes it more tacit and less easy to share. Therefore, although it was easier for the product line marketing specialists to share knowledge, they did not feel that they could obtain the knowledge that they needed. At times the openness also interfered with explicit knowledge sharing, because not all employees were willing to reveal that they did not know something.

> There might be some people who have higher barriers to ask certain things when they know that everyone can see the question. And oftentimes these simple questions... it is probably so that people will not ask questions about things that should be obvious [...] I am particularly thinking certain salespeople who have been here for a long time but whose technological knowledge is not at that profound level. A fear of losing one's face might be especially in Asian countries a reason why they just won't do it. (Product line marketing manager)

We also detected somewhat differing views among the virtual teams regarding their aims and methods of working. The members of some teams approached their new work tasks as knowledge activists enthusiastically and with a very positive attitude, while people in other teams did not expect the virtual teams to foster many changes in VI's established method of knowledge sharing. Some teams seemed to share a vision or goals regarding the new tasks, but in other teams, people acted—at least initially—in a more individualistic way, without acquiring strong feelings of team affiliation. These differences were most pronounced between virtual teams that were formed around new product lines and those that focused on the existing lines. As opposed to individuals in teams that were formed around old product lines, those in the new product line teams tended to demonstrate higher levels of commitment to their teams and generally adopted a more optimistic attitude towards the virtual team project. Furthermore, some differences were noted among the virtual teams relative to whether they placed greater emphasis on the team (socially oriented) or on the Open House portal (task-oriented). Indeed, some perceived their role as being auxiliary to the portal while others viewed the teams as the major issue and the portal as their tool. The different orientations could influence the type of knowledge processes, transfer, sharing or joint creation utilized in the teams and the portal (e.g. Cook and Brown, 1999). In the next section, we will present the key implications of the study.

Discussion and contributions

This article reports a case study on the role played by virtual teams in augmenting organization-wide knowledge sharing. We examined how Vaisala Instruments (VI) created virtual teams that were intended to act as knowledge activists and improve knowledge sharing among salespeople, product line marketing specialists, and R&D personnel. Furthermore, our study investigated the barriers of knowledge sharing that VI's virtual team project had to overcome and the facilitating factors that helped virtual teams to perform their task. Our empirical investigation answered one question: how do virtual teams contribute to knowledge sharing in an international organization? In particular, the present study examined how virtual teams act as knowledge activists to exhort employees throughout the organization to participate in knowledge-sharing activities and organizational learning. In this section, we discuss how our observations contribute to what is currently known about virtual teams' knowledge-sharing activities.

As an answer to our main research question, the findings implied that, in general, cross-functional and cross-cultural virtual team compositions foster knowledge sharing across different borders and boundaries. The positive knowledge-sharing effects mainly rested on the increased cohesiveness, new methods of communicating, and the reallocation of the knowledge-sharing burden that followed from the launch of the virtual teams. As the virtual teams brought together individuals from various backgrounds, cohesion increased throughout Vaisala's organization, and thereby facilitated trust and knowledge sharing across organizational groups and functions. New methods of communicating emphasized multilateralism and open dialogue that was visible in all relevant actors. At the same time, repositories of earlier discussions and other materials on the portal enabled referring to already shared knowledge. These repositories made knowledge sharing more efficient because repetitive sharing of certain basic information ceased. Finally, the positive effect of reallocating the burden of knowledge sharing made the system less reliant on individual people, enabled faster responses, facilitated the emergence of alternative perspectives, and fostered peer monitoring of the accuracy of information.

In addition to their direct effects, our study shows that virtual teams promoted knowledge sharing by lowering the barriers that complicate knowledge sharing in multinational corporations (Figure 1). The case analysis shows that VI was able to overcome geographical and cultural distance boundaries, functional boundaries, and overreliance on too few individuals as knowledge providers. This achievement was due to the following effects: the virtual team project promoted trust, cohesion, and cross-functional collaboration; and VI launched an open-to-all virtual environment for knowledge sharing. At the same time, replacing individual knowledge activists with teams removed the firm's excessive reliance on a few active individuals. However, the organization was not entirely successful in overcoming the barriers of ignoring tacit knowledge sharing and seeing possessing knowledge as a source of power. The reasons for these shortcomings will be more closely elucidated later in this section. Furthermore, our study assesses the factors that facilitated virtual teams' positive effects on knowledge sharing. In line with Malhotra et al. (2007) and Jarvenpaa et al. (1998), the empirical analyses attest that important organizational and contextual factors such as trust, support, training, and knowledge-sharing space augment the positive knowledge sharing effects of virtual teams. Taking these findings further, this article clarifies previously poorly understood interrelationships between formal management methods and supporting cultural and contextual factors (Wang and Noe, 2010). Specifically, we show that the organizational and contextual variables are positive moderators in the relationship between virtual teams and the efficiency of knowledge sharing.

In addition to showing how virtual teams contribute to knowledge sharing, this article suggests other, finer-grained contributions to virtual team and knowledge-sharing literatures. To begin, the case study reported here shows that formal management mechanisms can be an effective means to encourage knowledge sharing in organizations. The earlier literature has emphasized mainly the role of organizational culture and climate. For instance, an organizational culture that emphasizes trust (Kankanhalli et al., 2005) and a climate that supports trust and cooperation (Collins and Smith, 2006) have been found to promote knowledge sharing. Moreover, De Long and Fahey (2000) argue that longstanding organizational values and practices play a key role explaining an organizations' ability to reap the knowledge-sharing benefits of technology infrastructures. However, this study shows that, besides these contextual and cultural issues, purposeful managerial actions are important in improving knowledge sharing. Notably, these actions can have positive effects even within a relatively short period of time. In particular, the present findings show how organizations can leverage their existing structures of knowledge sharing by building virtual teams that reinforce the nodes that are already important in the knowledge-sharing network. These findings are in line with Burt's (1992) structural holes theory according to which a greater number of employees bridging structural holes translate into efficiency of sharing knowledge.

In addition, the present findings might have implications for emerging discussions on knowledge activists. Nonaka and Toyama (2002) asserted that certain middle level managers play a crucial role as knowledge activists because they both create a knowledge vision and assume a facilitating role in building and managing a supportive context for knowledge sharing. Adding to these findings, Hall et al. (2006) showed that individual knowledge activists play an important role promoting change in work settings. Inkpen (2008) similarly submits that besides ensuring that knowledge gets transferred, knowledge activists help the organization to overcome the influence of sceptics and nonbelievers. Although these studies witness the potential benefits of knowledge activism, they fall short of showing the means that organizations might have to encourage knowledge activism. Therefore, this study's contribution is that it presents exactly how an organization can purposefully create knowledge activism. In short, the article demonstrates that by establishing virtual teams, by creating a virtual space for knowledge sharing, and by empowering virtual teams to coordinate knowledge sharing, firms can positively influence knowledge activism. Similarly, the present article's second contribution to the discussion on knowledge activism is that it displays teams as knowledge activists. Earlier studies have paid attention only to individuals acting in this role, without explicitly noting that knowledge activism might also be a team effort. In the long run, team-based knowledge activism is likely to be more beneficial for the organization because it eases the reliance on individuals in knowledge sharing and helps to create a more widely spread knowledge-sharing culture.

The fact that virtual teams took the role of knowledge activist—a role that is traditionally assumed by managers—raises the important issue of the leadership function virtual teams could play. In particular, this issue contributes to the literature on virtual teams because it highlights that the challenge is not only how to lead virtual teams but also how virtual teams lead the organization wherein they are embedded. An emerging body of research (e.g. Kirkman et al., 2004; Malhotra et al., 2007) has examined leadership in virtual teams, but to date no study has looked into the leadership role played by virtual teams. Complementing earlier studies, the present analysis indicates that virtual teams play a leadership role in knowledge sharing when they are the main actors in orchestrating the firm-wide knowledge-sharing network. The expectation to exhort the adoption of Open House and activate participation in knowledge sharing throughout the organization further accentuates the leadership role of virtual teams. Therefore, this article contributes to the leadership discussions in the virtual team context and proposes regarding virtual teams as actors that influence

other members of the organization. Because empowerment provides flexibility that is needed in the leadership role, it is even more necessary for virtual teams than previously acknowledged (Kirkman et al., 2004).

Our findings also have important implications for discussions on forming and managing virtual teams. They suggest that exploiting and enhancing existing knowledge structures proved to be beneficial in establishing the virtual teams. This implication became apparent in the interviews with the team members, who indicated that individuals that had strong ties with both the salespeople and the R&D personnel found it easy to assume their new roles in virtual teams. Moreover, the teams were responsible for fostering a mindset that was conducive to knowledge sharing. This task was not an easy and straightforward process because the teams did not completely come into virtual operation. As the teams were nominated, it became clear that the internalization of the mission and the role of the teams as knowledge activists required face-to-face meetings in which all of the team members were present. One of the reasonable explanations for the pronounced call for such meetings was that the company had slashed its travel budget in recent years and the individuals were too distant from each other to build the trust needed for heart-to-heart conversations and fruitful collaboration. Similarly, they needed to meet in person to achieve a shared understanding of the aims of the collaboration. This need is consistent with findings regarding the motivation and barriers to participation in virtual knowledge-sharing communities of practice (e.g. Ardichvili et al., 2003).

On some occasions, the existing communication patterns continued to dominate even after the virtual teams were formed. This observation indicates that more radical restructuring would have been necessary. Of particular note, the analyses revealed that the teams formed around new product lines were most willing and capable of encouraging employees throughout the organization to participate in virtual space knowledge sharing, which can be attributed to adaptability of these teams because they had not yet established rigid knowledge and communication structures. As such, they were more amenable to sharing responsibility for knowledge sharing. This contribution is an interesting addition to the discussions on effective knowledge-sharing structures that have almost exclusively emphasized connectedness, social capital (e.g. Inkpen and Tsang, 2005), and other issues that ease knowledge sharing. However, these discussions have paid less attention to the dark side of established structures. That is, although knowledge is more easily shared, knowledge structures become less adaptive, which makes them rigid and vulnerable to environmental changes (see Leonard-Barton, 1992). The contribution of this observation to the virtual team discussions is that it may not be advisable to build virtual teams that are too closely intertwined with the established patterns of the organizational structure because that might create inversely focused teams. This conclusion is in line with March (1991) who argues that long operating groups focus on repeating old patterns of acting. Similarly, Thomas-Hunt et al. (2003) found that distant actors provide more unique knowledge than socially well-connected members.

However, taking advantage of existing knowledge structures can benefit virtual teams as they serve as an already working platform or a spine for the team. Our case analysis did not show evidence of any considerable conflicts between existing knowledge-sharing structures and virtual teams. On the other hand, it cannot be unequivocally concluded that such problems would have been more pronounced even if the existing knowledge-sharing structure had been neglected. Taken together, the conclusion is that the optimal structure for virtual teams strikes a balance between exploiting existing structures and diversity of team members' backgrounds. Interestingly, this balance resembles that between exploitation and exploration, which is needed for simultaneously achieving efficiency in current operations and adaptability in prospecting new opportunities (Gibson and Birkinshaw, 2004). In VI, it seems that new product lines with an already established

knowledge network could achieve this balance. Another feasible solution might be creating teams that draw on established structures but incorporate sufficiently many distant members to ensure the availability of novel knowledge. From these perspectives, it also follows that over time any virtual team can become inert. Therefore, adding to the current knowledge on the management of virtual teams (Davis, 2004; Malhotra et al., 2007), this study emphasizes that a regular rotation of virtual team members might be advisable. Overall, this study contributes to the literature on establishing virtual teams (Maznevski and Chudoba, 2000), noting that managers must always balance the inertia that may lurk in the firm's existing knowledge structures due to the convenience and stability of those knowledge structures.

Our findings also raise one major caveat that needs to be considered in facilitating knowledge sharing through virtual teams. Although the virtual team project augmented knowledge sharing related to products and technologies, it failed to improve knowledge flows in the opposite direction. That is, compared to salespeople, product line marketing specialists had a significantly less favourable view of the virtual teams' knowledge-sharing performances. As a consequence, none of the product line marketing employees used Open House as their main method of communication. At the same time, product line marketing specialists gave salespeople considerably lower knowledge-sharing scores than those they received from them. This observation contradicts Kankanhalli et al. (2005), who argue that individuals share knowledge as a result of reciprocation. That is, salespeople were content with the knowledge they acquired but did not reciprocate by sharing their knowledge of the markets and customers. The major reason for this contradiction relates to the type of knowledge that was being shared. In short, product-related knowledge dealt with technological specifications and problems in the specific application areas of different technologies. Importantly, this knowledge was explicit and more easily shared in the portal. Market and customer knowledge, in contrast, was highly heterogeneous, context specific, and nuanced. Thus, for the sender this knowledge was first hard to explicate and then difficult for the recipient to absorb.

Another perhaps more intriguing explanation has to do with the perceived benefits and costs associated with sharing knowledge. For both product line marketing specialists and salespeople, the cost of sharing knowledge is approximately equal; it is the effort they have to take to log in to the portal and share what they know. However, the attained benefits are totally different. Because they share their knowledge in the portal, the product line marketing specialists do not have to send the same knowledge to numerous salespeople by email. Moreover, since knowledge is available in the portal, its accuracy is subject to the control of peers and R&D specialists, which decreases the perceived risk of disseminating false information. In contrast, salespeople do not see any immediate benefits of sharing their knowledge. The value of their knowledge on customers and markets—when combined with knowledge on several other customers and markets—is that a firm can develop better products and operations in the long term. However, this kind of benefit is rather abstract and the value of an individual salesperson's contribution remains obscure. Thus, because it is hard to see the usefulness of sharing this type of knowledge, salespeople usually consider it to be a lesser priority in their daily activities. This explanation contributes to earlier research that has demonstrated that employees share their knowledge when they believe that it is useful to others (Siemsen et al., 2007; Wasko and Faraj, 2005). Our study adds to these findings that employees are particularly inclined to engage in knowledge sharing when they are able to observe that the knowledge they shared was put to use and made some kind of difference.

Related to costs and benefits, an interesting issue that has received only limited attention in earlier knowledge-sharing discussions has to do with rewards. In earlier studies, the effects of rewards and incentives on knowledge sharing have yielded mixed results. Kankanhalli et al. (2005)

claim that tangible rewards are positively associated with employees' propensity to share knowledge. In contrast, Bock et al. (2005) demonstrate the negative effects of extrinsic rewards on the willingness to share knowledge. This study helps to interpret these mixed results. In particular, it implies that intangible rewards are effective motivators for people who play central roles in the knowledge-sharing system. The main benefit for individuals in the VI's virtual team project was based on intangible recognition, namely meritocracy, which here means a system in which talented individuals are chosen and moved ahead on the basis of their achievements. Meritocracy was addressed in VI's virtual team project through making both the virtual team and the individual members of the teams visible as knowledge activists. In the Open House platform, the answers to the requests for knowledge were posted in the names of the persons who provided the knowledge. As a result, the experts made their voices heard across the organization because both the persons in need of knowledge and their managers were able to see the sharers of each piece of knowledge. In this vein, knowledge sharing became visible in two ways: by giving the virtual teams the responsibility to act as knowledge activists and by equipping them with tools that could raise their profile within the organization.

However, intangible rewards are probably less effective motivators for employees whose knowledge-sharing role is more peripheral. In the VI case, for example, individual salespeople did not have an opportunity to attain an especially visible position based on meritocracy, which made it more rational for them to pursue only activities they knew would be rewarded (i.e. selling). Another possible reason is that salespeople, more often than employees in other functions, are performance goal oriented. Therefore, they are less willing to devote time and effort to knowledge sharing, as long as it is not extrinsically rewarded (Wang and Noe, 2010). Extrinsic rewards often have a corrupting effect on employees, so that if certain activities are rewarded, employees become reluctant to perform other tasks that are not similarly rewarded (Kauppila et al., 2010). Since VI's salespeople were already pursuing selling activities that were rewarded based on their outcomes, it would probably have helped if similar incentives had been provided for sharing knowledge in Open House. However, since such rewards were not offered, salespeople opted to spend their time on activities that were rewarded.

Finally, our findings have important implications for practising managers. First, we show that by employing virtual teams, multinational firms can both improve their internal knowledge sharing and overcome the challenges brought along different borders and boundaries. This achievement is especially the case when knowledge is not deeply embedded in its context and its benefits for the organization are relatively easy for the actors involved to recognize. It is particularly important to note that virtual teams act as knowledge activists that play a leadership role; they not only share knowledge but orchestrate knowledge sharing throughout the organization. Therefore, virtual teams need to be sufficiently empowered, supported, and rewarded for their efforts. Second, our results show the necessity to urge firms to continue developing yet richer media for communicating and sharing knowledge. Vaisala's Open House is a right step in that direction, but it is not yet sufficient for promoting tacit knowledge sharing. Interestingly, social media such as Facebook provide viable models for these platforms, as they have proved to be versatile environments for sharing knowledge and keeping abreast of what is going on even within large networks of people. Finally, this article contributes to management practice by proposing the use of sociograms for selecting the virtual team members. As the VI case showed, sociograms can be used to illustrate an organization's knowledge-sharing structure, and they are easy to interpret. Without sociograms, it might be difficult to get a comprehensive picture of what roles different individuals play and how the organization should be developed without overly disturbing existing structures and relationships.

Conclusion

The main contribution made by this article is that it acknowledges virtual teams as knowledge activists. By replacing individual knowledge activists with virtual teams, VI increased the number of individuals responsible in knowledge-sharing processes and incorporated their knowledge-sharing expertise into an organization-wide network. Hence, by appointing a group rather than individuals to act as knowledge activists, a company can create organizational TMS. In other words, multinational companies can improve their internal knowledge sharing by founding virtual teams whose explicit task is to share knowledge and persuade other employees to follow suit. It is important to note that the formal knowledge team structure allows the organizational power and legitimacy for both team- and individual-level knowledge activism. Hence, the virtual team concept needs to be enhanced to incorporate the notion of knowledge activism.

Moreover, this research underscores the multifaceted nature of knowledge, which is to a large extent conditional on its context, e.g. task context, social context, and physical context as suggested by Johns (2006). Such situational features of knowledge are especially salient in teamwork, where the locus of knowledge resides not only in individuals but also in communities. Accordingly, the current study demonstrates that teams need a communal space in which they can continuously recreate and reconstitute knowledge. We contribute to research on knowledge management and learning in international organizations by showing that, when formed to reinforce existing knowledge-sharing structures, and when equipped with a multilateral space for knowledge sharing, virtual teams can lower knowledge barriers in an international organization. This finding supports earlier findings in international business research while adding new insights that enrich the current knowledge.

While the use of a single case study limits the generalization of the findings, this particular case study raises important questions in organization-wide knowledge sharing that indicate intriguing avenues for further investigation. Future studies should continue to investigate these virtual spaces for knowledge sharing, especially from the perspective of continuously creating and reconstituting knowledge. In addition, the performance effect of virtual teams is a promising area for future research.

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