

Motivation and barriers to participation in virtual knowledge-sharing communities of practice

Alexander Ardichvili, Vaughn Page and Tim Wentling

Alexander Ardichvili is an assistant professor at the department of Human Resource Education, University of Illinois at Urbana/Champaign. He received his MBA and Ph.D. from the University of Minnesota, and Ph.D. from the University of Moscow. Dr. Ardichvili has published peer-reviewed articles and book chapters in the areas of human resource development, entrepreneurship, and knowledge management (ardichvi@uiuc.edu).

Vaughn Page is a doctoral student in Human Resource Education at the University of Illinois at Urbana-Champaign. His research interest centers on knowledge management and communities of practice. Page earned a Bachelor's degree in Career and Organizational Studies and a Master's in Training & Development from Eastern Illinois University, Charleston, Illinois (vpage@uiuc.edu).

Tim Wentling is a professor in the Department of Library and Information Science and a Senior Research Scientist in the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign. Professor Wentling holds a PhD in Education and an MBA from the University of Illinois and a Master of Science in Educational Psychology from the University of Wisconsin. Professor Wentling is the leader of the Knowledge and Learning Systems Group at NCSA where he heads a team of cross-disciplinary faculty, postdoctoral researchers, and graduate students (wentling@uiuc.edu).

Abstract This paper reports the results of a qualitative study of motivation and barriers to employee participation in virtual knowledge-sharing communities of practice at Caterpillar Inc., a Fortune 100, multinational corporation. The study indicates that, when employees view knowledge as a public good belonging to the whole organization, knowledge flows easily. However, even when individuals give the highest priority to the interests of the organization and of their community, they tend to shy away from contributing knowledge for a variety of reasons. Specifically, employees hesitate to contribute out of fear of criticism, or of misleading the community members (not being sure that their contributions are important, or completely accurate, or relevant to a specific discussion). To remove the identified barriers, there is a need for developing various types of trust, ranging from the knowledge-based to the institution-based trust. Future research directions and implications for KM practitioners are formulated.

Keywords Communities of practice, Knowledge management, Trust

Introduction

In recent writing on knowledge management, the most often mentioned strategy for bringing the human side into the KM equation is that of virtual communities of practice enabled by online interactive technologies (Cortada and Woods, 2000; Liedtka, 1999; Phillips and Bonner, 2000). The latest reports from the field suggest that virtual communities of practice are becoming a KM tool of choice for an increasing number of multinational corporations, including such well-known industry leaders as Hewlett Packard (Davenport, 1996), British Petroleum (Cohen and Prusak, 1996), Chevron, Ford, Xerox, Raytheon, IBM (Ellis, 2001), and Shell (Haimila, 2001), to name a few.

Despite the proliferation of virtual communities of practice in business organizations around the world, very little is known about factors leading to their success or failure. One of the critical factors determining a virtual community's success is its members' motivation to actively participate in community knowledge generation and sharing activities. Earlier studies have demonstrated that employees often resist sharing their knowledge (Ciborra and Patriota, 1998), that knowledge does not flow easily even

when an organization makes a concerted effort to facilitate knowledge exchange (Szulanski, 1996), that the success of knowledge exchange depends on the organizational KM system's social and technological attributes (Holsthouse, 1998), and on organizational culture and climate (De Long and Fahey, 2000). However, the reasons why individual employees decide to actively participate in virtual knowledge-sharing communities of practice are currently not well understood (McLure and Faraj, 2000). Therefore, the goal of the present study is to contribute to the understanding of factors determining the success of virtual knowledge-sharing communities of practice by exploring the reasons for the members' active participation in these communities, and barriers to this participation.

This article starts with a formulation of a number of broad research questions, based on the review of the extant knowledge management, intellectual capital, and communities of practice literature. Second, the article reports the results of an exploratory study based on an in-depth qualitative investigation of virtual knowledge-sharing communities of practice in a large, multinational corporation. Third, the study findings are integrated with insights gained from the review of relevant theoretical contributions from social psychology, sociology, and organizational behavior literature. The article concludes with a number of directions for future research and implications for KM practitioners.

The study background

The term community of practice (CoP) was coined by Lave and Wenger (1991) to describe an activity system that includes individuals who are united in action and in the meaning that action has for them and for the larger collective. Communities of practice are not formal structures, such as departments or project teams. Instead, they are informal entities, which exist in the minds of their members, and are glued together by the connections the members have with each other, and by their specific shared problems or areas of interest. Wenger (1998) asserts that the generation of knowledge in communities of practice occurs when people participate in problem solving and share the knowledge necessary to solve the problems. Researchers have observed that creating and supporting communities of practice is a strong alternative to building teams (Nirenberg, 1994/1995), especially in the context of new product development and other knowledge work (Stewart, 1997).

Among the chief reasons why communities of practice are efficient tools for knowledge generation and sharing is the fact that most of a firm's competitive advantage is embedded in the intangible, tacit knowledge of its people, and that competencies do not exist apart from the people who develop them (Dougerty, 1995). It was observed that tacit knowledge is embedded in the stories people tell (Horvath, 1999), and not only new knowledge, but also skills are discursively produced and disseminated in conversations and networking activities (Araujo, 1998; Brown and Duguid, 1991; Weick and Westley, 1996). Therefore, one of the ways to help people share and internalize tacit knowledge is to allow them to talk about their experiences, and to exchange their knowledge while working on specific problems. Since opportunities for face-to-face interactions are rather limited in today's globally dispersed multinational companies, virtual communities of practice that are supported by Internet technologies are among few viable alternatives to live conversations and knowledge exchange.

The successful functioning of a knowledge-sharing community of practice is impossible without an active participation of a substantial part (ideally, all) of its members. Dixon (2000) argues that the community of practice model allows organizations to overcome barriers to sharing information that conventional,

technology-based KM systems often encounter. For example, people who are reluctant to contribute when asked to write something up for a database are willing to share information when asked informally by their colleagues (Dixon, 2000). Members' contributions to virtual CoPs are not limited to posting lengthy and well thought-through knowledge entries. For a community to be truly vibrant, there should be an active participation of members in other knowledge-exchange activities: engaging in live chats, Q&A sessions, providing asynchronous feedback on previous postings, etc. (Hayes and Walsham, 2000).

Research shows that there are numerous reasons individuals could have for sharing their knowledge with other members of a CoP online, ranging from self-esteem boosting to altruistic and conformist considerations (McLure and Faraj, 2000). Furthermore, Osterloh and Frey's (2000) research on intrinsic and extrinsic motivation for knowledge sharing suggests that intrinsic motives are much more powerful enablers of such sharing than are extrinsic (e.g., monetary or administrative) stimuli.

However, posting of knowledge entries and other active contributions by some members of a community represent only one side of the equation: the supply of new knowledge. For a community to be vibrant, there should be also an active participation on the demand side: numerous members should be visiting the CoP Web site, using online search tools or posting questions when they search for advice or information (Cross *et al.*, 2001). Therefore, the second requirement for a successful virtual CoP is its members' willingness to use the CoP as a source of new knowledge. These two major requirements (willingness to share knowledge and willingness to use a CoP as a source of knowledge) apply to any community of practice, be it face-to-face or virtual. The study reported here deals with virtual online communities of practice and, therefore, it is necessary to add one more requirement: for a virtual community to be successful, its members need to be comfortable with participating in a computer-mediated, Internet-based community of practice, which involves very little face-to-face communication.

Thus, participation in CoPs, or lack of thereof, can be described in terms of reasons for such participation, and of barriers to participation. The same applies to the use of the community as a source of knowledge. Therefore, this study was guided by the following four research questions:

- (1) What are the reasons for employees' willingness to contribute their knowledge to virtual knowledge-sharing communities of practice?
- (2) What are the barriers to employees' contributing their knowledge to virtual knowledge-sharing communities?
- (3) What are the reasons for employees' willingness to use virtual knowledge-sharing communities of practice as a source of new knowledge?
- (4) What are the barriers preventing employees from using virtual knowledge-sharing communities as a source of new knowledge?

Context and methodology of the study

The organization

The reported research project involved an in-depth case study of virtual communities of practice in a large multinational corporation, Caterpillar Inc. Caterpillar is a *Fortune* 100 corporation, manufacturing heavy construction and mining equipment. It employs more than 60,000 employees in close to 100 locations in more than 20 countries around the world. The company's competitive advantage depends heavily on the

utilization of the professional knowledge of its employees, especially mechanical, electrical, and chemical engineers, designers, new product development personnel, equipment and material testers, and others. Therefore, it is not surprising that KM has been a central concern for this company for a long time.

Initially, Caterpillar's earlier KM efforts concentrated mostly on knowledge capture and dissemination. However, in the mid-1990s the company's strategy in this area started to shift to incorporate the community of practice ideas. Caterpillar's first virtual communities of practice (or "communities of knowledge sharing", as the company employees call them) emerged in 1997. At the time of this writing, there were more than 600 online communities with more than 15,000 members worldwide. Caterpillar's communities are supported by the Knowledge Network, an Intranet-based system designed to provide an infrastructure for community functioning and supported by a group of KM technology experts, and employees of the Caterpillar corporate university. The system allows users to find subject area experts, post questions to specific experts or to the community at large, post and find knowledge entries, conduct online chats and asynchronous threaded discussions of questions and problems, and connect to numerous other online communities. Most of the communities were formed at the initiative of employees, not as a result of interventions planned by the KM group or the top executive team. Communities tend to form around specific subject matter expertise or professional activity areas, but are open to all interested employees.

Context and methodology of the study

A typical community includes a community manager, one or more "delegates", a number of "experts", and "subscribers". Managers are typically elected by the team, and are, usually, senior, experienced members who have earned the team's respect through a strong history of contributions to the company. "Delegates" are associate managers, who can run the community in the manager's absence, or take on certain parts of the community management duties. "Experts" are people recognized for their skills and knowledge in certain areas. They actively participate in the community by posting knowledge entries, assisting managers in reviewing new postings, and answering questions posted to the community in general or to individual experts personally. Finally, any member of the organization, interested in a CoP's subject matter, can become a "subscriber" to that community.

The study design

This research project was based on a qualitative case study design, with main units of analysis being three communities of practice. These three communities were selected using the purposive sampling approach. One of the communities was among the most well-established and successful communities, with a large (more than 1,000 employees) membership, and high community "traffic" (measured by the number of postings, permanent knowledge entries, and various online activities). The other two communities were classified as less successful and struggling to establish themselves. Both had smaller memberships (several dozen people), and significantly lower levels of online "traffic".

The major method of data collection was based on semi-structured interviews. In addition, the researchers have collected a variety of company documentation, have visited a total of 5 different sites housing various work units, and familiarized

themselves with the functioning of the knowledge-sharing network over the company Intranet. Interviews were conducted with a total of 30 members, including managers of three communities, community experts, community members, and managers in administrative units responsible for managing and supporting the Knowledge Network (the software system at the backbone of Caterpillar's Internet communities). The procedure for selecting participants was that of purposive sampling: the lists of community participants and documentation on frequency of their participation in the community (the number of postings and knowledge entries contributed by them; the number of times they have accessed the system, etc.), provided by the Corporate University, were used to identify groups of heavy, moderate, and light users. Subsequently, random samples were drawn from each of the groups. The selected community members were contacted by email to solicit their participation in the study. Interviews with community managers and delegates were conducted face-to-face. The rest of the interviews were accomplished by phone. Interviews lasted from 45 minutes to two hours, and were tape-recorded and transcribed.

Interviews were conducted using a semi-structured interview instrument, developed based on the review of the literature and industry reports on knowledge management, virtual team work, and communities of practice, and the information obtained from Caterpillar representatives during the initial project planning meetings. The instrument was pilot-tested in an interview with one active community delegate. The pilot test allowed the researchers to adjust several interview questions, and eliminate questions that seemed redundant.

In addition to the interview data, researchers have collected and analyzed company documentation, which included: conference presentations and papers, developed by the Caterpillar employees, and describing the CoPs and KN; internally-circulated manuals for KN users; reports and statistics on KN use and CoP membership and participation levels.

Data analysis

The interview data were analyzed using two methods. First, the data obtained by dichotomous questions and questions that required the respondents to provide specific numbers were analyzed by calculating descriptive statistics for the sample. Second, the narratives obtained by way of open-ended questions were coded and analyzed by two researchers independently using the qualitative data presentation and analysis methods (Miles and Huberman, 1994). This included coding of individual interview data to identify major themes and categories, development of summary sheets for each interview, and development of cross-case data tables.

The qualitative analysis reported here involved an iterative process. The researchers started with coding the answers to open-ended questions, which resulted in identifying categories and issues pertaining to each of the questions. For example, to answer one of the questions, "What are the barriers to employees' contributing their knowledge to virtual knowledge-sharing communities?" the researchers content-analyzed not only those segments of the transcripts where a specific question about barriers was asked, but also the whole transcript, trying to find relevant discussions. Two researchers performed the coding independently. Categories generated by the individual coders were compared and discussed in research meetings between the two coders. These discussions resulted in re-coding of some data and re-analysis of relevant segments. Once a consensus was reached on categories, the two coders went back to the interview material to ascertain in how many cases various categories

were present. To continue with the example of barriers, the researchers first identified several categories of barriers mentioned by different respondents, and then re-analyzed the texts to see how many respondents had actually mentioned these barriers.

The iterative analysis of the interview data involved was augmented by the documentation analysis. This was accomplished by constantly referring to the information provided in the company documentation for checks and validation. For example, participants' comments on the uses of the system were compared with relevant segments of the KN manual, and their statements regarding the frequency of certain uses were verified by referring to the statistics provided by the company.

Participant checks and validation. In qualitative research, one of the methods for validating the accuracy of research findings is the use of participant checks. For this check, the researchers randomly selected eight participants, and shared with them summaries of the interview findings. Two of the participants provided a number of suggestions for changing the summaries to better reflect what they communicated to the interviewers. The rest of those contacted indicated that the summaries accurately reflected their opinions.

Findings

The study results are presented below, grouped according to the four research questions.

R1. What are the reasons for employees' willingness to contribute their knowledge to virtual knowledge-sharing communities of practice?

The interviews suggest that the majority of respondents view their knowledge as a public good, belonging not to them individually, but to the whole organization. This finding corresponds to what McLure and Faraj (2000) found in their study of online communities. When such perception exists, knowledge exchange is motivated by moral obligation and community interest, not by a narrow self-interest. The study participants pointed out two entities to which they feel this moral obligation: the organization as a whole, and their professional community of engineers (e.g. some have indicated that it is in the nature of engineering community to share knowledge, to work jointly on finding solutions for complex problems). The willingness to share was often credited by the interview participants to the organization's culture, which encourages mutually supportive relationships between employees.

Another set of reasons for contributing knowledge was associated with various self-based considerations. First, employees felt the need to establish themselves as experts (e.g. through gaining the formal expert status by contributing to the community, or through gaining an informal recognition through multiple postings and contributions to the community). Second, several managers and experts felt that they had reached a stage in their lives when it was time to start giving back, sharing their expertise, mentoring new employees; and they felt that the participation in the community provided them with this opportunity.

R2. What are the barriers to employees' contributing their knowledge to virtual knowledge-sharing communities?

Both the interview respondents' answers, and all other evidence (collected through the document analysis and on-site visits and meetings) point to the absence of a major barrier to knowledge sharing, often cited in the literature, and variously defined as "information hoarding", or as "knowledge as an individual's private asset and competitive advantage" mentality (McLure and Faraj, 2000). Thus, the majority of

participants (55 percent) believed that there was a strong evidence of employees' willingness to share, and only a small minority (less than 10 percent) believed that some employees are not willing to share because of the "information hoarding" reasons. The most important barriers to sharing, identified by this study, did not have anything to do with selfish attempts to hoard the information. Rather, participants indicated that, in many cases, people are afraid that what they post may not be important (may not deserve to be posted), or may not be completely accurate, or may not be relevant to a specific discussion. There was an element of a "fear to lose face", and of a fear to let the colleagues down, to mislead them. A related barrier was: "People are not always clear on what information should be posted". Here the participants were referring to their need for more clear directions for distinguishing between acceptable and not acceptable postings.

Furthermore, new employees often feel intimidated about posting because they do not believe they have "earned the right" to post on a company-wide system. Both new and experienced employees are also concerned that what they have to say might not be important or relevant enough to post. Many users fear possible criticism or ridicule of what they might post. This last group is concerned that they may receive responses belittling the importance of their contributions. Some are concerned that questions they might post deal with matters to which they should already know the answer.

Findings

Another important set of barriers was associated with the way the knowledge network is organized and managed. First, the process of getting knowledge entries approved by managers is time consuming (under the KN usage guidelines, CoP managers need to verify accuracy of knowledge entries before allowing their posting on the system). Second, security and confidentiality considerations lead to self-imposed censorship. Some users solve the security dilemma by employing old techniques of knowledge sharing – mailing files to individual coworkers in response to their questions posted on the system, giving information over the telephone, linking to personal Web sites – rather than posting on the KN.

R3. What are the reasons for employees' willingness to use virtual knowledge-sharing communities of practice as a source of new knowledge?

To address this question, two related issues were analyzed: uses of the system, and perceived benefits of it. When discussing uses, the majority of respondents (62 percent) view the system as a kind of encyclopedia, which is always available and can be consulted when needed. More than 50 percent have also indicated that the system is a useful problem-solving tool: participants can post questions about a specific problem they encounter and get specific solutions from other members. In addition, 35 percent of respondents indicate that the system is used to obtain help with specific problems from individual experts (This use is different from the "Use as a problem-solving tool" category. In the first case, members post a question on the system and may get numerous answers from a variety of people; in the latter case, they use the system to pinpoint specific experts and ask the question directly of them).

An additional 28 percent of participants use the system as a tool for keeping informed of general developments in their profession, or in the specific professional area within their company. A total of 35 percent of respondents found the system to be a useful

tool for managing the work of various study and professional interest groups. These groups post notices of meetings, meeting minutes, seminar agendas and summaries. Interviewees use the KN to both post this information regarding their events and to retrieve it from the other groups; 24 percent of respondents believe that the system is a useful tool that can replace or complement some of these meetings, by allowing to conduct threaded discussions, Q&A sessions.

The top two benefits mentioned (38 percent each) were: (1) The system helps new people to more quickly integrate themselves into their new place of work and become productive faster; and, (2) The system provides various geographically dispersed units with a place to work together, and to communicate better. Two additional benefits, "Access to Best Practices", and "Access to a Lessons Learned Database", received the third and fourth places as most often mentioned, respectively. Other relatively often mentioned benefits were: "Timeliness of the Information" (the system allows to get the same information that one could have obtained from other sources, but provides this information quicker, thus saving a lot of time); "An easy link not only to one's own community, but to other related communities and topics"; "Increased efficiency of one's work", (since the system integrates in one place features of the e-mail, Web sites, and user listserves); "The system's ability to provide benefits beyond specific solutions to immediate problems" (it was pointed out that a solution generated in a discussion of a specific problem of one group of people may end up helping many other people in the future); "The system provides a space for jointly generating new knowledge, not just capturing the existing knowledge" (a discussion of somebody's question leads not just to a posting with a solution that some other member may already have, but to a generation of a new solution or a method in the course of idea exchange).

R4. What are the barriers preventing employees from using virtual knowledge-sharing communities as a source of new knowledge?

Two main groups of barriers for using the CoPs were mentioned by the participants. First, it was pointed out that "Membership in a tight-knit, face-to-face group makes KN redundant". Members of such informal groups rely more on each other than on KN. As people build up time with the company, they begin to form their own networks of contacts and support. The interviews indicate that some of these networks could be construed as CoPs. For many people, these networks are their preferred method of working and knowledge sharing. When problems or issues arise, many individuals turn to their existing communities rather than the KN. Some participants have pointed out that there needs to be recognition on the company's part that these types of personal networks and CoPs are not going to be replaced by an online KN system, and that the task is not to figure out how to fit the existing CoPs into the KN, but rather how to make sure that the KN supports the existing CoPs.

The second group of barriers to using the system was comprised of those related to the nature of problems that require solutions. Some respondents indicated that some process-oriented problems are hard to duplicate thus making finding a solution on the KN difficult. Others indicated that, in some cases, they need a quick and accurate solution, and with the KN there is a danger of getting lots of answers, some of which may not be accurate and require additional time for verification.

Discussion and future research directions

This exploratory study confirms DeLong and Fehey's (2000) assertion that a supportive organizational culture is a key prerequisite for knowledge sharing, and McLure and Faraj's (2000) findings indicating that, when employees view knowledge

as a public good belonging to the whole organization, knowledge flows easily. However, the study has also found that supportive culture and employees' moral obligation are not enough to remove all barriers for knowledge sharing. Even when people give the highest priority to the interests of the organization and/or of their professional community, they tend to shy away from contributing knowledge for a variety of other reasons, which are not based on narrow self-interest. In fact, some of the barriers were grounded exactly in the concern for the community's interest (e.g. fear of letting the community down by providing wrong answers to questions posted to the community).

Additional barriers to participating include those associated with corporate security restrictions (limiting postings), and those related to the nature of the problem. Security restrictions arise in three areas. Caterpillar is engaged in a number of joint ventures. On one hand, Caterpillar would like to allow joint venture partners access to the KN. On the other hand, there is a need to protect the proprietary information stored on the system. Second, on some projects, security barriers are imposed by Caterpillar's contractors. Finally, one of the major purposes of KM is to capture the expertise of experienced workers before they leave an organization. However, while the KN may capture knowledge objects, the security restrictions keep retired employees from participating in the virtual CoPs, thus depriving members of the collaboration identified earlier as an important component of virtual CoPs, just as it is in face-to-face communities.

Discussion and future research directions

One of the main conclusions of this study is that to understand how to overcome several of the barriers identified in this study, researchers need to better understand the mechanisms of trust among community members and in the organizations. For example, the study's interviews suggest that participants will be less hesitant to post information on CoP sites once they trust that the other members will not misuse the posted information (potential misuses ranging from taking undue advantage of confidential information, to advancing one's personal agenda at the expense of the organization or other members, to using the posted information to personally attack those who posted it, challenging their professionalism). Furthermore, participants have pointed out that they will be more willing to use the CoP as a source of new knowledge if they trust it to be a source of reliable and objective information.

Here one needs to make a distinction between two types of trust: knowledge-based and institution-based. The first type of trust, knowledge-based trust, emerges on the basis of recurring social interactions between trustor and trustee, and takes root when actors get to know one another and are able to predict what to expect and how the other party will behave in a certain situation (Tschannen-Moran and Hoy, 2001). An additional rationale for promoting this kind of trust is provided by the social network theory. Granovetter (1985) argues that economic activity in organizations is embedded in prior social networks and this embeddedness determines the organizational behavior. One of the implications of the embeddedness argument is that people are more likely to share knowledge if asked by members of their earlier established social networks. When a virtual CoP is based on a prior network, participants know what to expect from the CoP members. This has implications for both willingness to contribute knowledge, and the willingness to use the KN as a source of knowledge. In the first case, workers, having had a prior satisfactory social interaction experience with

members of the community, have a reasonable assurance that the latter will not ridicule them in public, or take undue advantage of the knowledge provided them through the network. In the second case, workers know (again, due to prior contacts) that members have expertise in a certain area and, therefore, are likely to provide accurate, reliable information.

The need to promote the knowledge-based trust suggests that it may be advisable to promote online communities, which are based on already existing face-to-face communities or other informal and semi-formal groups (study groups, participation in corporate university courses, etc.). In fact, this study provided evidence that many of the participants, who felt comfortable using the community as a source of new knowledge, had prior knowledge of at least some other community members through such study groups and through the participation in courses, and commented on the importance of such prior acquaintance.

If it will be established that trust in individual CoP members indeed contributes to employees' willingness to participate in a CoP, the next step should be to gain an understanding of specific dimensions of this trust. Previous research has established that trust is a multidimensional construct, and includes trust in various attributes of trustees. Thus, Mishra's model of trust in one's manager includes trust in such attributes of a manager as reliability, openness, concern for employees, and competence (Mishra, 1996). Recent research on trust in organizations ranks integrity and competence as most important components of trust in individuals (Adler, 2001). The implication for building successful CoPs could be that their participants should have high levels of trust in the integrity and competence of its members, especially its managers and experts. However, before this conclusion can be made, these findings regarding the integrity and competence should be confirmed in the context of CoPs in general and online CoPs in particular.

The above argument suggests that employees are more likely to be comfortable working in virtual communities, which include a substantial number of already known to them people. However, given the geographic dispersion of contemporary multinational corporations, such communities based on prior face-to-face interactions could be rather limited in scope and would not contribute to the KM system's goals of wide dissemination of knowledge and of capturing the knowledge of as many competent organizational players as possible. At the same time, Granovetter (1973) argues that, when searching for new information or advice, people benefit more from weak ties (ties with people whom they do not know well), than from their strong ties (e.g. people with whom they have intensive, regular interactions through common work and/or friendships).

Therefore, one should also consider an alternative proposition: People will be willing to participate in wider communities including not only people well known to them, but also complete strangers. One of the reasons for a person's participation in a community populated mostly by strangers would be the employee's trust, not in individual CoP members, but in a larger social entity, the whole organization. Specifically, members would need to have trust in the integrity of the organization as a whole, and the competence of its members. This is so called institution-based trust, based on the belief that necessary structures are in place which will ensure trustworthy behavior of individual members, and protect the members from negative consequences of administrative and procedural mistakes (McKnight *et al.*, 1998). To insure this type of trust, organizations need to make the organizational expectations and procedures transparent through clear and widely accessible communication of these expectations and rules. A related need is for providing clear directions on

what constitutes a valid and useful knowledge entry or object that can be posted on the network, or widely advertising examples of successful problem solving and contributions by individual people, which led to such successes. Clear and transparent communication is not enough, however, if the organization, as a whole, does not demonstrate that it trusts its individual employees. It was observed that low-trust organizational forms are poor in promoting knowledge creation or sharing (DeLong and Fehey, 2000).

The discussion so far has focused on the positive role of prior participation in face-to-face communities of practice in promoting the participation in online communities. However, this study has also found that this prior participation could have a negative influence, too. Thus, the study suggests that participation in a tightly knit face-to-face community could make the online community redundant for some members, especially those who have been with the organization for long time. What can be learned from this finding? One of the implications is that, instead of trying to supplant face-to-face communities with online ones, the organization should capitalize on the existing communities and assist them in using the online communities to increase the effectiveness of their work, by providing a unique space for knowledge generation and exchange, which goes beyond of what is available in regular, face-to-face collaboration situations.

Another factor that impacts CoP emerged from the interviews: the nature of the work itself. While all three CoP studied in this project are comprised of engineers, their tasks are radically different. In one of the “less successful” CoP, interviewed members do not post questions designed to discover best practices and solutions. Their problem solving, rather, requires talking to numerous people and weighing various options. There does not seem to be that “one right answer”. Therefore, they rely more on face-to-face or telephone interaction with other CoP members. Members of the other less successful community do not view their role as one of providing the correct solution to a problem. Their main function is data mining. The community members stated that this undertaking is primarily based around information technology and is a solo task, thus collaboration is neither a concern nor a habit. Members of the successful CoP, on the other hand, do see problem solving, and sharing those solutions, as a primary role. Those members are spread across almost every business unit in the company. Collaboration, whether face-to-face or virtual, is a vital part of their work.

Based on the limited evidence provided by this exploratory study, it can be postulated that an organization striving to create a network of vibrant virtual communities of knowledge sharing would need to create a supportive environment, consisting of the following elements:

- A set of institutional norms promoting institution-based trust, including those clearly communicating that knowledge sharing is a norm of this organization, that the organization trusts its employees, and that sharing is a moral obligation of all employees.
- Multiple face-to-face communities of practice (study and discussion groups, informal task forces), which provide a foundation for knowledge-based trust. Some of these communities could later evolve into virtual communities; others will never be replaced by the virtual forms, but may use, as needed, some of the tools of the virtual communities to enhance their face-to-face interactions and learning.
- A set of clearly communicated norms and standards for sharing knowledge, which would reduce the anxiety associated with the uncertainty about what constitutes acceptable postings, what violates corporate security rules, etc.

To turn the above list of attributes of a knowledge sharing-friendly environment into a coherent framework, further development and testing of its elements is needed in subsequent studies. Thus, specific dimensions and attributes of institution-based and knowledge-based trust promoting participation in CoPs should be determined in further survey-based, case study, and experimental studies.

Numerous other questions, which this study has helped to illuminate, remain unanswered. For example, the study results raise questions regarding the role of online CoPs in enhancing the social capital of organizations. Social capital represents the knowledge flows among individuals in an organization (Coleman, 1988; Stewart, 1997). It is defined as “the actual and potential resources individuals obtain from knowing others, being part of a social network with them, or merely being known to them and having a good reputation” (Baron and Markman, 2000, p. 107). The study seems to suggest that online communities strengthen the social capital by strengthening the ties between people who have met in earlier face-to-face meetings, but would not have kept in touch if not for the network (due to geographic dispersion, for example). The online CoPs could be instrumental in strengthening social capital by extending the network of ties to a larger group of people in the same professional group, whom the members of a face-to-face network did not know before (e.g. in this study, some participants have pointed out that they had no idea that their peers, people with similar backgrounds and professional interests, were working at some remote locations, and they got in touch with these people for the first time through the KN). In addition, online CoPs could be helping in bridging the “structural holes” in networks (Burt, 1992). Burt (1992) argues that the strength of networks lies not in the dense relations existing between the main actors, who communicate on a regular basis, but in the networks’ ability to broker information flows between various, previously non-related, or weakly related entities. Therefore, virtual CoPs could be spanning the “structural holes” by involving people from different professional groups, who may not have participated in face-to-face communities in the past (e.g. engineers getting input from marketing people) in discussions. Studies based on social network theory and associated research methods would help to illuminate these relationships.

Implications for KM practitioners

One of the study findings is that the challenge in enabling virtual communities of practice is not so much that of creating them (since most communities emerge spontaneously) but that of removing barriers for individuals’ participation, supporting and enriching the development of each individual’s uniqueness within the context of the community, and linking that uniqueness with the community purpose. Therefore, under the virtual communities of practice model of KM, the role of KM professionals is not so much to aid in capturing and distributing knowledge, but to create conditions for its generation and dissemination. This work is achieved by enabling community interactions, by promoting conditions for an open exchange of ideas and information, by creating time and space for exchanging stories and expertise, and by supporting innovative thinking. At the same time, KM professionals must avoid an attempt to manage CoPs. One common theme in much of the literature (Stamps, 1997; Stewart, 1996; Ward, 2000; Weiss, 2001) is the recognition that CoP do not respond well to being managed, and, in fact, outside management efforts may throttle an otherwise thriving CoP.

The study points towards one additional area where KM professionals could make a strong contribution to the community of practice development. The research results indicate that participants view their communities as providing spaces for joint generation of new knowledge, not just for exchanging the existing knowledge.

Understanding the dynamics of interactions occurring in these virtual spaces, and helping the participants to unleash their creativity should be an important role of KM professionals. Since the phenomenon of virtual communities is new and largely unexplored, one of the tasks of KM practitioners should be to study the spontaneously emerging new forms of informal learning, and knowledge generation in virtual communities of practice, and identifying what needs to be done to facilitate this learning, again without imposing artificial restrictions, without inhibiting the spontaneity of these informal interactions.

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