Knowledge-sharing in cross-functional virtual teams

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The emergence of cross-functional virtual teams has presented both benefits and challenges to organisations. However, the unique characteristics of virtual teams make the sharing of knowledge among the geographically separated members difficult. This paper attempts to address this issue by looking at how the process of knowledge transfer takes place in a cross-functional virtual team. A case study is conducted to interview various cross-functional virtual team members in one local subsidiary of a multinational telecommunication corporation as well as two of its hardware vendors. The findings indicate that four knowledge-sharing mechanisms are being employed, including shared understanding, learning climate, job rotation and coaching. Among them, shared understanding and learning climate are thought to be able to solve the challenge related to the unwillingness among the virtual team members to participate in the knowledge-sharing process, whereas coaching and job rotation are argued to be the solutions for the lack of collective competence required for performing the co-operative works. Some practical implications are also suggested for the effective management of cross-functional virtual teams.

Introduction

Cross-functional virtual work teams have been around for a while. They are identified as a group of people who work interdependently with a shared goal across space, time and organisation boundaries by using the latest information and communication technology (ICT) (Brown, 1998; Dube and Pare, 2004; Grenier and Metes, 1995; Lipnack and Stamps, 2000; Martins et al., 2004). They have given organisations unprecedented opportunities to bring people located in different geographical locations together, including employees, representatives from external stakeholders such as suppliers, clients, vendors and joint venture partners, to work on a common initiative over a long period of time (Montoya-Weiss et al., 2001). For example, Hewlett Packard had reportedly been using various virtual teams to develop new products and services in its IT Resource Centre (Raths, 2001). A number of benefits can be attributed to the use of cross-functional virtual teams, including quality improvement, shorter response time, improved socialisation and better sharing of knowledge (Jessup and Kukalis, 1990; McCartt and Rohrbaugh, 1989; Townsend et al., 1998).
However, there is limited understanding about how the process of knowledge-sharing takes place in these teams (Blackburn et al., 2003; Corso et al., 2006; Griffith and Sawyer, 2006). As the separation of team members in dispersed physical locations reduces the opportunity for having frequent face-to-face interactions – a crucial requirement for effective sharing of tacit knowledge (Lave and Wenger, 1991; Nonaka and Takeuchi, 1995) – this can make the knowledge-sharing process difficult (Wilson, 2003), if not impossible. Past researches suggest the use of some technological fixes (King and Majchrzak, 2003) for overcoming the physical dispersions in cross-functional virtual teams to facilitate the knowledge transfer, such as advanced communication networks and groupware systems (Barrett et al., 2004; Boudreau et al., 1998; Haake and Pino, 1998). However, the results are far from satisfactory, since the reliance on information technology alone cannot substitute the social dynamics underlying the knowledge-sharing in virtual knowledge communities (Robey et al., 2000; Storck and Hill, 2000). For cross-functional virtual teams requiring the skills and knowledge from a whole range of people in different physical locations, the major challenge is to establish a “social infrastructure that allows the transfer of knowledge and information” (Corso et al., 2003; p. 207), an issue that is yet to be resolved.

The main objective of this paper is to investigate what facilitates the social process of knowledge-sharing in a cross-functional virtual team. In-depth interviews with participants of a cross-functional virtual team involving operational managers, top management and some IT specialists were conducted in the local subsidiary of a multinational telecommunication company in Macau, a special administration region (SAR) of People’s Republic of China, and also two of its hardware vendors. The findings indicated that four different organisational mechanisms, including shared understanding, learning climate, coaching and job rotation were employed to facilitate knowledge-sharing processes amongst the virtual teammates. By understanding how the cross-functional virtual team members actually engage in the day-to-day knowledge works, the study aims to contribute to the ongoing debate about knowledge transfer and sharing at the intra-firm level (Argote et al., 2000; Szulanski, 1996, 2000) and extend it into the virtual team setting (Griffith and Sawyer, 2006; Robey et al., 2000; Sole and Edmondson, 2002). Some practical implications were also suggested for the better management of cross-functional virtual teams. The paper is divided into four parts. Part two surveys some of the background literature pertinent to the cross-functional virtual teams and the related knowledge-sharing mechanisms. Description of method and research design is presented in part three. While the empirical evidence from the qualitative interviews in the telecommunication company and its hardware vendors are examined and explored in part four, conclusions are presented in the part five, followed by some practical suggestions and directions for future research.

**Background literature**

The cross-functional virtual work team is commonly known as the one where members are separated by space and time to work together primarily through
Knowledge-sharing in cross-functional virtual teams

ICT (Dubé and Paré, 2003; Montoya-Weiss et al., 2001). Cross-functional virtual team membership composition is more dynamic than in traditional teams, as it includes members from locations that would not have traditionally worked together. It represents a major structural alternative from traditional workgroups because of the ability to transform quickly according to changing task requirements and responsibilities. This dynamism requires virtual team members to be particularly adaptable to cope with different management challenges. However, the management and co-ordination of transfer of knowledge and ideas among individuals and functional groups could be a challenging aspect of the job (Lovelace et al., 2001; Sethi et al., 2001). It is of vital importance for the cross-functional virtual team members to share the information and know-how required for the implementation of joint tasks. Lussier and Achua (2004) state that the premise behind any cross-functional teams concept is that the opportunities for sharing information and cross-fertilisation of ideas amongst people from different functional areas (production, marketing, R&D, information systems, etc.) are essential. This is especially true for cross-functional virtual teams charged with developing innovative products/services or new technologies. Developing an effective cross-functional virtual team goes well beyond the technical problem of linking them together. As all the team members increasingly interact in a virtual mode, it is imperative that they participate in the situated knowledge processes (Sole and Edmondson, 2002) that are crucial for the organisational success.

There are reportedly two main kinds of problems and challenges related to management of the knowledge process in virtual teams. The first challenge is to overcome team members’ reluctance to participate in the shared knowledge works. The loosely defined structure, varied members’ background, fluid membership and lack of prior joint work experience increase the degree of demographic diversity and psychological distance in virtual teams (Dubé and Paré, 2003) and the dispersed organisational affiliations may affect how they perceive and identify each other. This may reduce their motivation to participate in the social interactions and knowing in practice (Orlikowski, 2002). The second challenge is to minimise the problem related to the lack of “mutual knowledge” (Cramton, 2001), or “knowledge that the communicating parties share in common” (p. 346), and the related negative consequences on the mutual engagement in action. Having unequal distribution of prior knowledge critical for the task on hand and work-related competence puts each member on an unequal footing, thus undermining their ability to cooperate interdependently and give contributions to the ongoing knowledge processes. After reviewing some background literatures (Brown, 1998; Griffith and Sawyer, 2006; Hildreth et al., 2000; Lagerstrom and Andersson, 2003; Sarker et al., 2005), four main mechanisms are identified as beneficial for overcoming these two challenges. First, members need to build up a shared understanding among each other (Hinds and Weisband, 2003). Shared understanding in a cross-functional virtual team is the degree of cognitive overlap and commonality in beliefs, expectations and perceptions about a given target. Since the cross-functional virtual team members come from different departments, business disciplines and geographical locations, they have different
ways of perceiving the tasks and taking up the issues together (Rivenbark and Frost, 2003). If there is a lack of common background and experiences, it is a constant challenge to maintain the commitment, coherence and continuity of work routines across the virtual team members, and having a shared understanding can help the team members to anticipate and predict the behaviour of other people.

Second, in order for the cross-functional virtual team to turn the new knowledge into social practices and sustain their effort, creating a learning climate among the team members is essential (Clutterbuck, 2004). Unlike traditional teams, cross-functional virtual teams are expected to have frequent changes of membership without losing productivity. This does not give much time for member to get to know each other and learn how to work collectively. A good climate conducive for knowledge-sharing would create a social context that gives meaning to what the virtual team members do (Orlikowski, 2002) and affords them a common orientation to each other. The learning climate serves to generate a common ground on which the knowledge-sharing works are structured. Third, as the cross-functional virtual team members might include internal employees and outsiders (such as vendors) it is important to ensure that each person shares the requisite technical knowledge and organisational know-how through various forms of coaching in order to enable them to participate in the ongoing social interactions and actively engage with each other in the virtual team (Lipnack and Stamps, 2000). Fourth, one of the best ways to get around the problem of knowledge isolation for the cross-functional virtual team members separated by time and location is to have job rotation across business functions and divisions. This entails the shifting of members across different jobs to increase their exposure to a variety of tasks and personnel. It would allow new and old members to know more about each other and participate in developing mutual understanding and shared practices (Gherardi et al., 1998).

Method

This study adopts a case study research method. As argued by Yin (1989, p. 14), the case study method allows the researcher to investigate and represent the complete and meaningful characteristics of real-life events. This method can also evaluate the phenomenon from the participants’ perspectives and obtain the relevant data to help generate the answers for the research question, which is about the knowledge-sharing practices in cross-functional virtual teams. It is particularly useful for this case since the phenomenon under study is fluid, exploratory and context-specific in nature (Marshall and Rossman, 1989; Mason, 2002). This study’s findings were obtained from the experience of implementing one cross-functional virtual team in the local subsidiary of a multinational telecommunication company, ABC, over a period of three years from 2001 to 2004. The company was chosen as the research context because of its rich experience with cross-functional virtual teams. ABC, a joint venture company with capital investments from Hong Kong, British, Chinese and Macau investors, aimed to enhance the service quality and maintain the leadership position in a local market to cope with the advent of new
technologies, increase of market competition and more demanding customer requirements. One of the areas for service improvement was the billing system. They were looking for a new billing system to provide mobile functionality as part of their business priorities. The new billing system was expected to charge for new and existing products and services, have a more flexible pricing scheme and customer loyalty program and provide customer care to their customers. With these objectives in mind, one of the major consortium projects, Customer Care and Billing System (CCBS), was initiated.

CCBS was a joint product development project with the participation of the corporate parent in London, other subsidiaries in Panama and West Indies, and two technology vendors from Israel and India respectively. The local telecommunication company intended to position this project as a critical mission for providing customer care and billing solutions. The output of CCBS project was to develop and support mobile solutions in ABC Company and the subsidiaries in Panama and West Indies, and then extend it to other fixed line and internet services at a later stage. The CCBS project was started in 2001 and terminated at the end of 2003. Data collection for this study was conducted after the project and was completed in two phases. The initial phase was a literature review to familiarise the researchers with the conceptual background and highlight a number of key concepts relevant for the study. Secondary data collection was also conducted to gather archival and background information about the CCBS project from various internal sources, which included policy documents, memos, progress reports, corporate emails, etc. All this information would be used as tangible testimonies and a triangulation device (Yin, 1989) for the primary interview data. The semi-structured interviews were performed in the second phase. The semi-structured interviews were conducted from March 2004 to June 2004. The final samples were comprised of 15 CCBS project participants, including departmental managers, top management and some outsourced IT vendors in other geographical regions (See Table 1 below). The respondents were all well-informed about the details of CCBS project and came from different hierarchies in the organisation (See Figure 1 below). They had a range of five to several hundreds people directly reporting to them in their specific organisation, with the tenure in the company from 1.5 to 22 years (Table 1).

The orientation to data collection and analysis was exploratory, with the early stages being more open-ended than the later ones. The top management (Program Sponsor) was interviewed first, in order to have a general understanding about the background and objectives of the cross-functional virtual team project from the company's viewpoint. More in-depth interviews were arranged with the middle-level managers (Program Manager, Project Manager and Business Manager), various representatives and specialists from different departments and the two hardware vendors. Interviewing respondents from different organisational levels and functional backgrounds served to greatly enhance knowledge about the diverse challenges encountered by the members in this cross-functional virtual team project. During the interviews, respondents were asked to identify their perceived knowledge-sharing barriers and the relevant solutions. In their descriptions of their distributed knowledge
Table 1: Respondents' profiles

<table>
<thead>
<tr>
<th>Position</th>
<th>Responsibility</th>
<th>Length of tenure</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Sponsor</td>
<td>• Represent local business unit at the Steering Committee</td>
<td>20 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Co-ordinate with business units in other regions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ensure the centralised management and co-ordination of overall communication for the CCBS project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Manager</td>
<td>• Provide co-ordination to endure the alignment of business process with CCBS project scope and business benefits</td>
<td>22 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Facilitate agreement and implementation of the local business process and functional design</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ensure the smooth local delivery of business process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Manager</td>
<td>• Facilitate the implementation of CCBS technical standards</td>
<td>11 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Equip the CCBS project with required infrastructure, policies and procedures to enable effective delivery and reporting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Manage the technical and integration risks of local business unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Manager</td>
<td>• Co-ordinate, manage, monitor and implement the CCBS project</td>
<td>4 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Be accountable to the program sponsor and liaise with program director in London, business units in other regions and the vendors from Israel and India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representative of Business Office</td>
<td>• Develop and manage the overall functional requirements from the business perspective</td>
<td>9 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Manage the testing risks and ensure business continuity throughout implementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representative of Finance Office</td>
<td>• Develop and manage the overall functional requirements from the finance perspective</td>
<td>10 years</td>
<td>Local unit</td>
</tr>
<tr>
<td>Specialist from Mobile Business Unit</td>
<td>• Consolidate the business requirements from the mobile business perspective and liaise with the vendors from Israel and India</td>
<td>8 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Support local adoption testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialist from Payment Unit</td>
<td>• Consolidate the business requirements from the payment perspective</td>
<td>10 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Liaise with the vendors from Israel and India</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Support local adoption testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialist from Tariff Unit</td>
<td>• Consolidate the business requirements from the mobile tariff perspective</td>
<td>9 years</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Liaise with the vendors from Israel and India</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Support local adoption testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialist from Technical team</td>
<td>• Ensure the local CCBS project solution can be adopted in a controlled manner</td>
<td>7 years</td>
<td>Local unit</td>
</tr>
<tr>
<td>Data Conversion Manager</td>
<td>• Ensure the delivery of data conversion to CCBS solution</td>
<td>1.5 year</td>
<td>Local unit</td>
</tr>
<tr>
<td></td>
<td>• Liaise with the vendors from Hong Kong, Israel and India</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Support local adoption testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Manager A</td>
<td>• Ensure the smooth delivery of CCBS project through participation in the Steering Committee and vendor partnering</td>
<td>12 years</td>
<td>Vendor from Israel</td>
</tr>
<tr>
<td>Expert A</td>
<td>• Provide business development training and user acceptance testing</td>
<td>9 years</td>
<td>Vendor from Israel</td>
</tr>
<tr>
<td>Site Manager B</td>
<td>• Ensure the smooth delivery of CCBS project through participation in the Steering Committee and vendor partnering</td>
<td>3 years</td>
<td>Vendor from India</td>
</tr>
<tr>
<td>Expert B</td>
<td>• Provide business development training and user acceptance testing</td>
<td>2 years</td>
<td>Vendor from India</td>
</tr>
</tbody>
</table>
work, both the virtual team members and hardware vendors repeatedly mentioned a number of broad mechanisms that facilitated the knowledge transfer in a virtual team setting. Because of the salient features of these mechanisms, data collection was focused more explicitly on the functions and contributions of these mechanisms. In the later stage, questions became more specific and directed, trying to engage participants in the discussions of how the broad mechanisms could enable them to participate in the sharing of knowledge in the cross-functional virtual team. The data analysis was carried
in accordance with the procedures suggested by Eisenhardt (1989). The first step was to categorise all primary and secondary data and transform them in some way as part of the process of sorting and organising them. After categorising the raw data, the issue arose as to what kind of information was relevant and should be addressed in the study. Four main knowledge-sharing dimensions were concluded, which were perceived to be equally important among all respondents. As some measures for data verification, all data were taped for subsequent transcription and interviewees were invited to review the transcribed data and give specific comments for corrections if necessary.

**Knowledge-sharing mechanisms in cross-functional virtual teams**

**Shared understanding**

Effective management of the knowledge-sharing process was found to be crucial for the success of a cross-functional virtual team, and the first and most critical task was to build a shared understanding among the team members. The diverse socio-cultural background of the virtual team members in the CCBS project made the management accept the fact that they needed to ensure everybody was on the same path. In the CCBS project, some of the team members thought the goal of this project was to replace the existing billing system with a new one and did not care about the quality or relevance for the local market. However, others believed that they should have a suitable, more flexible and operational billing system to cope with the existing competitors. The diverse understandings about the nature and meaning of the project undermined the effectiveness of knowledge-sharing. The Program Manager stated that:

"Shared understanding is a crucial factor to align all the virtual team members together to deliver the same strategy and achieve the same goals, working procedures etc. Virtual team members, sometimes operating alone or as a small team in their isolated location, tend to behave differently if there is no a common purpose."

Virtual team members needed to develop the shared understanding about what they were trying to achieve, how they would achieve it, what they needed to do and what each team member brought to the team task. Given the specific circumstances in the virtual team involving people from different disciplines, business units, organisations and cultures, it was natural that they had different ways of perceiving their tasks and making sense of the situation. The absence of a mutual and shared understanding about the team's common goal was believed to result in failures. By developing shared understanding, the team learned how to bridge the chasm between the thought worlds among the members.

"Shared understanding is important for a cross-functional virtual team. Taking another example of the grand opening of Sands (one local casino), several teams gathered and discussed some operating procedures that
Knowledge-sharing in cross-functional virtual teams

required the inputs from the front line as well as the back office staff. Without the shared understanding and knowledge, it was not possible to achieve" (Specialist from Payment Unit).

To develop a shared understanding was something that needed to be done with a great deal of care. It was important because it minimised the problems of adjustment or conflicts that arose from the incompatible goals later on. When the organisations failed to clearly define the common purpose, it would result in a failure.

"By not sharing the meaning and purpose of the project, the gap will be getting wider and wider until it is too late. In order to narrow the gap, extra manpower and time will be required, but the loss of time and revenue is already a disaster from the business point of view" (Representative of Finance Office).

Learning climate

Sharing a common goal is found to be important at the initial stage when embarking on knowledge-sharing activities, but to sustain interest and effort, the climate needs to be conducive for learning. Sometimes it is hard to bring the cross-functional virtual members with diverse backgrounds together and ask them to pool their knowledge voluntarily. Therefore, it is important to develop and institutionalise the corporate values and norms of knowledge-sharing, especially among virtual team members where the team composition is often subject to changes. For the CCBS project, members were continuously reminded that the final success mainly depended on their collective effort to solve problems and develop new ideas. As time went by, they began to develop better mutual understanding and create a comfortable climate of learning and collaboration in order to meet the project deadline and requirements.

"Being one of the team members for the CCBS project is a very good chance for me to learn different types of knowledge. Whether it is from the operational or management point of view, team members from different departments or companies worked as a single team and pulled their knowledge together for solving work-related problems" (Representative of Business Office).

Another respondent also stressed the importance of having a corporate culture oriented towards teamwork and learning:

"I want to emphasise that the project belongs to everyone and different parts of the team should be related to each other. We should not just pass the problem to other colleagues but rather work co-operatively to find out the solutions" (Specialist from Tariff Unit).

Throughout the process of collaboration, all team members started to realise the implicit norms and role expectations to take up the commitment of learning and experience new ideas. As innovation and knowledge creation all involved the identification of knowledge gap, it was understandable that people were often reluctant to speak out and admit their ignorance due to the concern for the negative impact on one’s reputation.
“For the virtual team to learn, or share information and knowledge, the individuals must overcome their reluctance to share information (both about their unique perspectives and the limits of their abilities or knowledge) and be open to learn from others” (Program Manager).

To establish a learning climate, the virtual team organised a daily review meeting and used it as a venue for sharing new ideas and maintaining social contacts. Members often took this opportunity to gain new knowledge and discuss any pending issues with the relevant individuals. All the conversations were witnessed by other parties and this gradually served as a domain of common knowledge and instilled an atmosphere of learning.

**Coaching**

Structured coaching between virtual team members enables them to learn from each other. Throughout the interactive and systematic coaching process, team members can have the opportunity to observe other people and work collaboratively for generating any new knowledge which would benefit the team, the project or the organisation. Working with the team leader can help define the team purpose, specify goals, develop mutual accountability and facilitate communications that lead to high performance results. Members have a responsibility to ensure that everyone else has the information and know-how they need to contribute effectively. Coaching between team members should happen naturally and willingly. However, this was not the case for the CCBS project at the beginning stage. Owing to their limited experience with the operation of cross-functional virtual team, the team members were confused about what they were supposed to do. There was no systematic guidance for them to participate in the knowledge-sharing process and share what they knew with other fellow team members. The Business Manager reflected upon the problematic situation:

“Some of the team members were not willing to coach the others. They thought they were the experts in the virtual team and they did not want to share anything with the novice even though they were from the same area. The reason might be that they want to protect their own turf!”

Other people in the project attributed this problem to their diverse background and occupational origins. The virtual team members might have different cognitive orientation and work commitment since they were from different functional areas.

“Some of the team members thought they were still the representatives of [the] Marketing or Finance Department even though they had joined the cross-functional virtual team. They just focused on anything related to their own areas. They just wanted to perform well and finish their own tasks on time. They thought there was no need to share any idea with anybody else, because it was nothing to do with others. However, if anyone wants to have a better performance, he/she should have team thinking and orientation. Then, he/she would share anything with other team members even though
Knowledge-sharing in cross-functional virtual teams

they come from different departments. It may also benefit the whole project if all the relevant knowledge could be shared amongst the team” (Business Manager).

Job rotation

One benefit of a virtual team is that members can utilise the knowledge and skills from others in the team. This was the main reason why the ABC company decided to launch the CCBS project. Team members were gathered from different areas of the organisation to pool their expertise and complement each other’s knowledge gap. This was openly acknowledged by the Project Manager:

“By forming a virtual team, we can combine the team members’ strengths and overcome their weaknesses. It was also helpful at the beginning to establish a knowledge database within the team. Later on, when it is appropriate, we can consider rotating the team members in order to get more ideas, information or knowledge from different people’s perspectives.”

The policy of job rotation was implemented with the objective of improving both individual knowledge and the team’s collective know-how. They were also encouraged to broaden their perspectives to look at the problems from different angles rather than just focusing on the issues of their particular functional department.

“The way that people were selected was based on their unique expertise and [we] expected contributions to the cross-virtual teams. After a certain period, some of the experienced members could be encouraged to transfer to other related areas in order to promote synergistic effects” (Business Manager).

Sometimes job rotation not only helped promote technical knowledge, but also facilitated their development of mutual engagement. In this study, team members were mainly recruited from two organisational units with radically different corporate cultures. One was very entrepreneurial, while the other one was conservative. Throughout the co-participation process, members learned gradually how to engage one and other to develop mutual relationships.

Conclusion and discussion

The recent emergence and popularity of cross-functional virtual teams has brought some benefits and challenges to the organisations, but it is difficult to ensure that all members would share their requisite knowledge effectively due to geographical dispersion, lack of prior collaborative experience and diverse membership background (Griffith and Sawyer, 2006; Rasmussen and Wangel, 2006). Following the sociological perspective of knowledge management (Currie and Kerrin, 2004; Sawhney and Prandelli, 2000; Storck and Hill, 2000), this paper argues that in addition to the choice of the appropriate communication medium and information technology (King and Majchrzak, 2003; Sarker et al., 2005), it is also important to consider the influence of social
and organisational arrangements that help facilitate the knowledge-sharing process and improve overall effectiveness (Gibson and Cohen, 2003; Martins et al., 2004; Maznevski and Chudoba, 2000). Specifically, the findings of this study indicate that there are four major mechanisms for enabling knowledge-sharing in cross-functional virtual teams, namely: shared understanding, learning climate, coaching and job rotation, each with unique contributions to the dynamics of knowledge management in virtual teams. Both shared understanding and learning climate can enhance the "learning intent" (Simonin, 2004; Hamel, 1991) of the members to participate in the knowledge transfer process. It is through the establishment of shared norms (Sarker et al., 2001; Suchan and Hayzak, 2001) and common goals (Kaiser et al., 2000) that the team members would join hands together to realise the differences of working habits of other cultures (Martin and Hammer, 1989) and participate in the development of shared knowledge repertoire (Wenger, 1998) and practices (Brown and Duguid, 1991). This helps facilitate the mutual engagement process and reduce the subsequent mutual adjustment problems (Hornett, 2004) in the virtual team setting where the members barely meet and know each other.

On the other hand, the learning climate provides a supportive institutional context (Nonaka and Kono, 1998) for overcoming the psychological barriers to share knowledge as evident in most teams with limited trust (Andrews and Delahaye, 2000). It constitutes a set of shared values and expectations about how the virtual team members should behave to share knowledge. It also paves the way for uniting the diverse team members, reducing the differences and developing the joint enterprise (Wenger, 1998) as a source of coherence for the cross-functional virtual team.

However, effective management of coaching and job rotation policies is also important to improve the "learning capacity" (Simonin, 2004) of the individual team members. Coaching, in the forms of training, communication, personal observation and interactions with vendors or customers, provides various structured occasions for the new members to participate in the knowing in practice (Orlikowski, 2002) under a distinctively constituted order. Throughout their daily encounter and guided instructions with other senior members in the virtual teams, they are able to acquire the embodied skills and absorb other embedded knowledge (Sackman, 1992; Sole and Edmondson, 2002) to enable them to interact with other fellow team members (Lave and Wenger, 1991). However, while coaching appears to be informal in nature, job rotation represents a formal arrangement where the new and old members can co-participate together (Gherardi et al., 1998). The increases in familiarity and experiences of dealing with each other help reduce the learning barriers due to lack of trust and confidence (Andrews and Delahaye, 2000), thus promoting the development of joint knowledge transfer (Lagerstrom and Andersson, 2003). Nevertheless, while the case study approach adopted in this research provides a good tool to explore the patterns and dynamics of knowledge-sharing in a virtual team and develop a rich understanding of the phenomenon, there are also some limitations that might affect the internal validity of the study.

First, the fact that all the interview data were obtained from a single
Knowledge-sharing in cross-functional virtual teams

company may pose a question about the generalisability of the findings. As the cross-functional virtual teams can appear in various forms and structures (Gibson and Cohen, 2003) and face different resource constraints and environmental challenges (King and Majchrzak, 2003), it is possible that some other social, organisational and technological factors can also affect the dynamics of knowledge-sharing among the team members. The mechanisms proposed in this paper, namely shared understanding, learning climate, job rotation and coaching, are deemed to be relevant for those companies without significant time pressures, because it needs a long time to build up interpersonal trust and improve the climate in organisations. The second limitation regards the data. Due to the access problems and sample availability, only the representatives from the local subsidiary and two hardware vendors were interviewed. Missing the voices of representatives from the units of Panama and West Indies may compromise the scope of analysis. However, judging from the profile of respondents (see Table 1 and Figure 1 above), it was possible to listen to their different concerns and collect the diverse viewpoints from different levels in the organisations. Results from the member-checking procedure also confirmed that the interpretations had accurately reflected their views. Moreover, the researchers were unable to participate in or observe any activities in the cross-functional virtual team directly, so understanding of the mechanisms and associated impact only came from interview data and from the traces of secondary data. This is the third limitation of the study.

Good management of a cross-functional virtual team needs more than just capital investment in information technology, and more resources should be devoted to the teams for developing both the 1) intention and 2) capacity of the members to share knowledge. For improving the “learning intent” of the team members and overcoming the psychological barriers due to lack of trust, the top management should also implement a company-wide effort to create an enterprise context (Nonaka and Kono, 1998) conducive for knowledge-sharing and creation, which “gives meaning to its everyday practices and routines, defines acceptable and unacceptable behaviours, and determines the way they (members) define problems and solutions” (Ciborra and Schneider, 1992, p. 270). The objective is to establish an overall social learning system (Hong et al., 2006), which affects the manner in which people from different virtual teams interact with each other. Specifically, more ongoing and regular corporate socialisation programs are necessary to help develop mutual understanding among virtual team members and foster a shared identity to overcome the reluctance to participate in the collective actions of knowledge-sharing. Conversely, more formalised staff development schemes can be offered to the participants for improving their capacity to share knowledge. Both the prior theories (Argote et al., 2000; Szulanski, 1996, 2000) and the findings of this paper suggest that the level and structure of prior individual knowledge affects the effectiveness of subsequent knowledge exchange process. So it is necessary for the leader of a virtual team to maintain a balanced level of knowledge similarity and diversity among the team members by maximising the opportunities for learning and social interactions on an ongoing basis, such as plant visits, short-term training programs, briefings and expert guidance.
As a conclusion, the study has opened up the debate about the enabling function of the social context in organisations and the impact on the overall knowledge-sharing. But given the qualitative nature of the study, it is yet to prove the causal relationship between these two conceptual variables, which is a potential area for further examination. Moreover, there is a chance to further explore other dimensions of the organisational context in addition to the shared understanding and organisational climate. One possible arena for future research is to investigate the relationship between trust and knowledge-sharing. In a self-managing virtual environment where the members seldom meet each other, it would be interesting to see how the organisational trust is developed and influences the knowledge-sharing process (Politis, 2003). Moreover, in order to rectify the limitations of single case study and improve the generalisability, another arena for further research is to replicate the study in a different industry context and environment. The interested parties should gather the data from other similar cases, particularly those under severe time pressure, for fine-tuning and expanding the emerging theories (Eisenhardt and Graebner, 2007). It is foreseeable that in a fast changing environment, more individual and organisational level mechanisms would appear to mitigate the challenges of managing the knowledge works in a cross-functional virtual team.

References


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