



Knowledge sharing in a globally
dispersed engineering service company

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by

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DECLARATION OF OWN WORK

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

Carel Nicolaas van Heerden

DEDICATION

To my wife Yvonne, and son Carl. Their prayers, love, patience, and endless support have helped me complete a personal goal. Thank you.

ACKNOWLEDGEMENTS

Above all, I would like to thank my family who always encouraged me to pursue my studies to completion. It is accurate to say that I could not have completed this effort without the support of my mentor Dr. Jim Otter. His advice, technical expertise, and encouragement were an inspiration to complete this study. There are numerous others that supported me throughout this journey. Of particular note is Bryan Rawson for his assistance with the survey questionnaires and data analysis. I could not have done it without him.

God is faithful! This leg of the journey is complete and I pray He will use me through this education to make a difference in people's lives.

EXECUTIVE SUMMARY

This qualitative and naturalistic approach to the study explores how interaction and trust can be promoted in virtual teams and the main drivers for these teams to behave in certain ways. This study focuses on a single multinational engineering service company. Multinational engineering companies are increasingly becoming more involved in international projects that are globally dispersed and complex. In order to achieve its objectives and service clients globally, flexible and dynamic organisational structures are required to meet the requirements of the competitive marketplace. The advances and development in ICT systems has allowed the establishment of virtual teams whose members make use of these systems to communicate and share information. The challenge to team building in a virtual environment is that of creating avenues and opportunities for team members to have the level and depth of dialogue necessary to create a shared future. Issues of cultural diversity, geographic distance and member isolation can increase the challenges to effective collaboration. This study investigates real organisational virtual teams in the engineering service industry. It enriches the knowledge management literature by introducing the practice perspective of interaction and collaboration in virtual teams, and explores knowledge transfer attributes and variables of virtual teams more fully. The study adds to the operational management literature by elaborating organisational structures to facilitate knowledge sharing, and presenting important knowledge management concern associated with collaboration by means of globally dispersed virtual teams.

Data was collected through in-depth interviews and a web-based survey. The aim of the study was to determine how interaction and trust can be promoted in virtual teams and the main drivers for these teams to behave in certain ways. In particular the study focuses to what extent interaction, collaboration and trust in virtual teams can be promoted and ways communication tools measure, strengthen, recognize, and capture virtual domain development. The study's second objective identifies in what way virtual teams contribute to organizational-level learning and knowledge management, and implications for competitive advantage and overall profitability. The third objective of the

study identifies specific needs for unique and innovative tools to locate engineering and technical resources, and the importance of using as many tools as possible.

This study confined itself to an exploratory interpretive approach aimed at expanding the understanding of some elements that may affect virtual teams. The study limitations include the time available to conduct the survey, the sincerity or truthfulness of the respondents during interviews and the survey, relative small sample size for the industry and the validity of the research questions asked. The author may also present some bias in the research findings and conclusions. It was further assumed that the respondents would openly and honestly answer the research questions.

This study highlights the advantage of virtual teams over FTF team and the significance of trust in a virtual team compared to FTF teams. The effectiveness of communication tools as a trust mechanism in the virtual team setting is questioned and emphasises the significance of FTF interaction at the start of the project. Trust is preserved by open, clear and honest communication and not necessarily a functionality of the tools. Other aspects such as integrity, timely feedback, achievement of project objectives and securing of information were reported as a way to ensure trust in a team. The prompt sharing of information and regular communications was identified as mutually beneficial to team members.

Virtual teams also have the ability to increase the overall profitability of the company by improved efficiency, shared resources and overall cost reduction. The results of the study revealed that culture diversity had little effect on knowledge sharing in a virtual team and was shown as an advantage. However language difference and communication issues were highlighted as issues affecting knowledge sharing. Several of the communication tools and such as e-mails, teleconference, telephone, video conferencing, and collaboration tools such databases (PWS/CWS and network drives) were discussed in general as being used in the company. The overwhelming response was that these were just communication tools and on their own cannot be used to ensure trust.

This study recommends that virtual teams have a project kick-off meeting that is held FTF. The management of knowledge can be improved if team leaders understand the social context of the team, and provide the necessary support. The team leader further has to create a team culture that facilitates the development of project goals and group norms with respect to decision making, conflict resolution, and so on. This study suggests training in intercultural communications to focus on differences in verbal styles instead of nonverbal differences. Finally while e-mail with synchronous chat or screen sharing might be better for team teleconferences, collaborative group systems should incorporate multiple media channels.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
ICT	Information Communication Technology
CWS	Collaborate Workspace
FTF	Face-to-face
IP	Intellectual Property
IS	Information System
IT	Information Technology
KBV	Knowledge-based view
PC	Personal Computer
PWS	Project Workspace
P&A	Principals and Associates
RBV	Resource-based View
UK	United Kingdom
USA	Unites States of America

CHAPTER 1: PROBLEM IN CONTEXT

1.1 Introduction

Globalization of business practices and the resulting requirement for flexibility have increased in the recent decade (Chen, Chen & Chu, 2008). Research suggests that the pace of technological innovation and the globalization of the economy have transformed the way companies operate due to the rapid innovation in ICT. The global nature of many engineering and construction projects means that project teams are increasingly geographically dispersed thus working across time zones, numerous organizational boundaries and a variety of cultures, using a combination of telecommunication and information technologies. Globally dispersed engineering service companies are structured very differently but are all taking advantage of these technologies to maximize competitive advantage from limited labour and resources (Chen and Chen, 2009). These companies provide a range of integrated planning, management, engineering and other services to clients in the execution of projects. Research points out that the development in ICT has allowed companies to establish virtual teams to resource these international projects (Fang, 2006). The virtual team as defined by Chinowsky and Rojas (2003:98), is "...a group of people with complementary competences executing simultaneous, collaborative work processes through electronic media without regard to geographical location". The location of teams is not dominant in determining their virtuality (De Jong, Schalk & Curseu, 1998). They argue that most scholars agree that if a team mainly relies on technology in order to communicate, it can be called virtual. Prasad and Akhilesh (2002:103) define the global virtual team, "...as a team with distributed expertise and that spans across boundaries of time, geography, nationality and culture". Chinowsky and Rojas (2003:98) state that in the virtual team environment individuals or groups "...collaborate on a project in real time though electronic media". Research suggests that the knowledge created from these experiences is of crucial importance to efficient execution of projects (Ajmal, 2008). The research suggests that companies must take into account the increasing number of technical and social relationships and interfaces in adapting knowledge and experiences from the daily work of the company and from

earlier projects. Huber (1991) emphasises that project team members frequently need to learn things that are already known in other contexts; in effect, they need to acquire and assimilate knowledge that resides in organizational memory. The growing importance of capturing and sharing this knowledge and experiences in these organizations is often related to the emergence of the knowledge-based economy and the importance of knowledge in providing competitive advantage (Bollinger and Smith, 2001).

Even though there has been a substantial increase in virtual teams and knowledge workers, very little research is available on the science of connectivity (that is how virtual teams interact and share information) in engineering service companies. The engineering service industry knows little about the concepts that make virtual teams effective or how they are different in comparison to FTF teams (Kirkman, Rosen, Gibson, Tesluk and McPherson, 2004). Bersing (2009) identifies certain research gaps in the field of virtual teams that are investigated in this study. In particular this study investigates in what way interaction and trust can be promoted and the main drivers for virtual teams to behave in certain ways (resulting in a rather different network depending on the type of delivery method and contact); how communication tools measure, strengthen, recognize, and capture virtual domain development from an overall operational management point of view.

1.2 Problem in context

Major engineering service companies are increasingly becoming more involved in international projects that are globally dispersed and complex. Most of these organisations have adopted flexible and dynamic organisational structures to meet the requirements of the competitive marketplace. Rapid advance of ICT systems have allowed these companies to quickly adapt to environmental changes and clients requirements. These enablers have established virtual teams whose members use ICT systems to communicate and share information. In addition these organisations benefit from virtual teams through previously unavailable expertise and enhanced cross-functional interactions (Solomon, 2001).

The challenge to team building in a virtual environment is that of creating avenues and opportunities for team members to have the level and depth of dialogue necessary to create a shared future. Particularly important is the need to ensure that adequate time is devoted to systems for generative conversations as well as creating shared meaning and a commitment to a culture of collaboration. Issues of cultural diversity, geographic distance and member isolation can increase the challenges to effective collaboration.

Virtual teams are on the increase and little guidance currently exists to understand the successful interaction and sharing of knowledge within these teams. The literature has shown that diversity and dispersion in virtual teams creates pronounced challenges to knowledge management (Ahuja, 2000). Nonaka and Takeuchi (1995) argue that knowledge exchange is a “social” process between individuals and interactions between individuals or groups of individuals are required to capture, convert, and create knowledge from existing knowledge. They continue that If socialization doesn’t take place, direct sharing of tacit knowledge (personal and hard to formalize) through social processes such as meetings and post-project reviews become less obvious. Research suggests that virtual teams have to rely on ICT and web based systems to share and capture information. When these systems are not functioning properly or are difficult to use, the system may become a barrier rather than an enabler. Cramton (2001) maintains that these technology constrains combined with geographical separation may limit members from spontaneous interaction and may result in inadequate mutual knowledge. This is supported by Sole and Edmondson (2002) who argue that this may create knowledge gaps that can prevent team members from integrating knowledge with other team members.

Bollinger and Smith (2001) suggest that the lack of sharing can cause frustration to other users and hinder the natural collaboration growth that may be seen when users feel confident in their ability to store, share, and find information. They identify other factors affecting knowledge transfer in virtual teams; that is the lack of awareness and time; lack of resources; cultural barrier of not willing to share knowledge and power balance. This greatly

affects the ability of companies to transfer knowledge and organizational learning, and may hinder competitive advantage.

1.3 Problem review

Each project involves the production or provision of a one-of-a-kind product or service. During a project, team-members continuously encounter new problems for which, where possible, a new solution is devised. This results in the development of knowledge and experiences that is a valuable organizational asset and can be an important resource for subsequent projects. This is rarely, if at all documented and reused. In simple terms, valuable knowledge and experience gained is lost. What remains is stored in the minds of those who where a part of the problem and the solution.

Knowledge management becomes particular difficult when it is shared across projects and different time zones. Problems can even exist between different phases within the same project. When this gained knowledge is not secured for later usage, there is risk that some knowledge and useful experiences get lost at the end of a project. Knowledge sharing is therefore important in the development and outcome of future projects and the systematical endorsement of learning processes within the virtual project team settings would be an important aid in the development of projects, as well as the development of the learning and project skills capability of individuals.

Many researchers have investigated knowledge management factors such as enablers, processes, and performance (Lee and Choi, 2003). Enablers identified by the authors are collaboration, trust, learning, centralization, formalization, T-shaped skills, and information technology support. Aulawi, *et al.* (2008) identify several dimensions which are considered supportive of knowledge sharing namely organizational culture, managerial, organizational structure, people, and information technology. Although all these factors enhance knowledge sharing, there is little understanding of how virtual teams interact and share information; and how they are different in comparison to FTF teams. Trust is built through relationships, transactions, interpersonal skills, likeness, and many other forms. People build trust as they get to know

each other and the key ingredient to building trust is the ability to be sensitive to the needs and interests of others (Kouzes and Posner, 2002). In the FTF environment, the social interaction between team members is developed over time but for virtual teams, social interaction is usually limited (Goodbody, 2005).

1.4 Problem statement

Virtual teams face different challenges than FTF teams due to diverse technical, social, time zones and other factors. Little research has been conducted into the issues that the engineering service industry faces on how interaction and trust can be promoted in virtual teams and ways communication tools measure, strengthen, recognize, and capture virtual domain development (Kirkman *et al.*, 2004).

The question that is addressed by this study is:

How can interaction and trust be promoted in virtual teams and what are the main drivers for these teams to behave in certain ways?

1.5 Research objectives

Research is needed to examine the theory that trust is an important part of a virtual team and factors investigated that can promote interaction and collaboration; as well as ways communication tools measure, strengthen, recognize, and capture virtual domain development. Domain connectivity is assessed in-order to evaluate and promote virtual interaction to foster trust, success, and continuity.

The objectives for this study are:

1. To identify how interaction, collaboration and trust of virtual teams can be promoted in engineering service companies. In particular this study investigates how interaction and trust can be promoted and the

main drivers for virtual teams to behave in certain ways (resulting in a rather different network depending on the type of delivery method and contact). Factors are investigated that make virtual teams effective and show how these are different in comparison to FTF teams.

2. To identify how virtual teams contribute to organizational-level learning and knowledge management, what the implication is for competitive advantage and how this can contribute to the overall profitability of the company. Factors are investigated on the effect that virtual team learning has on the learning at organizational level. In particular how knowledge is transferred and shared within virtual teams in the engineering service company that eventually achieves organizational-level learning.
3. To identify specific needs for unique and innovative tools to locate engineering and technical resources, and the importance of using as many tools as possible. How collaboration tools measure, strengthen, recognize, and capture virtual domain development from an overall operational management point of view.

1.6 Importance of the research

This study contributes to management theory and practice and to the engineering service industry in particular, in the following ways. First, it enriches the knowledge management literature by introducing the practice perspective of interaction and collaboration in virtual teams, and explores knowledge transfer attributes and variables of virtual teams more fully. Secondly the study adds to the operational management literature by elaborating organisational structures to facilitate knowledge sharing. Third, the study adds to the international business literature by presenting important knowledge management concern associated with collaboration by means of globally dispersed virtual teams. Finally the study investigates real organisational virtual teams in the engineering service industry.

Engineering service organizations can benefit from understanding the role and significance of virtual teams that influence the overall organizational

profitability. This information could be especially useful in enhancing top leaders' influence and effectiveness in large and geographically dispersed organizations.

1.7 Assumptions and Delimitations

This study confined itself to an exploratory and interpretive approach aimed at expanding the understanding of some elements that may affect virtual teams in a multinational engineering service company. Data was collected through in-depth interviews, a web-based survey and participation of organizational and team activities, and e-mail exchange over a one-month period. Data collection, coding and analysis were conducted in an iterative fashion to allow new, empirically grounded concepts to emerge. Surveys were conducted across the organization. The organization is geographically spread across continents and employs over 7,000 engineers, scientists and project managers.

The individuals for the study were randomly selected. Fifteen percent of individuals currently employed in the engineering service company were selected to participate. The respondents were categorized based on demographics. The demographic characteristics aided in defining the contextual basis for each participant's comments and views collected in the research. The actual number of participants for this study was seventy-four.

Because the human experience of knowledge sharing can be very broad, the scope of this study was narrowed to include the participant's interpretation of their knowledge-sharing experiences as influenced by, or related to, the following contextual elements: human values, personality type, and technology. The use of human values is representative of the value-laden characteristic of qualitative research. Personality type may influence the ways that individuals interpret their identity and can provide guidance regarding an individual's relationships with others and how information is shared. In particular it is important to access the power balances across teams. In this study, the contextual element of technology was confined to groupware that is often associated with knowledge management projects.

The study limitations include the time available to interview, the sincerity or truthfulness of the respondents during interviews, relative small sample size for the industry and the validity of the research questions being asked. Coldwell and Herbst (2004) noted that limitations of qualitative research may also address problems in data collection, unanswered questions by participants, or induced bias due to personal prejudices of either the designer of the study or the data collector. The researcher has worked in the multinational engineering service industry for eighteen years and may present some bias in terms of research findings and conclusions. The experience helped the researcher address appropriate questions, develop meaningful categories and themes, and selecting qualified candidates.

1.8 Overview of the report (Route map)

This dissertation consists of six chapters: Study Introduction, Problem Analysis and Theoretical Considerations, Literature Review, Research Design and Methodology, Results and Discussion, and Conclusions and Recommendations.

Chapter 1 provides a general introduction and outlines the problem and background related to the study. This chapter also outlines the research objectives and key questions around which the investigation is structured.

Chapter 2 explores and develops a broader understanding of the research problem through reflection and exploitation of appropriate models and theory.

Chapter 3 provides a comprehensive literature review of the major areas addressed in the investigation: virtual teams, culture knowledge management and knowledge transfer. The chapter is completed with a visual literature map demonstrating the particular area in which this research is focusing.

The research design, an interpretive approach used to expand the understanding of some elements that may affect virtual teams in a multinational engineering service company is described in Chapter 4. Data gathering included in-depth interviews and a web-based survey. These methods are described in details along with the reasons for their use.

The results of the study are presented in Chapter 5. This chapter sets out the overall survey results and the data analysis these results were subjected to in the investigation. Data gathering from virtual teams through the in-depth and web-based surveys are analysed for how interaction and trust can be promoted in virtual teams.

Chapter 6 discusses the key findings and conclusions of the study. It provides for final conclusions and recommendations for improving trust and interaction within virtual teams in the particular industry. This chapter outlines the contributions the study makes to management research and presents the limitations of the study while proposing recommendations for future research.

1.9 Summary

In this chapter the research question was outlined. The chapter described the qualitative grounded theory problem statement, purpose, and research question to evaluate virtual teams in the globally dispersed engineering service company. The research was conducted in-order to answer the main research question.

The study attempted to determine how interaction, collaboration and trust of virtual teams can be promoted in engineering service companies and how this can contribute to the overall profitability of the company; what are the specific knowledge transfer attributes and variables of virtual teams; and the contribution of virtual teams to organizational-level learning and knowledge management.

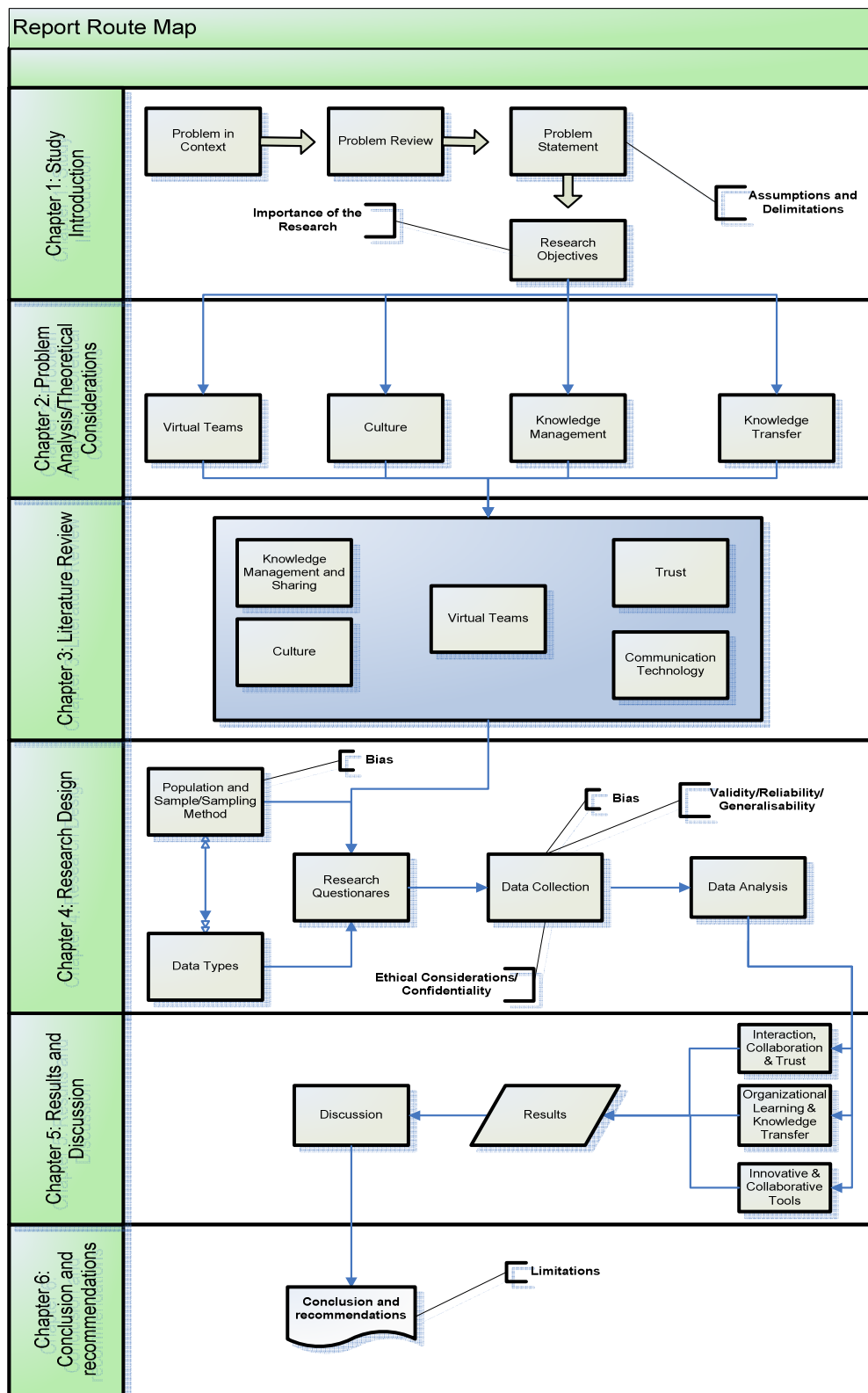


Figure 1 shows the study route map.

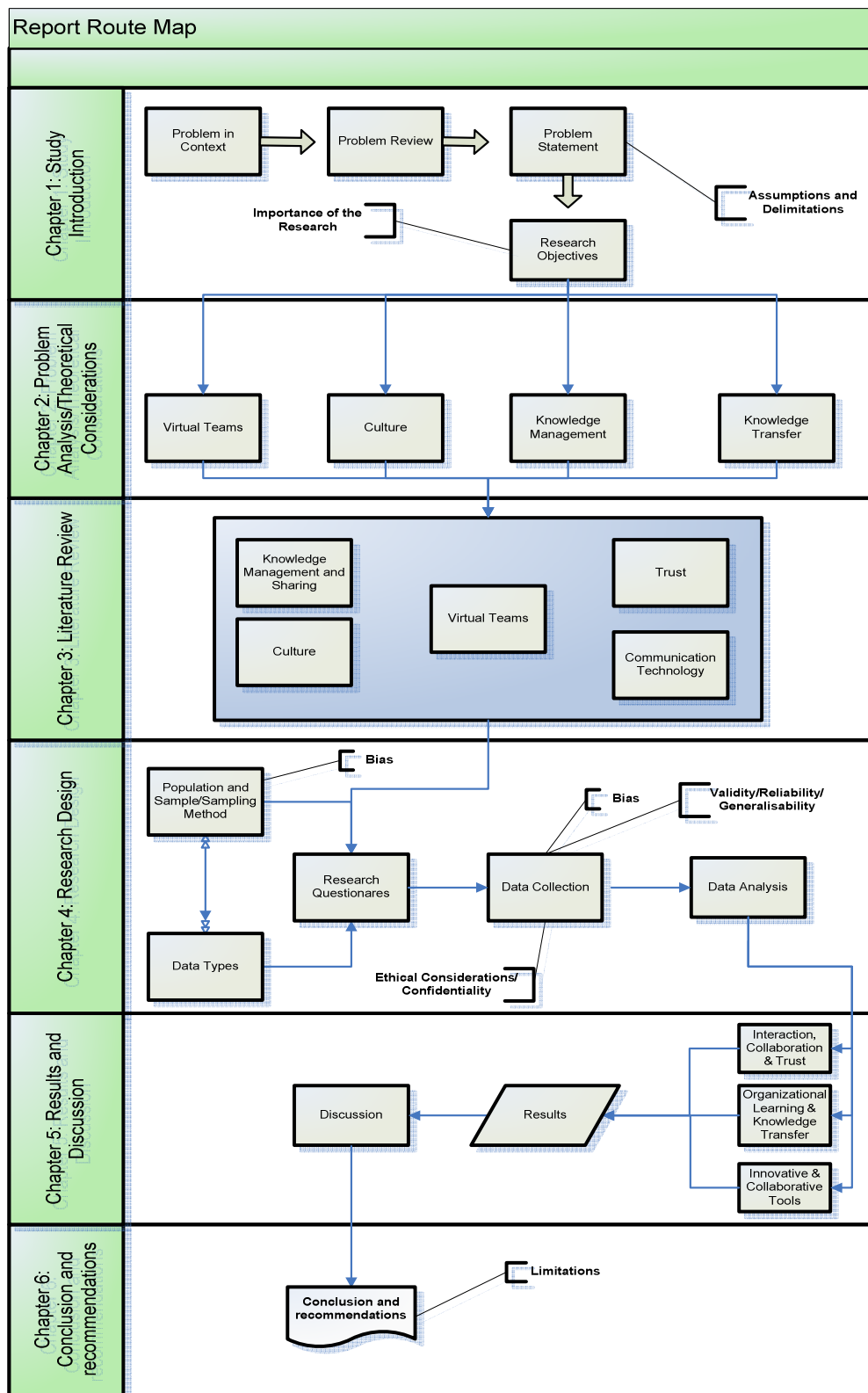


Figure 1: Study Route Map

CHAPTER 2: PROBLEM ANALYSIS / THEORETICAL CONSIDERATIONS

2.1 Introduction

Virtual teams face different challenges to those faced by FTF teams due to diverse technical, social, time zones and other factors. Little research has been conducted into the issues that the engineering service industry faces on how to promote interaction and trust in virtual teams and ways communication tools measure, strengthen, recognize, and capture virtual domain development (Kirkman *et al.*, 2004).

This chapter explores factors affecting virtual teams; explores the theoretical models on collaboration, culture, knowledge-based view and knowledge transfer.

2.2 Virtual teams

“Technology enables many teams to work totally remote manner, rarely, if ever, meeting face to face.” (Cameron, 2006:63). The author points out that there are many limitations to the workings of virtual teams and communication is the key to success. The author argues that two types of factors affect remote communication; that is physical and social. Physical factors consist of the proximity of other workers; time differences and time zones; and the availability of technology. Social factors consist of social presence and cues; trust and swift trust; and cross-culture communications. Cameron (2006) points out that trust is vital to effective and efficient team workings. The author introduces “swift trust” as an important concept to on-line groups that are often used as flexible teams and short-term workings.

2.3 Culture

Cameron (2006) emphasises that the first thing to recognise when working across boundaries (or within the same organisation) is that these teams have a different organisational culture. Many multinational companies rely on multicultural teams to perform work-related activities (Matveev and Milter, 2004). When teams are spread globally, this will reflect the team’s different

national cultures (Cameron, 2006). The work of Hofstede (1980) on national and organisational culture provides a framework for predicting outcomes of interaction behaviours and how individuals interact.

Members of a virtual team often possess different cultural backgrounds and may have limited interaction before the team is formed. Team members' interactions with each other are mainly guided by the norms, rules, and values provided by their national cultural backgrounds. The important feature of these models is that it takes into account a person's field of experience or how a person's culture, experiences, and heredity influence that person's ability to communicate and transfer knowledge.

The well-established dimensions of Hofstede (1980) provide the focus of this study. Hofstede defines national culture in terms of five value dimensions: individualism/collectivism (personal interests versus group interests), power distance (acceptance of inequality), uncertainty avoidance (dislike for ambiguity), masculinity/femininity (assertiveness and focus on work goals versus personal and family goals), and time horizon (sometimes called Confucian dynamism – short-term versus long-term orientation). In particular the dimensions of individualism/collectivism and uncertainty avoidance provide a theoretical foundation for understanding the similarities and differences in intercultural communications (Gudykunst, 2004) and how members may react to the interaction in which the team and communication environment are often new to team members. The third dimension, time horizon, is relevant to how virtual team members manage their coordination processes.

2.4 Knowledge Management

The KBV is derived from the RBV of the firm and knowledge is increasingly considered as a principal source of value in the organisation (Bakhr, Viney, Boojihawon & Segal-Horn, 2007). Spender (1996) argues that competitive advantage is more likely to arise from the intangible firm-specific knowledge which enables it to add value. This is supported by Grant (2008) who sees knowledge as a source of organisational competitive advantage. The KBV

considers the principle role of the organisation as integrating knowledge across employees, who are the creators and holders of knowledge and cross specialized subunits (Grant, 1996).

Research has further established that knowledge management is a difficult and problematic process. This is because knowledge is compounded given that it essentially consists of tacit (not easily coded and only revealed through its application) and explicit knowledge (more easily codified and available from manuals) (Bakhr, *et al.*, 2007). Tacit knowledge according to the authors is the most valuable characteristic for a resource-based source of competitive advantage. A further problem with tacit knowledge is that it is not “amenable to codification” (Grant, 2008:162) within an IT system and can only be replicated by other means such as collaboration, sharing and training (Grant, 2008). Effective knowledge management can only be achieved when the location of that knowledge is identified and the obstacles associated with the embeddedness and stickiness (Szulanski, 1996) of that knowledge overcomes (Grant, 1996).

2.5 Knowledge Transfer

Nonaka’s theory of knowledge creation (Grant, 2008) identifies the processes of knowledge conversion between tacit and explicit and between individual and organizational. The processes which collectively make up knowledge conversion and subsequent transfer are tacit to explicit (externalization); explicit to explicit (combination); explicit to tacit (internalization); and tacit to tacit (socialization).

Grant (2008) reasons that externalization (tacit to explicit) is a process of articulating tacit knowledge into explicit concepts as seen in the process of concept creation and integrated into product innovation. Internalization (explicit to tacit) according to him is a process of incorporating explicit knowledge into tacit knowledge and related to “learning by doing”. He further reasons that combination (explicit to explicit) is a process of systemizing concepts into a knowledge system and knowledge conversion includes training, instruction and education. He concludes that socialization (tacit to

tacit) is the process of sharing experiences thus creating tacit knowledge and can be acquired without using language. Grant (2008:163) points out that the conversion of tacit into explicit knowledge is “crucial to companies that wish to replicate their capabilities”. Within the context of knowledge transfer, he argues that when tacit knowledge is transferred, it is critical to define the background meaning of that knowledge.

2.6 Summary

Cameron (2006) points out that trust is vital to effective and efficient team workings. He also indicates that culture plays an important role when teams are working across boundaries and that these teams have a different organisational culture. Szulanski (1996) draws attention to the fact that effective knowledge management can only be achieved when the firm identify the location of that knowledge and overcome the obstacles associated with its embeddedness and stickiness (Grant, 1996).

Chapter 3 reviews literature on virtual teams in a project related environment, the issues related to knowledge management and sharing and access technology to facilitate knowledge sharing.

CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

The objective of the literature review is to examine to what extent trust and knowledge sharing can be promoted in virtual teams and the main drivers for these teams to behave in certain ways. The literature review explores the virtual team from a perspective of knowledge management, culture and trust and technology to facilitate knowledge sharing.

3.2 Virtual Teams

A considerable overlap exists in the literature regarding the definition of a virtual team with some small differences (Martins, Gilson & Maynard, 2004). Fang (2006) argues that virtual teams are functional teams that have clear objectives and rely on ICT systems for information and collaboration; and face obstacles such as geography, time and association. The author further argues that these teams are globally dispersed, are formed from different organizational functions and organizations. The virtual team is very similar to FTF project environment but faces different challenges if team member are not properly led (Bersing, 2009). Martins (2004) argues that the degree of ICT mediation may be one way to differentiate virtual teams form FTF teams.

Goodbody (2005) points out that the success or failure of virtual teams consists of team formation, trust and collaboration, and team communication. With regards to trust and collaboration, Goodbody (2005) identifies the importance of social interaction between the virtual team members. She adds that in the FTF environment, the social interaction between team members is developed over time but for virtual teams, social interaction is usually limited. She concludes that the development of trust is dependent on interaction and information exchange. Chen and Chen (2009) argue that trust and conflict are central issues in organizational forms for information and knowledge sharing, and virtual alliances. They point out that mutual trust can help improve knowledge sharing and resource sharing. The selection of the most appropriate technology is an important ingredient to facilitate virtual team communications. Goodbody (2005) further suggests that cultural and

language should be considered when virtual team communication is established.

Goodbody (2005) highlights the importance of trust and collaboration in the social interaction between virtual team members. In the FTF environment, social interactions between team members are developed over time. The difference is that on virtual teams, time is limited for social interaction, and trust depends on informal interaction and exchanges. She recommends that virtual team leaders ensure consistency, ensure collaboration, and celebrate achievements (importance emphasised by participants in this study) in developing a trustworthy, collaborative virtual team environment. Greenberg, *et al.* (2007) also emphasised the importance of FTF interaction. They argue social bond and professional respect leading to trust can only be developed during FTF interactions. Goodbody (2005) stated that leaders must establish a sound trust within the virtual team and collaborate effectively while not always being able to meet FTF. According to Wilson, Straus & McEvily (2006) communication in virtual teams must be more explicit because technology enabled communication does not convey the same visual cues that signal behaviour and attitude as in FTF communication.

3.3 Knowledge Management and Sharing

Gupta and Cao (2005) emphasise knowledge management as a major focus of attention in virtual team. Other factors to be considered for virtual teams according to them are trust, conflict, identity, empowerment, coordination, culture, and technology. More importantly, the role of social patterns, practices and processes play an important role in the process of knowledge capture, transfer and learning in a project environment (Huang and Newell, 2003). Regans, Zuckerman, & McEvily (2004) point out that when effective teams are constructed, the consideration of social networks is more important than the team's demography. The outcome of Wells's (2006) study revealed that tacit knowledge support and performance could be framed as problems of socialization (that is training, team-building, developed shared language and communications). She argues that tacit knowledge is not amenable to direct management and it is important to identify socialization processes to

support sharing in virtual teams. She implies that some individuals may be better candidates for work in virtual teams than others and that members with an orientation towards proactive behaviour might adjust more readily to a virtual team setting. She states that direct management of tacit knowledge is restricted by the fact that it typically operates at the level of the unconscious and is not easily expressed. Sharing in particular is limited in virtual work settings.

Knowledge management is of crucial importance to project-based organizations. The growing complexity of project work means that an increasing number of technical and social relationships and interfaces must be taken into account by project managers in adapting knowledge and experiences from the daily work of a company and from earlier projects. According to Huber (1991) project team members frequently need to learn things that are already known in other contexts; in effect, they need to acquire and assimilate knowledge that resides in organizational memory. Their effectiveness in doing this determines their personal effectiveness, the project's effectiveness, and ultimately, the company's effectiveness.

Disterer (2002) states there are significant individual and social barriers that prevent the articulation and documentation of knowledge and experiences. He argues that barriers exist with regard to the honest and open analysis of failures and mistakes. He continues that an open and productive atmosphere would facilitate the articulation and analysis of errors that is rarely present in most project-based organizations. This is unfortunate because successful projects demonstrate only that the methods that were employed were adequate for that specific task, whereas failed projects are likely to yield more valuable knowledge. More effort is required to expose what mistakes can teach (Boddie, 1987).

The empirical investigation of Brookes, Morton, Dainty, & Burns (2006) in UK engineering companies, has presented a framework to identify theoretical interventions that could improve project knowledge management. The framework is based on concepts of 'conductivity' and 'connectivity' and the authors argue that these concepts may increase social capital and project

knowledge management. Brookes, *et al.* (2006:476) defines connectivity as “increasing the number of project relationships between actors”; and conductivity as “making the links between project actors a more effective conduit for information, knowledge (and other resources)”. Their findings reveal that conductive relationships within projects are strongly and significantly correlated with trust and respect. They further maintain that there is a significant correlation between conductivity in a relationship during a project and the relationship’s longevity and the extent to which individuals in the relationship had a common background or a wider social context to the relationship. This is supported by Demian and Fruchter (2006) who argue that knowledge reuse in the architecture, engineering and construction industry occurs largely through social knowledge networks.

Davenport and Prusak (1998) add that the norm of reciprocity and trust are two of the most significant factors that drive knowledge sharing. They reason knowledge sharing in electronic networks is facilitated by a strong sense of reciprocity- defined as favours given and received along with a strong sense of fairness. Their research suggests that a basic norm of reciprocity is a sense of mutual indebtedness, so that individuals usually reciprocate the benefits they receive from others, ensuring ongoing supportive exchanges.

3.4 Culture in virtual teams

Eom (2009:5) states that “culture is a set of values, guiding beliefs, understandings, and ways of thinking enveloping across the entity to which one belongs.” Virtual teams according to him consist of members with diverse backgrounds along cultural and organizational dimensions. He maintains these differences may affect virtual team member’s perceptions of other members, interaction and communication with, and willingness to share information. The research of Eom (2009) suggests that the role of culture background is very important in the development of trust and closely associated with the overall success of virtual teams. Pia (2009) reasons that the difference in backgrounds, histories and cultures of virtual team members may give rise to conflict situations resulting from lack of understanding by some of the parties. Powell, Piccoli & Ives (2004) emphasise that cultural

diversity may be less apparent in virtual teams, potentially reducing the process losses caused by cultural heterogeneity. Carte and Chidambaram (2004) suggest that different types of diversity affect team functioning, propose how different types of electronic communication can affect the impact of diversity, and propose how time changes the effects.

In virtual domain, people with various cultural backgrounds come together to form a team, in which different ideas about what constitutes good performance, proper communication style, and notions of accountability are prevalent (Shachaf, 2005). This may result in lowering the levels of integration and cohesion and a lack of shared mental models that would enable understanding, which may increase stereotyping of other members, miscommunication, and mistrust (Vakola & Wilson, 2004). Working with different cultures with different level of understanding of time, and quality, poses challenges in creating and preserving trust.

Carte and Chidambaram (2004) note that the reductive capabilities of collaborative technologies (electronic tools such as e-mail, group support systems, computer conferencing) can reduce the negative effects of diversity early in the life of a diverse team. If the effect of cultural diversity is different for teams communicating electronically versus those communicating FTF, this may have important implications for the design of virtual teams and their organizations. They suggest diverse virtual teams may be better off not meeting FTF until relationships have been developed. Minimizing the salience of surface level diversity by avoiding FTF meetings early in the life of team may reduce the potential negative impact of this diversity.

Research has found that people from collectivist cultural backgrounds are more willing to help people, make personal sacrifices and are more cooperative than people from individualist cultural backgrounds (McLeod, Lobel, & Cox, 1996). Earley (1989) points out that individualism values potentially affect communication and coordination patterns among individuals working in teams and their expectations. Anderson and Hiltz (2001) find that team members in a high individualistic culture rely on the use of words to convey meaning but in a low individualistic/high collectivistic culture, the use

of voice tone, timing, facial expressions and behaviour are important parts of the communication.

Gudykunst (2004) points the attention to national culture; the dimensions of which influence an individual's behaviour through the norms and rules people use to guide their behaviours and how individuals socialise. He argues that members of a culture may not develop the same general orientation due to different socialisation processes.

Schein (2000) maintains that an awareness of the organization's culture increases the likelihood of learning. This is because a proper awareness of the organization's culture involves the identification and recognition of the tacit assumptions and beliefs that are embedded in the organization. An organizational culture according Senge (1996) is based on a commitment to truth and inquiry empowers individuals to: (i) reflect on their actions, (ii) consider how these actions can contribute to problems, (iii) recognize the necessity for change, and (iv) perceive their own roles in the change process. In terms of project management, "generative learning" is likely to occur only if the project design encourages team members to question institutional norms (Ayas, 1996).

Organizational culture has the potential to constrain or facilitate knowledge creation and transfer within an organization. West (1997) maintains the two fundamental dimensions of organizational culture are: (i) flexibility versus control and (ii) internal orientation versus external orientation. Greater flexibility is characterized by "flatter" organizational structures, decentralized decision making, and minimal specialization of jobs, whereas greater control is characterized by hierarchical structures, centralized decision making, and a large number of specialized jobs with a proliferation of job titles. Rigid and formal structures can promote mere functional efficiency, but this is often at the expense of collaborative and innovative activities.

3.5 Trust in virtual teams

Lee, *et al.* (2003) define trust as the degree of belief in good intentions, behaviors, competence, and reliability of members with respect to sharing knowledge in virtual communities.

Erdem and Ozen (2003) emphasise that social interaction between members is important to the overall performance of that team and cannot be guaranteed by the formal rules of an organization. They stress the existence of a climate of trust as an important factor in creating the interaction among the team members. This is because trust assists with the development and protection of the team spirit by providing the co-operation and the unity among team members. The results of their research support the positive relationship between the team performance and trust.

According to Greenberg, Greenberg, & Antonucci (2007), virtual teams often fail to meet their objectives due to the lack of traditional social and cultural norms for influencing team members' attitudes and encouraging cooperative behaviour. They reason that when team members are dispersed, it is more difficult to build relationships and that many traditional forms of monitoring and control are not feasible. Chen *et al.* (2008) argue that trust is a particularly crucial issue to the success of virtual teams because project tasks are interdependent, making team members reliant on the functional expertise of their partners. Tseng (2008) stress the importance of trust for effective team process and performance. The lack of trust is problematic because it is typically associated with added costs that can translate into decreased team effectiveness (Ashforth and Lee, 1990). The additional cost according to them is associated with additional time and effort monitoring other team members, backing up or duplicating others' work, and documenting problems.

Handy (1995) emphasises that the ability to work collaboratively is a core competency of a learning organization and trust denote the collaborative dynamic of a learning organization. Trust develops through frequent and meaningful interaction, where individuals learn to feel comfortable and open in sharing their individual insights and concerns, where ideas and assumptions can be challenged without fear or risk of repercussion and

where diversity of opinion is valued over commonality or compliance. Caring talk, personal conversations and storytelling are forms of discourse which can establish a mood of support and encourage self disclosure.

A further challenge stressed by Greenberg, *et al.* (2007) is that communication has to be “deliberately composed” and responses may be delayed if teams are working in different time zones. They argue that trust is critical to the cooperative behaviour that leads to success but technology-enabled communications makes trust more difficult due to the lack of richness of emotion and reaction; attributes common to FTF interactions. Wilson, Straus & McEvily (2006) conclude that cognitive trust and cooperation did not significantly decrease with a change to a computer-mediated communication medium. However Greenberg, *et al.* (2007) point out that social bond and professional respect leading to trust can only be developed during FTF interactions. Wilson, Straus & McEvily (2006) emphasise that communication in virtual teams must be more explicit because technology enabled communication does not convey the same visual cues that signal behaviour and attitude than FTF communication.

3.6 Communication Technologies

The development of the internet is impacting the way the consulting industry manages its business. It allows these companies to dispense advice and provide expertise online. Kirkman *et al.* (2004) argue that the development in ICT have created new opportunities for organizations to build and manage virtual teams. Ruikar and Emmitt (2009) state that communication technologies is an important medium for interaction between dispersed virtual team members. Their research supports this view with more than three quarters of the respondents agreeing that accessibility to communication technologies is a strongly desired feature amongst global team members. Another finding suggests that almost three quarters of the respondents had not mastered the technologies to share knowledge with globally dispersed team members. The research further emphasised that the use of technology significantly affects the effectiveness of the team.

Clayden (2007) argues that the medium used by virtual teams is an important mechanism of trust development and richness of communication media affects how the individual team members perceive and trust each other (Baker, 2002). Clayden's (2007) research to determine which technology best supported trust in a virtual team suggests that e-mail ("least rich medium according to the author) being preferred by a large margin of respondents over video conference, computer conference, web conference, web portals and groupware; which is a richer media according to the author. He suggests that the possible reasons for not using the latter as a tool for virtual team collaboration are cost, reliability, difficulty of use, and availability to all respondents. He highlights the importance of groupware in virtual teams for existence, operation and linkage of dispersed team members. He continues that the system has several advantages such as improved collaboration and communication, less administration, multi-media presentations; and reduced costs relocation cost. Prince (2006) indicates that general collaboration software; synchronous information sharing and information search tools are important technologies for the functioning and sharing of knowledge in virtual teams. She argues that as technologies develop physical presence can be added that can supplement the need for FTF interaction. She concludes that this can reinforce trust by allowing visual and audio interaction to occur as well as the ability to sense the emotional state of other team members.

Denton (2006) maintains that groupware makes it possible for project information to be fed into a huge and structured database that can be accessed by all team members. He highlights that people will only feed the system what they know and share with those who they trust. This trust is built on communication and receiving the same information that is specific and direct. He concludes by expressing the need for feedback on team performance and highlights the role of ICT in providing rapid and easily understandable feedback so group members stay focused on the big picture. He argues that rapid and easily understandable feedback encourages a flexible control that is the ideal for self-directed work. Pai (2009) adds that advances in communication technologies such as instant messaging or video conferencing has give birth to virtual teams and allowed organizations to recruit the best talent from around the world without incurring significant

relocation, travel or administrative costs. He argues that technology issues such as accessibility and reliability hinder communication and coordination between the team members. He adds that when group members do not co-exist physically, they depend on mediated interactions for coordination and communication and inevitably face the shortcomings of mediated communication such as lack of social presence, delayed responses and slow graphical refresh rates.

Carte and Chidambaram (2004) propose that communication technologies have bundles of capabilities and these capabilities can be categorized as two types: reductive or additive. Reductive capabilities reduce aspects of communication and speech patterns that would be present in traditional face-to-face communication. Reductive capabilities according to them include visual anonymity (identification is limited), equality of participation (normal turn taking may be reduced), and asynchronous communication (immediate feedback is limited). They continue that additive capabilities enhance normal communication exchanges and include coordination support (tracking resources and project progress), electronic trails (creating records and retrieving information) and enhanced functions (decision making tools, file transfers and rich messaging). They summarise that the bundles of capabilities are most useful at different stages of a diverse team's development. Specifically, reductive capabilities are valuable early in the life of a diverse team, whereas the additive capabilities will add value later in a team's life (that is after a shared team identity is established), by providing support for decision-making and coordination.

3.7 Summary

Current literature with respect to virtual teams shows that trust, cultural background and communication technologies play an important role in how team members manage and share knowledge. This chapter reviewed literature in understanding the concept of the virtual team, the role that trust and culture in knowledge sharing and communication technology.

The literature reviewed was used to establish the demographic questionnaire and pertinent multinational engineering service interview questions. The following section, chapter four, describes the qualitative research (phenomenological) approach to evaluate virtual teams in a multinational engineering service company. Based on the literature reviewed in chapter three, the next chapter outlines the methodology in how to answer the research question of how interaction and trust can be promoted in virtual teams and what the main drivers are for these teams to behave in certain ways.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

Coldwell and Herbst (2004) state that research design provides the structure and information about the appropriate techniques to use to gather information. It further assists with the kind of sampling and outlines constraints such as timing and cost. One of the design methods discussed by the authors is exploratory. An exploratory approach according to the authors is appropriate where the development of data is limited.

This study was exploratory, using an interpretive approach that aimed to expand the understanding of some elements that may affect virtual teams in a multinational engineering service company. An interpretive approach according to Walsham (1995) is a type of research that does not predefine dependent or independent variables, or set out to test hypotheses. The aim is however, to understand the social context of the phenomenon and the process. The interpretive approach is related to qualitative research (phenomenological) that maintains that the world is socially constructed and that human interest drives science (Otter, 2009), and depend on the philosophical assumptions of the researcher (Rowlands, 2005). Phenomenological research seeks out the 'why', not the 'how' of the topic through the analysis of unstructured information (Coldwell and Herbst, 2004). In short qualitative research tends to work with text rather than numbers (Rowlands, 2005). The advantage of qualitative and interpretive research orientation is that the findings of the research have greater validity and are less artificial than quantitative research since it enables the researcher to develop a more accurate understanding of those phenomena (Otter, 2009).

The interpretive approach thus seems to be the most appropriate for this study to answer the research question. Due to the lack of similar studies in a virtual team setting, this study applied a qualitative and naturalistic approach that was designed to collect data from participants in their everyday environment. This study further describes the ways participants understand, collaborate, and interact with other virtual team members.

Data was collected through in-depth interviews and a web-based survey. The web-based survey was used due to the convenience and the potential to reach a large number of virtual teams in the globally dispersed organisation. It was further assumed that participants are familiar and experienced with information and communication technology. The surveyed company has over seven-thousand employees spread globally over a hundred-and-sixty offices. The surveyed company is a consultancy and provides services in the design and management of engineering projects. Most of these employees work in a virtual team environment.

4.2 Population and Sample /Sampling method

The purpose of sampling according to Coldwell and Herbst (2004) is to balance out the costs and time of obtaining complete information with the need for an accurate picture of the population of interest. They point out that it is possible to collect data on all the subjects in the population of interest. They suggest this will inevitably give a more accurate picture than that obtained from a sample.

The study sample was taken from the population of an existing web-based internet list-server. Participants comprised a wide variety of professionals; administrative personnel and various related occupations who were involved in virtual team work. By using this sample, the researcher sought information from all potential virtual teams in the organisation, although the participants were limited to the criteria listed below.

The sample participants were currently working in virtual teams and within a single industry and organization. The mayor source of data was a web-based survey in an international engineering company and was conducted in English. The in-house survey tool was used to generate a 15% randomly selected sample. This produced an e-mail address list that was copied into Microsoft Outlook™ and send to participants.

Two in-depth interviews were also conducted in the researcher's office setting and participant's work mainly in a virtual team environment. The data resulted

from two weeks of data collection. Interview durations ranged from 10 to 15 minutes and conducted in English.

In total the study included 176 participants, and included individuals from six countries of residence, with the number per country ranging from 3 to 34 participants.

The survey was sent to 1,021 randomly selected individuals from a greater potential pool of 7,000. The author received 176 returned surveys with return rate of approximately 17%. **Error! Reference source not found.** graphically represents a summary of the surveys.

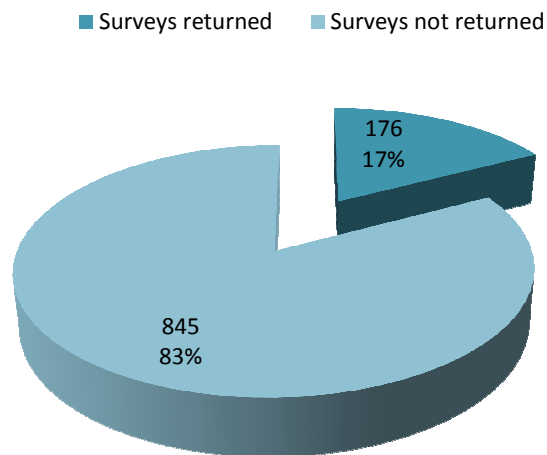


Figure 2: Survey Summary

Of the 176 returned surveys, 74 respondents answered yes on the qualifying question that asked the participant about membership of a virtual team and graphically represented in Figure 3.

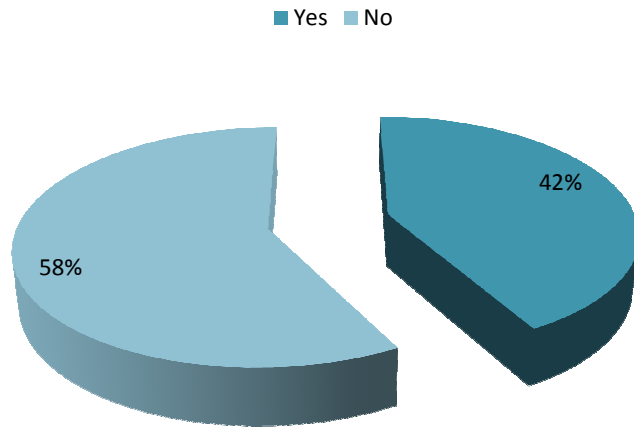


Figure 3: Qualifying question

No limitations were placed on the geographical distribution of teams or their members; gender or ethnic origin. Because of the chosen sampling method, participants were located throughout Australasia, Africa, Canada, Europe, South America and the USA. The multinational engineering service industry experience was not location specific or did not rely on the geographical location of the participant. Multinational experience in the engineering service industry meant the participant had experience managing projects virtually with resources in two or more countries.

Most the 174 returned surveys were in English. Figure 4 graphically represents the geographical locations of respondents. It is noteworthy to mention that the response rate from Canada was more than twice as great as that of the USA (at 18%). There is no evidence in the data that can explain these differences. The average non-response rate for the open-ended questions was about 12%.

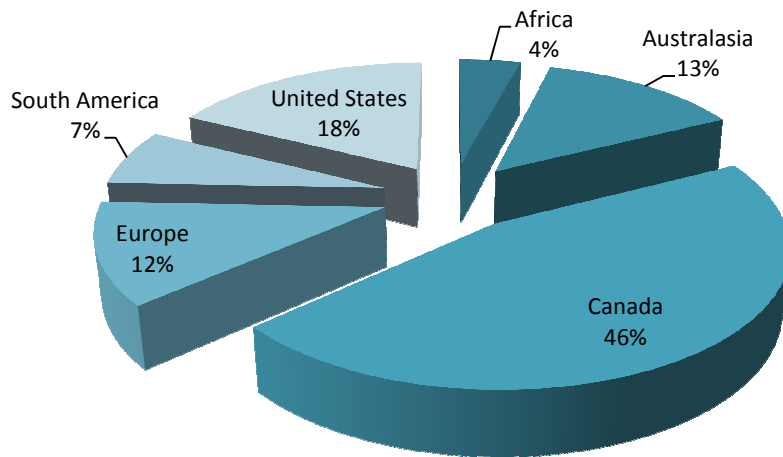


Figure 4: Geographic Location of Respondents

The primary qualifications for inclusion in this study were:

1. All participants were competent in using English for communication.
2. Virtual team members relied primarily on communication technologies for team interaction.
3. Virtual teams contained no less than three members.
4. Participants were part of a virtual team for at least three months at the time of the survey.
5. All potential virtual teams were included in the study from all of the organization's available virtual teams.

The teams ranged in size from three to more than ten members.

4.3 Data types

Charlesworth, Lawton, Lewis, Martin & Taylor (2003) describe two data types; phenomenological or qualitative and positivist or quantitative. For the purpose of this study the phenomenological approach was used for data collection. A web-based questionnaire was used to carry out the survey. Rowlands (2005) offers a detailed justification of a qualitative approach to research. According to the author qualitative methods are increasingly accepted in social science

and business research as this type of research differentiates itself from a scientific positivist paradigm. He points out that human organisations and human behaviour are difficult to hold still and isolate, since they change constantly and can offer different dimensions of themselves to different audiences.

4.4 Data collection techniques

According to Martin (2000) there are five basic steps involved in survey research: planning, sampling, constructing the instrument, conducting the survey, and processing the data. A questionnaire is an instrument for the measurement and collection of particular kinds of data and has to be designed to particular specifications with clear defined objectives. She points out the importance that the survey is not “contaminated with unnecessary questions”. The questionnaire should be validated by at least two persons other than the creator of the survey who are experts on the area of inquiry or are experts in research design. She further suggests the questionnaire being redistributed to non-respondents in order to get the most accurate information possible. Pallant (2007) suggests a pilot study before the survey commences.

The research instrument utilized consists of a self-administered questionnaire designed and optimized to collect the required data. The questionnaire or survey is the preferred type of data collection instrument for this particular research because it provided for an economical and fast way for obtaining data (Coldwell and Herbst, 2004) across national borders. Data were collected for this study through a series of closed-ended and open-ended questions.

The design of the study was broken into three phases. First a pilot study with seven participants to validate interview questions, second phase consisted of data collection and interviews, and finally the data analysis phase. The pilot study is discussed in section 4.10.

The interview questions (Appendix D) consisted of eighteen questions, six that address general questions, two questions on communications, three questions on knowledge sharing two questions on culture, and the remaining

five questions relate to trust in virtual teams. Each question was developed to assist in answering the main research question.

The questionnaires presented to participants were divided into six sections. Section one asked six questions to collect data on location and demographic variables. Section two asked one general question to assess the team member's perception of the different success factors between virtual and FTF teams. Section three asked two questions and sought to collect data on how virtual teams communicate. Section four asked three questions on how the team member shares knowledge. Section five asked two questions on the team member's perception of how culture affects knowledge sharing and communications in virtual teams. Section six asked five questions about trust in virtual teams. These five questions were adopted from Jarvenpaa, Knoll & Leider (1998) trust scales due to their validity and reliability. The questions were rephrased to assess the team member's general perceptions of trust between the respondent and other team members in virtual teams.

With the assistance of the company's IS team, the company's in-house survey tool was used to generate a 15% randomised list of active company e-mail addresses. These e-mail addresses were then copied into Microsoft Outlook™ and sent to the employees in the company to express appreciation for their participation. This e-mail contained an introduction and instructions with hyperlink link to the questionnaires (see Appendices A and B). A deadline requesting completion of the questionnaire was sent by e-mail encouraging completion and once again expressing appreciation for their prompt response. Completion of the questionnaire took each respondent no longer than twenty minutes.

4.5 Bias

In sampling contexts, the standard error is called sampling error or bias and gives an indication of the precision of the statistical estimate (Coldwell and Herbst, 2004). According to the authors a low sampling error indicates relatively less variability or range in the sampling distribution. In the process of identifying a sample, there is the possibility of introducing systematic error.

Coldwell and Herbst (2004) identify two basic causes of sampling error; that is chance and sampling bias. Chance occurs due to untypical choices- for example; by randomly selecting two departments with large number of employee compared to other departments within the population may result in a higher sample average than what should be. Sampling bias according to Coldwell and Herbst (2004) is a tendency to favour the selection of units that have particular characteristics and the result of a poor sampling plan. Bias in information collection according to Charlesworth, *et al.* (2003) is a distortion in the collected data so that it does not represent reality. They discuss possible sources of bias during data collection. Defective instruments for example are questionnaires with fixed or closed questions on topics about which little is known; open-ended questions without guidelines on how to ask (or to answer) these; vaguely phrased questions; leading questions that cause the respondent to believe one answer would be preferred over another; or, questions placed in an illogical order. The authors point out that these sources of bias can be prevented by carefully planning the data collection process and by pre-testing the data collection tools. This study collected data on all the subjects in the population of interest and it can be argued that sampling bias was reduced.

According Charlesworth, *et al.* (2003) observer bias can occur when conducting observations or utilising loosely structured group- or individual interviews. The authors point out that the risk is that the data collector will only see or hear things which are of interest or will miss information that is critical to the research. They point out that the informant may mistrust the intention of the interview and avoid certain questions or give misleading answers. This may even be enhanced when respondents know the purpose of the interview (Coldwell and Herbst, 2004). Charlesworth, *et al.* (2003) argue that bias can be reduced by adequately introducing the purpose of the study to informants, by phrasing questions on sensitive issues in a positive way, by taking sufficient time for the interview, and by assuring informants that the data collected will be confidential. According to Coldwell and Herbst (2004) respondents may also give wrong information to impress the interviewer. They point out that this is very difficult to avoid because it represents dishonesty on the part of the respondent.

Coldwell and Herbst (2004) emphasize that objectivity is therefore virtually impossible in qualitative research and sometimes undermined by the subjectivity of the researcher and the unreliability of the findings. For example, two researchers of the same phenomena at the same time may arrive at very different conclusions because they have different perspectives and agendas. The researcher has worked in the multinational engineering service industry for eighteen years and may present some bias for research findings and conclusions. The experience helped the researcher address appropriate questions, develop meaningful categories and themes and selecting qualified candidates for the pilot study and interviews. During the interview and research process, the researcher noted personal bias and based research findings and conclusions on common themes from the interviewees.

4.6 Data analysis techniques

Qualitative data cannot be easily analysed by means of mathematical techniques because “an incident does not take place often enough to allow reliable data to be collected” (Coldwell and Herbst, 2004:13). Silverman (2006) argues that qualitative data analysis depends on very detailed textual analysis and points out that the data should be limited to what is needed to answer the research question.

Hawe, Degeling, & Hall (1990) suggest four basic steps to analysing qualitative data. The first step is to categorise data into a format that is easy to work with. The next step is to shape the data into information by shorting the data into categories or types. The next step is to separate the data into groups that share similar characteristics. Finally the information needs to be explained. They point out that this last phase should be treated with caution to avoid unsupported conclusions or assumptions.

This study used coding for the open-ended questions to categorise and group responses required for analysis. According to Silverman (2006) coding should be tested to ensure certainty, which can be done through pretesting, interviewer training, using a fixed set of answers, and checking reliability of

codes on open-ended questions. Details of the coding and categories are provided in Appendix E.

Data analysis and coding began once the data was received. The data analysis of the study was supported by the use of Microsoft Excel™ for qualitative analysis.

4.7 Limitations and delimitations

This study targets virtual teams in the entire organisation. The only qualifying criterion was membership of a virtual team. No test as such was required to assess virtual team membership of the respondents to this survey. The researcher further assumed that respondents have experience working in a collaborative virtual team. It was further assumed that the respondents would openly and honestly answer the research questions. Team members were asked to complete the survey via an e-mail invitation containing a hyperlink to the survey web page.

Bradley (1993) proposes four criteria for trustworthiness in qualitative research: credibility, transferability, dependability, and confirmability. Bradley (1993:436) defines credibility as the “adequate representation of the constructions of the social world under study”. One of the limitations of the data from the survey on individual’s perception is the possibility of biased data that does not present the social phenomena under investigations. The validity was increased with multiple points of view from team members spread over the globe. These respondents provided multiple perspectives on the issues under study and addressed the issue of dependability (defined by Bradley (1993:437) as “the coherence of the internal process”). However dependability (validity) of the interviewer’s questionnaire may be criticized for induced bias. Coldwell and Herbst (2004) state that induced bias occurs when the personal prejudices of the designer place focus on specific aspects that the respondent is required to respond to. This may suggest that these aspects are prominent issues in the respondent’s personal experience without actually being the case. Another concern related to this study’s confirmability, is the subjectivity of the data interpretations made during data

analysis (Bradley, 1993). Coding reliability was addressed by an independent audit of the data as suggested by Tinsley and Weiss (2000). Transferability is not discussed because it is outside the scope of this study.

Coldwell and Herbst (2004:23) argue that “triangulation is based on the premises that no single method can fully explain or describe a phenomenon”. Triangulation requires different methods and different kinds of data (quantitative and qualitative) to fully investigate a particular area of research. Potential biases can exist in this single study. However, this was addressed by introducing a different data collection method such as in-depth interviews. It also assisted to enrich the study.

4.8 Ethical issues / Confidentiality

Confidentiality and anonymity were promised to all participants as stated in Appendices A and B. The e-mail conversation explained the nature of the study, its relevance, and potential benefits for the company. Participant’s names were not asked in the survey and instead a unique code was assigned to each participant during the analysis. The published data will therefore not include participant names and only contains summarized results, categories, and findings. The data will be kept by the company for three years.

4.9 Validity, Reliability, Generalisability

According to Coldwell and Herbst (2004) validity is usually discussed in terms of internal and external validity. According to the authors internal validity refers to the findings of particular study: the extent to which the hypotheses are supported by the available evidence and only relevant to the specific study in question. They point out that internal validity means that there is evidence that the study was done and external validity is related to generalizing from other similar situations and contexts. According to Charlesworth, *et al.* (2003), validity is a key test for any research and is concerned with the extent to which cause and effect can be demonstrated: does the instrument measure what it’s supposed to measure?

Coldwell and Herbst (2004) define reliability as "repeatability" or "consistency". According to the authors a measure is considered reliable if it would give the same result over and over again. Creswell (2003) points out that qualitative study heavily relies on valid and reliable information. The pilot study was conducted to determine the reliability and validity of the survey instrument. The pilot study used the same mechanism for collecting and analyzing data as the full study. The instrument was accessed via a web based survey page and the data was analyzed by a third party and results forwarded to the researcher.

The company's survey tool has been used extensively over the last eight years for hundreds of internal and external surveys. Internally the survey tool is used to manage performance (360 degree peer reviews) and annual professional development review processes. Externally the tool is used to assess the company's "Client Satisfactory" surveys in Australasia, Canada and USA. The survey tool is internally managed by the company's global IS team.

4.10 Pilot study

The pilot study validated the instrument for the main study. The pilot study began by distributing an informed e-mail (Appendix A), and an interview questionnaires (Appendix B) to seven work colleagues working in a virtual team environment. The e-mail informed participants about the survey and provided a link to the questionnaires. Participants were asked to answer yes on the qualifying question in order to access the web-based survey. The advantage of using this process was that the interviewee only had to go to the survey link, fill out the information, and submit the survey. Furthermore, virtual team members appreciate quick and easy electronic work and were more inclined to participate in the interview process.

By interviewing two virtual team members first, the interview questions were validated and amended to ensure the instrument was useful in researching the problem identified. The results from the pilot study were useful in the research study and helped to select the questions that were most appropriate

in assessing factors that enhance interaction and trust in virtual teams. During the survey the author was contacted to clarify certain questions. Feedback on the pilot study questionnaires was used to amend the main survey questionnaire. After the pilot study was finalized with appropriate interview questions, and categories, the data collection and survey phase began.

The pilot study began by interviewing two multinational engineering services virtual team members face to face. Participant 1 is currently working in Australasia as a Principal at the engineering service company. He has over 25 years experience in the industry and has worked in the Australasia, Africa, Europe, and the USA in the engineering service industry. Participant 2 is currently working in Australia as a senior engineer in the information technology as well as engineering service industry. He has over 15 years experience throughout Africa and Australia and is a registered professional engineer.

The pilot study was then sent to twelve colleagues within the company and participants were asked to complete the survey in four days. Only seven of the twelve responded. Participants have on average about fourteen years experience in the engineering service industry and 3,4 years in virtual teams. Table 1 outlines the position and experience within the industry and virtual team.

Table 1: Demographic overview

Participant	Position	Nationality	Years experience in Industry	Years experience in Virtual Team
1	Associate	Australian	20	3
2	Principal	Australian	22	3
3	Principal	Canadian	20	7
4	Engineer/ Scientist/Consultant	South African	5	5
5	Engineer/ Scientist/Consultant	British	16	4
6	Associate	Australian	8	1
7	Engineer/ Scientist/Consultant	Canadian	7	1

4.11 Summary

Chapter 4 explains the procedures that were used to explore the research questions. The chapter discusses and justifies the research design, the data collection procedures, data analysis techniques, instrumentation, pilot study and handling of the data. Chapter 5 presents and discusses the results obtained and how these are linked to the research objectives.

CHAPTER 5: RESULTS AND DISCUSSION

5.1 Introduction

The basis for the eighteen questions was to examine to what extent trust and knowledge sharing can be promoted in virtual teams and ways in which communication tools measure, strengthen, recognize, and capture virtual domain development. Domain connectivity is assessed in-order to evaluate and promote virtual interaction to foster trust, success, and continuity. The first six questions (section 1) aimed to assess general information about geographical location of participants; their nationality; position in the company and years of experience in the engineering services industry and virtual teams. A graphical outline of the various questions that assessed the four objectives is presented in Figure 5. Coding and results of questionnaires are presented in Appendix E.

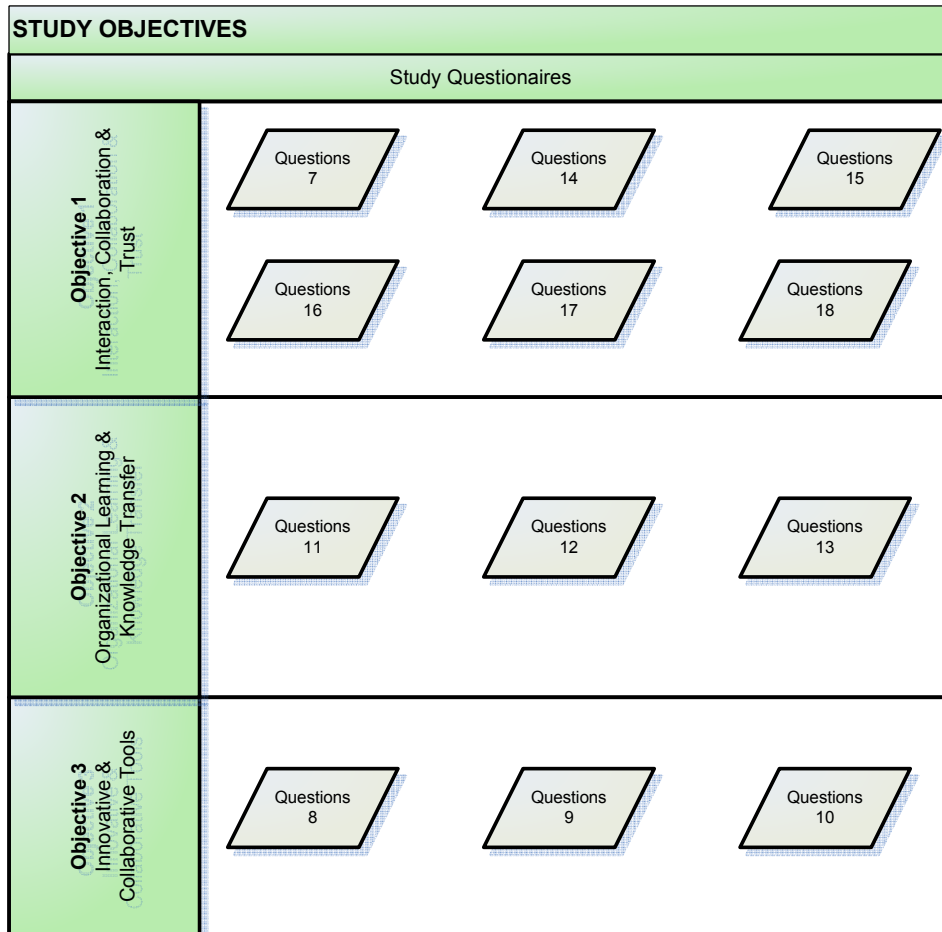


Figure 5: Research Questionnaire

5.2 Study Objectives

Interaction, Collaboration and Trust

The first objective requires the identification of how interaction, collaboration and trust of virtual teams can be promoted in engineering service companies. In particular this study investigates how interaction and trust can be promoted and the main drivers for virtual teams to behave in certain ways (resulting in a rather different network depending on the type of delivery method and contact). Factors are investigated that make virtual teams effective and show how these are different in comparison to FTF teams.

Organizational Learning and Knowledge Transfer

The second objective identifies how virtual teams contribute to organizational-level learning and knowledge management, what the implication is for competitive advantage and how this can contribute to the overall profitability of the company. Factors are investigated on the effect that virtual team learning has on the learning at organizational level. In particular how knowledge is transferred and shared within virtual teams in the engineering service company that eventually achieves organizational-level learning.

Innovative and Collaborative Tools

The last objective of this study identifies specific needs for unique and innovative tools to locate engineering and technical resources, and the importance of using as many tools as possible. It explains how collaboration tools measure, strengthen, recognize, and capture virtual domain development from an overall operational management point of view.

5.3 Study Results

5.3.1 Basic information / Demographics

Figure 6 graphical presents participant's nationality. Four participants misinterpreted the question and indicated citizenship. This is presented in

Table 2. The first nationality that was stated by the participant was assigned to the group. Nationalities less than two were grouped under “Other”.

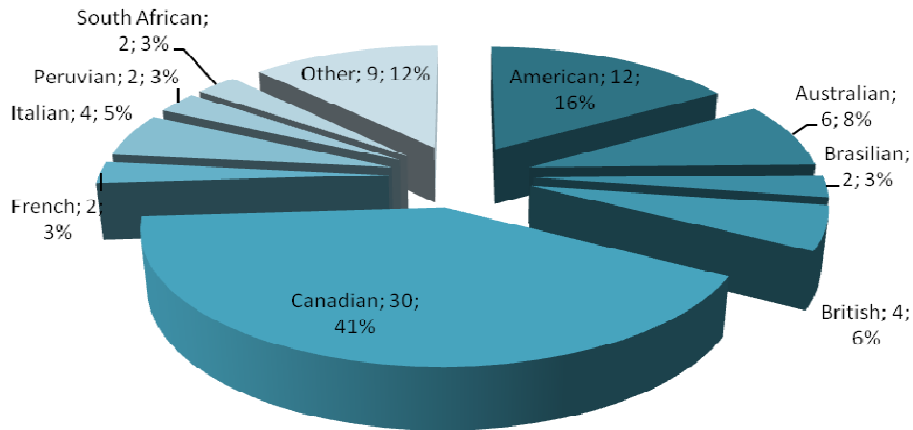


Figure 6: Respondents Nationality

Table 2: Nationality

Dual	Other
British/Australian	Bulgarian
Canadian/Australian	Caucasian
Canadian/Turkish	Chilean
Dutch/American	Irish
	Malawian
	New Zealander
	Romania
	Trinidadian

Figure 7 presents the respondents position level in the company. Approximately 57% of the respondents indicated that they are part of the Engineer/Scientist/Consultant level directly handling major project business, which is the focus of this research. 11% listed themselves as Associates, Principals (9%) or Administration (14%) indirectly associated with project business providing technical support and administrative support to virtual teams. The remaining 9% were at a management level in the company structure and provided multi-project strategic management.

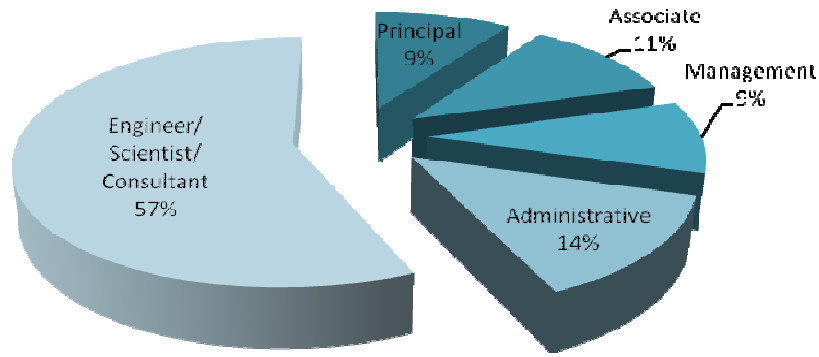


Figure 7: Respondents position level

All participants were part of a virtual team for more than three months. The experience in the industry ranged from 3 to more than 20 years.

The majority of the respondents (78%) indicated they had less than 5 years virtual team experience and the remainder 22% were equally spread between 5 to 10 and more than 10 years experience. For the industry the majority of the respondents (84%) indicated they had between 3 and 20 years experience. Figure 8 graphically represents industry and virtual team's years of experience.

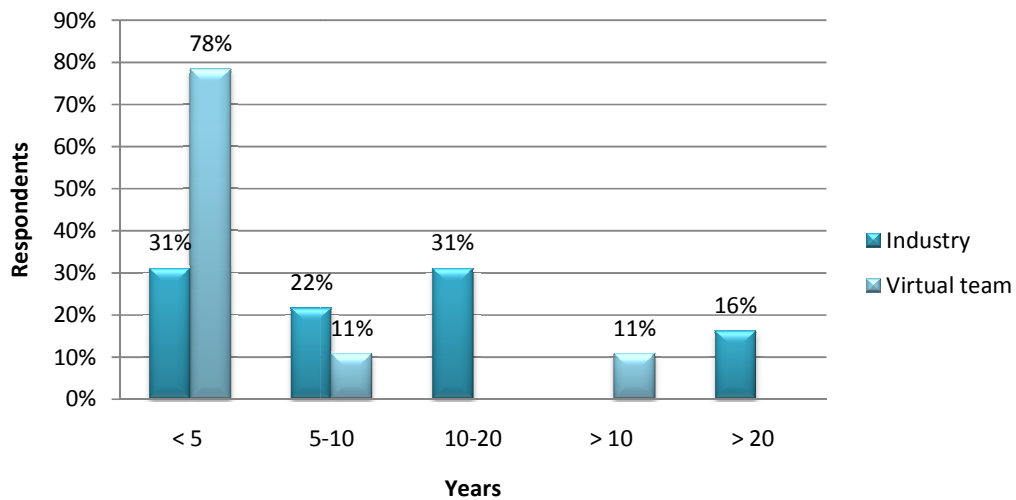


Figure 8: Years of Experience

Almost half of the participants (46%) indicated that a team consists on average of 1 to 5 members. These results show that the majority of teams

(86%) have less than ten members per team. Figure 9 shows the breakdown of team membership.

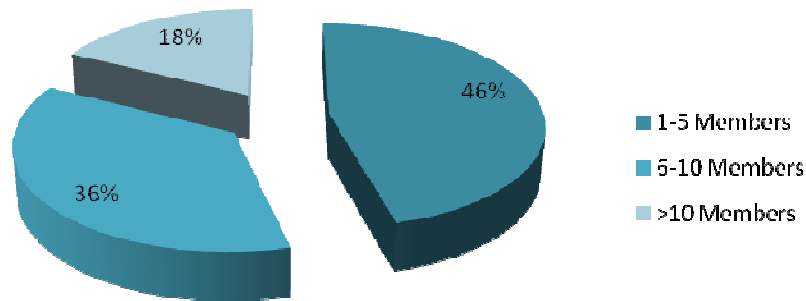


Figure 9: Average Team Members

5.3.2 Interaction, Collaboration and Trust

Question 7

Respondents indicated the difference between a virtual and FTF team is the ability to share knowledge across national borders and time zones (27%). Participants also indicated that the flexibility of virtual teams (22%) gives it a greater advantage over FTF teams. According to participant 5 a virtual team allows access to projects in other countries that may not be accessible due to budgetary restrictions. Participant 9 said virtual teams have access to members of expertise from different offices and allows for more effective bidding and management of projects. The participant went on to say that FTF teams have the benefit of easier access to team members working in the same time zone. Participant 22 said a FTF team has "...access to a wider and broader range of skills, ensuring the best people for each project are involved as time and distance do not matter". Participant 24 stated a virtual team can be local and has an understanding of in-country laws, restrictions and financial requirements. Participant 37 highlighted the success factors for a virtual team that include "...availability of required technology to facilitate the team's work, having a wide variety of experiences and strengths to pull from as the team is larger than one might get in a specific region" and "...little duplication of effort for projects that are global". The participant said that FTF also has benefits that include "...the ability to better manage timelines/responsibilities, creation of a team environment through FTF work,

better accountability to the team, and less reliance on technology for productivity”.

Participants emphasised the significance of communications (22%) in virtual teams. According to participant 3 the “success of a virtual team is dependent on the communication and facilitation skills of the team leader”. The participant went on to say that “information needs to be communicated to team members openly, honestly, and in a timely manner”. Participant 18 emphasised the importance of clarifying the project objectives and communication protocols at the start of the project. During the project, awareness of potential risks that might affect the outcome of the project is important.

Participants stated virtual teams have the potential to reduce overall cost (14%) of the company such as using technical experts globally without travel and better work / life balance. Participants also felt that virtual teams have the advantage over FTF teams to respond to client’s needs quicker (8%) and have better access to information (8%). Participant 67 felt communication needs of a virtual team are higher due to less effective “information streams” such as body language. This is because “the virtual team communication is mainly based on peculiar events that must be organized and managed”. Participant 9 was of the same opinion and suggested there has to be a higher level of communication follow-up and clarity with virtual teams.

Participants (9%) stated the significance of trust in a virtual team. According to participant 67 conflicts diminish trust and “...might be easily identified and solved by informal discussions”. The participant went on say that “in a virtual team it is also difficult to understand if there are conflicts, in particular if the team includes unassertive members”. His advice was to create and protect trust and understand signals creating empathy. He suggested the importance to “see team members by web cam or, if possible, by physically meeting team members at least once”. Participants stressed that trust is more difficult to build in a virtual than a FTF team. Participant 60 said that more trust and commitment is required in a virtual team.

Participants highlighted the potential barriers in virtual teams. According to participant 67 in a team that "...is not homogeneous in terms of technical capacity, commitment and efficiency, the overall performance might be jeopardized". The participant pointed out that in a FTF team it is easier to realize that there is a threat and manage the team accordingly by changing roles, tasks, and increase control over a specific section of the work. He stated that in a virtual team "signals may be delayed or hidden and, if it is too late, a sub-team can adopt a negative behaviour to corrective actions". Participant 61 and 66 were of the opinion that in a virtual team it can be more difficult to control progress and project deliverables due to time zones differences and inefficient communications. Participant 67 pointed out that language barriers such as talking or listening in a second or third language does not make communication easy. He suggested the importance of setting non-ambitious communication targets at the start of the project and ensures that everybody understands the basics.

Some participants indicated that FTF teams are better (5%) and 4% felt there is no difference between a virtual and FTF team.

Question 14

Respondents questioned how effective the use of communication tools could ensure trust in the virtual team setting. 8% of participants indicated that communication on its own cannot be used to ensure trust and the majority of the respondents (19%) stressed the significance of FTF interaction or at least one personal contact at the start of the project. Some participants indicated that a true sense of trust from the start of a virtual project or setting could only be established through FTF meetings. Participant 59 suggested that video conferencing is good alternative to FTF as trust is often built more quickly.

Participants stated that trust is preserved by open, clear and honest communication (18%) and not necessarily the tools (8%). Participant 1 stated that trust is earned, "not electronic" and stressed the significance of having a working relationship that involves prior "face time". Participant 25 stated that trust is "verified through actions" and participant 53 pointed out that trust in relationships develops through accumulation of positive experiences and an

absence of negative experiences. Participant 58 thought that trust can be easily achieved by "...giving credit to the intelligence and good will of all the network members by being open, discussing issues with the group, seeking consensus and group decisions". Participant 43 said trust is a very important component and that "...activities that foster relationship building before and beyond the project can be very helpful". Participant 40 stated that "communication styles are affected by the thinking strengths of the team members" and thought that "trust improves when team members appreciate the different thinking styles of their colleagues". According to participant 19, "...technology is secondary to the human factor" and the "...overuse of the technology may create resentment from people who are less secure, less involved and already made to feel they are lesser members of the team". Participant 28 said that "one has to make sure that everyone not only feels included in the communication loop but also are provided all of the information". The participant stated that "screening of information and only passing on what we think people need to know" should be avoided to ensure trust.

The securing of information (7%) was reported as a way to ensure trust in a team. According to participant 65 the use of secure sites / networks is important to ensure trust in a virtual team setting because "...without these tools in place, it is not possible to ensure that the information is only shared with the project team", The participant further argued that "...if accessibility of information is provided only to the project team, there is less chance the information will be tampered with". Participant 18 felt that all information and discussions should be documented.

Some respondents (5%) indicated that trust was not an issue in their teams.

Question 15

The question asked participants how they allow other team members to create and preserve trust. Respondents stressed the important of clear, open and honest communications (27%) and 14% strongly believe that FTF involvement creates the trust, more so than anything else. Participants pointed out that people's openness and honesty with each other are very

important. According to participant 15 creating trust via e-mail "...can only be based on strength / quality / diplomacy of language used in e-mail communication". The participant continued to highlight other factors that assist in building a level of trust such as "...knowing the level of experience and position of the team members, speaking the local language if different to one's own". Participant 31 stated that "...being open and honest during team meetings, providing constructive feedback and praise for group work, and ensuring that meeting time is a safe environment for all team members to speak" ensure trust in a virtual domain.

Participants also indicated that listening and timely feedback to members (11%) and knowing team member's ability (3%), allow working independently (4%) all assist with trust in the team. Patience with team members was valued by participant 20 as the most important aspect of building trust. Participant 27 stated that "...by allowing everyone to voice their opinions and suggestions" and "...getting everyone around a table to talk through items" works really well. Participant 53 pointed out that "...routine communication is key to trust, inform all team members about the progress and clarify responsibility for each project tasks".

Some participants (15%) strongly believed that the achievement of project objectives (meeting deadlines and budgetary requirements) assist with creating and preserving trust. Participant 57 stressed the importance having a project schedule "with a very clear division of labour" and "...clearly outlined responsibilities".

Question 16

Participants (15%) stated that the achievement of project objectives plays a major role in allowing team members to trust each other for providing project information. According to participant 74 the only way to build and retain trust in a team is to "follow through with any promises made about content, quality, and schedule". The participant went on to say that "if you continually go back on your word and submit information past deadlines or submit poor quality work, the rest of the team may realize that they could do a better job without your input". Participant 15 stated that "my reputation for producing quality

work on schedule allows people to have confidence in me”. According to participant 35 he’s role “...is not to make the decisions but to ensure the right decisions are made. I am the coach and manager”.

Participants also indicated the importance of integrity (11%) and honest open communications. Participant 24 stressed the significance of being “...open about your limitations and abilities; by undertaking all work in an honest and transparent manner”. Participants emphasised the importance of regular follow-up and feedback (12%). Participant 9 said he /she “be prompt and reliable” and “attempt to provide encouragement and recognition as often as possible”. Participant 66 said it is “...expected to give good updates on schedule and work progress”. The participant 66 went on to say that “engineers need to trust that I am on task and taking care of business even though they are not here to see what I am doing”. Participant 67 stated that he “...provide weekly status reports so other team members can observe my work progress”. Participant 50 stated that “being open / honest about what information can be expected, and certainly not make false assurances on level / detail of information” assists with trust. Participant 14 stressed the significance of “knowing” team members and FTF interaction. Participant 44 said that “by giving them free access to available information and information systems and being receptive to any input that they may have” assists with trust amongst team members to provide project information. According to participant 35 a project manager should understand the different specialities in a team and their significance to the overall project success.

Participants (3%) stressed the importance of trust amongst members. According to participant 47 “trust is gained with time and project experience”. Participant 56 pointed out that “in a virtual team environment, the trust element must be there and all data sets should be provided at an early stage.” The participant continued to say that all members should be included in the sharing of information so that “... the project can progress quickly and in so doing, allows for trust to be strengthened”. According to participant 34 respect and understanding of differences in culture plays an important role. Participant went on to say that interest in culture diversity should be demonstrated and “...always offer assistance and make them feel part of the

team” in order to built relationships. Participant 14 said the organisation should be cautious because “...there is no electronic widget that can do that” (replace trust) and the company would be “misguided to believe that a new piece of software will ever accomplish this”.

Question 17

Participants indicated that regular communications (18%) mutually benefit team members. According to participant 65 “...honesty regarding progress, knowledge, time required, deadlines, and budgets with project managers” are important in a team”.

Participants also highlighted the importance of sharing information in a prompt fashion (8%), regular project feedback and updates (5%) to achieve project deadlines (8%). Participant 74 was of the opinion “when there is a strong team relationship within the virtual team, most likely the product will be high-quality and will exceed the client's expectations”. Participant 74 continued to say that “this could potentially lead to additional work with the client and could help the team grow and prosper together”. Participant 66 said that communications should ensure that “...everyone knows what work needs to be done” in order to avoid “unnecessary surprises”. Participant 73 stated that the exchange of ideas, discussion of possible data interpretations and evaluation of possible solutions are mutually beneficial to team members. Participant 8 said that the sharing of information in big teams are difficult but stressed the importance to “keep in touch” with team members and send regular but short updates. Participant 55 stated that “...evidence of misconduct can break the faith of a collaborative behaviour”. Participant 55 continued that actions need to be taken to create a “good and trusting climate”. Participant 12 stated that “trust doesn't just benefit the team” but it is critical to the performance”. The participant went on to say that “unresponsiveness, particularly under pressure, is a major trust-destroyer”.

Question 18

Participants (26%) stated that open and clear communications are vital to ensure trust within a virtual team setting. Participant 74 stated that “without communication and organization, the team would not be able to function

across geographic boundaries”. Participant 74 went on to say that “...while these are particularly important in virtual teams, they are vital to ensuring trust and success in any team setting, whether virtual or face-to-face”.

Participants indicated the significance of honesty and openness (18%). Participant 30 said that “honestly, openness, dedication, commitment to group objectives, a positive attitude and a willingness to work with others” are important to ensure trust. Participants 68 stated that “leading by example and promoting ownership in the project at all levels, constructive feedback, emphasis on quality” are important to demonstrate trust.

Participants highlighted the important of achieving project objectives (11%) to ensure trust in a virtual team. According to participant 65 “respect for deadlines, budgets, and availability” assist with trust. Participant 55 provides “factual information” and ensures all team members are working towards a common goal to achieve the objectives. Participants emphasised the significance of respect (9%) for each other and according to participant 55 “willing to help despite personal interests”. Participants stressed the importance of technical competency and technical ability (8%) in creating trust. According to Participant 38 “...technical excellence and a good understanding of boundaries/responsibilities” are important. Participant 55 was of the opinion that “...adequate technical and managerial skills and integrity needs to be demonstrated”. Participant 55 continued that responsibility is not “...transferred to other members if this was not agreed and shared”.

5.3.3 Organizational Learning and Knowledge Transfer

Question 11

Participants indicated that improved efficiency (31%) and shared resource (24%) contribute to the overall profitability of the company. According to participant 3 “knowledge sharing promotes efficiency and if communications are efficient, employees are better able to perform their roles and produce higher quality work”. The participant went on to say that “profitability is

dependent on work efficiency (working within budget), and the quality of the final product (future contracts are dependent on level of quality)”.

Participants indicated the sharing of lessons learned (19%) contributes to the overall profitability. Participant 32 stated that “without this sharing projects tend to hit bumps which end up costing everyone time and money to fix”. The participant went on to say that “...this confusion can be largely avoided in the first place if people simply talk to each other and not fall into the trap of selective sharing”. Participants pointed out that there is no standard process to capture the knowledge or lessons learned on projects. The tendency is to close the project and move on to the next job. They added that knowledge management is crucial because if just a small portion of the lessons learned or knowledge is capture on projects, the potential savings to clients and the organization would be tremendous. Participant 7 said that “knowledge sharing stops us from reinventing the wheel and should make us more effective and therefore profitable”. Participant 23 used the quote from Bill Gates who wrote in *Business @ the Speed of Thought: Using a Digital Nervous System* that “if you take an inefficient person and add technology, you make them less efficient” to highlight efficiency.

The reduction of cost was also highlighted by participants (19%) as another way to increase profitability. Participant 10 stated that “e-communications has saved multiple hours of travelling and travelling costs of teams that work together”. This was also the view of participant 21 who stated that technology such as Skype and PWS offer free ways to share knowledge without travelling”. Participant 41 used the example of a client in the USA who requested a project in Brazil. The local office in Brazil was contacted to do the work instead of sending someone from the USA. The participant highlighted the benefit of using local knowledge that is familiar with the country laws and regulations.

Participants also emphasised the importance of synergies and sharing of IP. According to participant 47, “synergies between projects increase the commercial opportunities”. Participant 57 said that “IP provided us with a

substantial competitive advantage” that the whole company can benefit from if the knowledge is shared.

Question 12

Participant questioned the effect of culture diversity on knowledge sharing in a team. Participants (30%) felt that culture diversity in a virtual team was not an issue but pointed out that language difference (12%) and communication issues (9%) may affect sharing. Participant 3 stated that “I have experience working with people from around the world and cultural diversity has never influenced knowledge sharing, as long as one method of communication is shared between all team members”. Participant 7 was of the opinion that “knowledge sharing is more of an individual issue rather than a cultural issue”. This was also the view of participant 10. Participant 33 said that “I don't believe culture (external) is too much of a barrier. I think as our culture has shifted more away from P&A to Office based or Management this has stifled to some degree knowledge sharing”. Participant 34 pointed out that the company “...has created a culture by which all team members feel comfortable sharing ideas, concerns and working together to create solutions”. The participant continues to say that diversity “...is a valuable asset in ensuring that all solutions are a best fit for all employees”. This was also the opinion of participants 28, 34, 35, 61 and 62. According to participant 62 diversity opens up a variety of standpoints because it adds “...richness if the team is able to add value from different perspectives without decreasing the scientific and technical value of the work, and if everybody considers differences as a value for the group”. The participant continued that it “could be a threat if the advantage of having different perceptions, languages, ideas are not managed and considered appropriately”.

Some participants (11%) stressed that culture diversity restricts sharing. Participant 67 stated that “culture diversity influences the way knowledge sharing occurs in groups because of the way that individuals view their knowledge, their position, and the stability of their place within the company”. Participant 62 was also of the opinion that “...cultural diversity (both in terms of disciplines and geography), the mechanisms are similar and might create friction that can slow down the process of knowledge exchange and the

willingness to cooperate”. Delayed decision making was also pointed out by participants 20, 21, and 38. Participant 62 proposed some general actions that might be needed to break barriers and stated “...the effectiveness of the knowledge sharing is stimulated by clear rules of the play, sharing of common objectives, full and sincere respect for everybody, control of body and verbal language and, above all, demonstration of our capacity to work hard and well”. Participant 42 suggested communications need to be improved when culture diversity of a team is large.

Participants also stated that language barriers (12%) can be an issue. Participant 39 used the example that company documents that are in different languages (other than English) such as French or Spanish cause some issues with sharing. Participant 48 stated that differences in language and educational backgrounds have “...a huge impact on knowledge sharing activities as you cannot express yourself”. The participant continued to say that time zone differences also influences knowledge sharing in a team. Participant 39 pointed out that trust may be an issue when you rely on others to share information. She stated that in some countries it may be difficult to communicate with local team members when there is a “culture hierarchy”. She explains that the person “...may be shy or does not dare asking questions or discussing things” and points out that “...being a female has so far never been a problem in knowledge sharing with local team members in overseas work”.

Question 13

Participants were asked how the difference in culture background affects knowledge sharing in a team. 18% of participants indicated that different languages can be a barrier to share knowledge. Participant 58 said “communication in a multicultural team is limited by the need of adopting common language” and argues “English for non native English speakers, is a limiting factor in the capacity to properly express concepts and emotions”. The participant suggested English speakers have to avoid the use of jargon. Participant 5 was of the opinion that culture norms need to be considered and communication style adopted to suit the situation. Participant 4 said that language is sometimes a barrier and “...as with new team members you have

to gain trust to work well together”. According to Participant 69 responsiveness varies by culture, both in terms of promptness as well as openness and used the example that junior team members in some cultures are more deferential to senior team members than in other cultures. The remedy offered by the participant is to establish clear expectations with regard to frequency and frankness of communication. Participant 67 said preconceived ideas of other people on the team negatively impact effectiveness of the team itself and it takes time to "level the field" so members feel respected and part of a team with something to contribute.

Misunderstanding and interpretation of messages (14%) were also highlighted by participants as issues. According to participant 63 “cultural backgrounds can dictate how we as individuals work and communicate in a group setting. Some cultures emphasize discussing facts, while others focussed on facts and provable ideas.” The participant used an example where two people may be discussing the same idea, but may approach it from completely different and seemingly unrecognizable angles. Participant 63 continued to say that in “western cultures people tend to jump directly into the heart of a conversation, while those from eastern cultures focus on the needs of the person before the needs of an organization or project”. He / she said “in a virtual setting the context of a conversation that comes from body language and physical contact may be lost in a conversation”.

Some participants (15%) indicated culture differences had no effect on knowledge sharing. Participant 56 did not notice any impact on communication between team members as a result of differences in cultural background but “...is paying attention to encourage dialog; values technical experience of individuals, and promotes a flat structure with a network leader as a facilitator rather than the representative of a management structure”. Participant 33 was of the opinion that cultural differences enhance the group but felt in some situations, team members from other countries were not as open and honest about concerns, and not as willing to constructively critique solutions. Participant 57 said differences in culture can “...sometimes be an obstacle, taking more time, but generally the output is a more complete product as a result”.

5.3.4 Innovation and Collaborative Tools

Question 8

Error! Reference source not found. shows that 26% of participants indicated that e-mails were the preferred way to communicate with other team members followed by telephone (23%) and teleconference (20%). Other communication technologies are shown in **Error! Reference source not found.**

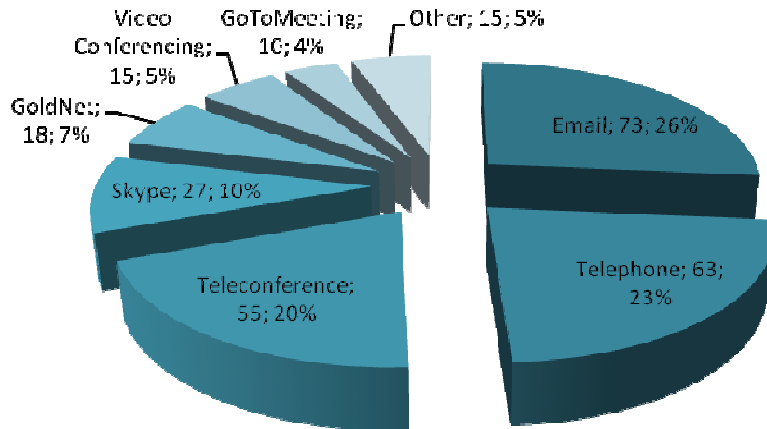


Figure 10: Communication Technologies

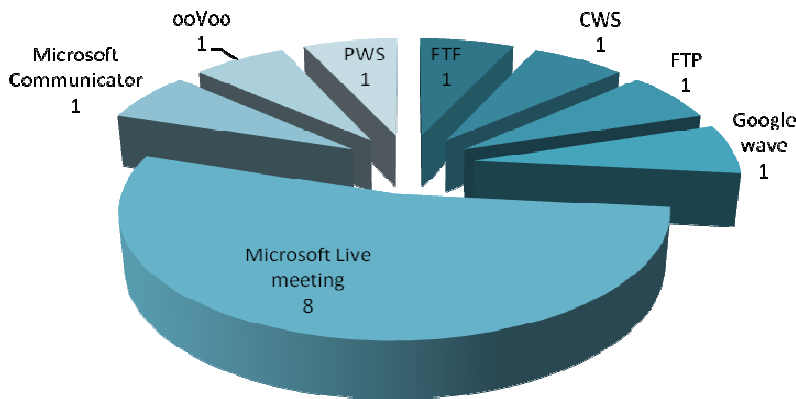


Figure 11: Other Technologies

Question 9

Participants (21%) indicated that e-mails are the preferred way to share information with other virtual team members followed by telephone (17%) and

PWS or CWS (14%). Figure 12 graphically presents the different technologies to share information.

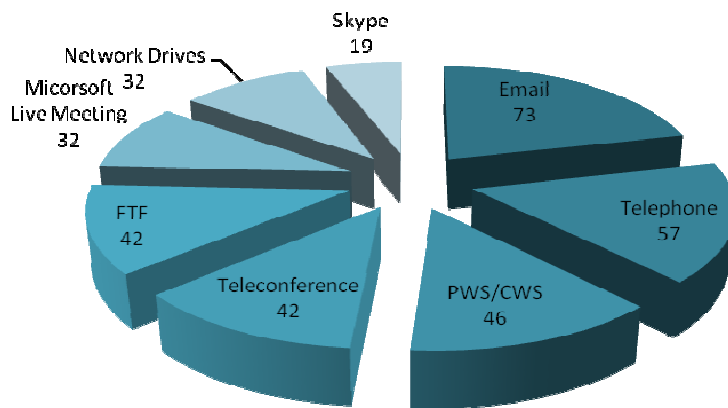


Figure 12: Information Sharing Technologies

Question 10

Participants stressed the significance of good internet connection. In particular improvements to bandwidth and speed of the connection (24%) were raised by participants to improve knowledge sharing. Many participants work remotely and complained about accessibility from home and off-site offices. Participant 2 said the systems should be improved to make PWS and CWS easier to access remotely and accessible from non-company computers. Participant 47 was of the opinion that the CWS system is still difficult to use, slow to respond, and lacks sophistication. The participant went on to say "...much effort is required to encourage non-users to participate at all". Participant 53 stressed "it is impossible for team members to simultaneously work on a document in PWS or discuss elements of a project without the aid of a presentation or planned sharing of information". Participant 4 suggested changes to the architecture of PWS such as using the same file structure and network drives.

Participant 6 and 53 said that bandwidth limits video conferencing capabilities and has some technical issues every time it is used. Participant 54 said "video conference systems can be tricky to set up and do not always work as they should". He suggested PWS / CWS should be utilised and promoted on a much broader basis.

Participants also indicated that systems are fine but internal support to improve the CWS would help. Participant 34 was of the opinion that the problem was not with the system but regular conference calls (or communications) can help facilitating the exchange of information and understanding of information needs between team members. Participant 1 said “the electronic system is fine but the business system needs a major overhaul”.

Participants emphasised the importance of a wide variety of tools. Participant 39 suggested an “intercompany Messenger type service” as an alternative to e-mails. The participant said that the system can allow quick messaging and save the company considerable cost and improve efficiency. Participant 51 was of the opinion that the company should adopt a unique system to share video, PC screens, chat and audio at global level. The participant went on to say he / she “believes this can be achieved by improving LiveMeeting and Messenger tools and introducing correlated procedures”.

A participant’s e-mail response stated “the problem of sharing information is not related to trust but to problems related to the company’s inefficient methods of information sharing”. He went on to say that “phone calls and e-mails work well but CWS / PWS are an extremely cumbersome way of sharing information. In many cases, they hinder communication. Access to network drives is far better because most of us follow a common intuitive filing method, which is not apparent in the CWS’s”.

Participants 17, 25 and 27 had not experienced any problems with the technology they have used.

5.4 Summary

Chapter 5 presents and discusses the results obtained from the survey instrument and how these are linked to the research objectives. The three significant fundamental themes of the study are (a) virtual team interaction, collaboration and trust, (b) organizational learning and knowledge transfer, and (c) innovative and collaborative tools.

The study sought to understand if there were shared views and opinions on each of the themes. Participants were all employees of the engineering service company and provided a uniquely detailed picture of the three themes. The participants identified the importance of: (a) initial FTF interaction, (b) importance of clear and honest communications, (c) sharing of information to achieve overall project objectives, and (d) importance of a wide variety of ICT tools for collaboration. The results, based on each participant's unique experiences, strong beliefs, impressions, and feelings, were both predictable and enlightening. Chapter 6 addresses the findings in detail.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter summarises the findings as described by participants related to the elements of interaction and trust that may affect virtual teams in a multinational engineering service company. This study applied a qualitative and naturalistic approach that was designed to collect data from participants in their everyday environment. Answers to the research questions are summarized and the implication of the results with respect to the problem statement is discussed. Strategic ramifications of the study are presented along with recommendations for future research. The chapter concludes with reflections from the author regarding personal experiences and study limitations.

The study began through a systematic process of conducting a pilot study and interviews to validate the main study. The study was broken into four phases: (a) pilot study and in-depth interviews to validate study questionnaires, (c) data collection, and (d) a data analysis phase. The study results, chapter 5, were based on all participants interviewed and broken into three main themes: a) virtual team interaction, collaboration and trust, (b) organizational learning and knowledge transfer, and (c) innovative and collaborative tools. The underlining objective of the study was to determine to what extent interaction and trust can be promoted in virtual teams and the main drivers for these teams to behave in certain ways.

6.2 Limitations

The study limitations include the time available to conduct the survey, the sincerity or truthfulness of the respondents during interviews and the survey, relative small sample size for the industry, and the validity of the research questions asked. The researcher has worked in the multinational engineering service industry for 18 years and may present some bias for research findings and conclusions. The experience helped the researcher address appropriate questions, develop meaningful categories and themes, and selecting qualified

candidates for the pilot study. All participants that answered yes on the qualifying question were allowed to participate in the survey. The author assumed that all respondents have experience in working in a collaborative virtual team. It was further assumed that the respondents would openly and honestly answer the research questions. The study also assumed the participants had a common understanding of the term virtual and that the majority of the participants would strongly agree they meet this definition. The survey was limited to one organization. Team members were asked to complete the survey via an e-mail invitation containing a link to the survey web page.

Another limitation to this study is its sample which included only a few members from some cultures (that is French, Italian, and British) and many (jointly 57%) from other cultures (Canada and USA). The findings are probably skewed and primarily reflect perceptions held by members of these two cultures. A similar limitation of this study lies in the selection of quotations used to illustrate the various points. Since native English speakers were more articulate in English, most of quotations used in this study are from interviews with native English speakers.

6.3 Conclusions

Interaction, Collaboration and Trust

The participants identified the importance of building trust and the importance of collaboration to achieve the overall team objectives. A great deal of room for helping establish new virtual teams and organization structure in the engineering service industry exist. Virtual teams are different from FTF teams in organizing, because the resources come from many different areas, knowledge is shared across national borders and time zones and have the great advantage of flexibility over FTF teams. Participants stressed the significance of the virtual team having a combined view, and common objectives as a team first develops and gets organized, which may directly relate to the level of trust. Trust is further preserved by open, clear and honest communications and achieving project objectives. Based on the

interviews the virtual domain outcomes are based on increased trust and success in relation to the importance of long-term continuity. If trust is present in the virtual team collaboration takes place and the need for FTF interaction becomes less of an issue. Team members share information freely and enjoy the learning environments, have fewer problems and enjoy an increased sense of long-term continuity. When the trust is low, the opposite is true.

Most of the interviewees questioned how effectively communication tools could create and preserve trust and responded by stressing the importance of FTF interaction in the beginning and during the life of the team. Participants indicated that virtual teams require a higher level of communication and clarity. Several of the communication tools such as e-mails, teleconference, telephone, video conferencing, and collaboration tools such as databases (PWS / CWS and network drives) were discussed in general as being used in the company. The overwhelming response was that these were just communication tools and on their own cannot be used to ensure trust. A participant said the organisation should be cautious to replace trust with electronic tools. In order to create and preserve trust FTF interaction should be integrated into the project. Although some validity to the fact that creating and preserving trust is better through FTF interaction exists, trust building can be accomplished and strengthened virtually. Several participants suggested that trust is preserved by clear and honest communications, through transparency, building relationships by prior “face time”, integrity and achievement of project objectives.

Employees working in the virtual domain are influenced by humanistic needs and their peers (Burns, 2000). This could be the reason most participants stressed the importance of FTF meetings within the virtual domain. Innovative solutions to virtual trust building are needed. The virtual domain is increasing exponentially, and working within the FTF construct becomes more costly and in the case of global dispersed companies, often impossible.

Some participants were able to give examples of how well the company used a variety of communication tools to spur increased dialogue. Other

participants could not understand how trust could be created or preserved in the virtual domain.

Chinowsky and Rojas (2003:98) argue that a global virtual team leader must demonstrate “clear expectations for each member or subgroup”. Virtual team leaders must not only understand the virtual team environment, the cultural differences and impacts, and expertise of each virtual team member but also be able to define project objectives clearly. Participants indicated that trust is created and preserved by strong leadership. Leadership needs to be demonstrated by effective communication and clear team and project objectives. Participants pointed out that all team members should know exactly what the project objectives are and what is expected of them.

The culture of the surveyed company can be described as participatory; which values flat structures, open communication channels and participation and involvement in decision-making. This can enhance sharing of information and facilitate a virtual team. According to one participant the company “...has created a culture by which all team members feel comfortable sharing ideas, concerns and working together to creating solutions”. Another participant said that “once on a *company* team, we are all supposed to be professionals, regardless of culture”. The majority of participants’ national culture backgrounds are Canadian or USA. According to Hofstede’s dimensions, both national cultures rank individualism highly and are thus indicative of a society with a more individualistic attitude and relatively loose bonds with others. Characteristically, success is measured by personal achievement and individuals look out for themselves and their close family members. Privacy is considered the cultural norm and attempts at personal ingratiation may meet with a rebuff. It was observed in this study that cultural variations at the national level were not consistent with that at the individual level. Gudykunst (2004) argues that culture has direct and indirect effects on individual communications. The indirect effects are mediated by individual socialisation processes. The relationship between national cultural dimensions and individual culture orientations were not investigated in this study and further systematic investigation is required.

Cultural background (whether it is based on national or organizational culture) is likely to be closely associated with the success of a virtual team by having an impact on the development of trust. There is very little evidence in the survey data that suggests culture diversity was an issue. Participants questioned the effect of culture diversity on knowledge sharing in a team and felt culture diversity was not an issue. Some participants argued that culture diversity is a valuable asset in ensuring that “all solutions are a best fit for all employees”. However participants pointed out that language difference and communication issues restrict sharing. Pia (2009) reasons that the difference in backgrounds, histories and cultures of virtual team members may give rise to conflict situations resulting from lack of understanding on part of some of the parties.

Organizational Learning and Knowledge Transfer

Knowledge management was stressed by most of the participants as being very important to the success of the company and contributes to the overall profitability. They added that knowledge management is crucial because by capturing just a small portion of the lessons learned or knowledge on projects, the potential savings to clients and the company would be tremendous. According to Rezgui (2007) a knowledge-based organization needs all of its employees to share a culture that promotes the qualities of knowledge acquisition and sharing, requiring a number of essential attributes. Participants pointed out that the company has created a culture by which all team members feel comfortable to share information. However there is also evidence in the data that sharing does not occur freely. One participant pointed out that the reason why this does not happen is that the “current business systems stifle knowledge sharing because they are all done for free, which means that they come at the expense of my family time”. A failure to practice effective knowledge management means that the company is unable to appraise projects and learn from them. As pointed out by Wells (2006) sharing of tacit knowledge is particularly limited in virtual work settings because it operates at the level of the unconscious and is not easily expressed.

At its simplest, a failure to review a finished project means that the past errors are likely to be repeated. Boddie (1987) finds a broad range of reasons for this failure in knowledge management such as organizational, technical, methodological, and cultural issues. Motivation to undertake a proper review is a problem. It is apparent that the organization as a whole can benefit if individual employees can make use of the knowledge and experiences of their colleagues in previous projects. However, these synergies among employees can only be fully established and developed if all employees are willing to take part in the knowledge exchange. Unfortunately, these potential benefits to the organization are not readily apparent to individual employees, who are inclined to ask: "What benefit is there in it for me?" In short, there is insufficient individual motivation to document the lessons learned. It has been shown that human networks can only be effective if the social conditions that underpin collaboration are met (including trust). This emphasizes the role that social capital plays in creating organizational value facilitated by strong human networks. As stated earlier a participatory culture helps develop trust, respect, and understanding. Clearly, a culture of confidence and trust in which people are willing to communicate is perceived to promote knowledge value creation. It can be argued that these problems reflect inadequacies in organizational culture. Knowledge transfer involves communication among people, and although technology can handle the communication of already explicit knowledge, the communication of tacit knowledge (and the creation of new knowledge by the transformation of information into knowledge) requires social interaction and human cognition. Any analysis of knowledge transfer thus requires the culture of the organization to be taken into consideration.

Innovative and Collaborative Tools

There was no difference in the way participants communicate with other members of the organisation or share information with fellow virtual team members. The survey yielded similar results to Clayden's (2007) study that indicated the less-rich media as being preferred by a large margin over the richer media of video conference, web portals and groupware. Participants indicated that CWS / PWS are an extremely cumbersome way of sharing information and argued it may even hinder communication. This may be the

reason why less-rich media is preferred. Nedelko (2008) argues that groupware is crucial for existence, operation and linkage of dispersed team members and highlights potential problems for sharing.

Participants indicated that communications via telephone and electronic chat (video conferencing) did reduce the negative impact of team diversity. Prince (2006) indicates that general collaboration software; synchronous information sharing and information search tools are important technologies for the functioning and sharing of knowledge in virtual teams. She argues that as technologies develop physical presence can be added that can supplement the need for FTF interaction.

Participants indicated that the effect of culture diversity increased the quality of decision-making and performance. Participants also indicated that it increases communication breakdown which decreases team performance and satisfaction. These difficulties are further increased when language differences are involved.

6.4 Recommendations

This study suggests that virtual teams should have a project kick-off meeting that is held FTF. This helps establish social bonds and relationships. Carte and Chidambaram (2004) suggest that this practice should only be followed if the teams are homogeneous. If teams are diverse, especially on surface-level elements, then rich media meetings, such as FTF, should be avoided until a team identity has been established. Teams should communicate using collaborative technologies that have reductive capabilities. In this way, the creation of subgroups that hurt team processes and outcomes is minimized. If the surface-level diversity is low in the team, then the practice of early FTF meeting is likely advantageous.

Enhancing the human aspects in order to foster trust and acceptance of virtual team diversity is extremely important in developing continuous or reoccurring project lifecycles. In the virtual domain, it seems as though virtual team leaders have taken the virtual or human aspect out, when not FTF, and

have made the virtual constructs more mechanical. When the human aspects are taken away from the organizational constructs, even partially, more problems may occur.

There is some evidence in the survey that suggests knowledge is not managed effectively. This may be relating to the lack of team leadership. Although most methodologies recommend particular work packages for securing knowledge and experiences, the fact is that these processes are often not included in the overall project plan. It is not surprising that team members do not perceive effective knowledge management as being significant if the project plan does not explicitly assign sufficient time and resources to this aspect of the project. The management of knowledge can be improved if team leaders understand the social context of the team, and provide the necessary support. The team leader further has to create a team culture that facilitates the development of project goals and group norms with respect to decision making, conflict resolution, and so on. The team leader has to develop plans and strategies to allow effective communication with various subcultures and external cultures.

This study also suggests training in intercultural communications is required and should focus on differences in verbal styles instead of nonverbal differences. When teams are dispersed they are better off using e-mail for intercultural communications. E-mail with synchronous chat or screen sharing might be better for team teleconferences. Collaborative group systems should incorporate multiple media channels. Participants indicated that ICT combination requires that systems enable users to customize and mix channels according to different needs in different situations.

Recommendations for Further Research

Participants in this study were drawn from members from different cultures. Further research should examine how described variations such as culture differences might influence socialization processes and eventually adjustments of individuals. It is likely that identified best practises for member adjustment and performance may well depend upon dominant virtual team characteristic configurations. Variations in task environment are likely to

influence outcomes such as realisation of social contexts capable of supporting knowledge sharing and performance. Further research is required to investigate characteristics of task complexity that may dictate knowledge sharing in engineering service industry's virtual teams.

Diversity of national background and national culture is multi-faceted and is a challenge to assess adequately. Participants in this study were diverse in four aspects – country of birth, nationality and native language, and individualism / collectivism the dimension of Hofstede's measure of national culture. Although these provided reasonable indications of team-level cultural diversity, there are other aspects of Hofstede's dimensions that could be examined. For example, power distance could be important to the way team member interact, if there is diversity of status present in the team. Research determining which aspects of cultural diversity are important to team functioning would also be valuable. If one or two aspects were identified as being critical, companies could use this information to create a diagnostic tool to identify good candidates for working in virtual teams and / or to identify training needs.

6.5 Summary

Chapter 6 is the final chapter of the study. The chapter presents and discusses the conclusions and limitations to the study. Practical and theoretical recommendations are discussed and suggestion for further research proposed. References and Appendices are presented in the next section to conclude the study report.

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APPENDIX A: E-MAIL INVITATION (PILOT STUDY)

Via Email: (Email Address)

Dear (participant' name),

Your assistance is requested in completing the following **pilot survey** upon receipt. This survey is being sent to a limited number of people to assess several aspects of working in virtual teams. This information will be used in strict confidence. Thank you in advance for your prompt feedback before close of business on the **24th of February 2010**.

The advantages in participating in this survey will be an enhanced understanding of the factors that may improve virtual team's performance. If you are a member of a team or have been involved in one for more that 3 months, you can participate in this survey by answering **yes** on the qualifying question. This will allow you access to the nineteen survey questionnaires and will take approximately 10-15 minutes. Your participation in this study is voluntary and you may withdraw from the study at any time.

You can access the survey by the following link –

[2010 Virtual Teams Survey](#)

For any further information regarding this survey please contact me directly.

Background to the study

Globalization of business practices and the resulting requirement for flexibility has increased in the recent decade. The pace of technological innovation and the globalization of the economy have transformed the way companies operate due to the rapid innovation in Information and Communication Technology (ICT). The global nature of many engineering and construction projects means that project teams are increasingly being geographically dispersed working across time zones, numerous organizational boundaries and a variety of cultures, using a combination of telecommunication and information technologies.

The development in ICT has allowed "*Company*" to established virtual teams to resource international projects. A virtual team has been defined as a team with distributed expertise that spans across boundaries of time, geography, nationality and culture. The sharing of knowledge is crucial to the success of "*Company*" and therefore we are conducting a companywide survey to evaluate how knowledge is shared amounts virtual teams.

The objectives of this survey are to:

The objectives of this survey are to:

1. To identify how interaction, collaboration and trust of virtual teams can be promoted and how this can contribute to the overall profitability of the company.
2. To identify how virtual teams contribute to organizational-level learning and knowledge management, what the implication is for competitive advantage and how this can contribute to the overall profitability of the company'.
3. To identify specific needs for unique and innovative tools to locate engineering and technical resources, and the importance of using as many tools as possible.

APPENDIX B: QUESTIONNAIRE (PILOT STUDY)

Question number	Question	Response
Qualifying question		
	Are you a member of a virtual team for more than three months?	Yes/No
Section 1 Basic Information		
1	Where is your office location?	Choose from the list
2	What is your position level in the company?	Choose from the list
3	How many years have you been working in the engineering services industry?	
4	How many years have you worked on a virtual project?	
5	How many members on average are in your teams?	
Section 2 General		
<i>In this question we want to know what you think the different success factors are between a virtual team and face-to-face team.</i>		
6	What are the different project success factors on a virtual team compare to face-to-face teams?	
Section 3 Communications		
<i>In this question we want to know how you communicate with other team members.</i>		
7	How do you communicate with other virtual team members?	
<i>This question asks you to list your preferred media to communication with team members.</i>		
8	What communication media do you use to communicate with other team members?	
Section 4 Knowledge sharing		
<i>Here we need to know how you share knowledge with other team members and with other employees within the company.</i>		
9	How do you share information with other virtual team members?	
<i>We also need to know how the system or systems you have selected in the previous question can be improved.</i>		
10	How can the above system or systems you have selected be change to improve knowledge sharing?	
<i>In this question we want to know how knowledge sharing can contribute to the profitability of the company. You can use practical examples to explain this.</i>		
11	How can knowledge sharing contribute to the overall profitability of the company?	

Section 5 **Culture**

In this question we need to know what your perception is of how culture affects knowledge sharing in your team.

- 12** How does culture diversity influence knowledge sharing in your team?

We also want to know how the difference in culture background affects knowledge sharing in your team.

- 13** How do differences in culture background affect communication?

Section 6 **Trust**

In this question we want to know what role trust plays in your daily communications and sharing of information

- 14** How do you use communication tools to ensure trust in the virtual team setting?

Here we want to know what your perception is of trust and how trust is managed in your team.

- 15** How do you allow for virtual team members to create and preserve trust?

In this question we want to know what you do to allow other in your team to trust you for providing project information.

- 16** How do you allow other team members to trust you for providing project information?

Here we want to know what you do to ensure that trust benefits the team in general.

- 17** What actions do you take that are mutually beneficial to both you and other team members?

Finally we want to know what values are important to trust others and others to trust you in sharing information.

- 18** What values are important to ensure trust in virtual teams?

APPENDIX C: E-MAIL INVITATION (MAIN SURVEY)

Via Email: (Email Address)

Dear colleague,

Your assistance is requested in completing the following survey upon receipt. This survey is being sent to a limited number of people to assess several aspects of working in virtual teams. This information will be used in strict confidence. Thank you in advance for your prompt feedback before close of business on the 5th of March 2010.

The advantages in participating in this survey will be an enhanced understanding of the factors that may improve virtual team's performance. If you are a member of a team or have been involved in one for more than 3 months, you can participate in this survey by answering **yes** on the qualifying question. This will allow you access to the nineteen survey questionnaires and will take approximately 10-15 minutes. Your participation in this study is voluntary and you may withdraw from the study at any time.

You can access the survey by the following link –

[2010 Virtual Teams Survey](#)

For any further information regarding this survey please contact nvanheerden@company.com.au

Background to the study

Globalization of business practices and the resulting requirement for flexibility has increased in the recent decade. The pace of technological innovation and the globalization of the economy have transformed the way companies operate due to the rapid innovation in Information and Communication Technology (ICT). The global nature of many engineering and construction projects means that project teams are increasingly being geographically dispersed working across time zones, numerous organizational boundaries and a variety of cultures, using a combination of telecommunication and information technologies.

The development in ICT has allowed “Company” to establish virtual teams to resource international projects. A virtual team has been defined as a team with distributed expertise that spans across boundaries of time, geography, nationality and culture. The sharing of knowledge is crucial to the success of “Company” and therefore we are conducting a companywide survey to evaluate how knowledge is shared amongst virtual teams.

The objectives of this survey are to:

1. To identify how interaction, collaboration and trust of virtual teams can be promoted and how this can contribute to the overall profitability of the company.
2. To identify how virtual teams contribute to organizational-level learning and knowledge management, what the implication is for competitive advantage and how this can contribute to the overall profitability of the company.
3. To identify specific needs for unique and innovative tools to locate engineering and technical resources, and the importance of using as many tools as possible.

APPENDIX D: QUESTIONNAIRE (MAIN SURVEY)

Question number	Question	Response
Qualifying question		
<i>A virtual team is a group of individuals who work across time, space, and organizational boundaries and communicate electronically.</i>		
	Are you a member of a virtual team for more than three months?	Yes/No
Section 1 Basic Information		
1	What region do you work in?	Africa Asia Australasia Canada South America United States
2	What is your nationality?	
3	What is your position level in the company?	Principle Associate Management Administrative Engineer/ Scientist/ Consultant
4	How many years have you been working in the engineering services industry?	< 5 years 5-10 Years 10-20 years >20 years
5	How many years have you worked on a virtual project?	< 5 years 5-10 Years >10 years
6	How many members on average are in your teams?	1-5 6-10 >10
Section 2 General		
<i>In this question we want to know what you think the different success factors are between a virtual team and FTF team.</i>		
7	What are the different project success factors on a virtual team compare to FTF teams?	
Section 3 Communications		
<i>This question asks you to list your preferred media to communicate with team members.</i>		
8	What communication technology do you use to communicate with other team members?	Email Telephone Teleconference Video conferencing GoToMeeting Skype

		Sharepoint
		Other
Section 4	Knowledge sharing	
	<i>Here we need to know how you share knowledge with other team members.</i>	
9	How do you share information with other virtual team members?	Email Telephone Teleconference FTP PWS Sharepoint Network Drives Live Meeting Skype Other
	<i>We also need to know how the system or systems you have selected in the previous question can be improved.</i>	
10	How can the above system or systems you have selected be changed to improve knowledge sharing?	
	<i>In this question we want to know how knowledge sharing can contribute to the profitability of the company. You can use practical examples to explain this.</i>	
11	How can knowledge sharing contribute to the overall profitability of the company?	
Section 5	Culture	
	<i>In this question we need to know what your perception is of how culture affects knowledge sharing in your team.</i>	
12	How does culture diversity influence knowledge sharing in your team?	
	<i>We also want to know how the difference in culture background affects knowledge sharing in your team.</i>	
13	How do differences in culture background affect communication?	
Section 6	Trust	
	<i>In this question we want to know what role trust plays in your daily communications and sharing of information</i>	
14	How do you use communication tools to ensure trust in the virtual team setting?	
	<i>Here we want to know what your perception is of trust and how trust is managed in your team.</i>	
15	How do you allow for virtual team members to create and preserve trust?	
	<i>In this question we want to know what you do to allow other in your team to trust you for providing project information.</i>	
16	How do you allow other team members to trust you for providing project information?	
	<i>Here we want to know what you do to ensure that trust benefits the team in general.</i>	
17	What actions do you take that are mutually beneficial to both you and	

other team members?

Finally we want to know what values are important to trust others and others to trust you in sharing information.

18 What values are important to ensure trust in virtual teams?

APPENDIX E: QUESTIONNAIRE CODING AND CATEGORIES

Question 7		
Category	Code	Result
Shared skills/knowledge/expertise	7	27%
Flexibility	1	22%
Communications	2	22%
Cost	5	14%
Negative factors	11	12%
Trust	6	9%
Better response	4	8%
Easy & effective access / communications	12	8%
Other	50	8%
FTF better	10	5%
Didn't understand question	99	5%

Question 10		
Category	Code	Result
Improve remote access	1	4%
Training/support	2	7%
Speed/bandwidth	3	24%
Access to more tools	4	14%
System flexibility	5	7%
No change/improvement	6	11%
Communications	7	5%
Reliability	8	3%
User friendly	9	4%
Storage space	10	1%
Other	50	7%
No response	99	26%

Question 11		
Category	Code	Result
Improved efficiency	1	31%
Learning from others/mistakes	2	19%
Effective teams	3	4%
Cost reduction	4	19%
Shared resources globally	5	24%
Reduce duplication	6	3%
Synergy	7	4%
Sharing of intellectual property	8	6%
Other	50	10%
No response/didn't understand question	99	10%

Question 12		
Category	Code	Result
No issue	1	30%
Restricts sharing	2	11%
Language barriers	3	12%
Different perspective	4	11%
Communication issues	5	9%
Adds value	6	5%
Delayed decision making	7	4%
Affects understanding (systems/standards)	8	3%
Not sure	9	3%
Sharing increase understanding/knowledge	10	3%
Other	11	9%
Trust issues	12	1%
Didn't understand question	51	4%

Question 13		
Category	Code	Result
Language	1	18%
No issue	2	15%
Misunderstanding/misinterpretation	3	14%
Didn't understand question	4	8%
No detail provided	5	7%
Communication options	6	3%
Knowledge sharing	7	4%
Depended on individual	8	4%
Open and honest	10	3%
Other	11	12%
No response	99	16%

Question 14		
Category	Code	Result
Can't use communications tools alone	1	8%
Reliable/clear/honest communications	2	18%
Trust no issue	3	5%
Personal contact/follow-up/FTF contact	4	19%
Secure information	5	7%
Regular discussions	7	3%
Sharing	8	3%
Follow-up	9	3%
Share all information/involvement	10	3%
Other	11	19%
Didn't understand question	50	3%
No detail provided	51	3%
No response	99	15%

Question 15		
Category	Code	Result
Clear/open/honest communications	1	27%
FTF discussion	2	14%
Listen/timely feedback	3	11%
Outcome base- achieve objectives	4	15%
Encourage participation	5	5%
Knowing team members ability	6	3%
Flexibility/freedom	7	4%
Trust not an issue	8	1%
Control over information	9	4%
Team leadership	10	3%
Information sharing	11	5%
Other	12	5%
Didn't answer question	50	3%
Unsure	51	1%
No response	99	15%

Question 16		
Category	Code	Result
Outcome base	1	15%
Integrity	2	11%
Follow-up/feedback	3	12%
Regular communication	4	5%
Commitment	5	4%
Set/clarify expectations	6	7%
Relationship building	7	5%
Correctness of information	8	3%
Access all information	9	4%
Provide all information	10	4%
Trust others	11	3%
Other	12	12%
No response	99	1%

Question 17		
Category	Code	Result
Regular communications	1	18%
Share information regularly/promptly	2	8%
Project outcome	3	8%
Available to members	4	4%
Acknowledgement	5	3%
Build relationships	6	4%
Regular updates/feedback	7	5%
Integrity	8	3%
Other	9	28%
No issue	10	1%
Didn't answer question	50	5%
No response	99	28%

Question 18		
Category	Code	Result
Open/effective communications	1	26%
Project outcome	2	11%
Honesty/integrity	3	18%
Time management	4	9%
Respect	5	9%
Competency/technical ability	6	8%
Sharing information	7	4%
Support	8	3%
Promptness	9	7%
Quality	10	3%
Understanding of different boundaries/responsibilities	11	4%
Ownership	12	3%
Other	13	15%
Didn't answer question	50	1%
No issue	51	1%
Not applicable	52	1%
No response	99	11%