

UNIVERSITÉ DU QUÉBEC À RIMOUSKI

ÉQUIPES VIRTUELLES ET COMMUNICATION

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PAR

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RÉSUMÉ

Les équipes virtuelles ont connu une croissance accélérée avec le développement de technologies de l'information. En raison de la composition des équipes virtuelles hétérogènes, les équipes virtuelles sont confrontées à des défis différents de ceux des équipes traditionnelles. Un de ceux-ci est celui posé par les problèmes de communication qui viennent considérablement affecter le processus de communication au sein des équipes virtuelles.

Cette étude cherche à mieux appréhender les problèmes de communication ainsi que leur fréquence d'apparition au sein des équipes virtuelles. Par la suite, l'étude explore la relation entre les problèmes de communication, certaines variables démographiques, les processus de communication et l'efficacité de l'équipe virtuelle.

Pour atteindre les objectifs de l'étude, celle-ci débute par l'identification des problèmes de communication grâce à un examen exhaustif de la littérature. Un questionnaire a été réalisé auprès de professionnels au sein d'équipes virtuelles pour mesurer la force de la relation entre les problèmes de communication, certaines variables démographiques, les processus de communication et l'efficacité de l'équipes virtuelles.

Plusieurs conclusions ont été tirées de cette étude. Premièrement, l'absence de communication non verbale, le transfert de connaissances complexes, les relations instables entre les membres, les différences dans l'éducation, l'expérience et l'expertise, et l'identification réduite avec l'équipe dans son ensemble sont les cinq problèmes de communication les plus fréquents au sein des équipes virtuelles.

Deuxièmement, la taille des entreprises, le type d'entreprise et le nombre de projets auxquels l'entreprise a participé ont un impact dans les occurrences de certains problèmes de communication telles que l'insuffisance de la communication technique, une diminution de la satisfaction au travail, des connaissances contextualisées moins partagées, le manque de signaux non verbaux et une identification de l'équipe plus réduite.

Troisièmement, le coefficient de corrélation de Pearson a été utilisé pour déterminer la direction et l'importance des relations entre les problèmes de communication et les processus de communication (compréhension, satisfaction, précision, efficacité, confiance). Les résultats suggèrent de fortes corrélations négatives entre la plupart des problèmes de communication et les processus de communication des équipes virtuelles mais les relations ne peuvent pas être expliquées par l'équation de régression.

Finalement, par le biais de ce mémoire qui propose une meilleure compréhension des problèmes de communication en relation avec les processus de communication dans les équipes virtuelles, le lecteur averti aura des pistes pour améliorer la communication au sein

des équipes virtuelles et les gestionnaires du projet pourront rendre le processus de communication plus efficace.

Mots clés: équipe virtuelle, gestion de projet, problèmes de communication, processus de communication,

ABSTRACT

Virtual teams have undergone accelerated growth with the development of information technology. Due to virtual teams' heterogeneous composition, virtual teams are facing different and greater challenges than traditional teams. One of the challenges is various communication problems are emerging. The communication problems are deeply affecting the communication process in virtual teams.

This study attempts to investigate the frequency of occurrence of communication problem in virtual teams. In addition, the study explores the relationship between the communication problems, team demographic variables and the communication process.

To achieve the purposes of the study, the study started by identifying the communication problems through a comprehensive literature review. A survey questionnaire to investigate virtual team professionals was conducted to quantitatively measure communication problems and the relationship between team demographic variables and the communication process.

Several conclusions were drawn from this study. First, lack of non-verbal cues, complicated knowledge transfer, unstable relationships between members, differences in educational background, experience and expertise, reduced identification with the team as a whole are the most five frequent communication problems in virtual teams.

Second, company size, company type and number of projects the company participated was significantly different in the occurrences of some communication problems such as communication technical failure, decreased job satisfaction, less shared contextual knowledge, and lack of non-verbal cues and reduced team identification. Third, the Pearson correlation was used to determine the direction and significance of the relationships between communication problems and communication process. The results suggest strong negative correlations between most communication problems and virtual team communication process, but the relationships can't be explained by regression equation.

By understanding the communication problems and the relationship with the communication process in virtual teams, supporting programs for communication improvement can be established, both individual virtual team members and managers of the project can manage the communication process more effectively.

Keywords: virtual team, project management, communication problems, communication process.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF PROJECT MANAGEMENT

Project management as an idea has been around a long time, this idea was used can be traced back to some major ancient infrastructure such as the pyramids of Egypt. However, as a management science, his history is less than half a century.

Project management was first used by the US military as a management discipline during the Second World War. The typical case is the U.S. military developed the atomic bomb by Manhattan Project. In 1958, the "Program Evaluation and Review Technique" (PERT) was developed by Booz Allen Hamilton as part of the United States Navy's Polaris missile submarine program (Boozallen, 2010). At the same time, DuPont invented a similar model called the Critical Path Method (CPM). And PERT was extended by the work breakdown structure (WBS) later. After that these structures of process and mathematical techniques quickly spread into many private enterprises.

After 1980s, project management developed as science into modern project management, with the increasing global competition, expanding of project activities , more complex and dramatic increase of the number of projects, the expanding of the scale of project team, the growing conflict between project stakeholders, the pressure of rising cost of project and a series of situation. The project owner and a number of government departments and enterprises were forced to invest a great deal of manpower and material to analyze and study the basic principle.

1990s later, the emergence of information systems engineering, network engineering, software engineering, large-scale construction projects and high-tech projects promoted the development of new project management theories and methods. In this period, modern project management gained rapid development and great progress. At the same time, project management is rapidly spreading to all areas of social productions and industries.

1.2 VIRTUAL TEAM

As the development of high technology and gradually increasing global marketplace, the modern management system is slowly changing, there has been a marked increase in the numbers of companies that regard themselves as the project oriented. In the late of the 20th century, the revolution of information technology has turned human society into the Internet age, and greatly changed the way of world running, these project-oriented companies and their associated projects are no longer limited by physical boundaries.

With the globalization of markets, the growing of firm size and the expanding of operations scope, organization members spread across many time zones around the world. A salary survey of project management professionals showed that 21% of the respondents worked on a project involving multiple states or provinces, and 15% worked on projects involving multiple continents (PMI, 2000). Resources like customers, suppliers and employees will no longer be limited in a single location. Customers demand products and services support that are adaptive, flexible, and integrated. In the right labor market, as the cause of the nature of work has changed from mostly physical labor to knowledge work, allowing people to work away from factories employees demand more choice and flexibility. Work/life balances are increasingly important to people. Skilled workers now live everywhere instead of in clumps surrounding corporations.

Another growing reality in modern organizations is that of employees belonging to multiple teams simultaneously which based on project, function, task forces and so on. More employees are holding multiple, simultaneous team memberships rather than the

traditional employees were just core members of one fixed team like a department. The rigid, hierarchical organizations of the past; the cautious, process-oriented approach they took to get things done have given way (Lojeski & Reilly, 2007)

While teamwork is common in nearly all project-oriented organizations, the concept of virtual teaming is a relatively new development in new business environment. The emergence of virtual teams may can response to the increasing demands of globalization and the economic realities of a dynamically changing workforce.

In 1998, Mayer noted that the virtual organization or the virtual corporation is the model for corporations in the future. It is highly like that in the coming decades, most project management professionals will work on virtual structure organizations for at least some part of their duties. Only a few years later, this vision has become an accepted as a viable opinion.

Compared to the traditional project team, virtual teams can select the resources based on the people who are the best suited for a project. It enables the project managers select the most suited members with appropriate skills. Managers have access to a large portfolio of resources available, albeit individual resources are in different locations (Rad & Levin, 2003). These provide a cost effective and efficient organizational entity that would facilitate the achievement of better results.

However, as companies seek to leverage the potential benefits of virtual teams, they must also face the numerous complexities inherent to this new type of work group (Kayworth & Leidner, 2000). These complexities include differences in culture, law, time, language, trust, and the use of technology. Adding to team-level complexity, individuals may be members of multiple teams with members in a variety of different physical locations (Chudoba et al., 2005; Watson-Manheim & Belanger, 2007). Virtual teams require their own procedures and guidelines, although some of the procedures and guidelines can

be adapted from the existing guidelines that have been prepared for traditional teams. Different new approaches and technologies are in the evolutionary process to be used for managing virtual teams.

The next chapter will review the past research that focuses on virtual teams and communication problems in virtual teams.

CHAPTER 2

LITERATURE REVIEW

This chapter presents a systematic review of research related to the communication and communication processes of virtual teams from academic and corporate contexts. This study addresses the virtual team and virtual team communication processes as represented by the resources of academic and scholarly publications such as textbooks, journal publications, and conference proceedings designed as educational references and instructional materials.

2.1 DEFINITION OF VIRTUAL TEAM

Cohen & Baily (1997) defined team as the form of a collection of individuals who are independent in their tasks, who share responsibility for outcomes, who see themselves and are seen by others as an intact social entity embedded in one or more larger social systems, and who manage their relationship across organizational boundaries. The *American Heritage Dictionary* defines “virtual” as “existing or resulting in essence or effect though not in actual fact, form, or name.”

With the emergence of virtual teams, the definition of a team no longer applies to the virtual team. Through a literature search, the prototype of the virtual team can be traced back to 1994. O’Hara-Devereaux and Johansen suggested that geographically dispersed, culturally diverse, and functionally mixed teams would become the building blocks of successful global businesses. They argued that these types of teams would need different tools/approaches. Grenier & Metes (1995) defined virtual teams as teams whose members are not co-located and might come from different organizations. They are usually project focused and may share very little except a common purpose. In the same year, Kristof et al.

(1995) defined virtual team as a self-managed knowledge work team, with distributed expertise, which forms and disbands to address specific organization goals. A virtual team is characterized by fluid human resources in terms of membership, leadership and boundaries (functional, organizational, and geographical).

The concept of virtual teams becomes an accepted reality for many organizations with the development of modern communication technology, more and more researcher began to focus on virtual teams. Lipnack and Stamps (1997) introduced a widely quoted definition of virtual teams: “A virtual team is a group of people who work interdependently with a shared purpose across space, time, and organization boundaries using technology”. In 1998, Townsend et al. proposed an influential definition of virtual teams as follows: “groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task” (p. 18). The same year, Nemiro (1998) defined virtual teams as groups of geographically dispersed organizational members who communicate and carry out their activities through technology.

As we entered the 21st century, the development of information technology makes virtual teams emerged all over the world. Research on virtual team became increasingly popular and started a new chapter. In order to have a comprehensive understanding of the definition of virtual teams, we summarize the virtual team definitions used in literature before from 2000:

Table 1: Virtual Team Definitions from Reviewed Studies

Definitions	Source
“a group of geographically and temporally dispersed individuals who are assembled via technology to accomplish an organizational task” (p. 1251)	Montoya-Weiss, Massey, & Song, 2001
“a collection if task-driven members behaving as a temporary group, whose members are separated by geographic or temporal space.”	Delisle et al. (2001)

“geographically and temporally dispersed and electronically communicating work group” (p. 575)	Schmidt, Montoya Weiss, & Massey, 2001
“if all of the members perform the majority of their work from different locations” (p. 525)	Lurey & Raisinghani, 2001
“members have distinct complementary areas of expertise and are geographically and often temporally distributed ... via ... technology ... can interact” (p. 424)	Potter & Balthazard, 2002
“groups of individuals collaborating in the execution of a specific project while geographically and often temporally distributed, possibly anywhere within (and beyond) their parent organization.”	Leenders et al. 2003
“groups of employees with unique skills, situated in distant locations, whose members must collaborate using technology across space and time to accomplish important organizational tasks” (p. 175)	Kirkman et al., 2004
“groups of geographically, organizationally and/or time dispersed workers brought together by information technologies to accomplish one or more organization tasks.”	Powell et al., 2004
“a group of people who interact through interdependent tasks guided by a common purpose . . . works across space, time, and organizational boundaries with links strengthened by webs of communication technologies” (p.478-479)	Hertel, Konradt, & Voss. 2006
“individuals collaborating in geographically dispersed work teams who may reside in different time zones and countries” (p. 472)	Horwitz, Bravington, & Silvis, 2006
“geographically dispersed and communicate via computer-mediated tools” (p. 783)	Kanawattanachai & Yoo, 2007
“members collaborate through technology mediated interaction . . . cooperate on global projects while resident in their home geographies and cultures” (p. 355)	Workman, 2007
“a group of people with complementary competencies executing simultaneous, collaborative work processes through electronic media without regard to geographic location” (p. 830)	Liu, Magjuka, & Lee, 2008
“consist of members in different locations working together interdependently and using various form of advanced information technology to communicate and coordinate their efforts” (p. 479)	Peters & Karren, 2009

Gibson and Cohen (2003) introduced a more formal definition of virtual teams:

“It is a functioning team—a collection of individuals who are interdependent in their tasks, share responsibility for outcomes, see themselves and are viewed by others as an intact social unit embedded in one or more social systems, and collectively manage their relationships across organizational boundaries. The members of the team are geographically dispersed. The team relies on technology-mediated communications rather than face-to-face interaction to accomplish their tasks.” (p. 4).

From the literature we can find that though there are many different definitions of virtual teams and no standardized definition, most of them include two important concepts: geographic dispersion and technology which mean teams were separated by space and time using technology to accomplish their work. Some other dimensions were less frequently included in the definitions such as time zones, cultural distance, organizational boundaries, and cross-functional skills. In this study, a virtual team is defined as a team whose members is not co-located and collaborates with others by information communication technology.

2.2 TYPE OF VIRTUAL TEAM

Depending on the nature of the work, a team comes together to do and the types of organization they work for/with. Duarte and Snyder (2006) in their book observe that virtual teams have many different configurations and that they can be categorized in to seven basic types of teams: Networked teams; Parallel teams; Project or product-development teams; Work or production teams; Service teams; Management teams; Action teams.

1) Networked Teams

Consist of individuals who collaborate to achieve a common goal or purpose, membership is frequently diffuse and fluid. Team members from different organizations come in and out of the network as their expertise is needed to make recommendations.

Team members always rotate on and off the team as their expertise is needed examples of the networked team are often found in consulting firms and high tech organizations. (Duarte & Snyder, 2006)

2) Parallel Teams

Parallel virtual teams carry out special assignments, tasks, or functions that the regular organization does not want or is not equipped to perform. The members of a parallel team typically work together on a short-term basis to make recommendations for improvements in organizational processes or to address specific business issues. They are different from networked teams because they have a distinct membership that identifies it from the rest of the organization. It is clear who is on the team and who is not. (Duarte & Snyder, 2006)

3) Project or Product-Development Teams

In this kind of virtual team, members conduct projects for users or customers for a defined but typically extended period of time. Tasks are usually non-routine, and the results are specific and measurable. Different from parallel teams, project virtual teams usually exist for a longer period of time and have the decision making authority, not just recommendations. And they are different from networked virtual teams because the team membership is more clearly delineated and a final product is clearly defined. (Duarte & Snyder, 2006)

4) Work or Production Teams

Virtual work teams and production teams perform regular and ongoing work usually in one function and have clearly defined membership. Such teams usually exist in one function, such as accounting, finance, training, or research and development. (Duarte & Snyder, 2006)

5) Service Teams

These teams support customers or the internal organization in typically a service/technical support role around the clock. An example of a virtual service team is a customer support center that has operations in strategic locations across the globe to take advantage of a “follow the sun” strategy. Each team works during its members’ daylight hours and transitions work and problems to the next designated time zone at the end of the day. (Duarte & Snyder, 2006)

6) Management Teams

These management teams are dispersed across a country or around the world and work collaboratively on a daily basis within a functional division of a corporation. (Duarte & Snyder, 2006)

7) Action Teams

These action teams offer immediate responses activated in typical emergency situations. They can cross distance and organizational boundaries. They are different from all of the other types of teams in that they are usually formed only to meet a specific and urgent need. (Duarte & Snyder, 2006)

2.3 CHARACTERISTICS OF VIRTUAL TEAM

Lipnack and Stamps (1997) described a virtual team as a group of people who interact through interdependent tasks guided by common purpose that work across space, time and organizational boundaries with links strengthened by webs of communication technologies. But there is not a definitive characterization of virtual teams. In the early research, the virtual team is characterized by members who are physically dispersed, and are both culturally and organizationally differentiated. Boudreau et al. (1998) define three characteristics of the virtual organization: Dependence on a federation of alliances and partnerships with other organizations; relative spatial and temporal independence; flexibility.

With the popularity of virtual teams in the world, more and more scholars began to focus research on virtual teams. In order to define the characteristics common to virtual teams, it is important to understand what distinguishes virtual teams from traditional teams. Kimball (1997) pointed out some of these different characteristics.

Table 2: Different characteristics of virtual team

TRADITIONAL TEAM	VIRTUAL TEAM
Fixed team membership	Shifting team membership
All team members drawn from within the organization	Team members can include people from outside the organization
Team members are dedicated 100% to the team	Most people are members of multiple teams
Team members are co-located organizationally and geographically	Team members are distributed organizationally and geographically
Teams have a fixed starting and ending point	Teams form and reform continuously
Teams are managed by a single manager	Teams have multiple reporting relationships with different parts of the organization at different times

Drawing from the existing conceptualizations of the virtual team, we argue that the virtual team manifests the following characteristics: 1) *Team members geographic dispersed*; 2) *Diversity of members*; 3) *Communication technology is used*; 4) *Structural dynamism*.

2.4.1 Geographic dispersion

Distance and proximity between people have been topics of research for decades (Kiesler & Cummings, 2002). Majchrzak et al. (2000) represents a detailed description of the extent and configuration of virtual team's geographic dispersion:

“Two members were located in different ends of the same building, three other members were each one mile away in different buildings; one member of a second

organization was located 100 miles away; and two members of the third organization were located 1,000 miles away in different buildings. Team members limited their travel since they were involved with many different teams within their company. As a result, all members were together only once – at the end – although there were three other formal meetings held in which some members attended ...”

Geographic dispersion involves much more than simple physical distance, which includes both distance and configuration. The distance includes spatial, temporal and social components. A configuration is the arrangement of team independent of distance factors which include isolation, the number of sites and balance (See figure 1).

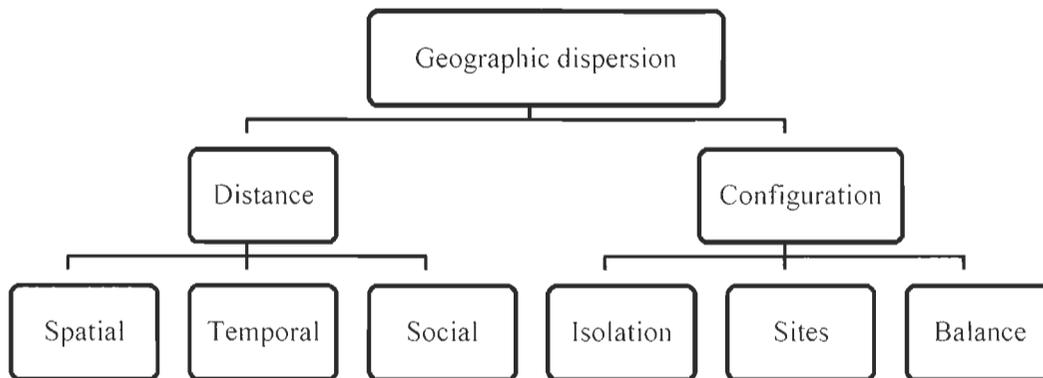


Figure 1 : Geographic dispersion

As noted by King & Frost (2002), “distance is not of one type, but can be seen in several forms”, though the notion of distance refers to the physical distance between peoples.

The spatial component of distance is measured in feet, yards or meters. Small distance in the virtual team can be traversed by foot; large distance can be traversed directly with transportation technologies or indirectly with communication technologies.

The temporal component of distance is often experienced in terms of the time. The temporal distance is how evenly the members were spread among the Greenwich Mean Time zones (Knoll, 2000). She measured temporal dispersion in two terms: 1) the mean of the “absolute” hourly difference between pairs of team members and 2) the standard deviation of these differences. The virtual teams often span many time zones, to overcome this distance, virtual teams must use a more flexible approach to manage and organize the work of the team.

We often focus on the immutable physical distances: spatial and the temporal distance, also distance in the virtual team can be viewed in the terms of demographic diversity called social distance. Virtual team is made up by individual members, many factors invisible include the relationship history (the extent to which team members have worked together before or know some of the same people socially), cultural distance (the extent to which team members share cultural values, similarities in communication style, and attitudes toward work.), interdependence distance (the extent to which team members feel interdependent on one another for their own success) affect the virtual distance in the virtual team (Lojeski, 2006).

If we combine the three forms of distance we can get a new concept of distance in the virtual team called the virtual distance. It is defined as the perceived distance between two or more people, groups, teams, organizations, or networked enterprises, brought on by pervasive electronic communication and resulting changes in behavioral norms, regardless of whether people are separated by millimeters, miles, or continental masses (Lojeski, 2006).

The configuration of a virtual team can be understood as the arrangement of team members independent of the spatial and temporal distances among them. It can also refer to the arrangement of team members with particular roles or demographic characteristics. Armstrong & Cole (2002) discuss two important aspects of configuration: 1) the differences

between being at a small or remote site vs. being at a large or headquarters site and 2) the location of a team's leader in relation to other team members. These issues can lead to conflict or to members being left out of team communications. Grinter et al. (1999) made a vivid metaphor for dealing with the impact of team configuration: Team members of sites may be like "satellites" to the core of a team, with those satellites having few opportunities for "corridor conversations" and more "out of sight, out of mind" problems.

2.4.2 Diversity of members

Virtual teams are increasingly dependent on diverse members for developing innovative products, making important decisions, and improving team efficiency. A review of the existing literature depicts diversity is an umbrella term for the extent to which members of a team are dissimilar with respect to individual-level characteristics (Jackson, 1992).

Researchers in existing literature have examined various forms or types of diversity existing in virtual teams. The basic type of diversity in the virtual team is demographic diversity. It refers to the degree to which a unit is heterogeneous with respect to demographic attributes. It can be classified as age, sex, or race, on reactions toward team level functioning and team performance (Milliken & Martins, 1996). In examining gender diversity, Lind (1999) found that compared to men, women in virtual teams perceived their teams as more inclusive and supportive and were more satisfied. And a number of virtual team studies have examined the role of cultural differences among team members (Powell et al. 2004). Brett et al. (2006) believe that cultural diversity is responsible for the following categories of challenges: direct versus indirect communication, trouble with accents and fluency, and conflicting norms for decision making.

Although the majority of team diversity researches have focused on demographic characteristics, some unobservable intro-group differences also affect the team. These differences which include disparities in personality, idiosyncratic attitudes, values, and

preferences termed are referred to as deep level diversity. Deep level diversity has strong effects on the functioning of virtual teams, though the effects of demographic diversity can be reduced. Carte and Chidambaram (2004) proposed a theoretical model for understanding deep level diversity and how capabilities of technology can be harnessed to leverage the positive aspects of diversity while limiting its negative aspects.

A third form of diversity is functional diversity which is the extent of differences in the team members' functional backgrounds. The different functional backgrounds imply team members' non overlapping knowledge and expertise which would affect decisions and actions of the members. These differences may result in team members' feelings of superiority or inferiority and lead to various serious problems.

Existing literatures point out that virtual teams offer significant opportunities to overcome demographic diversity as most of the communication and interaction take place through electronic mediums. But because of the complexity of virtual team diversity, both deep level diversity and functional diversity have significant impact on their effective performance and outcome.

2.4.3 Communication technology used

Virtual teams can be possible only because of the advances in computer and telecommunication technology. These new communication technologies define all the operational environment of the virtual teams, bring obvious opportunities for virtual teams such as increased information flow and exchange, the elimination of space and time boundaries, and the enhancement of group collaboration.

Although all of the new communication technologies are somewhat independent, Townsend et al. (1998) consider them belonging to one of three broad categories of technology: Desktop videoconferencing systems; collaborative software systems; and Internet/Intranet systems.

Desktop videoconferencing systems are the core system around which the rest of virtual team technologies are built. These systems can recreate the face to face interactions of conventional teams and make more complex levels of communication possible among team members. They can also recreate a work environment where team members have more options available to help them collaborate and share data than would be possible working around a conference table.

Collaborative software systems are the second component of the virtual team communication technology. These systems can be differed in three categories. The simplest collaborative software application involves sharing traditional software products through the desktop videoconferencing systems. The second category system is designed to empower a real time group decision such as group support systems (GSS) which provide the users with a tool to poll participants, assemble statistical information. The third category systems provide specific support for the collaborative accomplishment when team members conducted a task independently and then passed along to the rest of the team at appropriate stages of the team's project. Although most of these systems were designed to facilitate teamwork in traditional work environments, they provide an equally powerful foundation for the collaborative empowerment of virtual teams (Anthony et al., 1998).

If we say the desktop videoconferencing systems are the core system of the virtual team communication, the Internet and Intranets can be likened as the blood vessels. They allow virtual teams to communicate in the form of text, visual, audio in a user-friendly format, and all collaborative software systems can be linked. The Internet and Intranets create a communication channel and a collaborative environment for the whole virtual teams.

Taken together, the desktop videoconferencing systems, collaborative software systems, the Internet and Intranets form an infrastructure of virtual teams, and they make the using communication technologies become a characteristics of virtual teams. Although these new technical systems provide an incredibly rich communication context for virtual

team members, how to work and communicate with these new technologies becomes a challenge to virtual teams.

2.4.4 Complex task and dynamic structure

The structure of an organization becomes increasingly important when it grows, a large organization can't be managed properly unless it has a strong and stable internal structure. But in the current fast-paced, technology-driven business environment, changes occur frequently among organizations' participants, their roles, and their relationships to each other (Brown & Eisenhardt, 1995).

All these greatest changes bring out the task complexity to the virtual team which led to the work flow processes become diverse. Team members depend on each other for resource or material to accomplish their tasks, the extent of interdependence will influence the team structure. Thompson (1967) defined three types of interdependence that influence organization structure. The least interdependent arrangement is termed pooled, in this form, work and activities are performed separately by all team members and then combined into a finished product. Sequential interdependence is of serial form which means team activities flow from one member to another. Sometime work and activities flow back-and-forth among team members, one-by-one, over time, this kind of interdependence is the third one called reciprocal interdependence. Van de Ven et al. (1976) described a new form of arrangement named intensive interdependence in which team members must diagnose, solve problems, and/or collaborate simultaneously. Both the reciprocal and intensive interdependence need high communication.

Bell & Kozlowski (2002) figured out as tasks become more complex they grow increasingly more dynamic and involve more tightly coupled external linkages. More complex the tasks were, more collaboration and information sharing among team members were required.

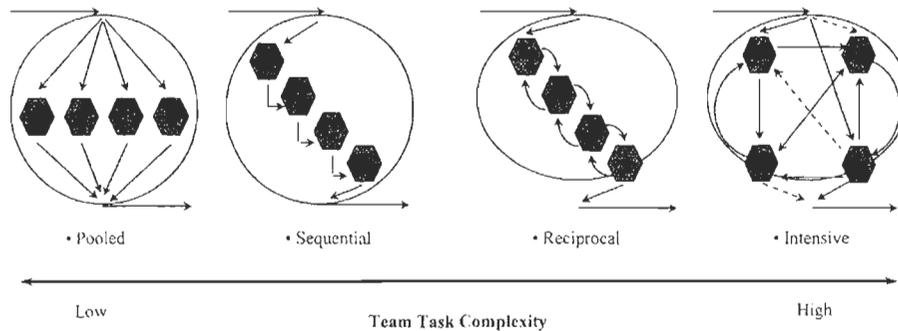


Figure 2 : Team Task Complexity
Bell & Kozlowski (2002)

Unstable and unpredictable environments create changing and complex contingencies that poorly match the specialized skills of individual team members (Moon et al., 2004). The virtual team needs an ability to transform quickly according to the changing tasks requirements and responsibilities and its structure must be adaptively engineered to be fitted the needs and aligned with project goals. In such circumstances, the structure of virtual teams become dynamic, they often cooperate with their partners through informal, temporary, relatively unstructured arrangements, such as outsourcing or consortia, or using slightly more formal but dynamic partnerships such as licensing, networks, or project-limited structural arrangements, especially on knowledge-intensive tasks (Carson et al., 2003).

The dynamic structure makes the team members with a short history together which tend to lack of information sharing, limit amount and variety of information that can be communicated, it nearly impossible to develop strong relationships, preserve organizational memory among team members. A dynamic structure also reduces the strength of social ties among the members which is a function of the amount of interaction, emotional intensity, and reciprocity between any two individuals (Granovetter, 1973).

2.4 EFFECTIVENESS OF VIRTUAL TEAMS

Most teams exist and persist because the purpose of a team cannot be accomplished by individuals, and certain needs of individual members can be satisfied by belonging to the team. The success of a team requires the members within it to work together to attain commonly held objectives. But this does not ensure that a team will operate effectively. Hexmoor and Beavers (2002) defined efficiency as a measure of the resources used by the team in its attempt to achieve the team goal where resources can be time, effort, etc. Team efficacy is not simply the sum of the efficacy beliefs of individual members (Bandura, 2000; Chan, 1998). So far, there is no a uniform standard in the measurement of the effectiveness of a team. Different scholars established different standards. Many studies of team effectiveness use a model of Input-Process-Output as the basic framework. This framework of I-P-O was first proposed by McGrath (1964) and it has had a powerful influence on recent research.

Ancona et al. (1999) suggests that there are four components of team efficiency: 1) performance - how well team members produce output in terms such as quality, quantity, timelines, efficiency and innovation; 2) member satisfaction - how well do team members create appositive experience through commitment, trust and meeting individual needs; 3)team leading - how well do team members acquire new skills, perspectives and behaviors as needs by changing circumstances; 4) outside satisfaction - how well do team members meet the needs of outside constituencies such as customers and suppliers. Campion (1993) measured the team effectiveness by examine the criteria of team productivity, employee satisfaction and the manager judgment.

Today's projects are operated by various organizations and teams, they involve creative and innovative products and services, effective collective action involves complex paths of interwoven and reciprocal social influence, members in a team must coordinate

their effects, share their ideas, and discuss their insights, they are likely to be influenced by the beliefs, motivation, and performance of their coworkers.

Virtual teams are considered as the most effective tools to operate the global projects. If every member in the virtual team is totally engaged and fully productive, then the team will be successful. However, considering the specific attributes of a virtual team, more different factors influence the effectiveness of the virtual team. Because of the characteristics of virtual teams, team members are easy to work as isolated individuals and not to perform as a team in such a virtual environment.

Three words capture the essence of virtual and traditional teamwork: People, purpose, and links (Lipnack and Stamps, 1997), these three elements constitute a simple model formed by input, process and output.

Table 3: Model formed by input, process and output

	<i>Inputs</i>	<i>Processes</i>	<i>Outputs</i>
<i>Purpose</i>	<i>Goals</i>	<i>Tasks</i>	<i>Results</i>
<i>People</i>	<i>Members</i>	<i>Leadership</i>	<i>Levels</i>
<i>Links</i>	<i>Media</i>	<i>Interactions</i>	<i>Relationships</i>

Staples (2005) studied the effectiveness of a virtual team by using a self-managed team effectiveness model. In this study, case studies in three different industries were conducted and thirty-nine members in virtual teams were interviewed. The relationship between input factors and team performance was examined and they found interpersonal skills, team size, team turnover, team potency, team spirit, and innovations have a positive effect on virtual team effectiveness.

Kankanhalli et al. (2007) examined the antecedents of virtual team conflict and the circumstances under which conflict affects team performance. This study observed that cultural diversity is likely to contribute to task and relationship conflict, while functional diversity may result in task conflict and large volume of electronic communication and lack of immediacy of feedback in asynchronous media can contribute to task conflict in the virtual team. These conflicts have effect on team performance.

Shachaf (2008) study focused on the effects of cultural diversity and information communication technology on virtual team effectiveness. Shachaf (2008) suggested that cultural diversity had a positive influence on decision-making and a negative influence on communication by interviews with 41 team members from nine countries employed by a Fortune 500 corporation were analyzed. Information communication technology mitigated the negative impact on intercultural communication and supported the positive impact on decision-making.

Lin et al. (2008) identified the key factors from the literature that impact on virtual team effectiveness. They developed a research design that included a meta-analysis of the literature, a field experiment and survey. First they use a meta-analysis to identify the factors which impact on the effectiveness of virtual teams and develop a preliminary framework for evaluating the effectiveness of virtual teams, then studied the preliminary framework. After that, they use a survey to validate the preliminary framework. The study indicated that social dimensional factors need to be considered early on in the virtual team creation process and are critical to the effectiveness of the team. They found that communication is a tool that directly influences the social dimensions of the team and in addition communication processes of teams were closely associated with team effectiveness.

The researches reviewed above on communication and effective teams concluded that communication is one of the most important team factors affecting team effectiveness.

2.5 COMMUNICATION IN THE VIRTUAL TEAM

2.5.1 Introduction

The word “communication” is historically related to the word “common” which means to share and in common. When we communicate, we share our knowledge, make our things common and increase our common sense. Communication may take place everywhere, and occur between and within individuals, groups, organizations, nations and countries of the world.

For decades, man has known the importance of communication. The importance is reflected in daily life, military, scientific and other aspects. In the modern business, every organization, no matter where they are situated and what scale they operate, realize and value the importance of good communication. Communication is the life blood of a team or an organization. It’s the key to connect all the part of team and organization. No organization can succeed or progress, build up reputation, and win friends and customers without effective communication.

We always casually use the word “communication” with some frequency in our daily life, but communication is a tricky concept though it is immensely rooted in human behaviors and society. There is no single working definition of communication agreed upon by scholars. Dance (1970) differed various definitions from the basic dimensions.

Table 4: Definition of virtual team

Dimension	Definition
Symbols/Verbal/Speech	“Communication is the verbal interchange of thought or idea” (Hoben, 1954).
Understanding	“Communication is the process by which we understand others and in turn endeavor to be understood by them. It is dynamic, constantly changing and shifting in response to the total situation” (Anderson, 1959).
Interaction/	“Interaction, even on the biological level, is a kind of

Relationship/Social Process	communication; otherwise common acts could not occur” (Mead, 1963).
Reduction of Uncertainty	“Communication arises out of the need to reduce uncertainty, to act effectively, to defend or strengthen the ego” (Barnlund, 1964).
Process	“Communication: the transmission of information, idea, emotion, skills, etc., by the use of symbols-words, pictures, figures, graphs, etc. It is the act or process of transmission that is usually called communication” (Berelson and Steiner, 1964).
Transfer/Transmission/Interchange	“The connecting thread appears to be the idea of something’s being transferred from one thing, or person, to another. We use the word ‘communication’ sometimes to refer to what is so transferred, sometimes to the means by which it is transferred, sometimes to the whole process. In many cases, what is transferred in this way continues to be shared; if I convey information to another person, it does not leave my own possession through coming into his. Accordingly, the word ‘communication’ acquires also the sense of participation. It is in this sense, for example, that religious worshipers are said to communicate” (Ayer, 1955).
Linking/Binding	“Communication is the process that links discontinuous parts of the living world to one another” (Ruesch, 1957).
Commonality	“It (communication) is a process that makes common to two or several what was the monopoly of one or some” (Gode, 1959).
Channel/Carrier/Means/Route	“The means of sending military messages, orders, etc., as by telephone, telegraph, radio, couriers” (American College Dictionary).
Replicating Memories	“Communication is the process of conducting the attention of another person for the purpose of replicating memories” (Cartier and Harwood, 1953).
Discriminative Response/Behavior Modifying Response	“Communication is the discriminatory response of an organism to a stimulus” (Stevens, 1950).
Stimuli	“Every communication act is viewed as a transmission of information, consisting of a discriminative stimulus, from a source to a recipient” (Newcomb, 1966).
Intentional	“In the main, communication has as its central interest those behavioral situations in which a source transmits a message to a receiver(s) with conscious intent to affect the latter’s behaviors” (Miller, 1966).

Time/Situation	“The communication process is one of transition from one structured situation-as-a-whole to another, in preferred design” (Sondel, 1956).
Power	“Communication is the mechanism by which power is exerted” (Schacter, 1951).

Rosengren (2000) noted a broad definition of communication as

- interaction (i.e., mutual influence) which is both
- inter subjective (i.e., mutually conscious) and
- intentional, purposive, and which is carried out by means of
- a system of signs, mostly building on a system of verbal symbols, characterized by
- double articulation, and in its turn building on fully developed systems of
- Phonology, syntax, semantics and pragmatics.

By using the most specific sense of word, communication is inter-subjective, purposive interactions by means of doubly articulated human language based on symbols.

Therefor we can define communication in the virtual teams as a process consists of transmitting information from one person to another or one organization to another. And this process has a characteristic of social interaction which means there are at least of two interactive agents share the common signs and a common rules.

2.5.2 Communication Model

The business team and organization use a variety of communication methods to send information such as written communication in the form of emails, letters, reports, memos and various other documents; oral communication like face to face meeting; non-verbal communication by using gestures or simply body movements.

Once the methods have been understood, the sender should consider various communication models to achieve the purpose. The models help the organizations and other institutions to understand how communication works, how messages are transmitted, how it is received by the other party, and how the message is eventually interpreted and understood.

One of the earliest models of communication that introduced was the Shannon-Weaver Mathematical Model. Their basic model of communication presents is the early simple linear process model which is a one way model to communicate with others. It consists of the sender encoding a message and channeling it to the receiver in the presence of noise. The sender the message and the receiver are the key components of communication theories and models.

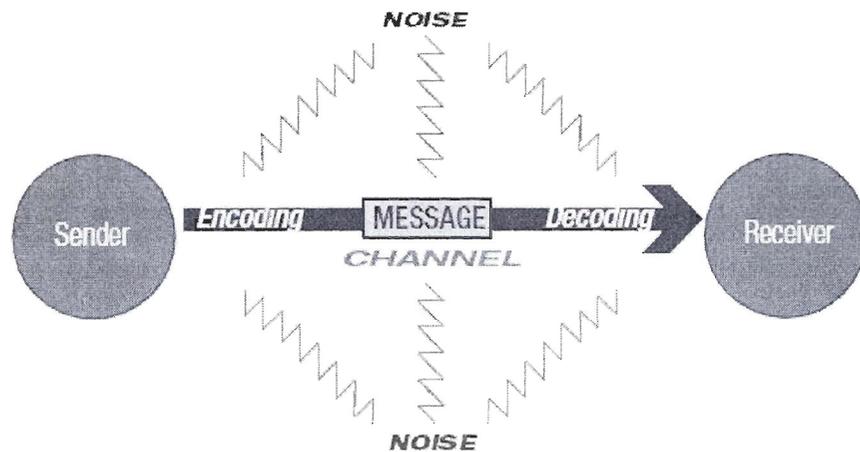


Figure 3 : Linear Model of Communication

According to Shannon (1949), any communication system can be divided into single components, and any of them can be treated as different mathematical models. This model enables them to measure the capacity of any given one channel to carry information.

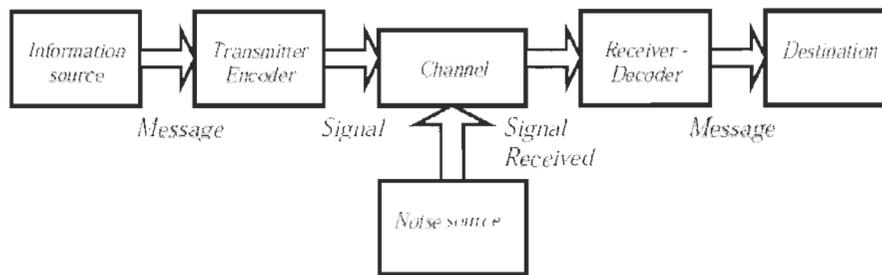


Figure 4 : Shannon-Weaver Mathematical Model

Berlo (1960) took a different approach to constructing a linear process model. This model identified controlling factors which include communication skills of the participants; awareness of the participants' level; social system; cultural system; attitudes of all the participants. These factors can influence all the four identified elements of communication: Source, message, channel, and receiver.

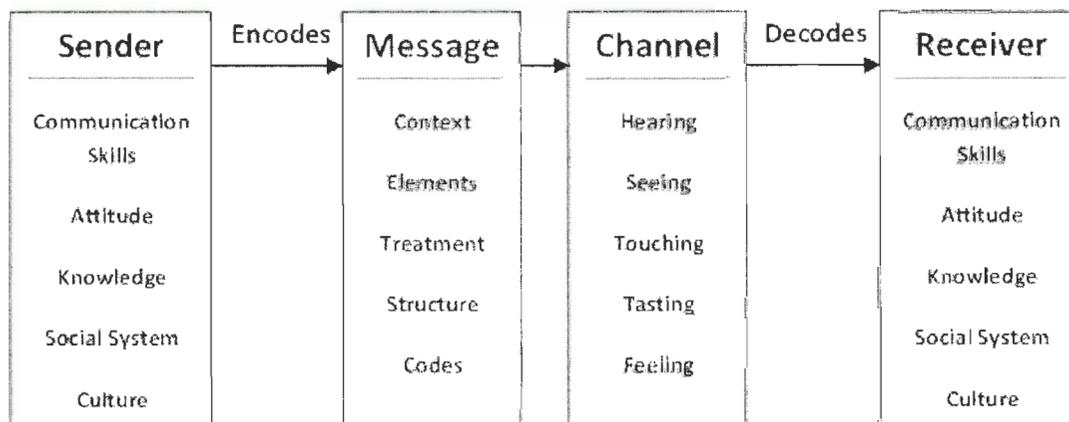


Figure 5 : Berlo's Model of Communication

Although the linear models explain the most basic communication process, there are limitations. In the linear models, the communication flows from a sender to a receiver in only one direction, a person in this process is only a sender or a receiver. The sender doesn't even know if the messages ever reached the receiver based on this model because it is

essentially linear. Communication scholars realized that in the process of communication, not only the senders send message to the receivers, but also listeners respond to senders, they adds the concept of feedback to the linear models, feedback is a response from the receivers to the senders about the message. The addition of the concept of feedback formed a new series of communication models called interactional models.

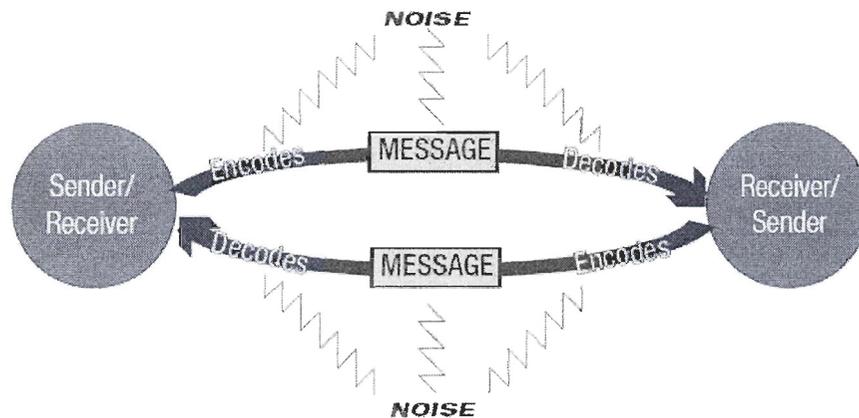


Figure 6 : Interactional Model of Communication

Wilbur Schramm is one of the early theorists to demonstrate the intercommunication interactional model. In Schramm's model of communication, both the sender and the receiver take turns playing the role of the encoder and the decoder when it comes to communication. The sender sends a message, and the receiver sends back a feedback as the second message. In this model, the communication is a circular process. Schramm also suggests that for communication take place between the sender and the receiver, they must have something in common. Schramm (1961) noted if the source's and destination's fields of experience overlap, communication can take place. On the contrary, the communication becomes nearly impossible if the sender and receiver have no overlap or only a small area in common. An obvious example is that two people from completely different cultures with different languages and no common experiences may find that communication between them is nearly impossible.

Although an interactive model was an improvement over the linear one, it still didn't capture the dynamism of human communication (Wood, 2010). A new model more accurately reflects a real-world model of interpersonal communication appeared.

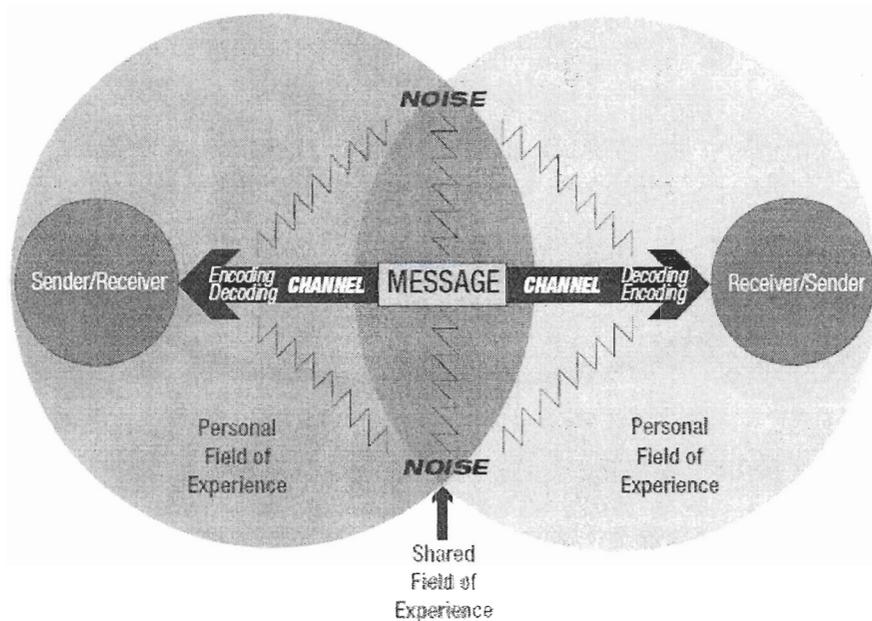


Figure 7 : Transactional Model of Communication

This model is transactional model of communication, Anderson and Ross summarize the model as follows: "Encoding and decoding are not alternating sub processes of communication, however, but are mutually dependent, each contributing to the meaning the communicators are building together (Anderson & Ross, 1994). In this model, communication is a process of cooperation between the sender and receiver. Communicators are participating simultaneously in the communication situation, communication is no longer just a simple circular process, and both the sender and receiver are making an adjustment to the message exchanged within the transaction rather than isolating a sender or a receiver. And individuals communicate with each other based on their field of experience, the field includes things like personal culture, gender, social influences and past impacting experiences.

The transactional model also views all behavior as having the potential of being meaningful to others, whether intended or not. We don't necessarily communicate what we attempt to communicate and we may communicate even when we were not attempting to do so. Once a transaction is underway we cannot avoid communicating (Ledingham & Bruning, 2000).

2.5.3 Communication model in virtual team

Having as a basis the transactional model of communication and taking into consideration the particularities of communication within virtual teams, we have made a model of a communication within virtual teams.

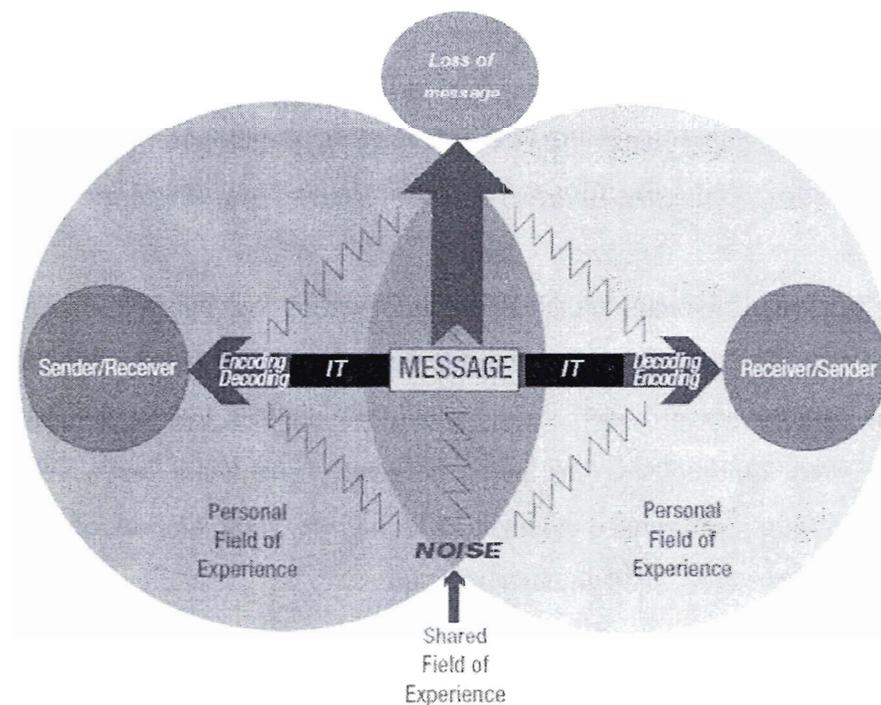


Figure 8 : Communication model in virtual team

Unlike the communication channel in the simple model, variety informational technology became the main communication channel within a virtual team in this model, the channels increase continuously and become more intertwined including a variety of synchronous and asynchronous channels. These channels are used by virtual team to cope in the current dynamic environment of diverse business pressures that are caused by ever changing technologies and the globalization of business (Pauleen & Yoong, 2001). There is a formula for determining the number of communication channels on a virtual team.

Communication channels = $[N * (N-1)] / 2$, where N is number of team members. In case there are 5 team members. Then number of communication channels are $[5 * (5-1)] / 2 = 10$.

The communication noises in this model are the factors which influence, impede or break the continuous communications loop. For example, for a software development project, designers of the virtual team involved in the project may receive some information from their functional departments that does not have any relation to the current project. The noises block, distort, or alter the information transferred among virtual members.

In the process of message transmission, information loss has become a very common situation between team members. Most information technologies will reduce the level of detail in the information provided, they typically result in a loss of information. In this model, we cannot ignore these lost parts, because virtual team has a great amount of information and more intertwined channels, after add up, small amount of information loss has an enormous impact on such an unstable team.

As started earlier, the communication models show clearly that communication is not simply a transfer of meaning at all. Earlier in this chapter we broadly define communication as a process consists of transmitting information from one person to another or one organization to another. Based on the three kind of communication models presented, we can more accurately define communication as a mutual process of sorting, selecting, and

sending symbols by communicators in such a way as to help them find in their own mind a meaning similar to that intended by the others and therefore involves dynamic, mutual influence between the participants.

2.5.4 Communication process in virtual team

Understanding is the base of in the process of communication. The basic purpose of communication is to transfer understanding (Kreitner, 1980). Communication requires the sender to package the idea in an understandable manner (Kreitner, 1980). Various communication technologies were used in virtual teams and different members from different places with different experiences work together. Trakroo and Mathiyazhagan (1997) figured that the use of various communication media affect the understandability of language and meaning in communication. Joiner et al. (2002) examined the relationships between the extent of use of technical language and understandability of communication, the results indicate that the overuse of technical language reduces the understandability of communication. Understandability becomes an important aspect in virtual team communication process.

Timeliness is one of the important indicators associating with effective team performance for a variety of different types of teams (Liu, 2007). Macmillan dictionary defines timeliness as “when something happens at the most suitable time”. Each member in the virtual team should access and get the information needed in the communication process on time. PMI (2000) stated one of the aims of project communication management is the timeliness of information received.

Communication accuracy is defined as the degree of correspondence between the referents decoded, or inferred, from a set of communication behaviors by an addressee and the referent encoded, or represented, in those communication behaviors by the communicators (Mehrabian & Reed, 1968). In the same year, Alkire et al. (1968) noted that accuracy of communication should be a joint function of the information contained in the

sender's messages and that resulting from the clarifications by the receiver. In the chapter above, we have mentioned that the communication noises block, distort, or alter the information transferred among virtual members. Communication accuracy may be influenced by this noise.

Virtual team members may have reasons to withhold or distort information in the communication process, such as when group members wish to conceal their lack of knowledge, have hidden agendas, possess information they do not wish to share with others, and have other vested interests that result in introducing false, faulty, or misleading information (Burgoon et al., 2003). Everybody knows the about trust, but under such circumstances the trustworthiness of team members and truthfulness of their communication are no longer valid. Giffin (1967) defined trust as reliance upon the communication behavior of another person in order to achieve a desired but uncertain object in a risky situation derived. Burgoon et al. (2003) indicated that communication modalities differentially affect the extent to which group members develop trust in communication process.

Satisfaction is an internal response to the environment or perceived environment (Hecht, 1978a). In another research by Hecht (1978b), communication satisfaction was typically referred to "the affective response to the fulfillment of expectation-type standards" in message exchange processes and "symbolizes an enjoyable, fulfilling experience". Bailey and Pearson (1983) say satisfaction is the 'sum' of an individual's negative and positive 'feelings' to a set of variables. Olaniran (1996) found that the ease of use of communication medium; participation; and decision confidence were explored as determinants of member satisfaction in process of the computer-mediated communication. Communication satisfaction can be considered as an important factor in virtual team communication process.

2.6 COMMUNICATION PROBLEMS CAUSED BY VIRTUAL TEAM CHARACTERISTICS

Before the days of videoconferencing, instant messaging, and email, teams generally needed to be in the same physical location in order to work effectively. With the emergence of virtual teams, members work regularly with colleagues based in different buildings, cities, countries, and even continents. They may rarely see others in the same team or perhaps they have never even met each other.

In a virtual team, members are worked in different external contexts which we define as a way of life and work in a specific geographical area with its own set of business conditions, cultural assumptions, and unique history (Gluesing et al., 2003). Gluesing et al. (2003) also documented that a single context provides team members with a common and largely unspoken framework for how to communicate with managers, the expected work hours, the processes for obtaining resources, and even for what constitutes good work and rewards for that work. Communication problems emerge constantly when members work in virtual teams although team managers have practiced various methods to avoid them.

Table 5 will list some common communication problems caused by virtual team characteristics.

Table 5: Communication problems

	Geographic dispersion	Diversity of members	Communication technologies were used	Complex tasks and dynamic structure
Few opportunities for monitoring team members	×			×
Complicated knowledge transfer	×	×		×
Lack of non-verbal cues	×		×	

Information delay and lost	×		×	×
Communication technical failure			×	
Different language	×	×		
Role conflict and ambiguity		×		×
Role overload		×		×
Negative work attitudes	×	×		×
Decreased job satisfaction		×	×	×
Less shared contextual knowledge	×	×		×
Poor interpretation of feedback	×			×
Lack of effective working patterns and information sharing	×		×	×
Poor relationships between members	×	×	×	×
Shorter windows of communication time	×		×	×
Decreased team involvement	×	×		×
Trouble with accents and fluency	×	×		
Differing attitudes towards hierarchy and authority		×		×
Ethnocentrism		×		
Differences in educational background, experience and expertise	×	×		×
Poor message clarity	×	×	×	×
Delayed feedback	×		×	×
Reduced identification with the team as a whole	×			×
Conflict between team members		×		×

Geography dispersion makes the daily operation of the virtual team cannot do without support of information technology such as email, video conferencing, net meeting and etc. Virtual team members use a variety of technologies to communicate to ensure that they can receive all the information necessary to complete the assigned task. According to Switzer (2004), virtual teams have four different options in which to work collaboratively: same time/same place, same time/different place, different time/same place, and different time/different place. The team members can be in the same geographic locale at the same time, or they can be in different locations at the same time or they are separated by both time and distance. Gibson and Gibbs (2006) state that in highly geographically dispersed teams, it is more difficult to coordinate members, given that there are shorter windows of time for synchronous meetings, and many meetings take place outside of standard working time. Even an Internet-based synchronous meeting can be difficult to organize due to time zone differences.

Although modern communication technology enables the virtual teams work more flexibly, it can be a disadvantage as well. Computer-mediated communication reduces nonverbal cues about interpersonal affections such as tone, warmth, and attentiveness, which contribute to message clarity and communication richness (Tidwell & Walther, 2002). Virtual team members will feel isolated, lonely, and disconnected from the team. They may fear their accomplishments will not be recognized by the team. In such an environment, the virtual team cannot be a productive and cohesive working unit.

Modern communication technologies enable the transmission of information between virtual team members more rapid. But the information totally or partially lost will inevitably occur. This will lead to delays in the communication process. Delays in receiving the information lead to misunderstandings between team members which resulting in conflict, responsibility shirking, low efficiency of the team. The consequences of losing totally or partially the message are more serious. The team will be difficult to identify the 'missing link' among the series of information between the members, and thus, the team

will not be able to realize its task or objective in time. Virtual teams also need a backup plan if one of the primary technologies becomes inoperable. Some methods for urgent communication in the case of technical failure should be established by the virtual team at the very beginning of the process (Switzer, 2004). Information technology has limits and may not be able to transfer the same rich social, emotional, and non-verbal information present in traditional face-to-face settings (Kayworth & Leidner, 2000)

Diversity in teams poses both opportunities and threats and empirical findings are mixed regarding the impact of diversity on team outcomes and performance (Kirkman et al., 2004). Diversity has either a positive or negative effect on both member turnover within and from the team and on teams performance and member satisfaction. Cox and Blake (1991) argued that diversity in teams has a positive impact on performance because of unique cognitive resources that members bring to the team. The diversity can promote the team's capability of creativity, innovation, and problem solving. Meanwhile, team diversity can cause some negative effects. The most important aspect of virtual team diversity may be the cultural differences. Gibson and Gibbs (2006) define culture as characteristic ways of thinking, feeling, and behaving, shared among members of an identifiable group. Cultural diversity consists of both national and linguistic diversity. Cultural differences can be barriers to effective communication among all members of the team. It can easily create major misunderstandings within a virtual team.

In virtual teams, not everyone may speak the same language, resulting in misunderstandings such as less accuracy in communication, slower speech, and translation problems that can be damaging to the organization (Bidgoli, 2004). Members who aren't fluent in the team's dominant language may prevent the team from using their expertise and create frustration or perceptions of incompetence. Virtual team members often come from many different organizations. Different members have their own way of working, or differing attitudes towards hierarchy and authority. Some team members use direct, explicit communication while others are indirect, for example, asking questions instead of pointing

out problems with a project. When members see such differences as violations of their culture's communication norms, relationships can suffer. (Brett et al., 2006)

People from functional areas such as marketing and human resources frequently operate with a different set of processes than those from more technical areas, such as engineering and information systems. Effective communication within virtual teams which have functional diversity was always difficult.

On the other hand, gender and age differences make communication instability between the team members and potentially result in conflicts.

Barna (1985) suggested that there are six reasons why intercultural communication fails to create mutual understanding: false assumptions of similarity, language, nonverbal misunderstanding, the presence of misconceptions and stereotypes, the tendency to evaluate, and the high anxiety that exists. In addition, the social problems such as ethnocentrism and prejudice impede communication between members of the virtual team.

Virtual teams today usually have a dynamic structure, the participants, team roles, team member relations change frequently. A highly dynamic structure of virtual team increases uncertainty and perceived risk. The task assigned to the members is distinct but closely related. Members require nontrivial communication and coordination to complete these separate but related tasks. Social ties between virtual team members have already been unstable due to the teamdynamic structure. This uncertainty relationship between members results in hesitancy to share information, as the members do not fully trust each other. Members need a wider spectrum of abilities like analytical skills, adaptability to new environments, management skills, the ability to communicate and other social skills to communicate with coworkers (Egger & Grossmann, 2005).

All of the problems stated above make team members cannot collaborate and communicate effectively. The communication process in virtual teams becomes more and more unstable.

2.7 PROPOSED STRATEGIES FOR VIRTUAL TEAM COMMUNICATION PROBLEMS

Since communication is more delicate in the virtual team than its traditional counterpart, many managerial guidelines were proposed by the scholars. Schlenkrich and Upfold (2009) provided a broad solution to the communication problems by review the previous literature:

- *Create a psychologically safe communication climate*
- *Embrace diversity*
- *Seek team members' input*
- *Facilitate the coordination of technology and work processes*
- *Train the team members for new team strategies and working method*
- *Reshape organizational culture to support new team structure*
- *Modify organizational structures to reflect new team dynamics*
- *Design new management control system*
- *Use technologies to increase team interaction and coordination*
- *Allow members to gather feedback and evaluate their own performance*
- *Observe conflict between members*
- *Create team profiles*

Although it is agreed by the authors that the board guidelines are still useful when attempting to overcome the communication problems affecting virtual teams as they reduce friction between members, different virtual teams have their own characteristics, managers of virtual teams need more specific strategies detailed to solve their own daily communication problems.

Some strategies detailed have been proposed in previous researches intend to overcome the problems caused by virtual characteristics.

Virtual teams may counteract communication problems caused by geographic dispersion by: **A)** planning and managing tasks, conducting virtual meetings and

collaborating with each other (Joinson, 2002). Planning and managing tasks can arrange team members' working time and quality, the meeting is an opportunity to discuss product, component architecture and set a common understanding with everyone. Conducted a kickoff meeting to build relationships and outline team goals and responsibilities. During the meeting, the team leader clarified team member roles and established how the team would work together. Once things were underway, the leader used virtual meetings and regularly updated postings on the team's intranet site to inform team members about any updates and changes over time (Lepsinger & DeRosa, 2010). **B)** Following international standards. It is necessary for virtual teams to use some international standards like CMM, ISO, and PMI etc. (Anjum et al., 2006). It is better that the standards should be applied completely but they can be customized according to the needs. This will help in streamlining the teams' processes and will directly effect on the working of virtual teams. **C)** Establish a common database for placement of all projects related information (Anjum et al., 2006). Virtual teams need to share information in a variety of forms, including documents, designs, picture of objects and source code. In addition to the basic ability to transmit digital files to each other, distributed group members require a common place accessible by all where digital representations of group artifacts can be stored and retrieved.

Diversity in virtual teams is one of the most difficult problems for managers to overcome. In order to manage the communication process, team manager need to **D)** adapt by acknowledging cultural gaps openly and working around them (Brett et al., 2006), this means to keep an open door policy. The leader should inform the members that he is available to chat about diversity and workplace issues and allow them to express their own concerns when they need. **E)** Create a "team handbook," which provided background on each team member and clearly laid out how each person was to contribute to the team. When questions arose during large, complex projects, team members would consult the handbook to determine which team member to consult with (Lepsinger & DeRosa, 2010).

Dealing with the problems caused by communication technologies, the managers need: **F)** Establish clear communication procedures, buy and support reliable

communication and collaboration tools for all team members and they have to know how to use the right mix of technologies and how and when team members will use the available technologies for the specific team (Lepsinger & DeRosa, 2010). **G)** Establish procedures for project critical information sharing and help increase engagement and social interaction. Proper communication management plans must be in place. Take proper care of information sharing and information distribution. Project Management Information System must be established and create shared spaces using social networking based tools such as Facebook, instant messaging to help team members get to know one another and strengthen interpersonal relationships. These tools allow team members to learn about one another despite the lack of face-to-face contact (Lepsinger & DeRosa, 2010). **H)** Conduct reviews on propagated project critical information and arrange discussion sessions (Anjum et al., 2006). Conduct reviews on all the information shared in form of documents, mails etc. so that it can be verified that project critical information is properly propagated to avoid loss of knowledge. Also arrange sessions for written and verbal problems and confusions. These sessions will also provide the clear picture of completed tasks to all the teams.

The problems caused by structural dynamism within the team may be controlled by: **I)** Establishing a communication structure properly. Each professional was asked to report his work-related, oral communication on a number of selected days (Tushman, 1979). **J)** Conducting timely formal and informal meetings among virtual team members. To remove project related ambiguity, project meetings are very important. Formal and informal meetings make virtual team members to develop understanding about the team related tasks, clarify their team related issues and decrease communication gap. **K)** Sharing virtual team integrated plan and clearly identify project deliverables among virtual teams. The people working on the tasks must know about the fact that these tasks are going to be integrated. Also all the integration points, relations among individual work packages, interfaces, dependencies must be clear to everyone concerned during the individual tasks and in the integration activity. Only by fully sharing their unique information and making it common

information could the team actually solve the problem and perform well on the task (Warkentin & Beranek, 1999).

CHAPTER 3

RESEARCH PROBLEM

3.1 PROBLEM STATEMENT

Virtual teams have undergone accelerated growth during the past decade, primarily thanks to the development of information communication technologies for project communication. Despite the growing prevalence of virtual teams, little is known about the management within these teams.

Due to virtual teams' heterogeneous composition, these teams are facing greater challenges than traditional collocated teams. Most of virtual team studies have focused on comparison of virtual and face-to-face teams in terms of leadership, team interactions, social issues, and knowledge management with possible advantages and limitations of both team forms.

At the core of virtual team process is communication. Communication is inherently an act that is socially and culturally situated since individuals are embedded within social systems that influence their behaviors (Zack, 1993). The communication process barriers between the team members lead to a negative effect on team performance, innovation and satisfaction (Lojeski et al., 2006; 2007; Lin et al., 2008). A wealth of research in the practitioner press discussed the importance of communication focusing on the need to create a team of excellent communication, on the selection of the right information communication technology for virtual teams.

While there have been numerous researches addressing the hindrance which virtual teams might encounter as the result of poor communication process, little has been researched on the relation between communication problems and communication process in virtual teams. Therefore, a study that focuses on these relations in virtual teams is needed.

3.2 PURPOSE OF THE STUDY

The purpose of this qualitative study was to better understand the characteristics of virtual team such as geographic dispersion, diversity of members, communication technology used, complex task and dynamic structure, then empirically investigate the frequency of occurrence of communication problems in virtual teams. In addition, the study will explore the relationship between the communication problems and the communication process in virtual teams. This study is designed to discover how virtual team members perceive the influence of various communication problems caused by virtual team characteristics on communication process.

The study would like to discover the information that will help organizations which are implementing virtual teams improve communication process, and enlighten managers on the management of virtual teams.

3.3 RESEARCH QUESTION

This study will seek to answer the following questions.

- What communication problems occur more frequently in the communication process in virtual teams?

- Whether the frequency of occurrence of the communication problems is the same in different virtual teams?

- What are the relationships between the communication problems and the communication process in virtual teams?

CHAPTER 4

METHODOLOGY

4.1 RESEARCH DESIGN

This research utilizes a qualitative method. Qualitative research is a methodology by studying a phenomenon through questioning, description, and theme analysis (Moustakas, 1994). A qualitative method allows the researcher for a deep understanding of how the communication problems affect communication process in virtual teams. The research includes five major phases: preparation, model design, survey design, data collection and data analysis.

In the phase of preparation, it involved the development of research questions, definition of context, and review of literature. The preparation phase has been presented in the chapter above. The purpose of this phase is to confirm the research question and the research context through an extensive literature review, then explore an initial research model.

Once the initial research model was built, a survey design begins. The survey was designed according to the research context, research question, and the review of literature. The survey was sent to participants after it was developed and the data begin to be collected.

In the last phase of research, the data collected were analyzed by Statistical Package for the Social Sciences (SPSS), the findings will be interpreted, and all the implications for practice will be discussed.

4.2 RESEARCH FRAMEWORK DESIGN

A conceptual research framework will be developed in this chapter based on the Input- Process-Output (IPO) model prevalent in the team literature. An IPO model based on McGrath's (1964) perspective is the dominant way of thinking about team performance. The IPO model is also a dominant way of thinking about virtual team performance.

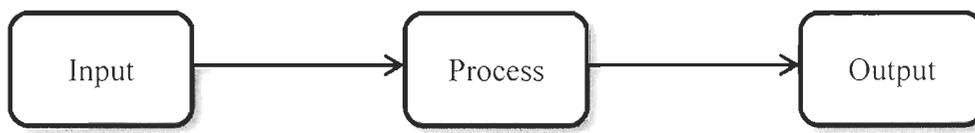


Figure 9 : Input- Process-Output (IPO) Model

In the IPO model, inputs refer to things that team members bring to the group, as well as the context in which the team operates. According to McGrath (1964), input factors can be at the level of the individual, the group or the environment. Individual factors are for example skills of the individual group members, as well as attitudes (e.g. preference towards teamwork) and personality characteristics (e.g. extraversion, conscientiousness) (McGrath, 1964). Group size, group structure, and the level of “cohesiveness” (McGrath, 1964) or tenure (Cohen & Bailey, 2007) are considered as group level input factors.

Process refers to “members’ interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing task work to achieve collective goals (Marks et al., 2001). The activities of the work group are behaviors that are relevant to reach the groups’ goal, like effort, or strategies used by the group

(Brodbeck, 1996). Other examples for interaction processes are time spent together, communication, encouragement among group members (McGrath, 1964), conflicts, strategy discussion, boundary management (Gladstein, 1984).

Outputs occur at different levels: the individual, group, unit, or organization (Cohen & Bailey, 2007). It refers to the effectiveness, and includes things such as performance, the satisfaction and attitudes of group members, and their behavioral outcomes.

In order to narrow the scope of this study and focus on the research questions, this research will concentrate on virtual team characteristics as the central tenet of team input. In the framework, the inputs refer to four characteristics of virtual team: geographic dispersion; diversity of members; communication technology used; complex task and dynamic structure.

At the process level, we will examine the communication process among team members.

At the outcome level, this study is more interested in virtual team effectiveness. Figure 10 can be seeing as our initial model of research.

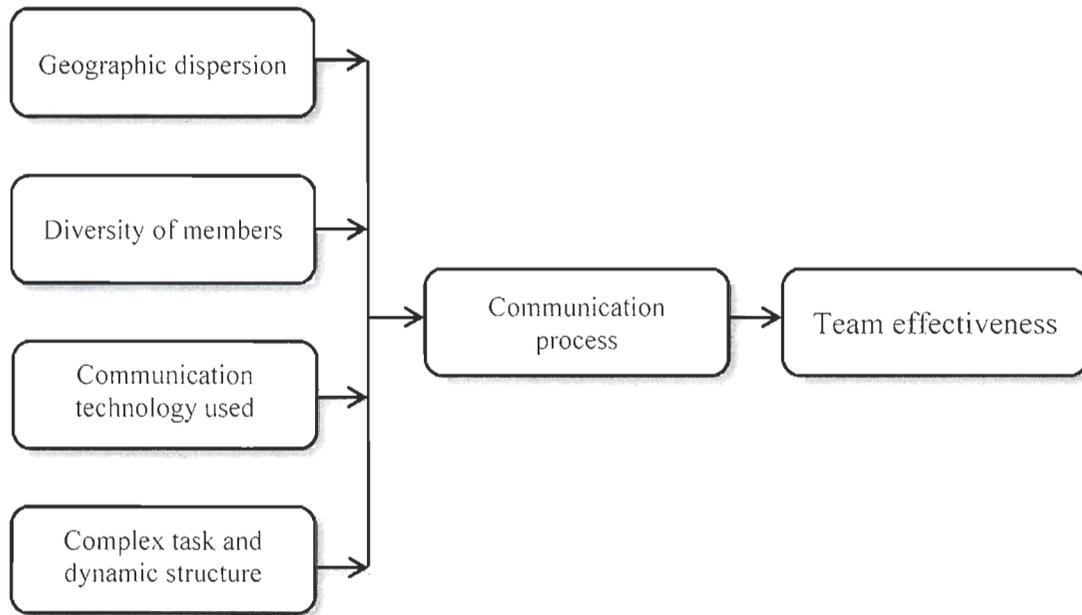


Figure 10 : Initial framework of research

However, this initial IPO models might be less useful to generate knowledge which helps to manage virtual teams. To enable a deeper understanding and also an improvement of virtual teams, it is necessary to focus on pieces of this model. This work focuses on input factors and problems that can be shown to play an important role within the communication process of virtual team. It helps to explore the relationship between team communication problems caused by characteristics and communication process.

Existing researches on virtual teams have identified many communication problems caused by virtual team characteristics (Barna, 1985; Tidwell & Walther, 2002; Bidgoli, 2004; Brett et al., 2006; Lepsinger & DeRosa, 2010), the framework in the current study refers to these problems as the input factors. In the level of process of the model, this research assesses the communication process by utilizing criteria which have been identified by previous researches (Mehrabian & Reed, 1968; Hecht, 1978; Burgoon et al., 2003; Macmillan et al., 2004). The five criteria are communication efficiency;

communication understanding; communication accuracy; communication trust; communication satisfaction. Figure 11 depicts the research framework for this study.

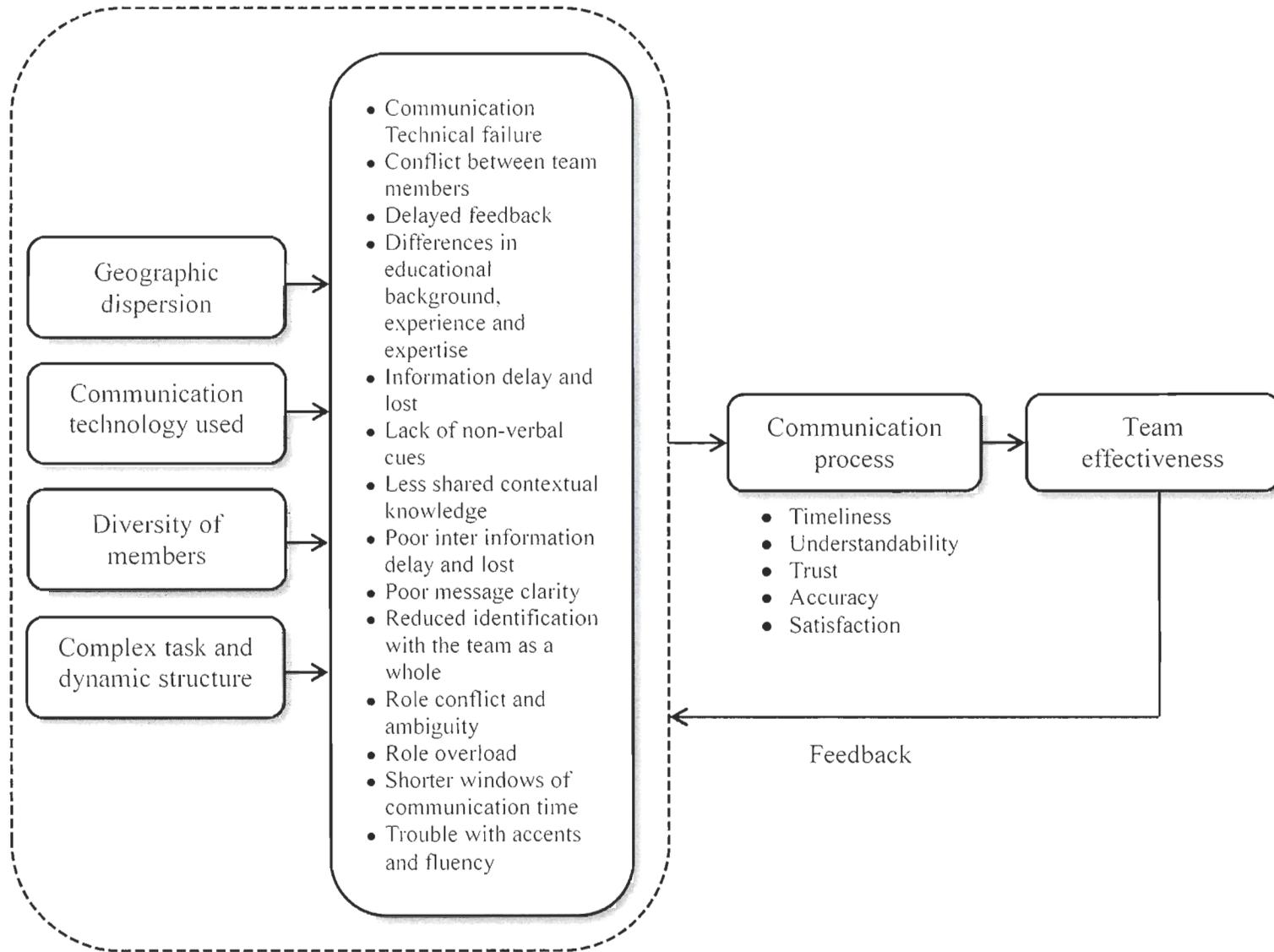


Figure 11 : Research Framework

4.3 PARTICIPANTS

All participants involved in the research were employees at the firms which may use virtual teams in firms' normal activities. The selection of the participants was not random. People who work in a virtual environment are most knowledgeable about working experience in virtual teams, only they can provide honest and applicable response.

Nevertheless, types of work tasks, ages, and education background setting were included in the research population to allow a generalizable study.

4.4 SURVEY DESIGN

The purpose of a survey is to seek to discover relationships between constructs and provide generalized statements about the objects of study (Jick, 1983, p. 136). A survey can depict relationships between variables in a sample which can be done by through questionnaires, interviews or published statistics. According to Judd et al. (1991), a questionnaire has low cost, can avoid potential interview bias and give less pressure for immediate response on the subject. Using a questionnaire is highly applicable in this study because of its advantages of "economy of the design and the rapid turnaround in data collection" (Creswell, 2003, p. 154).

The questionnaire in this study is designed in the form of web-based survey. It comprises four sections including an introduction and a welcome page to explain the reason and purpose of the study.

First section of the questionnaire contains demographic questions such as age, working years, type of business, etc. Second section investigate the basic conditions of communication process and team effectiveness in responders' virtual team. These two sections are to obtain general information about participants and their companies.

The main section of the questionnaire asks participants to respond the numerical values assigned to the frequency of occurrence of the communication problems caused by virtual team characteristics. This part has 22 Liker-type scale rating questions which is the most frequently used variation of the summated rating scale (Cooper & Schindler, 2003, p. 253). Using of a 5 point scale rating from 1-5: 1-Never, 2-Rarely, 3-Sometimes, 4-Often, 5-Always were chosen to exploit the frequency of occurrence of the communication problem in virtual teams.

The last cognitive section of the questionnaire was designed to measure the level of communication understanding, timeliness, accuracy, trust and satisfaction to the virtual team communication process. The researcher also uses a five point Liker-type scale rating from 1-5: 1-Strong disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strong agree to measure the view point of the participants.

Before sending out large quantities of questionnaires to participants, the last step in the questionnaire design is to pre-test the questionnaire. Five individuals who participated on virtual teams pre-tested the questionnaire. They completed a draft version of the questionnaire and provided feedback on question wording, meaning of the content, the appropriate order of rating scales, questions and logic. The pre-test used the same mechanism for collecting and analyzing data as did the full study. Revision of the questionnaire was made based on the feedback from the pre-test.

4.5 DATA COLLECTION

With the finish of revision of the questionnaire, the questionnaires were sent to participants. In order to improve the rate of the questionnaire return, the researcher contacted the director of Jiangsu Telecom of China which is a company provides fixed-line telephone services, broadband Internet access and often use virtual team in their daily work. The researcher obtained permission and support from the director before collecting data from the employees.

The participants in the study were recruited through snowball sampling. The snowball sampling is a method that has been widely used in qualitative research (Biernacki & Waldorf, 1981). The method yields a study sample through referrals made among people who share or know of others who possess some characteristics that are of research interest (Biernacki & Waldorf, 1981).

The researcher identified twenty individuals in Jiangsu Telecom of China whom were involved in virtual team works, and these individuals were asked to if they could provide additional contact information of virtual team members in their own or other organizations. Thereby the researcher got contact information of more and more individuals who are working or worked in virtual teams.

The researcher translated the questionnaire into Chinese, and distributed the questionnaires in English and Chinese to the participants. As a result, 92 questionnaires were returned. However, 10 returned questionnaires were incomplete. This led to 82 effective questionnaires for further research. Once the data collected, the statistical analysis was used to get the research results. And the results will export to an excel spreadsheet for the follow-up data analysis after the survey was completed.

CHAPTER 5

DATA ANALYSIS

In this chapter, Statistical Package for the Social Sciences (SPSS) was used to analyze the data. A descriptive analysis was used to examine the demographic profile of participants and frequency of occurrences of communication problems. After descriptive analysis, one-way ANOVA was used to explore significant differences among demographic variables of participants on occurrences of communication problems. Pearson correlation analysis was used to measure the direction and strength of the relationship between communication problems and communication process. Multiple regression tests examined if the relationships between the independent variables and dependent variables can be explained by regression equation.

5.1 DEMOGRAPHIC PROFILE OF PARTICIPANTS AND COMPANIES

Demographic characteristics of the participants were investigated to rule out their moderating or spurious effects on the virtual team communication problems. The variables include age, level of education, length of experience, size and scope of participants' company, number of projects the participants' companies participated, frequency of use of virtual team.

Age of participants: Look at Figure 12, there is 25.6% of the respondents were ranged in the <30 years old group, 37.8% of respondents were ranged in the 30-39 years old group, 30.5% fell into the range of 40-49 and 6.1% were ranged in the 50-59 years old group. No respondents were above 60 years old.

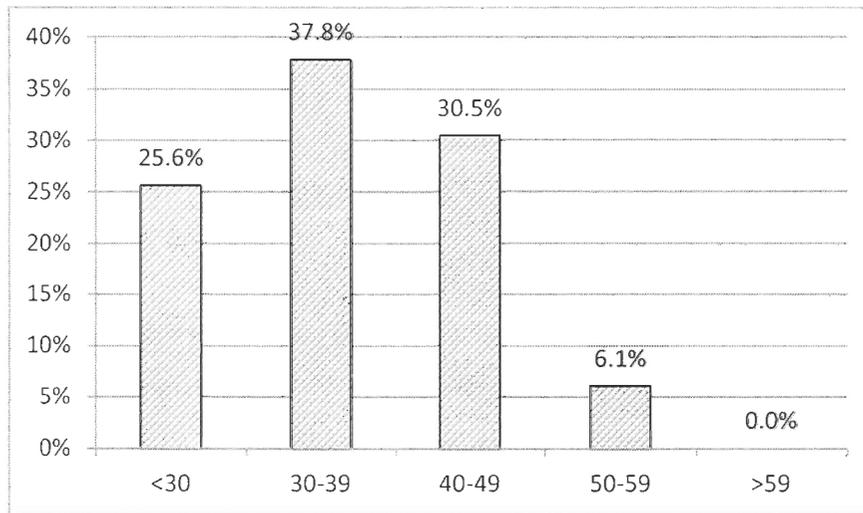


Figure 12 : Age of participants

Level of education: Out of total, there is more than half (61.0%) of the respondents who received a university degree, and approximately 14.6 % of participants who held a college diploma. There are 24.4% of participants who received a graduate degree and not participants had a high school diploma or below.

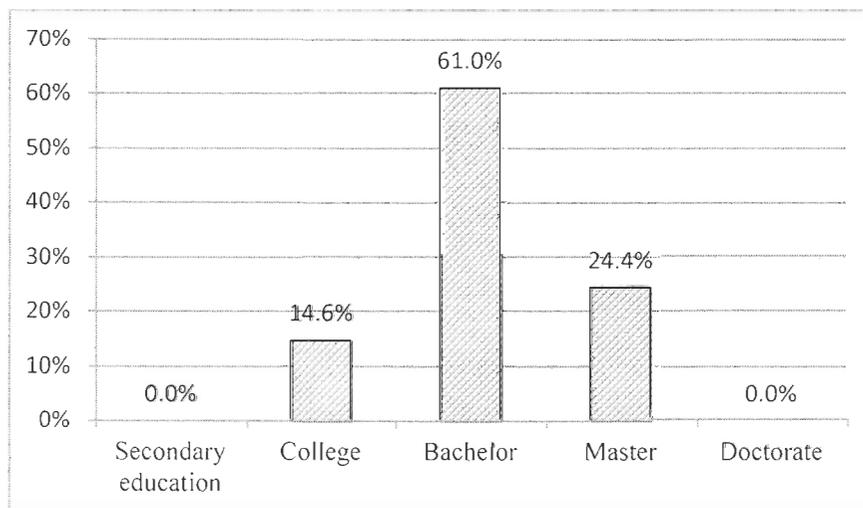


Figure 13 : Level of education

Length of virtual team experience: Figure 14 shows the length of virtual experience of the participants. 17.1% of participants have less than 1 year's virtual team experience. 25.6% of participants have 1~2 years' virtual experience. Most participants (31.7%) have virtual team experience for 3~4 years. Only 3.7% of participants have 7~8 years' experience and just 1.2% of participants have more than 8 years' experience.

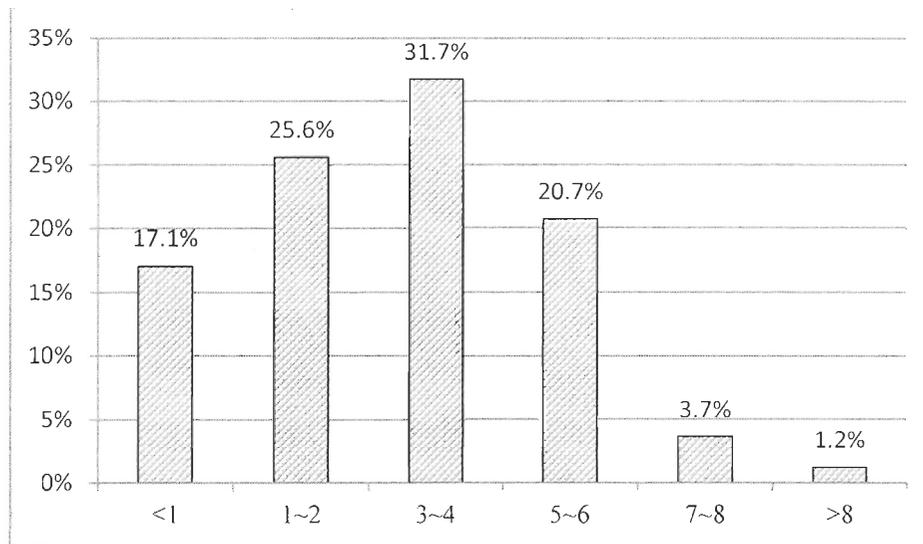


Figure 14 : Length of virtual team experience

Size of participant's company: The companies involved in the study were classified into four groups based on the number of employees. Figure 15 shows the grouping of different sized companies. 12.2% of respondents' companies are micro companies, 32.9% are small companies, 35.4% are medium companies and 19.5% are large companies.

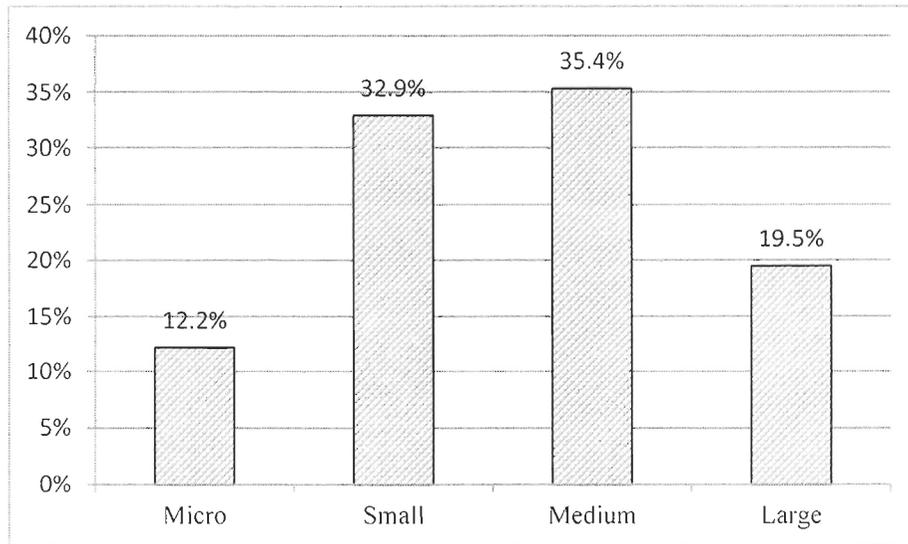


Figure 15 : Size of participant's company

Scope of participant's company: The respondents' companies can be presented in terms of their business scopes. Figure 16 shows the business scopes of the respondents' companies, 6.1% of respondents engage in assurance companies, 11.0% of respondents engage in bank or financial service, 15.9% of respondents engage in software development, 24.4% of respondents engage in information system support, 28.8% of respondents engage in telecommunication, 8.5% of respondents engage in consulting and 6.1% of respondents engage in others.

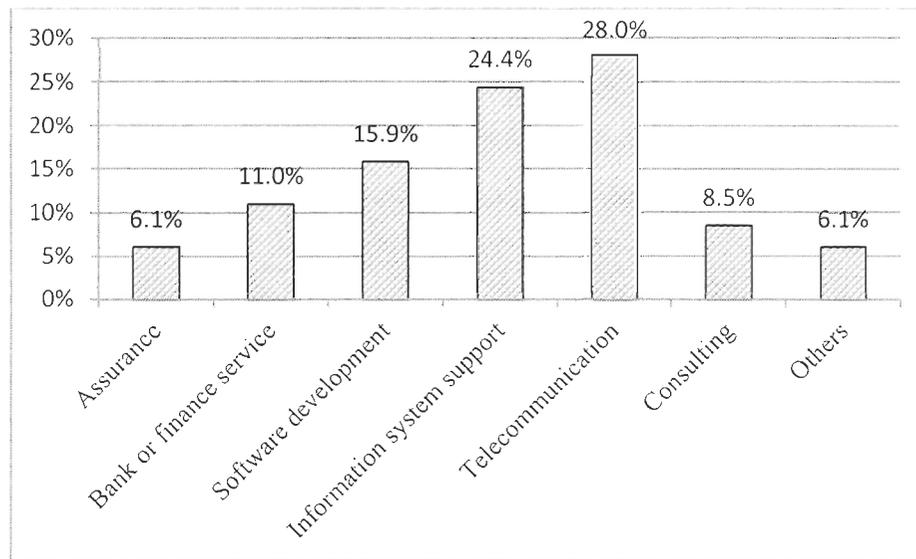


Figure 16 : Scope of participant's company

Number of projects: Figure 17 shows the number of projects of the respondents' companies participated in the past year. It shows that 6.1% of companies participated 0-4 project, 43.9% of companies participated 5-9 projects, 35.4% of companies participated 10-20 projects and 14.6% companies participated more than 20 projects in the past year.

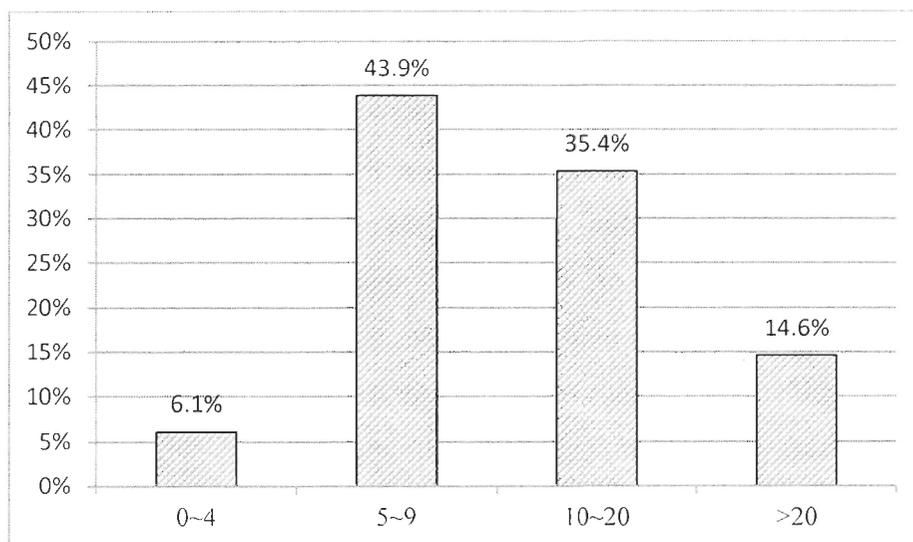


Figure 17 : Number of projects

Frequency of use of virtual team: Table 18 shows the frequency of use of virtual team in respondents' companies. 24.4% of the companies use virtual team rarely, 37.8% of the companies use virtual team sometimes, 28.0% of the companies often use virtual team and 9.8% of the companies always use virtual team in daily activities.

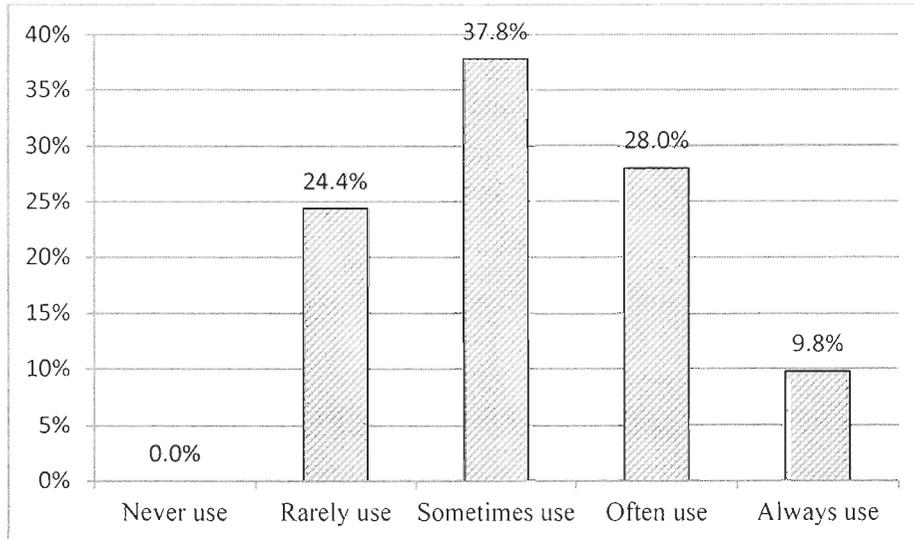


Figure 18 : Frequency of use of virtual team

5.2 COGNITIVE ANALYSIS OF COMMUNICATION PROBLEMS

A self-report in the survey for the attitude of impact of communication problems were collected from the respondents. The Figure 19 shows the results. Just 2.4% of the respondents think communication problems have no impact on their virtual teams' communication process. 6.1% of respondents think the impacts are slight. 32.9% of respondents think the problems moderately affect their communication process, 45.1% the problems very affect their communication process and 13.4% of the respondents the problems affect their communication process extremely.

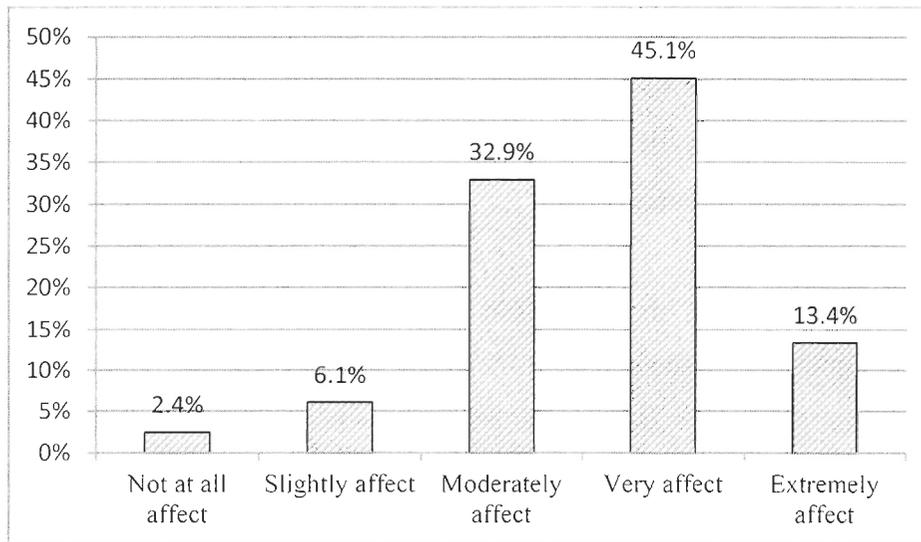


Figure 19 : Impact of communication problems

Figure 20 shows the attitude of the respondents about the impact of the communication process on team effectiveness. 2.4% of respondents consider the communication process can't affect virtual team effectiveness, 4.9% respondents consider the process affect team effectiveness slightly, 36.6% or respondents consider the process affect team effectiveness, 46.3% or respondents consider it very affect team effectiveness and 9.8% of respondents think the process affect virtual team effectiveness extremely.

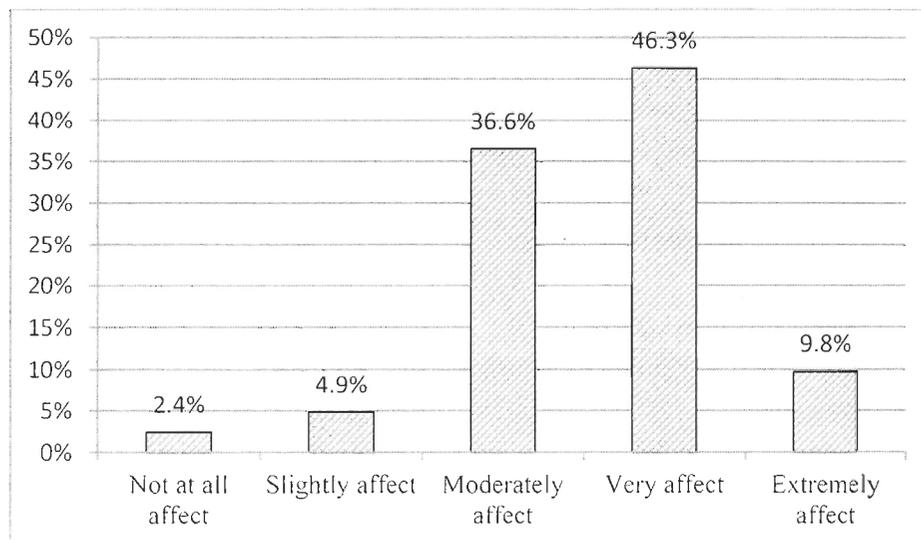


Figure 20 : Impact of communication process

The means, standard deviations and rank of the communication problems happened in virtual teams are displayed in Table 6. The communication problems are ranked by the values of means. The means of the problems indicate that the higher the value is, the more frequently the problems occurred.

It can be seen from the table: lack of non-verbal cues ($Mean=4.20$, $SD=.565$), complicated knowledge transfer ($Mean=3.80$, $SD=.554$), unstable relationships between members ($Mean=3.80$, $SD=.838$), differences in educational background ($Mean=3.79$, $SD=.797$), experience and expertise, reduced identification with the team as a whole ($Mean=3.73$, $SD=.649$) are the most five common problems in virtual team communication process. On the other hand, the problems of differing attitudes towards hierarchy and authority ($Mean=2.41$, $SD=.684$), poor interpretation of feedback ($Mean=2.39$, $SD=.766$), role conflict and ambiguity ($Mean=2.33$, $SD=.817$), poor message clarity ($Mean=2.22$, $SD=.685$), communication technical failure ($Mean=2.20$, $SD=.675$) don't play important roles in the communication process. These problems rank at the bottom of the table.

Table 6: The means, standard deviations and rank of the communication problems

Communication problems	Mean	Std. Deviation	Rank
Lack of non-verbal cues	4.20	.656	1
Complicated knowledge transfer	3.80	.554	2
Unstable relationships between members	3.80	.838	3
Differences in educational background. experience and expertise	3.79	.797	4
Reduced identification with the team as a whole	3.73	.649	5
Decreased team involvement	3.72	.742	6
Shorter windows of communication time	3.70	.697	7
Lack of effective working patterns and information sharing	3.60	.829	8
Different language	3.52	.878	9
Less shared contextual knowledge	3.49	.707	10
Ethnic/cultural group	3.40	.799	11
Trouble with accents and fluency	3.29	.778	12
Information delay and lost	3.26	.625	13

Conflict between team members	3.01	.676	14
Delayed feedback	2.57	.754	15
Role overload	2.55	.669	16
Decreased job satisfaction	2.54	.740	17
Negative work attitudes	2.52	.820	18
Few opportunities for monitoring team members	2.41	.684	19
Communication technical failure	2.41	.684	20
Poor message clarity	2.39	.766	21
Role conflict and ambiguity	2.33	.817	22
Poor interpretation of feedback	2.22	.685	23
Differing attitudes towards hierarchy and authority	2.20	.675	24

5.3 ONE-WAY ANOVA

The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences between means of three or more independent groups (Larson-Hall, 2009). In the analysis, post-hoc tests were used which tell all of the pairings of groups for statistical differences.

In this study, the one-way ANOVA was used to reveal if there are significant differences between the size of company, business type of company, and number of projects participated on the various virtual team communication problems.

Data outputs showed there are significant differences between the size of company (micro, small, medium, and large) in their communication problems.

According to the Table 7, different size of company have significant difference in communication technical failure ($F=2.795$, $p<0.05$), decreased job satisfaction ($F=5.433$, $p<0.002$), and less shared contextual knowledge ($F=3.672$, $p<0.016$). The size of company has no significant difference in the other communication problem.

Table 7: ANOVA for size of company

		Sum of Squares	df	Mean Square	F	Sig.
Communication technical failure	Between Groups	3.679	3	1.226	2.795	.046
	Within Groups	34.224	78	.439		
	Total	37.902	81			
Decreased job satisfaction	Between Groups	7.672	3	2.557	5.433	.002
	Within Groups	36.718	78	.471		
	Total	44.390	81			
Less shared contextual knowledge	Between Groups	5.010	3	1.670	3.672	.016
	Within Groups	35.477	78	.455		
	Total	40.488	81			

Table 8 shows that the business type of company has no significant difference in the communication problems except the problem of lack of non-verbal cues. The significant difference has a value of $F=2.423$ ($p<0.043$).

Table 8: ANOVA for business type of company

		Sum of Squares	df	Mean Square	F	Sig.
Lack of non-verbal cues	Between Groups	4.795	5	.959	2.423	.043
	Within Groups	30.083	76	.396		
	Total	34.878	81			

Table 9 shows that the number of project the company participated have significant difference in the communication problems of reduced identification with the teams as a whole ($F=4.493$, $p<0.01$) but no differences in the other problems.

Table 9: ANOVA for business type of company

		Sum of Squares	df	Mean Square	F	Sig.
Reduced identification with the team as a whole	Between Groups	5.024	3	1.675	4.493	.006
	Within Groups	29.074	78	.373		
	Total	34.098	81			

5.2.1 Result of LSD Post Hoc multiple comparison test

In order to explore further and compare the mean of one group with the mean of another, Fisher's least significant difference (LSD) test was conducted following one-way analysis of variance.

Table 10 shows the differences of different size of company in the problems of communication technology failure, decreased job satisfaction, and less shared contextual knowledge.

Table 10: Multiple Comparisons (LSD) for different size of company

Dependent Variable	(I) Size of company	(J) Size of company	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Communication technical failure	Micro company	Small company	-.022	.245	.928	-.51	.47
		Medium company	-.490 [*]	.243	.047	-.97	-.01
		Large company	-.175	.267	.514	-.71	.36
	Small company	Micro company	.022	.245	.928	-.47	.51
		Medium company	-.467 [*]	.177	.010	-.82	-.11
		Large company	-.153	.209	.467	-.57	.26
	Medium company	Micro company	.490 [*]	.243	.047	.01	.97
		Small company	.467 [*]	.177	.010	.11	.82
		Large company	.315	.206	.131	-.10	.73
Large company	Micro company	.175	.267	.514	-.36	.71	

		Small company	.153	.209	.467	-.26	.57
		Medium company	-.315	.206	.131	-.73	.10
Decreased job satisfaction	Micro company	Small company	-.307	.254	.230	-.81	.20
		Medium company	-.831 [*]	.252	.001	-1.33	-.33
		Large company	-.212	.277	.445	-.76	.34
	Small company	Micro company	.307	.254	.230	-.20	.81
		Medium company	-.524 [*]	.183	.006	-.89	-.16
		Large company	.095	.216	.662	-.34	.53
	Medium company	Micro company	.831 [*]	.252	.001	.33	1.33
		Small company	.524 [*]	.183	.006	.16	.89
		Large company	.619 [*]	.214	.005	.19	1.04
	Large company	Micro company	.212	.277	.445	-.34	.76
		Small company	-.095	.216	.662	-.53	.34
		Medium company	-.619 [*]	.214	.005	-1.04	-.19
Less shared contextual knowledge	Micro company	Small company	.404	.250	.110	-.09	.90
		Medium company	-.059	.247	.813	-.55	.43
		Large company	.513	.272	.063	-.03	1.05
	Small company	Micro company	-.404	.250	.110	-.90	.09
		Medium company	-.462 [*]	.180	.012	-.82	-.10
		Large company	.109	.213	.611	-.31	.53
	Medium company	Micro company	.059	.247	.813	-.43	.55
		Small company	.462 [*]	.180	.012	.10	.82
		Large company	.571 [*]	.210	.008	.15	.99
	Large company	Micro company	-.513	.272	.063	-1.05	.03
		Small company	-.109	.213	.611	-.53	.31
		Medium company	-.571 [*]	.210	.008	-.99	-.15

*. The mean difference is significant at the 0.05 level.

The medium companies have significant mean difference with micro (0.490, $p < 0.05$) and small (0.467, $p < 0.05$) companies, it means medium-sized companies are more likely to have the problem of communication technology failure than micro and small company. The problems of decreased job satisfaction are also easier to happen in medium-sized companies than in micro (0.831, $p < 0.05$), small (0.524, $p < 0.05$), and large company (0.619,

$p < 0.05$). In the demission of less shared contextual knowledge, medium companies have more the problem than small ($0.462, p < 0.05$) and large company ($0.521, p < 0.05$).

Table 11 shows the differences of different type of company in the communication problem of lack of non-verbal cues.

The results reveal that, when using virtual team, the assurance companies have less of non-verbal cues in the communication process than the companies of bank or financial service ($0.700, p < 0.05$), software development ($0.671, p < 0.05$) and consulting ($0.743, p < 0.05$). Telecommunication companies are also lack of non-verbal cues than companies of bank or financial service ($0.517, p < 0.05$), software development ($0.488, p < 0.05$) in the process of communication.

Table 11 Multiple Comparisons (LSD) for different type of company

Lack of non-verbal cues

(I) Business type of company	(J) Business type of company	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Assurance	Bank or financial service	.700 ^a	.345	.046	.01	1.39
	Software development	.671 ^a	.328	.044	.02	1.32
	Information system support	.327	.312	.297	-.29	.95
	Telecommunication	.183	.309	.555	-.43	.80
	Consulting	.743 ^a	.368	.047	.01	1.48
Bank or financial service	Assurance	-.700 ^a	.345	.046	-1.39	-.01
	Software development	-.029	.260	.913	-.55	.49
	Information system support	-.373	.240	.124	-.85	.11
	Telecommunication	-.517 ^a	.237	.032	-.99	-.05
	Consulting	.043	.310	.890	-.57	.66
Software development	Assurance	-.671 ^a	.328	.044	-1.32	-.02
	Bank or financial service	.029	.260	.913	-.49	.55
	Information system support	-.344	.215	.114	-.77	.08
	Telecommunication	-.488 ^a	.212	.024	-.91	-.07
	Consulting	.071	.291	.807	-.51	.65
Information system support	Assurance	-.327	.312	.297	-.95	.29
	Bank or financial service	.373	.240	.124	-.11	.85
	Software development	.344	.215	.114	-.08	.77
	Telecommunication	-.144	.186	.441	-.51	.23
	Consulting	.416	.273	.132	-.13	.96
Telecommunication	Assurance	-.183	.309	.555	-.80	.43
	Bank or financial service	.517 ^a	.237	.032	.05	.99

	Software development	.488*	.212	.024	.07	.91
	Information system support	.144	.186	.441	-.23	.51
	Consulting	.560*	.270	.042	.02	1.10
Consulting	Assurance	-.743*	.368	.047	-1.48	-.01
	Bank or financial service	-.043	.310	.890	-.66	.57
	Software development	-.071	.291	.807	-.65	.51
	Information system support	-.416	.273	.132	-.96	.13
	Telecommunication	-.560*	.270	.042	-1.10	-.02

*. The mean difference is significant at the 0.05 level.

Table 12 shows that the virtual team members who have participated 0-4 projects in the past year reduced identification with the team as whole than the members who participated 5-9 projects (1.017, $p < 0.01$), 10-20 projects (0.910, $p < 0.01$) and more than 20 projects (0.683, $p < 0.325$) in the past year.

Table 12: Multiple Comparisons (LSD) for numbers of projects participated

Reduced identification with the team as a whole

(I) Number of projects the company participated	(J) Number of projects the company participated	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
0-4	5-9	1.017*	.291	.001	.44	1.60
	10-20	.910*	.296	.003	.32	1.50
	>20	.683*	.325	.039	.04	1.33
5-9	0-4	-1.017*	.291	.001	-1.60	-.44
	10-20	-.106	.152	.487	-.41	.20
	>20	-.333	.204	.105	-.74	.07
10-20	0-4	-.910	.296	.003	-1.50	-.32
	5-9	.106	.152	.487	-.20	.41
	>20	-.227	.210	.282	-.64	.19
>20	0-4	-.683*	.325	.039	-1.33	-.04
	5-9	.333	.204	.105	-.07	.74
	10-20	.227	.210	.282	-.19	.64

*. The mean difference is significant at the 0.05 level.

5.4 CORRELATION ANALYSIS

The purpose of this analysis is to investigate what communication problems, if any, were more correlated with the virtual team communication process. A Pearson Correlation

analysis was conducted using timeliness, understanding, trust, accuracy, and satisfaction of communication process as the dependent variable and communication problems as independent variables. Results of the analysis are showed in Table 13.

The results conducted that the problems of few opportunities for monitoring team members ($r=-.297$), information delay and lost ($r=-.463$), communication technical failure ($r=-.385$), negative work attitudes ($r=-.407$), decreased job satisfaction ($r=-.302$), lack of effective working patterns and information sharing ($r=-.417$), shorter windows of communication time ($r=-.368$), decreased team involvement ($r=-.352$), delayed feedback ($r=-.294$) significantly correlated ($p<0.01$) with timeliness of communication process. And the lack of non-verbal cues ($r=-.254$), Reduced identification with the team as a whole ($r=-.255$) also correlated with timeliness of communication process, but is significant at the 0.05 level

The problems significantly correlated ($p<0.01$) with understandability of communication are: complicated knowledge transfer ($r=-.437$), lack of non-verbal cues ($r=-.439$), different language ($r=-.446$), Role conflict and ambiguity ($r=-.284$), less shared contextual knowledge ($r=-.394$), decreased team involvement ($r=-.288$), trouble with accents and fluency ($r=-.422$). At the 0.05 level, differences in educational background, experience and expertise ($r=-.270$), conflict between team members ($r=-.254$) have correlation with understandability of communication.

The problems have a significant correlation ($p<0.01$) with trust of communication include: communication technical failure ($r=-.308$), different language ($r=-.348$), decreased team involvement ($r=-.466$), trouble with accents and fluency ($r=-.301$), differing attitudes towards hierarchy and authority ($r=-.347$). At the 0.05 level, few opportunities for monitoring team members ($r=-.280$), complicated knowledge transfer ($r=-.278$), lack of non-verbal cues ($r=-.268$), role overload ($r=-.276$), decreased job satisfaction ($r=-.253$),

unstable relationships between members ($r=-.230$), shorter windows of communication time ($r=-.224$) also correlated with trust of communication process.

Different language ($r=-.380$), role conflict and ambiguity ($r=-.340$), negative work attitudes ($r=-.330$), poor interpretation of feedback ($r=-.408$), trouble with accents and fluency ($r=-.539$), ethnic/cultural group ($r=-.328$), poor message clarity ($r=-.287$), conflict between team members ($r=-.386$) have significant correlation ($p<0.01$) with accuracy of communication. Lack of effective working patterns and information sharing ($r=-.231$), differences in educational background, experience and expertise ($r=-.271$) have significant correlation ($p<0.05$) with accuracy of communication too.

The problems have significant correlation ($p<0.05$) with communication satisfaction include: information delay and lost ($r=-.226$), shorter windows of communication time ($r=-.229$), ethnic/cultural group ($r=-.278$), reduced identification with the team as a whole ($r=-.224$).

By the analysis of correlation between communication problems and communication process, the researcher can initially see how the communication problems affect which aspect of communication process in virtual teams.

Table 13: Pearson Correlation

	Timeliness	Understandability	Trust	Accuracy	Satisfaction
Few opportunities for monitoring team members	-.297**	-.052	-.280*	.105	-.057
Complicated knowledge transfer	-.050	-.437**	-.278*	-.098	-.148
Lack of non-verbal cues	-.254*	-.439**	-.268*	-.132	-.217
Information delay and lost	-.463**	-.060	-.107	-.171	-.226*
Communication technical failure	-.385**	-.170	-.308**	-.055	.144

Different language	-.158	-.446**	-.348**	-.380**	-.212
Role conflict and ambiguity	-.039	-.284**	-.088	-.340**	.052
Role overload	-.124	.103	-.276*	.055	-.195
Negative work attitudes	-.407**	-.125	.077	-.330**	.026
Decreased job satisfaction	-.302**	-.088	-.253*	-.084	.136
Less shared contextual knowledge	-.156	-.394**	-.086	-.207	.010
Poor interpretation of feedback	-.009	-.101	.090	-.408**	.150
Lack of effective working patterns and information sharing	-.417**	.127	-.047	-.231*	.039
Unstable relationships between members	-.248*	-.059	-.230*	-.009	.026
Shorter windows of communication time	-.368**	-.206	-.224*	-.034	-.229*
Decreased team involvement	-.352**	-.288**	-.466**	-.102	-.187
Trouble with accents and fluency	-.178	-.422**	-.301**	-.539**	-.208
Differing attitudes towards hierarchy and authority	-.203	-.189	-.347**	-.128	-.185
Ethnic/cultural group	-.017	-.172	-.169	-.328**	-.278*
Differences in educational background, experience and expertise	-.211	-.270*	-.099	-.271*	-.159
Poor message clarity	-.025	-.207	.074	-.287**	.079
Delayed feedback	-.294**	-.173	-.136	-.123	-.031
Reduced identification with the team as a whole	-.255*	.050	.009	.156	-.224*
Conflict between team members	-.036	-.254*	.032	-.386**	.092

p = degree of significance

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

5.5 MULTIPLE REGRESSION ANALYSIS

In the previous section, the researcher has analyzed the correlation between communication problems and communication process. If two variables are correlated, then knowing the score on one variable will allow predicting the score on the variable correlated. The stronger the correlation, the closer the scores will fall to regression line (Brace et al., 2009). Multiple regression analysis is a statistical technique that allows us to predict one variable on the basis of several other variables (Brace et al., 2009).

By previous correlation analysis, the researcher has got the predictor variables. As Brace et al. (2009) noted that human behavior is inherently noisy and therefore it is not possible to produce totally accurate predictions. In this section, the researcher will use the “predictor variables” to identify a set of variables which together influence the communication process.

In “statistical” methods of multiple regression analysis, the order in which the predictor variables are entered into (or taken out of) the model is determined according to the strength of their correlation with the criterion variables (Brace et al., 2009). In this study, the researcher uses the method of “stepwise” which is the most sophisticated of these statistical methods. In this method, if adding of a variable contributes to the model then it will be retained (Brace et al., 2009). The method can get the smallest possible set of predictor variables which influence the communication process.

In this analysis, the communication problems correlated would emerge as significant predictor variables, which allow us to estimate the criterion variable: the timeliness, understandability, trust, accuracy, and satisfaction of communication process.

5.2.2 Timeliness of communication

Table 14 below is the model summary of the analysis for timeliness of communication. It lists which variables are in the regression, and the variables which are

not in the regression were reduced by this method. The table shows four communication problems: information delay and lost, communication technical failure, lack of effective working patterns and information sharing, negative work attitudes are in the regression of timeliness of communication. The value of Adjusted R Square in the table always increases with the inclusion of additional predictor variables.

Table 14: Model Summary for timeliness of communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.463 ^a	.214	.205	.735	.214	21.840	1	80	.000
2	.583 ^b	.340	.324	.678	.126	15.060	1	79	.000
3	.628 ^c	.395	.372	.653	.055	7.061	1	78	.010
4	.658 ^d	.433	.403	.637	.038	5.121	1	77	.026

a. Predictors: (Constant), Information delay and lost

b. Predictors: (Constant), Information delay and lost, Communication technical failure

c. Predictors: (Constant), Information delay and lost, Communication technical failure, Lack of effective working patterns and information sharing

d. Predictors: (Constant), Information delay and lost, Communication technical failure, Lack of effective working patterns and information sharing, Negative work attitudes

Dependent Variable: Timeliness of communication

After all the variables were added, the Adjusted R Square is .403 which means that the 40.3% variance of timeliness of communication can be explained by the regression on information delay and lost, communication technical failure, lack of effective working patterns and information sharing.

The next is a table of coefficients, which gives estimated values of the regression coefficients and their stand errors. Standardized Beta coefficients in the table 16 give a measure of the contribution of each problem to the timeliness of communication. A large value indicates that a unit change in this predictor variable has a large effect on the criterion variable. The table shows that information delay and lost has a coefficient of $-.348$ ($p < .01$), communication technical failure has $-.219$ ($p < .01$), lack of effective working patterns has $-.242$ ($p < .01$) and information sharing has $-.213$ ($p < .05$).

Table 15: Coefficients^a for timeliness of communication

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.171	.476		15.075	.000
Information delay and lost	-.459	.118	-.348	-3.875	.000
Communication technical failure	-.264	.114	-.219	-2.314	.023
Lack of effective working patterns and information sharing	-.240	.091	-.242	-2.644	.010
Negative work attitudes	-.214	.094	-.213	-2.263	.026

a. Dependent Variable: Timeliness of communication

5.2.3 Understandability of communication

Table 16 is the result of regression analysis for understandability of communication. The table shows that different language, complicated knowledge transfer, lack of non-verbal cues, less shared contextual knowledge are in the regression of understandability of communication. 37.1% variance of understandability of communication can be explained by the regression on the four variables above.

Table 17 shows the standardized Beta coefficients of the four variables are: $\beta = -.186$, $p < 0.1$ for different languages, $\beta = -2.84$, $p < 0.01$ for complicated knowledge transfer, $\beta = -.272$, $p < 0.01$ for lack of non-verbal cues, $\beta = -.191$, $p < 0.05$ for less shared contextual knowledge.

Table 16: Model Summary for understandability of communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.446 ^a	.199	.189	.691	.199	19.883	1	80	.000
2	.535 ^b	.286	.268	.657	.087	9.613	1	79	.003
3	.609 ^c	.371	.347	.621	.085	10.559	1	78	.002
4	.634 ^d	.402	.371	.609	.031	4.010	1	77	.049

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.446 ^a	.199	.189	.691	.199	19.883	1	80	.000
2	.535 ^b	.286	.268	.657	.087	9.613	1	79	.003
3	.609 ^c	.371	.347	.621	.085	10.559	1	78	.002
4	.634 ^d	.402	.371	.609	.031	4.010	1	77	.049

a. Predictors: (Constant), Different language

b. Predictors: (Constant), Different language, Complicated knowledge transfer

c. Predictors: (Constant), Different language, Complicated knowledge transfer, Lack of non-verbal cues

d. Predictors: (Constant), Different language, Complicated knowledge transfer, Lack of non-verbal cues, Less shared contextual knowledge

Dependent Variable: Understandability of communication

Table 17: Coefficients^a for understandability of communication

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.815	.614		12.738	.000
Different language	-.163	.089	-.186	-1.828	.071
Complicated knowledge transfer	-.394	.133	-.284	-2.962	.004
Lack of non-verbal cues	-.319	.114	-.272	-2.792	.007
Less shared contextual knowledge	-.207	.103	-.191	-2.003	.049

a. Dependent Variable: Understandability of communication

5.2.4 Trust of communication

Table 18 is the result of regression analysis for trust of communication. The table shows that decreased team involvement, different language, and role overload are in the regression of understandability of communication. 31.2% variance of trust of communication can be explained by the regression on the communication problems of decreased team involvement, different language, and role overload.

Table 18: Model Summary for trust of communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.466 ^a	.217	.207	.566	.217	22.182	1	80	.000
2	.536 ^b	.287	.269	.544	.070	7.734	1	79	.007
3	.581 ^c	.338	.312	.527	.051	6.010	1	78	.016

a. Predictors: (Constant), Decreased team involvement

b. Predictors: (Constant), Decreased team involvement, Different language

c. Predictors: (Constant), Decreased team involvement, Different language, Role overload

Dependent Variable: Trust of communication

Table 19 shows the standardized Beta coefficients of the problems on the regression of trust of communication. Decreased team involvement has coefficient of $\beta=-.396$, $p<0.01$, different languages has coefficient of $\beta=-.261$, $p<0.01$, role overload has coefficient of $\beta=-.227$, $p<0.05$.

Table 19: Coefficients^a for trust of communication

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	6.357	.400		15.906	.000
Decreased team involvement	-.339	.081	-.396	-4.201	.000
Different language	-.189	.068	-.261	-2.783	.007
Role overload	-.216	.088	-.227	-2.452	.016

a. Dependent Variable: Trust of communication

5.2.5 Accuracy of communication

The regression analysis for accuracy of communication shows an adjusted R square of .423, which was significant ($p<0.01$). There are three significant variables amongst the accuracy of communication. Trouble with accents and fluency has the highest Beta value ($\beta=-.462$, $p<0.01$), followed by Poor interpretation of feedback ($\beta=-.357$, $p<0.01$) and negative work attitudes ($\beta=-.210$, $p<0.01$).

Table 20: Model Summary for accuracy of communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.539 ^a	.291	.282	.669	.291	32.812	1	80	.000
2	.631 ^b	.398	.383	.620	.107	14.072	1	79	.000
3	.666 ^c	.444	.423	.600	.046	6.449	1	78	.013

a. Predictors: (Constant), Trouble with accents and fluency

b. Predictors: (Constant), Trouble with accents and fluency, Poor interpretation of feedback

c. Predictors: (Constant), Trouble with accents and fluency, Poor interpretation of feedback, Negative work attitudes
Dependent Variable: Accuracy of communication

Table 21: Coefficients^a for accuracy of communication

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	6.503	.368		17.688	.000
Trouble with accents and fluency	-.462	.088	-.455	-5.271	.000
Poor interpretation of feedback	-.357	.099	-.310	-3.607	.001
Negative work attitudes	-.210	.083	-.218	-2.539	.013

a. Dependent Variable: Accuracy of communication

5.2.6 Satisfaction of communication

Table 22 shows the result of regression analysis for satisfaction of communication which has an adjusted R square of .106 ($p < 0.01$). There are two significant predictors amongst the satisfaction. The ethnic/cultural group has the highest Beta value ($\beta = -.250$, $p < 0.01$), followed by reduced identification with the team as a whole ($\beta = -.248$, $p < 0.05$).

Table 22: Model Summary for satisfaction of communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.278 ^a	.077	.066	.692	.077	6.697	1	80	.011
2	.357 ^b	.128	.106	.677	.050	4.570	1	79	.036

a. Predictors: (Constant), Ethnic/cultural group

b. Predictors: (Constant), Ethnic/cultural group, Reduced identification with the team as a whole
Dependent Variable: Satisfaction of communication

Table 23: Coefficients^a for satisfaction of communication

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	5.165	.544		9.487	.000
Ethnic/cultural group	-.250	.094	-.279	-2.652	.010
Reduced identification with the team as a whole	-.248	.116	-.225	-2.138	.036

a. Dependent Variable: Satisfaction of communication

CHAPTER 6

DISCUSSION

This chapter includes a discussion of the data analysis results and the implications and meanings of the findings.

6.1 FREQUENCY OF OCCURRENCE OF THE COMMUNICATION PROBLEMS

The first research question of this study is “What communication problems occur more frequently in communication process in virtual teams?” By ranking the mean scores of each question in the survey about the communication problem, we can know what communication problems are the common and frequently happened problems in virtual teams.

Analyses of data in previous chapter have indicated the most frequent communication problems in communication process in virtual teams are: lack of non-verbal cues, complicated knowledge transfer, unstable relationships between members, differences in educational background, experience and expertise, reduced identification with the team as a whole.

The participants in this study considered the lack of non-verbal cues as the most frequent problem in virtual teams. The development of modern information technology makes it possible to generate virtual teams. Team members communicate with each other under the support of information technologies such as email, fax, voice software, etc. Face to face activities continue to decrease and the opportunities for using non-verbal cues

become less and less. The lack of non-verbal cues inevitably becomes one of the most common communication problems in virtual teams

Complicated knowledge transfer was considered as the second common problems in virtual teams. Knowledge transfer occurs when knowledge is diffused from one entity (e.g., an individual, team, or organization) to other entities. A virtual team consists of individuals in various fields, team members have to continuously communicate and learn from each other. Further, a virtual team often involves multiple organizations which are geographic dispersed, this potentially increasing the difficulty of knowledge transfer. Boisot (2002) noted that transfer of knowledge depends not only on the type and complexity of the knowledge but also the attributes or behaviors of the people sharing the knowledge. The increased use of information technologies to bridge the distance gap between team members in virtual teams further complicate the knowledge transfer process. Another most basic barrier to knowledge transfer in virtual team is language and culture. Due to the diversity of virtual teams, members are from around the world and have different language and culture, which make the knowledge transfer cost more time and resources. Complicated knowledge transfer becomes the common problem in communication process which almost all of the virtual teams are difficult to avoid.

In the life cycle of a virtual team, the team needs for different skills at different stages of the team's project, team members are explicitly assigned in the team during a project only while their skill is required. After a limited time, these members may be out of the team. The relationships between virtual team members become unstable. Certain task, personnel or environmental conditions make unstable relationships between virtual team members unavoidable and become the third problem occurred most frequently in virtual teams.

Differences in educational background, experience and expertise were considered as the fourth problem occurred most frequently in virtual teams. Team member's educational background reflects his or her domain of professional expertise, but also the person's

personality, cognitive styles, values. Differences in team members' educational backgrounds make them have little overlap in shared information and don't trigger each other's knowledge in the communication process. In the previous chapter, the researcher has mentioned if the communication source's and destination's fields of experience overlap, communication can take place (Schramm, 1961). The differences of educational background limit the extent to which information is conveyed to, understood, and used in communication process by the virtual team. But the needs for different skills make the levels of educational diversity in virtual team continue to rise, and the existence of this problem has become a common phenomenon in virtual teams

Reduced identification with the team as a whole was considered as the fifth problem occurred most frequently in virtual teams. Gundlach et al. (2006) defined team identification as "the extent to which an individual team member identifies with a specific organizational team rather than social groups in general". In virtual teams, the members can have different cultures, work in different regions, and communicate mainly through information technology, and this situation is unavoidable. The nature of virtual team means that team identity is created in virtual interaction, as the members rarely have the opportunity to see each other. Under the condition of low team identification, team member's sense of individualism may be enhanced and the importance of the team may be reduced. Creating a team identity in such an environment through virtual communication takes more time and effort.

The analyses of data in previous chapter indicated that the problems of few opportunities for monitoring team members, communication technical failure, poor message clarity, role conflict and ambiguity, poor interpretation of feedback, and differing attitudes towards hierarchy and authority occurred relatively less often. With the continuous development and improvement of modern information technology, variety of communications technology is widely used. Unlike the past, communication technical failure usually does not occur. Even if such problem occurred, virtual teams usually have a contingency plan to deal with if one of the primary technologies becomes inoperable.

Meanwhile, poor message clarity also occurred less often. Mutual use of a variety of communication technologies has compensated the disadvantage of using single communication technology. Transmission of information is becoming increasingly clear.

With years of continuous development of virtual teams, managers know virtual teams more deeply and the management of virtual teams becomes more mature. Some of the problems caused due to management approach become less and less. The progress of management also makes the problems such as few opportunities for monitoring team members, role conflict and ambiguity, poor interpretation of feedback, and differing attitudes towards hierarchy and authority have lower and lower probability of occurrence in communication process in virtual teams.

6.2 DIFFERENCES RELATED TO DIFFERENT VIRTUAL TEAMS

Based on the one-way ANOVA analyses of the survey data, the results intended to clarify the impact of demographic variables on the occurrences of communication problems.

Companies with different sizes are significantly different in their occurrences of problems such as communication technical failure, decreased job satisfaction, and less shared contextual knowledge. The frequency of occurrences of communication technical failure between large companies and medium companies has no significant difference. But if we compare medium-sized companies with small companies and micro companies, we can find the communication technical failure occurred more in medium companies. The micro and small companies may have less communication equipment and use relatively simple communication technology, as Boutieller et al. (1998) noted, for the smaller companies, financial limitations often play a significant part in the communication resources virtual teams have at their disposal. Because of the limited size of the companies, the frequency of use of the equipment is less than medium companies and these equipment are easier to manage and maintain. But for medium companies, the large number and the

frequent use of communication equipment make the communications technical failure probability become higher than small and micro companies.

Companies of different sizes are also significantly different in job satisfaction. Employees from medium companies felt job satisfaction decreased more than the other companies when they work in virtual teams. The micro and small companies can have flexible corporate system than medium companies, this kind of flexible corporate system may allow the employees work in virtual teams more flexibility. In contrast, the conservative system of medium companies may restrict employees' work in virtual teams, and lead to their decrease of job satisfaction. Meanwhile, large companies' advanced management system may eliminate the system's impact on job satisfaction when the employees work in virtual teams.

Shared contextual knowledge is different in different companies too. Medium companies show less shared contextual knowledge when their employees work in virtual team. Medium companies have more employees and participated more virtual teams than small companies, the increase of diversity make the shared contextual knowledge decrease. Large companies take more cost and effect on knowledge management, the employees from large companies can share more contextual knowledge than medium companies when they work in virtual teams.

The results of analyses also indicated that the degree of use of non-verbal cues was significantly different among different type of companies. The employees from assurance and telecommunication felt they lack more non-verbal cues. This may be due to they don't just need language to describe their work in their communication process, but also need more texts, pictures or body language to explain their ideas. So, the lack of non-verbal cues occurred more in assurance and telecommunication companies than the other type of companies when they participate virtual teams.

We have found the team identification was significantly different between the qualities of projects the members participated. The companies who have participated 0-4 virtual projects in the past year have the lower team identification than the companies who participated more than five projects. The employees in the companies participated 0-4 projects may have few opportunities to participate in virtual teams, they work in reality environments more often. When they enter the virtual team, they may not be able to immediately adapt to the environment of virtual team. In such circumstances, the employees reduced the identification of team as a whole. Those staff in the companies involve more projects have more virtual team experience, and can adapt to this virtual environment. They have higher degree of team identification when they work in virtual teams.

6.3 RELATIONSHIP BETWEEN COMMUNICATION PROBLEMS AND COMMUNICATION PROCESS

The third objective of this study is to examine the relationship between communication problems and communication process. This section discusses the study's findings and includes a discussion of the correlation analysis and regression analysis on five communication process criteria (timeliness of communication, understandability of communication, trust of communication, accuracy of communication, and satisfaction of communication).

6.3.1 Relationship with timeliness of communication

The results indicated that few opportunities for monitoring team members, information delay and lost, communication technical failure, negative work attitudes, decreased job satisfaction, lack of effective working patterns and information sharing, shorter windows of communication time, decreased team involvement, delayed feedback were significant negatively correlated ($p < 0.01$) with timeliness of communication process.

And the lack of non-verbal cues, reduced identification with the team as a whole were moderate negatively correlated ($p < 0.05$) with the timeliness of communication process.

Based on this study information delay and loss displayed the highest degree of correlation with the timeliness of communication. At the individual (team member) level, if the information needed is delay or loss, the member must stop his work and look for the information again. During this period, if members want to discuss related issues with him, the communication has to be postponed. At the team level, an important video conference may be delayed as the cause of needed information loss. For virtual teams, it's not easy to organize such a meeting, and the timeliness of communication in virtual teams was reduced.

Lack of effective working patterns and information sharing, negative work attitude also displayed a high degree of negative correlation with timeliness of communication. The lack of effective working patterns and information sharing make the team members don't want to communicate with each other, even don't want to share their idea in the team. In this situation, it's difficult to get timely communication between team members or managers. Plus the negative attitude of some members, the timeliness of communication will continue to be reduced in virtual teams.

Meanwhile, few opportunities for monitoring team members, communication technical failure, decreased job satisfaction, communication technical failure, decreased team involvement, delayed feedback all have a negative impact on the timeliness of communication in virtual teams. Lacks of monitoring make members' attention to team communication reduce. And communication technical failure, communication technical failures inevitably make the communication plan need to changed and re-arranged. Both decreased team involvement and delayed feedback can't allow team members obtain the information they need when necessary in the communication process.

The researcher attempts to model the relationship between the communication problems related above and timeliness of communication by fitting a linear equation to observed data. According to the multiple regression analysis where the timeliness of communication is the dependent variable and the communication problems related are independent variables, only four variables (information delay and lost, communication technical failure, lack of effective working patterns and information sharing, negative work attitudes) were entered in the equation. In the equation, information delay and loss has the largest effect on the timeliness of communication. But in this study, the R square values for the four variables are less than .50 (see Table 14), which indicates no good fit for the model. It's hard to explain the correlation between the communication problems related and timeliness of communication by fitting a linear equation.

6.3.2 Relationship with understandability of communication

Complicated knowledge transfer, lack of non-verbal cues, different languages, role conflict and ambiguity, less shared contextual knowledge, decreased team involvement, trouble with accents and fluency were significant negatively correlated ($p < 0.01$) with understandability of communication. Differences in educational background, experience and expertise, conflict between team members were moderate negatively correlated ($p < 0.05$) with understandability of communication.

Both different languages and trouble with accents and fluency belong to the language problems. Due to these two problems, the information may be transmitted in a way that it is not understandable by others in team's communication process, and the members may not be familiar with the topic of communication. As Chudoba et al. (2005) indicated language problems may be especially reflected in virtual teaming environments since most communication is mediated through computer technologies. More language problems the virtual teams have, the lower understandability of communication the team has.

The non-verbal cues include eye movement, facial expression, hand gestures and other body language. Warkentin and Beranek (1999) noted these cues can help virtual team

members regulate the flow of conversation, facilitate turn taking, provide feedback and convey subtle meanings. Under the help of non-verbal cues, team members can understand each other easier. As the current study shows, the lack of non-verbal cues has a negative impact on understandability of communication in virtual teams.

The level of team involvement is positively related to understandability of communication. Team involvement is a crucial component of communication process. With the decrease of team involvement, the understandability of communication decrease.

Complicated knowledge transfer and less shared contextual knowledge also have negative impact on understandability of communication. According to the study, with the increase of complication of knowledge transfer, the degree of understandability of communication in virtual team decreases. In other hand, the members have less shared contextual knowledge, they can't understand the information transmitted in communication process.

According to the multiple regression analysis where understandability of communication is the dependent variable and the communication problems related are independent variables, only four variables (different language, complicated knowledge transfer, lack of non-verbal cues, less shared contextual knowledge) were entered in the equation. 37.1% variance of understandability of communication can be explained by the regression on the four variables, and the Beta coefficients of the four variables are all low than 0.30. This regression analysis indicates it's not good for fitting a linear equation between the independent variables and dependent variables.

6.3.3 Relationship with trust of communication

Communication technical failure, different language, decreased team involvement, trouble with accents and fluency, differing attitudes towards hierarchy and authority were significant negatively correlated ($p < 0.01$) with trust of communication.

Although trust is important in any type of team, it's more essential in virtual teams. Trust is pivotal in preventing geographical distance from leading to psychological distance in virtual teams (Jarvenpaa et al., 1998). In virtual teams, ongoing and successful communication is the foundation for building trust between team members. The problems of communication technical failure, different language, decreased team involvement, trouble with accents and fluency, differing attitudes towards hierarchy and authority make a successful communication process can't be sustained. It's difficult to establish a trust relationship between members in the communication process.

Jarvenpaa et al. (1998) indicated that the relationship of trust between team members was established after the members have interacted for a while. Lacks of non-verbal cues, unstable relationships between members, shorter windows of communication time were also moderate negatively correlated with trust of communication. These communication problems make the interaction can't keep ongoing, and the relationship of trust becomes weaker and weaker.

When the researcher tries to fit a linear equation to observe the relationship between communication problems and trust of communication, it was found that the R square value for the model is just .312 (see Table 18), and only three variables (decreased team involvement, different language, role overload) entered the equation. There is no convincing to describe the relationship between them by using equations.

6.3.4 Relationship with accuracy of communication

According to the correlation analysis, different language, role conflict and ambiguity, negative work attitudes, poor interpretation of feedback, trouble with accents and fluency, ethnic/cultural group, poor message clarity, conflict between team members have significant negative impact ($p < 0.01$) on accuracy of communication.

In the communication process in virtual teams, poor message clarity can affect the accuracy of the communication obviously. Vague information makes the members can't get the accurate information they need different language, ethnic/cultural group, trouble with accents and fluency are very common and were negatively correlated with accuracy of communication. The current study is consistent with previous finding. Shachaf (2005) indicated that slower speech by nonnative speakers and translation problems reduced the accuracy of communication. The need for communication accuracy required team members to invest more time and effort in the processes of encoding and decoding information.

Role conflict and ambiguity, negative work attitudes, poor interpretation of feedback, conflict between team members affect the accuracy of communication. One possible explanation may be the hostility between team members. The membership in virtual teams is yet not stable enough. These problems exacerbated the hostility between members. When hostility reaches the point where they don't want to communicate with each other and the accuracy of communication reduced in the end.

The researcher also tries to fit a linear equation to observe the relationship between communication problems related and accuracy of communication. The R square value of the analysis is .423, less than 0.50. The value means that 42.3% variance of accuracy of communication can be explained by the regression on the three variables entered in the equation. And the relationship can't be explained by the equation.

6.3.5 Relationship with satisfaction of communication

Information delay and loss, shorter windows of communication time, ethnic/cultural group, reduced identification with the team as a whole were significant negatively correlated ($p < 0.01$) with satisfaction of communication.

In virtual teams, team members are usually scattered around the world, they have a shorter window of communication time than traditional teams. Baltes et al. (2002) reported in their meta-analysis a decrease in members' satisfaction in computer-mediated groups

when discussion time was limited. The current study result is consistent with Baltes and his colleagues' research.

Hecht (1978) defines communication satisfaction in terms of how one feels about an encounter after it is over. The information delay and loss, ethnic/cultural group make the communication ineffective. Honeycutt and McCann (2008) suggested that higher communication satisfaction is associated with enjoying the communication and believing the process flowed smoothly. As the current research shows, in the case of information delay and loss, ethnic/cultural group, the communication process can't get higher satisfaction.

Honeycutt and McCann (2008) indicated that communication satisfaction also occurs within the mind. When people communicated with persons that are important in their lives including co-workers, friends, they felt higher satisfaction. The current study also shows this significant correlation. With the identification with the team as a whole decreased, the satisfaction of communication between team members reduced in the communication process.

According to the regression analysis, only two variables entered the linear equation. The R square value is just .106. The results indicate that it's not good for fitting a linear equation between the communication problems and the satisfaction of communication.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATION

7.1 CONCLUSION

The use of virtual teams is an increasing phenomenon in organizations all over the world, more and more members from different organizations work for the same team at different time without the constraints of geography. The possibility of working in virtual teams is based on long distance communication between team members. Unlike traditional team, the foundation of communication in virtual teams is computer-mediated communication rather than face to face communication. Many new communication problems that the traditional teams don't have are slowly emerging in virtual teams. It is important to understand these communication problems and identify the relationship with communication process in virtual teams.

This study uses a mix of qualitative and quantitative method to investigate the communication problems in virtual teams. The survey results revealed the different frequencies of occurrence of each communication problem in practice. Lack of non-verbal cues was the most common communication problem in virtual teams, followed by the problems of complicated knowledge transfer, unstable relationships between members, differences in educational background, experience and expertise, reduced team identification.

This study also answered the call to better understand the relationships between team demographic variables and communication problems. It discovered that company size had significant relationships with frequency of communication technical failure, decreased job satisfaction, and less shared contextual knowledge. Company type had significant

relationships with frequency of less shared contextual knowledge and lack of non-verbal cues. The numbers of projects the company participated had significant relationships with team identification.

The impacts of the communication problems on the virtual team communication process in practice were also explored. In this study, the communication process was measured by timeliness, understandability, trust, accuracy, and satisfaction. The statistical results indicated nine communication problems were significant negatively associated with timeliness of communication, seven communication problems were significant negatively associated with understandability of communication, five communication problems had significant negative relationship with trust of communication, and eight of them had negative significant relationship with accuracy of communication, four of them were significant negatively associated with satisfaction of communication process.

This study also tries to explain the relationship between communication problems and communication process by multiple regression analysis. The results revealed that the communication process variables have low variance which can be explained by the regression equation on the communication problems.

Based on the understanding of the impacts of the communication problems on communication process in virtual teams, the virtual team participants or managers can effectively work in virtual teams. Managers of virtual teams can check their own team if there are serious communication problems, and assess the impact of these issues on team communication process based on the findings of this study. Furthermore, the study can provide managers with a guiding principle to enhance the performance of virtual team communication.

7.2 LIMITATION OF RESEARCH

There are a number of limitations in the current study. One of the limitations is the population for the study derived from a common geographic location. More than half of the participants of the survey are from China. It is possible that populations from different countries have a different cultural environment which resulted in the different research findings. And limited data impacted the significance of the results.

Participants in this study were limited in answering certain questions regarding their evaluation of communication process. The questions in the survey were on a Likert scale and ranking a response from one to five. The questionnaire did not allow for justifications or individual indications. This may cause the deviation of the data collected.

One final limitation of the study was the possibility of variables ignored. Some of these variables, out of the scope of this study such as team structure, members' ability, leadership may have a unique impact on communication process.

7.3 RECOMMENDATION FOR FURTHER RESEARCH

Based on the research results of this study and theoretical consideration, a number of potential future research opportunities can be considered.

Participation on virtual teams requires effective communication skills, technology knowledge and communication experience. Future research can investigate the relationship between team members' communication skills, technology knowledge, communication experience and communication problems in virtual teams. The research should evaluate how the variables affect the communication process in virtual teams.

In addition, a mix of communication media was used in virtual teams. Future research can explore how different media use affects the frequency of occurrence of communication

problems in virtual teams and investigate how virtual team members select the applicable communication media under specific circumstances.

Equally important, future research should explore appropriate solutions and strategic approach to reduce or avoid communication problems in virtual teams. It is expected that future research into a set of scientific guidelines for the communication process in virtual teams will occur.

Finally, communication technologies are ubiquitous and evolving rapidly, future research may wish to consider the impact of some emerging technologies such as cloud computing, social media on the communication problems we experienced today.

CONCLUSION GÉNÉRALE

Le recours aux équipes virtuelles est un phénomène croissant dans les organisations du monde entier. De plus en plus, les gestionnaires sont amenés à travailler en équipe malgré les distances géographiques et les contraintes de fuseau horaire. Contrairement à l'équipe traditionnelle, la communication dans les équipes virtuelles est une communication médiatisée par l'ordinateur et non une communication de type face à face. Ceci explique pourquoi plusieurs problèmes de communication sont apparus progressivement depuis ces dernières années. Il est important de comprendre ces problèmes afin de les mettre en relation avec le processus de communication au sein des équipes virtuelles.

Cette étude utilise une méthode mixte, qualitative et quantitative, pour étudier les problèmes de communication dans les équipes virtuelles. Plusieurs conclusions ont été tirées de cette étude. L'absence de communication non verbale, le transfert de connaissances complexes, les relations instables entre les membres, les différences dans l'éducation, l'expérience et l'expertise, et l'identification réduite avec l'équipe dans son ensemble sont les cinq problèmes de communication les plus fréquemment rencontrés au sein des équipes virtuelles.

Par ailleurs, la taille des entreprises, le type d'entreprise et le nombre de projets auxquels l'entreprise a participé ont un impact dans les occurrences de certains problèmes de communication telles que l'insuffisance de la communication technique, une diminution de la satisfaction au travail, des connaissances contextualisées moins partagées, le manque de signaux non verbaux et une identification de l'équipe plus réduite.

Les impacts des problèmes de communication sur le processus de communication de l'équipe virtuelle dans la pratique ont également été explorés. C'est la raison pour laquelle le coefficient de corrélation de Pearson a été utilisé afin de déterminer la direction et

l'importance des relations entre les problèmes de communication et les processus de communication (compréhension, satisfaction, précision, efficacité, confiance). Les résultats suggèrent de fortes corrélations négatives entre la plupart des problèmes de communication et les processus de communication des équipes virtuelles. Ainsi, neuf problèmes de communication sont associés à l'efficacité, sept le sont à la compréhension, cinq le sont à la confiance, huit le sont à la précision et finalement quatre le sont à la satisfaction. Toutefois, les relations ne peuvent pas être expliquées significativement par l'équation de régression.

En se basant sur les résultats de cette étude, les gestionnaires des équipes virtuelles pourront désormais mieux évaluer les impacts des problèmes de communication sur leurs processus de communication et, par le fait même, améliorer la performance de leur équipe virtuelle.

Plusieurs limites existent dans cette étude. Une des principales est sans aucun doute le fait que plus de 50% des répondants étaient d'origine chinoise. Il serait donc souhaitable de reprendre cette étude dans un contexte différent. Une autre limite provient du choix des variables retenues pour cette étude. Il serait souhaitable d'introduire d'autres variables comme le leadership, la compétence, la structure des équipes, etc. Il serait aussi souhaitable d'avoir un nombre important de répondants pour réaliser des traitements statistiques plus riches. Il serait également intéressant de reprendre cette étude par type de médium de communication utilisé.

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APPENDICES

Virtual team and communication problem

Thank you for participating this study of virtual team communication problem.

We see you as a professional with vast experience in virtual team work or management and request you to kindly fill up this survey.

All questions are framed in multiple choice format,so, kindly place a mark in the relevant column.

We assure you that all data will be kept strictly confidential and used solely for academic purposes We will provide you the main research findings when they are available if you indicate that you would like to know.

It will take you 5-10 minutes to complete the questionnaire.

I thank you very much indeed in advance for taking the time to participate in the survey

Your sincerely,

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Responder information***1. What's the size of your company?**

- Micro company (1-9 employees)
- Small company (10-49 employees)
- Medium company (50-249 employees)
- Large company (>250 employees)

***2. What is the business of your company?**

- Assurance
- Bank or finance service
- Software development
- Information system support
- Telecommunication
- Consulting

Other (please specify)

***3. In which is your company?**

- United States
- Canada
- China
- Europe

Other (please specify)

***4. Number of projects your organization participated over the past year?**

- 0-4
- 5-9
- 10-20
- >20

***5. Do your company use virtual team?**

- Never use
- Rarely use
- Sometimes use
- Often use
- Always use

***6. Did you participated in the work of virtual team?**

- Never
- Rarely
- Sometimes
- Often
- Always

***7. Please indicate your age.**

- <30
 30-39
 40-49
 50-59
 >59

***8. What's your educational background?**

- Secondary education
 College
 Bachelor
 Master
 Doctorate

Other (please specify)

***9. How many years of experience do you have in virtual team?**

- <1 years
 1-2 years
 3-4 years
 5-6 years
 7-8 years
 >8 years

Communication

***10. Did you know the model of Input-Process-Output (IPO)?**

- Yes
 No

***11. Did your virtual team have communication problems?**

- Never
 Rarely
 Sometimes
 Often
 Always

***12. Did the communication problems affect your virtual team communication process?**

- Not at all affect
 Slightly affect
 Moderately affect
 Very affect
 Extremely affect

***13. Did the communication process problems affect your virtual team effectiveness?**

- Not at all affect
 Slightly affect
 Moderately affect
 Very affect
 Extremely affect

Communication problems

14. Please indicate if the following problems happened in your virtual team?

	Never	Rarely	Sometimes	Often	Always
Few opportunities for monitoring team members	<input type="radio"/>				
Complicated knowledge transfer	<input type="radio"/>				
Lack of non-verbal cues	<input type="radio"/>				
Information delay and lost	<input type="radio"/>				
Communication technical failure	<input type="radio"/>				
Different language	<input type="radio"/>				
Role conflict and ambiguity	<input type="radio"/>				
Role overload	<input type="radio"/>				
Negative work attitudes	<input type="radio"/>				
Decreased job satisfaction	<input type="radio"/>				
Less shared contextual knowledge	<input type="radio"/>				
Poor interpretation of feedback	<input type="radio"/>				
Lack of effective working patterns and information sharing	<input type="radio"/>				
Unstable relationships between members	<input type="radio"/>				
Shorter windows of communication time	<input type="radio"/>				
Decreased team involvement	<input type="radio"/>				
Trouble with accents and fluency	<input type="radio"/>				
Differing attitudes towards hierarchy and authority	<input type="radio"/>				
Ethnic/cultural group	<input type="radio"/>				
Differences in educational background, experience and expertise	<input type="radio"/>				
Poor message clarity	<input type="radio"/>				
Delayed feedback	<input type="radio"/>				
Reduced identification with the team as a whole	<input type="radio"/>				
Conflict between team members	<input type="radio"/>				

Communication process

***15. I can timely access and get the information in the communication process**

- Strong disagree
- Disagree
- Neutral
- Agree
- Strong Agree

***16. In my virtual team's communication process, I can understand all the content of communication.**

- Strong disagree
- Disagree
- Neutral
- Agree
- Strong Agree

***17. I can trust my colleague in my team's communication process.**

- Strong disagree
- Disagree
- Neutral
- Agree
- Strong Agree

***18. I can get the information needed accurately from virtual team's communication process.**

- Strong disagree
- Disagree
- Neutral
- Agree
- Strong Agree

***19. My virtual team's communication process is satisfaction.**

- Strong disagree
- Disagree
- Neutral
- Agree
- Strong Agree

End of survey

Thank you for your participation in this study.

Click submit at the end of the survey when completed. Please do not leave the survey before seeing the message that your survey was sent successfully!

If you would like a summary report of the results of this questionnaire survey, please leave your email address below. Also, we promise that the information will be solely used for the purpose of sending the report.

Thank you again for your kind participation!

20. Your email address

