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Virtual Competencies and Knowledge Transfer in Global NPD: A Case Study

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Virtual new product development teams are geographically dispersed and cross-functional, yet they work on highly interdependent tasks by communicating electronically in work groups. This virtual interdependence, among other issues, presents new challenges for the management of knowledge transfer in global New Product Development (NPD). In this project, virtual competencies were studied with the use of qualitative methods to assess the most significant issues affecting knowledge transfer in virtual settings in global NPD. As a result, the existing theory regarding virtual competencies and virtual organizations was refined and potential barriers for knowledge transfer were discovered. The success of knowledge workers is crucial for the performance of knowledge-based organizations, which form the basis of our global economy; therefore, this study's findings are significant.

Keywords: knowledge management; virtual organization; new product development; knowledge transfer; virtual competencies

Introduction

The competition in international markets has increased requiring rapid changes in the business environment. Accordingly, the pace of new product innovation has sped up and it has become increasingly important to rapidly leverage existing in-house competencies, resources, and capabilities into new product projects. In global companies, the only way to rapidly carry out new product development (NPD) is to form a virtual product development team (Cooper, 2001). Within a few years, more than 1,3 billion people will work in virtual organizations; therefore, it is important to better understand the development of virtual work and characteristics of this development (Johns & Gratton, 2013). Studies have produced mixed results on how technology affects knowledge transfer; therefore, more knowledge on virtual collaboration is needed. (Li, 2010; Faraj, Jarvenpaa, & Majchrzak, 2011) Research should therefore focus on understanding how virtual organizations respond to the tensions that arise in constantly and rapidly changing environments.

The above discussion can be condensed into the following research questions:

1. How is knowledge transfer in global NPD identified in the literature?
2. What are the challenges for virtual knowledge transfer in the case project?
3. What is the role of virtual competencies in global NPD?

The case study organization is a leading global enabler of telecommunications services. With its focus on innovation and sustainability, the company provides a complete portfolio of mobile, fixed, and converged network technology, as well as professional services including consultancy and systems integration, deployment, maintenance, and managed services. It is one of the largest telecommunications hardware, software, and professional services companies in the world.

Research Process and Methods

The research process started with a review of the literature on virtual organizations, including cultural issues, communications, virtual work environment structure, and knowledge transfer theories. Theoretical foundations lie mostly in knowledge management, virtual organizations and human resource management.

The literature review was synthesized and first research question is answered in the section 'Characteristics of Knowledge Transfer in Global NPD.' Consequently, the theoretical basis was outlined and research questions were formed for the case company. The actual study was conducted with qualitative semi-structured interviews, which enable flexible research design. To ensure the exploration, a qualitative method is the most appropriate method for conducting the study (Marshall & Rossman, 1999). The answer to the research question 2 is presented in the section 'Empirical Study' and, finally, the research question 3 is answered in the section 'Role of Virtual Competencies in Global NPD.' Figure 1 represents the research process.

The study focused on level four managers within the case company. Examples of managers' work positions are Head of Product Management and Head of Programs. Five of the managers' positions were in R&D, two were positioned in product management and one of the manager's positions was in the sales organization. All of their work duties were in operative management. Figure 2 describes the informants' position (L4 = Level 4) in the case company. Figure was modified by Tozer's (2012) 'Integrated levels of leadership.'

All of informants' teams are globally dispersed and involved in virtual communication on a daily basis among various different locations. These

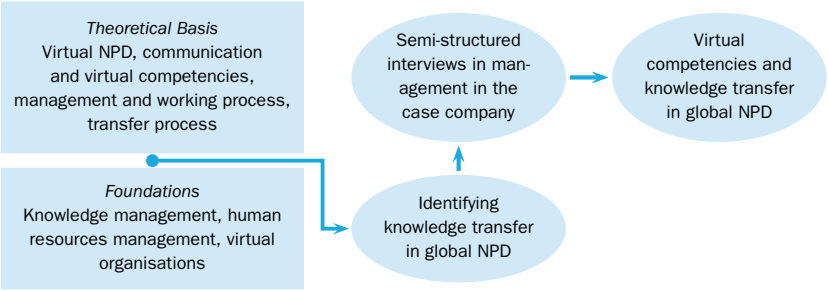

Figure 1 Research Process

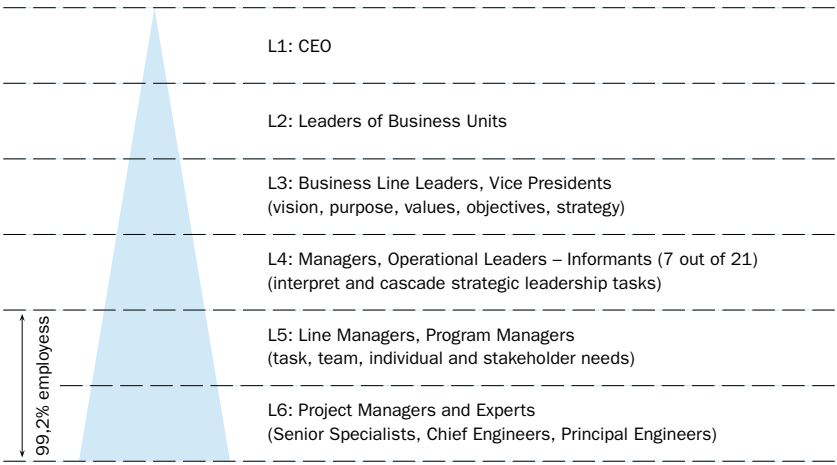

Figure 2 Informants' Position in a Case Company

managers had 14–28 years of work experience and their work experience in virtual projects was between 10–20 years. Their organizational unites have employees in 25 sites in 11 different countries.

Characteristics of Knowledge Transfer in Global NPD

It is typical for global virtual teams to rapidly change form and become matrix-managed and culturally diverse. Communication is mainly performed with the use of information and communication technology (ICT). Virtual team members usually work on several different projects with competing priorities (Daim et al., 2012.) Virtual product development teams are geographically dispersed and cross-functional, yet they work on highly interdependent tasks. This, among other issues, presents new challenges for the management of both explicit and tacit knowledge transfer (Zigurs, 2003). Furthermore, Daim et al. (2012) state that there are many risks involved

when it comes to on-time project deliveries. In following chapters, the main characteristics of knowledge transfer are summarized based on the latest research with the use of Distanont, Haapasalo, and Vaananen's (in press) solutions to overcome challenges in knowledge transfer. The classifications of this theory are based on the division of Communication, Transfer Process, Working Process and Management.

These classifications have been modified into a virtual organization context and explained further in the following chapters and summarized in Tables 1, 2, 3 and 4.

Communication

Communication and knowledge transfer are closely linked; effective communication enhances knowledge transfer and vice versa. This can be achieved by providing guidance and a standardized way of knowledge transfer, and by linking the transferring processes (Distanont, Haapasalo, Vaananen, & Lehto, 2012). *Explicit knowledge* is formal knowledge that is easy to transmit between groups and individuals as Nonaka and Takeuchi (1995) have discovered. Explicit knowledge is usually represented in the form of specifications, codes, and numbers or different kinds of formulas. Distanont et al. (2012) discovered that explicit knowledge is considered easy to transfer via e-mail, databases, and documentation, but it does not guarantee successful knowledge transfer in all cases. It is crucial to choose a proper method to transfer knowledge. *Tacit knowledge* is personal knowledge, insights, know-how, and a deep understanding of context; and is usually difficult to communicate formally to others. It develops in extended periods of time and is therefore highly personal and unique. Thus, organizations need to convert tacit knowledge into explicit knowledge in order to secure the competitive advantage in innovation and new product development (Nonaka & Takeuchi, 1995). Many studies have shown that in knowledge-intensive businesses, the main portion of critical knowledge is in tacit form and cannot be easily expressed in explicit form (Merat & Bo, 2013.) Only human beings led by tacit knowledge have the capability to generate new knowledge (Choo, 1998).

Virtual organization members' patterns of communication: when, why, how, how often, and with whom they communicate can reveal a lot about the organization's communication practices. These micro-interactions shape the dynamic negotiation of members' multiple interests and expectations (Im, Yates, & Orlikowski, 2005). In brief, knowledge transfer is a particularly specialized communication process between the source and the recipient, which results in the changed ability of the recipient or both (Wang & Haggerty, 2009). Table 1 presents a review of knowledge transfer characteristics in the Communication category.

Table 1 Review of Knowledge Transfer Characteristics in the Communication Category

Communication	Researchers
Virtual communication. Effectiveness in task-related communication is stronger in a virtual environment. Dislike is not revealed in a virtual discussion and cultural differences are not so significant.	Gressgård (2011), Wang and Haggerty (2009), Badrinarayanan and Arnett (2008).
Communication skills. Verbal, written, oral, cultural knowledge and language skills are needed in order to ensure efficient communication between parties. The goal is usually to generate action or change, or create common understanding.	Bergiel, Balsmeier, Bergiel, and Erich (2013), Holton (2013), Faraj et al. (2011), Malhotra, Majchrzak, and Benson (2007), Dennis, Meola, and Hall, (2013), Snowden and Boone (2007), Maude (2011), Luther and Bruckman (2011), Cooper, Edgett, and Kleinschmidt (2004).
Members are knowledge transfer agents. Networking in is possible across time, location, and organizational boundaries.	Wang and Haggerty (2009), Johns and Gratton (2013), Ivan, Ciurea, and Doinea (2012).

Transfer Process

Davenport & Prusak (2005) present that sharing and finding relevant information becomes very difficult in large organizations. The stock of all knowledge in an international company is scattered in offices and plants, and the complex mix of products and services is vast. As a result, it becomes very challenging for the expert to find what he needs. In summary: Knowledge is valuable only if it is accessible. However, modern technology can integrate mechanisms and systems and, in this way, provide a suitable platform for sharing internal and external resources (Cooper, 2001).

Johns and Gratton (2013) present that it is the company's responsibility to offer technologies that support higher achievement. Malhotra et al. (2007) show that there are several ways to share knowledge virtually. However, it is crucial to remember that the medium is only a tool without content (Davenport & Prusak, 2005). Vittal, Anantatmula, and Kanungo (2010) emphasize the view that virtual teams and organizations require highly skilled individuals, who participate extensively in conversations, have good communication skills, engage in trustworthy behavior, and share collectivist values. In addition, Wang and Haggerty (2009) found that early face-to-face meetings, training and assimilating other employees' backgrounds, and enhancing personal relations with team members can overcome problems in technology. Also, increasing technology skills and general familiarity with lean media is useful. Wang and Haggerty (2009) have suggested the following three competencies for successful virtual work:

- *Virtual self-efficacy* (Future-oriented belief about one's technical abilities to work in virtual settings)

Table 2 Review of Knowledge Transfer Characteristics in the Transfer Process Category

Transfer process	Researchers
Technology. Modern technology can integrate mechanisms and systems and in this way provide a suitable platform for sharing internal and external resources. Technological failures can risk on-time project deliveries.	Gatlin-Watts, Carson, Horton, Maxwell, and Maltby, (2007), Badrinarayanan and Arnett (2008), Cooper (2001), Goh (2002).
Multiple time zones & geographical dispersion. Multiple time zones can be a challenge in a global multicultural company, when there is a need for shared meetings.	Bergiel et al. (2013), Badrinarayanan and Arnett (2008), Faraj et al. (2011), Dennis et al. (2013), Zigurs (2003), Li (2010), Kankanhalli, Tan, and Wei (2007).
Virtual competencies. Virtual social skills, virtual media skills, ICT skills and virtual self-efficacy.	Wang and Haggerty (2009), Faraj et al. (2011), Dennis et al. (2013), Luther and Bruck man (2011), Foss and Robertson (2000), Kankanhalli et al. (2007), Zigurs (2003).

- *Virtual media skills* (Using ICT in its full potential to enhance communication)
- *Virtual social skills* (Recognizing the difference between communication in a regular work environment and virtual settings)

When it comes to knowledge transfer in virtual NPD, Malhotra et al. (2007) have noted that, in virtual communication, it is typical for goodwill to be hard to observe, and expectations about actions, and the actions themselves, are not visible. Also, it is notable that various uses of technological resources are socially constructed between customers, and internal and external functions. Considering this, the technological change makes the virtual organization's operating environment a very complex system in which everyone is influenced by others (Foss & Robertson, 2000). Table 2 represents the characteristics in the Transfer process category.

Working Process

Riege (2005) states that in order to achieve continuous growth in business, knowledge-sharing practices need to become a day-to-day work procedure. Successful sharing and goal achievement depend on three main factors: motivation, organizational structure and modern technology. Flat and open structures make transparent knowledge flows possible which, in turn, provides a culture of learning. In virtual organizations, structure is a fluid object, which is more dynamic than a typical organizational structure. In virtual organizations, boundaries, norms, participants, artifacts, and interactions continually change. All organizations change, but these kinds of organizations change all the time (Faraj et al., 2011).

According to Riege (2005) when an organization structure is flat and

Table 3 Review of Knowledge Transfer Characteristics in the Working Process Category

Working process	Researchers
Training for virtual work. Characteristics of virtual collaboration should be acknowledged and training provided to enhance communication among team members. The sense of 'we' rather than a sense of 'I' needs attention.	Zigurs (2003), Kankanhalli et al. (2007), Han and Harms (2010).
Relationship building and teaming. Relationships and roles between team members need to be planned, identified and evaluated.	Gatlin-Watts et al. (2007), Holton (2013), Foss, Minbaeva, Pedersen, & Reinholt, (2009), Wang and Haggerty (2009), Faraj et al. (2011), Malhotra et al. (2007), Dennis et al. (2013), Snowden and Boone (2007), Senge, Lichtenstein, Kaeufer, Bradbury, and Carroll, 2007; Zigurs (2003), Kankanhalli et al. (2007), Greer (2008), Goh (2002), Paghaleh et al. (2011).
Passion, creativity and originality of multicultural team members. Cultural and personality issues need to be considered and planned when forming teams, sharing tasks, communicating and giving feedback.	Bergiel et al., (2013), Johns and Gratton (2013), Holton (2001), Badrinarayanan and Arnett (2008), Gressgård (2011), Gatlin-Watts et al. (2007), Faraj et al. (2011), Luther and Bruckman (2011), Dennis et al. (2013), Li (2010), Snowden and Boone (2007), Maude (2011), Kankanhalli et al. (2007), Gressgård (2011), Chen, Wu, Ma, and Knight, (2011), Paghaleh et al. (2011).
Effective new product development. New product innovation has become increasingly important and rapid in its nature. In-house competencies, resources and capabilities need to be leveraged into new product projects. In global companies, this is performed with the use of modern communication technology in virtual product development teams.	Badrinarayanan and Arnett (2008), Gressgård (2011), Luther and Bruckman (2011), Kankanhalli et al. (2007), Cooper et al. (2004).
Temporary convergence. Human and ICT-related delays need to be planned and taken into consideration when planning a virtual project.	Faraj et al. (2011), Li (2010), Zigurs (2003).
Tacit knowledge transfer. Face-to-face meetings are needed and knowledge transfer in virtual collaboration needs extra attention.	Holton (2013), Dennis et al. (2013), Zigurs (2003), Distanont et al. (2012), Wang and Haggerty (2009).

open, it is easier to link goals and processes together in people's daily lives and in this way provide clear directions and feedback processes. Paghaleh, Shafiezadeh, and Mohammadi, (2011) present that knowledge sharing depends on the quality of informal and formal conversations between employ-

ees, and it is the organizational culture that decides how and with whom these conversations take place. Schein (1996) stated that culture is a set of basic tacit assumptions about how the world is and how it ought to be. Basically, culture is a group of people that share and determine their perceptions, thoughts, feelings, and, to some degree, their overt behaviour. Cultures arise within organizations based on their own histories and experiences. In virtual organizations, cultures meet on many levels.

The characteristics of virtual work need to be identified and explained to the team members through training to avoid conflict and to secure effective work throughout the project, suggests Kankanhalli et al. (2007). Possible clashes caused by cultural diversity could be minimized through the appropriate selection of virtual team members; also, in high-complexity tasks, functional diversity can be enhanced to promote discussion about the work tasks. Table 3 (p. 191) presents the characteristics of knowledge transfer in Working process category.

Management

Johns and Gratton (2013) suggest that, in virtual organizations, it is crucial to focus on collaboration, because it is the foundation of faster and better innovation. With this kind of purpose in mind, right decisions can be made and leadership becomes more effective. Distanont et al. (2012) offer the following solutions to improve knowledge transfer:

1. Organize face-to-face communication at the beginning of the project.
2. Improve stakeholders' skills.
3. Enhance social relationships.
4. Assign the right people to the right project.

Chen et al. (2011) show that collaborative activities can reduce uncertainty and improve transactional efficiency; however, some kind of social context is also needed in virtual teams to enhance their interpersonal relationships. Otherwise, virtual teams will be more fragile than regular teams.

Possible conflicts in virtual teams are broadly categorized into two main types: relationship-based and task-based conflicts. Relationship-based conflicts involve issues like mutual dislike, personality clashes, and general annoyance among team members. Some conflicts can have a severe impact on the team performance, but others can actually help teams to perform better. Task-related conflicts, in particular, seem to be more common and more severe in virtual teams than in traditional teams. Task-related conflicts are usually based on functional differences caused by different backgrounds, assumptions, and understandings based on previous employee training and experiences. However, when conflicts occur, they need to be re-

Table 4 Review of Knowledge Transfer Characteristics in the Management Category

Management	Researchers
Establish and maintain trust. Special attention to mechanisms and communication processes in establishing trust is needed.	Bergiel et al. (2013), Malhotra et al. (2007), Dennis et al. (2013), Vittal et al. (2010), Holste and Fields (2010), Mitchell and Zigurs (2009), Maude (2011), Peters and Mantz (2007), Han and Harms (2010), Holton (2001), Chen et al. (2011).
Conflict resolution strategies. Potential issues causing conflicts should be acknowledged and strategies for proper conflict resolution methods should be planned beforehand.	Bergiel et al. (2013), Zigurs (2003), Maude (2011), Kankanhalli et al. (2007), Holton (2001).
Strong leadership. A leader's presence, support, control, and motivation skills are needed in virtual collaboration. Shared goals, clear communication, and competence in managing experts is needed.	Bergiel et al. (2013), Faraj et al. (2011), Malhotra et al. (2007), Dennis et al. (2013), Snowden and Boone (2007), Zigurs (2003), Luther and Bruckman (2011), Merat and Bo (2013), Ivan et al. (2012), Cooper et al. (2004), Goh (2002), Chen et al. (2011).
Rewarding and feedback. Reward and feedback processes need to be planned and established to support virtual collaboration and goals.	Malhotra et al. (2007), Dennis et al. (2013), Snowden and Boone (2007), Zigurs (2003), Lam and Lambermont-Ford (2010), Kankanhalli et al. (2007), Cooper et al. (2004), Goh (2002).
Job satisfaction. A virtual environment can cause feelings of isolation and a lack of social contact; also multitasking and dynamic work roles can, in some cases, decrease satisfaction at work.	Dennis et al. (2013), Kankanhalli et al. (2007).
Less hierarchy and social conventions. In virtual organisations, structure is a fluid object and interaction is easier and less formal in a virtual context.	Faraj et al. (2011), Lam and Lambermont-Ford (2010).
Recruitment of talented employees. A virtual environment enables recruitment of talented employees without changing the geographical location. Moving away from the home country is not necessary.	Bergiel et al. (2013), Holton (2001), Faraj et al. (2011), Ivan et al. (2012).

solved either in integrative or distributed fashion in order to improve performance (Kankanhalli et al., 2007). Therefore, a common set of procedures and communication norms are needed to prevent misunderstandings. The absence of communication norms leads members to communicate in their own ways, which does not necessarily mean good knowledge sharing practices and, therefore, distrust may start to develop. (Malhotra et al., 2007.)

Trust is an important variable in work places and it has been addressed in great deal in previous research (Han & Harms, 2012; Huotari & Iivonen,

2004; Malhotra et al., 2007). According to Denton (2012), trust is essential to all relationships, including organizational ones, and is based on communication: how, when, and what you are communicating. Holste and Fields (2012) emphasize the meaning of trust with emphasis on knowledge-based organizations: affect-based trust is needed for an expert to be willing to use tacit knowledge. In brief, to support knowledge sharing, the structure of meetings and virtual projects in virtual organizations is very important. Giving feedback and quick responses to well performed work is crucially important in a virtual work environment (Kankanhalli et al., 2007). In addition, Tozer (2012) outlines that people don't necessarily have to like each other to work together effectively, but trust and respect is always needed. Table 4 (p. 193) represents the characteristics of knowledge transfer in the Management category.

Empirical Study

This empirical study of the case company was conducted with the use of semi-structured interviews in April of 2013. Based on their availability and ability to contribute to the study, seven informants were chosen from the management team of 21,. Interviews took place on the company's premises. Four of the informants' positions within the company are Head of Program Management in R&D, two are Heads of Product Management and one informant's title is Head of Sales. The informants' ages were from 41 to 51 years. Two of the informants' educational background was M.Sc. Eng. and five were B.Sc. Eng. Informants had work experience from 14–28 years, out of which 10–20 was in virtual organizations. Questions for the interviews were sent to the informants beforehand. Each interview lasted from 35 to 50 minutes; the interviews were recorded and transcribed.

After the interview, informants were asked to rate the challenges in the virtual knowledge transfer on a scale of 1–5 (1 = no challenge, 2 = minor challenge, 3 = average challenge, 4 = significant challenge, 5 = major challenge). Challenges were calculated and summaries were made for each topic. As the main finding, you can see a great variety and relatively big differences in opinions among the informants.

Table 5 Summary of the Challenges for Knowledge Transfer in Virtual NPD (%)

Category	(1)	(2)	(3)	(4)	(5)
Management	10.20	30.61	38.78	16.33	4.08
Communication	9.52	38.10	33.33	4.76	14.29
Transfer process	7.14	32.14	32.14	25.00	3.57
Working process	9.52	11.90	23.81	33.33	21.43

Notes Column headings are as follows: (1) no challenge, (2) minor challenge, (3) average challenge, (4) significant challenge, (5) major challenge.

The main findings regarding the challenges of knowledge transfer in the case company are presented in Table 5.

Challenges in Management

Trust has a significant role in virtual NPD according to all informants. Trust develops in face-to-face communication according to over half of the informants. Some informants stated that trust can also develop over time when communication is frequent and happens on a regular basis. Furthermore, the role of accurate information and expertise was emphasized.

Trust is rated from a minor to a major challenge and everything in between. Informant E saw only minor challenges in trust, and what stands out in the answers provided by informant E's is that he relies strongly on fact-based communication and professional competence:

> If you trust someone, you talk more openly about things. All facts will be discussed. There are all kinds of trust, but competence-related trust is received by your own actions and by your performance at work. The fact that you have earlier taken care of things reliably and successfully is one thing. Well, that is the most important thing.

Informants that saw trust as an average challenge emphasized more formal documentation and structure of messages, or the importance of phone calls instead of face-to-face conversations. Informants that saw trust as a major challenge emphasized face-to-face communication instead of just using fact-based formal communication via ICT. Table 6 presents the challenges in management.

Conflicts and conflict resolution strategies were mainly marked as either average challenge or significant challenge; however, one informant considered conflicts as a major challenge, while another informant considered them a minor challenge. All informants mentioned competence-related conflicts between sites as the most common issue behind conflicts. Other is-

Table 6 Challenges in Management

Category	(1)	(2)	(3)	(4)	(5)
Trust	0	2	2	2	1
Conflict and conflict resolution strategies	0	2	2	2	1
Leadership	1	1	4	1	0
Rewards and feedback	0	2	4	1	0
Job satisfaction	0	3	4	0	0
Hierarchy	2	4	1	0	0
Recruiting experts	2	1	2	2	0

Notes Column headings are as follows: (1) no challenge, (2) minor challenge, (3) average challenge, (4) significant challenge, (5) major challenge.

sues causing conflicts were time differences, which make it difficult to find time for meetings and also influence the availability of relevant information. Time differences also caused average challenges in the job satisfaction category. It is interesting that there are no conflict resolution strategies available and, therefore, managers are mainly the negotiators and mediators for solving conflicts. One informant mentioned co-operation in teams and on projects, which have been able to solve severe conflicts in the past. According to one informant, conflicts could be avoided by preventive actions (e.g., proactive information sharing and having shared discussions). Two informants emphasized the importance of fact-based conversations in solving conflicts. Hierarchy was not seen as a challenge despite the fact that in literature we can find certain viewpoint stating that the virtual environment can reduce hierarchy; however, according to these informants the virtual aspect does not affect hierarchy and is thus not a problem.

Generally leadership was seen as an average challenge, but what was interesting and very descriptive of this study as a whole was the fact that the informants stated altogether 24 different kinds of characteristics that mark the qualities of a good virtual leader. Almost all informants stated that the most important skill is the ability to lead people, to have 'people skills;' four mentioned that active and frequent communication is important, followed by more variety. Informants mentioned skills and characteristics such as written and oral communication skills, honesty and integrity, availability 24/7, professional competence, openness and prioritizing skills. Informants also mentioned strategy knowledge, trust, supportiveness, decision-making skills, innovativeness and the ability to see the big picture. These managers seem to do their work by applying a personal style with their own unique ways and experience.

Availability 24/7 was mentioned by all informants in the course of the interviews, which revealed that better knowledge on how to combine professional and personal life may be needed in order to enhance job satisfaction and efficiency. Two informants stated that they find it difficult to leave the office during work hours (8–16), even if there would be an opportunity to take care of some personal issues while working. Successful work in virtual organizations is hard to define, because it is hard to measure. In the literature, there are views that emphasize the successful combination of work and home life, and views that are concentrated on performance metrics at work (Muna & Zennie, 2010). Further studies of a successful combination of professional and personal life, as well as leadership in virtual organizations are undoubtedly needed.

Challenges in Communication

When informants were asked about the qualities of effective virtual communication, they mostly stressed the importance of taking into account

Table 7 Challenges in Communication

Category	(1)	(2)	(3)	(4)	(5)
Non-verbal communication	1	3	1	0	2
Task oriented communication, delegating	1	2	2	1	1
Knowledge transfer agents	0	3	4	0	0

Notes Column headings are as follows: (1) no challenge, (2) minor challenge, (3) average challenge, (4) significant challenge, (5) major challenge.

the message receiver. Correctly planning the content and outlook of the message was also mentioned as important. Decisions and information letters should be written and sent ad hoc according to almost half of the informants. Only a few mentioned the importance of clear and succinct e-mails, which is a significant part of virtual communication according to theory. Twelve other qualities of good communication were mentioned, which means a variety of different ways and kinds of practices are employed when communicating virtually. Communication is a crucial factor in a manager's work, and most delays in NPD are based on communication problems.

One informant participated in virtual communication training and he evaluated his own virtual communication competence as higher than that of others. The training issue was seen as a bigger challenge in the eyes of this informant, which might mean that he is aware of the issues concerning virtual collaboration and the connection of virtual communication competencies. This same informant mentioned that lack of face-to-face communication is a minor challenge, whereas those who evaluated their own virtual communication competence as weaker saw that a lack of face-to-face communication is a significant or major challenge. Communication training is also discussed in the working processes. Table 7 represents challenges in the communication category:

Challenges in the Transfer Process

All informants stated that there are problems with the ICT they use, but when rating the challenges, there was a lot of variety. It is surprising that informants had accepted the unbalanced situation with task-technology-structure fit. There are tools for social interaction and networking, but, according to these informants, they are not used due to many reasons, most importantly lack of time. They also did not see these tools as beneficial and useful for their work. The availability and the reliability of some virtual meeting tools posed further problems.

In rating the challenges, ICT was marked as a significant challenge, as an average challenge and also as a minor challenge, while some informants saw no challenges at all. In general, informants said that there are too many tools available and people do not seem to know where to find relevant information.

Table 8 Challenges in the Knowledge Transfer Process

Category	(1)	(2)	(3)	(4)	(5)
Technology	2	1	2	2	0
Time zones and geographical dispersion	0	1	3	2	1
My virtual communication competencies	0	3	2	2	0
My colleagues virtual communication competence	0	4	2	1	0

Notes Column headings are as follows: (1) no challenge, (2) minor challenge, (3) average challenge, (4) significant challenge, (5) major challenge.

Virtual communication competencies were an interesting issue. All informants rated their challenges regarding virtual competencies as higher than those of their colleagues.

Time differences and geographical dispersion were also mentioned by all informants; however, it was surprising that time differences were perceived as a greater challenge. Three informants mentioned that it can even be a benefit in testing new products. When the work day ends in one location, it starts in another location and the testing of products can thus be carried out continuously and effectively. Table 8 summarizes the challenges in the knowledge transfer process.

The Greatest Challenges Are in the Work Processes

From the managers' perspective, most challenges are attributed to the issues concerning work processes. In work processes the relationships, tacit knowledge transfer, effective NPD, and temporary convergence were the most challenging issues as described in Table 9.

The greatest challenges in the work processes were found in building and maintaining relationships within the multicultural virtual environment, which was stated as an average, significant or major challenge by all except one informant, who stated that it is not a challenge at all. All informants were familiar with the cultural differences and all informants mentioned that they consider cultural issues when sharing tasks and giving feedback. All informants had lived abroad and/or participated in cultural training.

Informant F describes the importance of taking the message receiver's background into consideration when sharing tasks, doing follow ups, and giving feedback:

> Delays in a project happen, because sometimes a person simply doesn't know what to do, so communication apparently hasn't been good enough. So then we come to the issue of how important successful virtual communication is. If you know who the person is, you know how to communicate the issue clearly, and then you do the follow up to see if it is going anywhere and in what direction it is going. Then depending on the culture, the feedback conversation is different

Table 9 Challenges in the Work Processes

Availability of training for virtual work	2	2	1	2	0
Relationships	0	0	2	2	3
Diversity, passion, cultural differences	1	0	3	1	2
Effective NPD	1	0	1	3	2
Tacit knowledge transfer	0	1	1	3	2
Temporary convergence	0	2	2	3	0

Notes Column headings are as follows: (1) no challenge, (2) minor challenge, (3) average challenge, (4) significant challenge, (5) major challenge.

> with each individual. Other cultures can't take feedback, but you just have to get the message through somehow. Those faults and failures need to be fixed.

In virtual projects in this field of business, fast innovation is crucial. Therefore, effective collaboration is needed and leading effective virtual teams is possible, if cultural issues are taken into consideration (Johns & Gratton, 2013). Success in any collaboration between people and organizations is based on the quality of relationships that shape cooperation, trust, mutuality, and joint learning. Some informants pointed out the importance of having face-to-face meetings first, as some informants said.

According to these managers everything, except negative personal issues, redundancy notices, and critical feedback meetings, can be handled virtually; however, it was also stated by half of the managers that if you have met face-to-face even once, everything can be handled virtually after that. Interestingly, according to one informant, everything can be handled virtually, and face-to-face conversation is not necessarily needed at all.

In building relationships within teams, the practices varied even more. Most informants stated that the quality and characteristics of team cooperation are not evaluated. Some informants said that in economically tough times there were no recreational team building events; however, one manager mentioned that creative and strong team leaders can organize low budget team building events at any time. Other ways to enhance team performance included horizontal interaction with cross-review, monthly information sharing meetings for formal and informal communication, and voluntary informal communication. In summary, there are no official procedures in evaluating team building and performance; team building practices are based on each manager's personal experience and preferences and evaluation is only performed if the team fails or performs exceptionally well.

Challenges in virtual NPD show strongly divided opinions: Most informants stated that a virtual organizational structure makes NPD more difficult and

it shouldn't even exist; however, some informants thought that virtual NPD should be seen as strength and should be built-in to the business.

Availability and participation in communication training was not seen as challenging among the informants. Most informants had participated in communication training a long time ago. Only a few informants mentioned a training portal, and only one named relevant virtual communication classes that are available. Almost all informants had not participated in virtual communication classes at all. One informant stated that he had not participated in any communication or virtual communication classes and he did not even know if there is such training available. The importance and meaning of virtual communication training is clearly not recognized.

In summary, there is a lot of variety in the managers' perspectives in a complex multicultural environment. Less than half of the informants thought that virtual NPD is an advantage, mainly due to inbuilt wide social networks and global contact surface. The rest of the informants believed that innovativeness can decrease and time differences can cause inefficiency and difficulties in decision making. Informants that saw virtual NPD as beneficial stated that it is possible to address the challenges by making preparations for virtual meetings in advance and taking time differences into consideration when making plans. Virtual NPD work is sometimes performed at home, which means that successfully combining work and home is needed in virtual work. Successful virtual work is beneficial to the company, but it is also beneficial to the manager working on virtual projects. According to Badrinarayanan and Arnett (2008), team members of successful virtual NPDs develop superior decision-making skills, perform future activities more efficiently, and also become more competent in acquiring, disseminating, and processing information.

Role of Virtual Competencies in Global NPD

Successful knowledge transfer in virtual NPD is based on personal and organizational virtual competencies. Figure 3 describes the most crucial organizational and personal virtual competencies needed in successful knowledge transfer in virtual NPD.

All communication processes are influenced by peoples' routines, which do not operate in isolation. Organizational virtual competence relates to the integration and the joint operation of routines. In this way, an organization is an effective operator that transforms employees' actions into collective actions and thus makes it possible to generate more knowledge and skills. In this way, virtual competencies give unique character to the organization and an individual (Metcalfe & James, 2000). Liker and Morgan (2006) have studied the factors behind Toyota's success and discovered that communication should be sufficient, well focused, accurate, and targeted on the

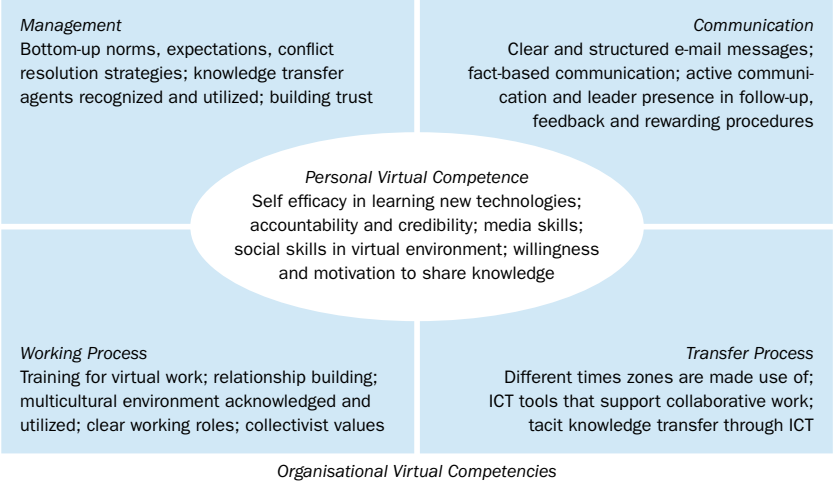

Figure 3 Organizational and Personal Virtual Competencies Based on Theory and this Study

essentials facts. Special attention is particularly needed in problem solving processes.

In contrast to virtual competencies, it can be concluded that based on the interviews and theory, there are organizational and individual level barriers that can harm efficient knowledge transfer in virtual NPD. Table 10 illustrates the other side of the coin of virtual competencies: The most common barriers for knowledge transfer based on the literature review and this study. Those are also divided into personal and organizational level barriers for knowledge transfer in virtual NPD.

According to this study, there are similarities between the case organiza-

Table 10 Potential Knowledge Transfer Barriers in Virtual NPD

Personal	• Inability and unwillingness to listen • E-mail messages are extensive, lack structure and are written without taking recipients into consideration • Replying to messages by one's own routines and habits • No interest in connecting with team members at a personal level • Unwillingness to adopt new technologies • Inactivity in social media and social collaboration platforms • Lack of motivation in sharing information • Communication is performed based on assumptions and feelings rather than on facts • Individualistic values
Organizational	• Absence of communication norms • Absence of conflict resolution strategies • Virtual meetings without planning, preparation and structure • Unreasonable amounts of ICT tools and systems • Information stored in too many locations • No rules in versioning and sharing documents • Communication and commenting on team's work is performed on an impulse • Employees' routines at work do not match • Organization structure that inhibits knowledge transfer • Absence of virtual feedback and rewarding procedures • Knowledge transfer agents are not recognized and utilized

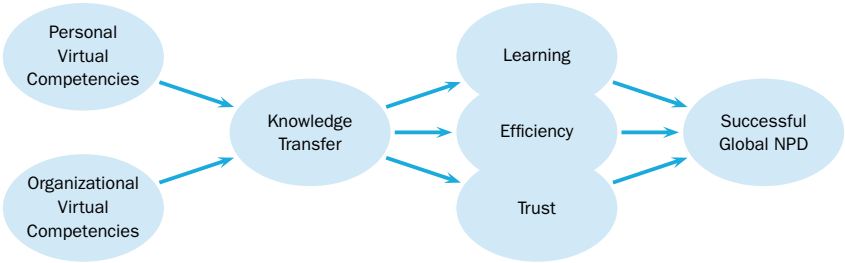

Figure 4 Connection between Personal and Organizational Virtual Competencies and Successful Global NPD

tion and virtual organizational studies. Communication without proper training in virtual collaboration leads to people communicating and operating in virtual environment in their own ways, and that can lead to development of distrust (Malhotra et al., 2007.) Also, it is evident that the possibilities offered by the new ICT aren't used to their full potential, in cases where management doesn't have proper virtual competence. It is crucial that virtual competencies are acknowledged and knowledge transfer is enabled in order for an organization to succeed in rapid new product development in global markets. Figure 4 describes the connection between virtual competencies and successful global NPD.

In this study, it can be seen that without recognizing the organizational and personal virtual competencies, managers find their own ways to solve problems and take actions based on their own experiences and preferences of leading experts. In this manner, the advantages of new ICT, knowledge transfer agents, and global environment aren't used to their full potential. It has to be noted that a limited amount of informants and analysis of one company does not allow generalizations to all organizations at this point. More information and studies about virtual competencies on an organizational and individual level in different levels of organizations are needed.

Conclusions

Success in virtual teams is based on virtual competencies on a personal and organizational level. More research of this topic is still needed, especially when newest ICT is used as a method of communication and for transferring tacit knowledge. In the evaluation of this research's validity, it should be noted that qualitative methods provide more in-depth knowledge on the complex issue of knowledge transfer in virtual NPD. Beyond that, informants had relatively lengthy work experience in virtual organizations, which is important and valuable when collecting this kind of research data and when evaluating the results. In this study, it was surprising how much

diversity exists among the managers that operate in the same company and within the same field. Informants are running their organizations with their tacit knowledge based on their past experiences, preferences, and training.

This research confirms the fact that traditional ways of communicating and managing experts may not work in best possible ways when leading experts in virtual organizations. Various ways of managing virtual NPD causes challenges and problems particularly in work processes related to human resources. It was also discovered that the connections between virtual communication competencies, relationship building, and tacit knowledge transfer have not been recognized or acknowledged within management. The importance and availability of communication training in a virtual context seems to need more attention.

What is controversial in virtual organization theory is that there are some views that point out the fact that everything can be taken care of virtually and face-to-face contact is not necessarily needed at all. Most informants in this study still emphasized the importance of face-to-face contact at the beginning of the project, which is still generally agreed in theory also; however, there were opinions stating that face-to-face contact isn't necessarily needed at all.

Newest ICT offers tools that enable contacts that are almost similar to face-to-face contact; however these tools aren't available to all users in some locations, while in other locations these tools aren't used enough, which means more development in this area is needed.

Future Research

The research results suggest that virtual team members cannot rely on simply transferring their behaviour from traditional teams and expecting it to be successful in virtual environments (Zigurs, 2003). Especially the meaning and role of virtual communication competencies at a personal and organizational level in efficient and successful knowledge transfer processes is interesting and needs further investigation. Furthermore, the characteristics of virtual leadership and the role and development of trust in knowledge transfer should be studied further in the virtual organizational context. The personal traits of the leaders and their relation to power in a virtual organization need more attention in further research. Other interesting areas are virtual collaboration tools and the role of internal and external social media within global companies. Further studies in this field are needed to enhance the quality of work and job satisfaction of employees in global virtual organizations, improve efficiency, and add the benefits of virtual collaboration in knowledge-based organizations to enrich the scientific discussion in this field.

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