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Ying-Chieh A. Liu
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COMPARING THE PERFORMANCE AND SATISFACTION OF FACE-TO-FACE AND VIRTUAL TEAMS IN A LEARNING ENVIRONMENT

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Bachelor of Economics
Master of Information Management

A thesis submitted in fulfilment of the
requirements for the degree of

Doctor of Philosophy

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Faculty of Business and Law
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Associate Professor Susan Stoney

June 2007

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

The main purpose of this study is to find whether virtual teams perform as effectively as face-to-face teams and if not, whether solutions can be derived to improve the levels of performance. To this end, the study compares the performance and satisfaction perception levels of virtual teams with face-to-face teams in a learning environment. In order to develop a sound framework for the research, a detailed literature review of prior research encompassing team satisfaction and performance in face-to-face and CMC (Computer Mediated Communication) supported environments was undertaken. Additionally the researcher performed a meta-analysis of previous research studies and from these was able to build a research framework to fit the particular context of this study. This framework has strong statistical power and a solid theoretical base.

The design of the study included the development of a group assignment which could be applied in both a face-to-face (FTF) and virtual team (VT) environment. Students enrolled in a fundamental unit for a bachelor of business course MIS1100 were chosen as the subjects. Quantitative (Structured Equation Model, SPSS) and qualitative methods (interview, discourse analysis) were applied for data analysis.

Findings are summarised as follow:

- (1) The perception of performance and satisfaction within FTF groups is higher than that for VT groups.
- (2) The three factors: communication, relationship building and cohesion show significant impacts on the performance and satisfaction in FTF groups, which implies that FTF groups tend to be social-oriented.

- (3) The three factors: communication, relationship building and collaboration show significant impacts on the performance and satisfaction for VT groups, which implies that VT groups tend to be both social-oriented and task-oriented.
- (4) FTF groups would achieve better performance if they followed regular communication patterns. VT groups would have better performance levels if their communication patterns followed the pattern: process → content → process → content.

In addition, five methods to improve the performance and satisfaction of VT are proposed: (1) Posting well-organised information; (2) Building strong relationships; (3) Increasing “process gain” activities and decreasing “process loss” activities; (4) Providing instructions and facilitation for the discussion of process and content equally, and to achieve better communication patterns; (5) Minimising members’ absences.

Future research should investigate more scenarios and factors affecting virtual teams. Varied scenarios combine different technologies, environments and tasks while other factors include participation, commitment, trust and culture.

DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

- (i) Incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;
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To all my friends who proofread my writing, listened to my complaints and helped me find jobs. Finally, special thanks go to all people who participated in my PhD project, I appreciated your valuable advice and suggestions.

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Articles published from this Research

The following articles were published in books, journals and conferences from this research:

Book Chapter

- (1) Liu, Ying-Chieh., Burn, J., & Stoney, S. (2007). Understanding virtual team performance and process. In G. D. Putnik & M. M. Cunha (Eds.), *Encyclopedia of Networked and Virtual Organizations*: Idea Group.
- (2) Liu, Ying-Chieh., Burn, J., & Stoney, S. (2007). Building a Framework for the effectiveness of virtual teams by meta-analysis. In G. D. Putnik & M. M. Cunha (Eds.), *Encyclopedia of Networked and Virtual Organizations*: Idea Group.

Journal Paper

- (1) Liu, Ying-Chieh., & Burn, J. (2006). A framework to evaluate the performance and satisfaction of virtual teams in on-line learning environment. *Journal of Universal Science and Technology of Learning*, 0(0), 19-47.

Conference Paper

- (1) Liu, Ying-Chieh., & Burn, M. J. (2007). *Can the performance of virtual teams be improved? An empirical study*. Paper presented at the European and Mediterranean Conference on Information Systems, Valencia, Spain.
- (2) Liu, Ying-Chieh., & Burn, M. J. (2007). *Improving value returns from virtual teams*. Paper presented at the European and Mediterranean Conference on Information Systems, Valencia, Spain.
- (3) Liu, Ying-Chieh., & Burn, J. (2006). *How do virtual teams work? Understanding*

virtual teams process by content analysis. Paper presented at the 6th IBIMA Conference, Bonn, Germany.

- (4) Liu, Ying-Chieh., Lin, C., & Li, F.-C. (2005). *Face-to-Face Versus Computer-Mediated Communication: A comparison of experimental literature*. Paper presented at the 10th Asia Pacific Decision Sciences Institute-Collaborative decision making in the Internet era, Taipei, Taiwan.
- (5) Liu, Ying-Chieh & Burn, J. (2005). *Development of a framework for the performance and satisfaction of virtual teams*. Paper presented at the Africa-Asia-Australias Regional Conference, Perth, Western Australia.
- (6) Liu, Ying-Chieh., Lin, C., & Cripps, H. (2005). *Using meta-analysis to develop a framework to evaluate the effectiveness of virtual teams*. Paper presented at the 6th International We-B Conference, Melbourne, Australia.

Key Terms and Abbreviation

- (1) CMC (Computer Mediated Communication): Using computer technology to communicate. For example, communicating through use of Blackboard, email and conference call.
- (2) Cohesion: “a dynamic process that is reflected in the tendency for a group to collaborate and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs.
- (3) Collaboration: working in conjunction with another or others to finish the tasks.
- (4) Communication Pattern: a specific characteristic or arrangement shown in the communication process.
- (5) Content Analysis: a research method used to determine the presence of certain words or concepts within texts or sets of texts. The presence, meanings and relationships of such words and concepts can be analysed to make inferences about the messages within the texts.
- (6) FTF: face-to-face meeting. It is used to present “FTF teams” which run with face-to-face meetings.
- (7) Meta-analysis: a set of statistical procedures designed to accumulate experimental and correlational results across independent studies that address related sets of research questions.
- (8) TEMPO system: a coding system developed by Futoran et al. (1989) to be used to code the contents of group activities.
- (9) VT (Virtual Teams): a team with a small group of people who work through computer communication technology for a specific purpose, normally without face-to-face meetings.
- (10) Virtual Team Processes: a series of actions that lead virtual teams to complete the jobs. They may include both task and social activities.
- (11) Virtual Team Performance: The quality and effectiveness of execution of virtual teams in performing the tasks.

Chapter 1 Overview

1.0 Chapter Introduction and Structure

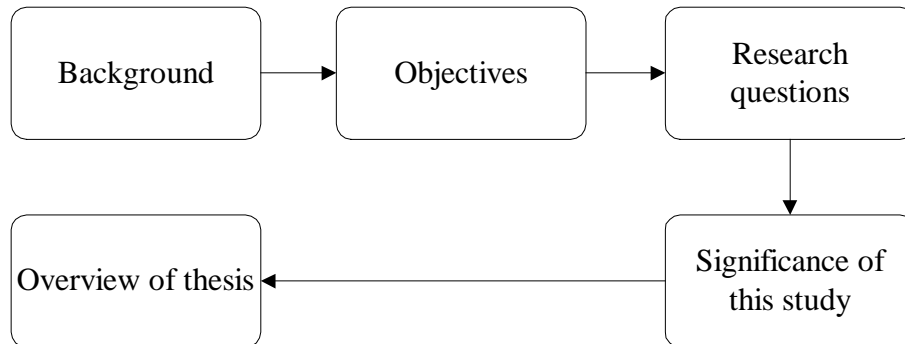


Figure 1.0 The structure of Chapter 1

The purpose of Chapter 1 is to give an overall picture of this thesis. Firstly the background of this study and the current problems of virtual teams are explained. It guides the objectives of this study and research questions, followed by the six key aspects of the significance. At the end of this chapter, the overview of this thesis is introduced. The brief processes and summarised findings of Chapter 2 to 7 are provided.

1.1 The Background of This Study

According to Toffler's (1980) Four Ages of Organization Model, the ideal typology for organizations in the present day is a network: information-based, electronically connected and globally interdependent. Computer networks are changing the way that people and organizations work and communicate (Anderson & Shane, 2002). This has led to a trend where increasingly teams do not work face-to-face but interact via a computer-mediated communication system (Driskell & Radtke, 2003). The trend is towards "virtual teams"- a different way of working.

The meaning of "virtual" in the Oxford English Dictionary is "not physically existing

as such but made by software to appear to do so from the point of view of the program or the user". This definition identifies two key characteristics: "virtual" does not exist in a practical sense - it cannot be touched or is hard to observe; "virtual" is highly dependent on information technology.

What, then is meant by "virtual teams"? According to Geyskens et al. (1996), a virtual team is a temporary gathering of individuals who are connected through information technologies working across time and space to finish a goal. Virtual team members are typically "geographically dispersed", "lack shared social context" and "lack face-to-face encounters" (Sarker et al., 2003). Morris et al. (2002) define "virtual teams" as "involves the creation of a team to meet a specific objective or complete a specific task. They are goal-oriented, temporary and disbanded once the goal has been achieved" (p. 23). Lipnack and Stamps (2000) define virtual teams as "a group of people who work interdependently with a shared purpose across space, time, and organization boundaries using technology" (p. 18).

From these definitions, this study defines "virtual teams" (VT) as "a team with a small group of people who work through computer communication technology for a specific purpose without face-to-face meetings". This definition encompasses three important issues. "Virtual teams" (VT) consists of a small group of people, typically less than 10. According to a review of VT research by Powell et al. (2004), approximately 90% of published articles have a sample size of less than eight individuals. Indeed, Lipnack and Stamps (2000) suggest that a group with 4-7 members is like a family where it is easy to build intimacy and communication and so ideal for VT. Secondly, VT exists temporarily for a specific purpose. For example, stagehands gather together for a show and are dismissed when the show ends. A

group of movie actors play movies together and dissolve after the movies are completed. Finally, VT uses Computer-Mediated Communication (CMC) to communicate with each other without face-to-face meetings. Some virtual teams hold a Face-To-Face (FTF) meeting intermittently and so team member relationships are more complex and further it is not easy to identify the effect of every factor. For example, Kirkman et al. (2004) added FTF meetings to virtual teams' processes to test the effect of the moderating variable "FTF" between empowerment and performance on virtual teams. This kind of virtual teams does not fit the definition of this study and so combined VT-FTF meetings are excluded from this study.

It is said that the use of VT can improve business performance dramatically (Lipnack & Stamps, 2000, p. 22; Roebuck & Britt, 2002; Furst et al., 2004):

- (1) They can cut costs by reducing travel costs and time.
- (2) They can shorten cycle time by changing from serial to parallel processes, building better communications and establishing more widespread trust relationships.
- (3) They can increase innovation by accommodating more varied opinions, motivating new products and processes and promoting new development synergies.
- (4) They can facilitate leveraged learning by retrieving knowledge in the natural situation of doing the jobs, gaining broad access to expertise and sharing experiences.

Although studies on the performance and satisfaction of VT and traditional FTF teams show a variety of findings, generally the performance and satisfaction of VT does not outperform traditional FTF. Warkentin et al. (1997) studied VT versus FTF teams in a

web-based conference system and found that the performance and satisfaction of virtual teams was lower than FTF teams. Due to the absence of FTF meetings in VT, it is not easy to establish intimacy and bonding among the members and so, the decision-making quality and satisfaction of VT is lower than in traditional FTF teams (Valacich & Sarker, 2002; Warkentin et al., 1997). Many research studies also support this result (Galegher & Kraut, 1994; Straus, 1997; Valacich & Sarker, 2002). However, there are a few studies that report the contrary (Sharda et al., 1988) and others found no difference between the two types of teams (Burke & Chidambaram, 1996).

Where there appears to be consensus is that some challenges need to be overcome to reach a better performance and satisfaction level in VT:

(1) Communication obstacle

VT's working efficiency is low due to the nature of online communication. Online communication takes more time for team members to understand the different viewpoints presented, as it is difficult to direct the discussion or interrupt a member's speech. As a result, when a collision of ideas occurs, it is extremely time consuming to reach a conclusion (Anderson & Shane, 2002).

(2) It is difficult to build social relationships

Cohesion among members in VT is weak (Anderson & Shane, 2002). Some members may attempt to contribute nothing and let others carry their workload. Others may feel angry, frustrated and dissatisfied and this results in the team being less productive. In addition, building trust within virtual teams is tough (Kirkman et al., 2002). Without regular FTF meetings, it is hard for people to feel significantly intimate to build social relationships.

(3) The misuse of communication technology

The misuse of communication technology can further break down relationships (Anderson & Shane, 2002; Kirkman et al., 2002). Many VT members experienced misunderstandings, mishearing or misinterpreting messages while working with each other, or overemphasized technical skills and underemphasized interpersonal and teamwork skills. All these issues may lead to low performance and satisfaction of VT.

Prior studies have explored the relationships between the performance of VT and various contributory factors. For example, Driskell and Radtke. (2003) studied the relationships between constructs (cohesiveness, status processes, counter-normative behaviour and communication) and performance of CMC based teams. Similar studies such as Ancona and Caldwell (1992) explored the relationships between diversity and performance; Anderson and Shane (2002) found that netcentricity contributes to the performance of VT; Balthazard et al. (2004) discussed the relationships between performance of VT and expertise, extraversion and group interaction styles. In short, it can be seen that most researchers have focused on the dimensions of factors that affect performance. Only a limited number of studies go further and discuss how to improve the performance and satisfaction of VT. Additionally, many researchers have focused solely on the task dimensions (Bradley et al., 2003; Kirkman et al., 2004; Janz et al., 1997), with few focusing on the social dimensions (Matveev & Nelson, 2004; Chin et al., 1999). There is clearly a need for more investigation on both task and social dimensions, and also the correlative relationships that affect the performance and satisfaction of VT.

There is a crucial meaning in studying in the comparison of FTF and VT. Theoretically the traditional communication theories, such as Social Presence Theory

(Short et al., 1976) and Media Richness Theory (Daft et al., 1987), considered the rich availability of social cues in the face-to-face meetings and supported this natural communication method for group working. However, Walther's (1996) hyperpersonal communication theory asserted that a virtual team, while deficient in face-to-face meetings, is still able to adapt itself to this new environment and achieve high levels of performance. To compare and validate these theories it is necessary to conduct an experiment using FTF and VT groups where the only difference between the two is the lack of face-to-face meetings. This comparison will allow us to identify the influence and role of face-to-face meetings and methods to improve the performance and satisfaction of VT (or FTF) groups.

Many previous studies have focused on the comparison of FTF and VT but these tended to investigate specific factors instead of developing a comprehensive picture for VT. For example, Straus (1997) studied the interactions between participation, extraversion and satisfaction. Warkentin et al. (1997) explored the relationships between group cohesion, process and outcomes. Galegher and Kraut (1994) examined the effects of communication modality and task types toward group performance. There is a need to aggregate these studies and present a more comprehensive framework for VT. Thus, a meta-analysis was applied in this study to summarise the achievements of the past studies statistically and to build such a comprehensive framework.

Summarily, this study applied a meta-analysis to a framework by Powell et al. (2004) which incorporates both social and task dimensions to build an aggregated framework. This framework then formed the basis for, comparing the process, performance and satisfaction of FTF and VT, and exploring methods to improve the performance and

satisfaction of VT.

1.2 Objectives

The study objective is to examine the performance and satisfaction level of virtual teams compared to face-to-face teams in a learning environment. In particular, the study aims to identify the factors that may influence performance and satisfaction, and furthermore builds frameworks for both teams. Then the researcher seeks for approaches to improve performance and satisfaction of virtual teams.

In detail, the objectives of this study are:

- (1) To reveal differences in performance and satisfaction between FTF and VT.
- (2) To explore the potential factors that influence the performance and satisfaction of FTF and VT.
- (3) To reveal how factors affect the performance and satisfaction of FTF and VT along both social and task dimensions.
- (4) To find methods to improve the performance and satisfaction of VT.

1.3 Research Questions

According to these objectives, four research questions are presented below:

- (1) Is there any difference in performance and satisfaction between virtual teams and face-to-face teams?
- (2) Are there any specific social or task factors that affect the performance and satisfaction of virtual teams and face-to-face teams?
- (3) How do the factors affect each other and what impact do the factors have on the performance and satisfaction of virtual teams and face-to-face teams?
- (4) How can we improve the performance and satisfaction of virtual teams?

These four research questions are reviewed in section 2.1.

1.4 Significance of This Study

This study is mainly significant in six key aspects because it:

- (1) Develops a preliminary framework by combining meta-analysis, literature review and research context analysis. This framework provides a holistic view of VT with strong statistical power and solid theoretical support.
- (2) Develops two validated models for FTF and VT individually. The two models give more in depth process views of FTF and VT.
- (3) Identifies different routes influencing FTF and VT processes. The different routes give a further understanding of FTF and VT.
- (4) Uses the TEMPO coding system to quantify the discourse of FTF and VT to represent the communication patterns. These communication patterns enable the researcher to describe members' conversation and uncover hidden facts.
- (5) Provides detailed procedures and documents to enable scholars to replicate the study.
- (6) Provides recommendations for improving the performance and satisfaction of virtual teams while gaining support from and modifying existing underlying theories.

The detailed significances are further elaborated in section 7.1.

1.5 The Flow of This Study

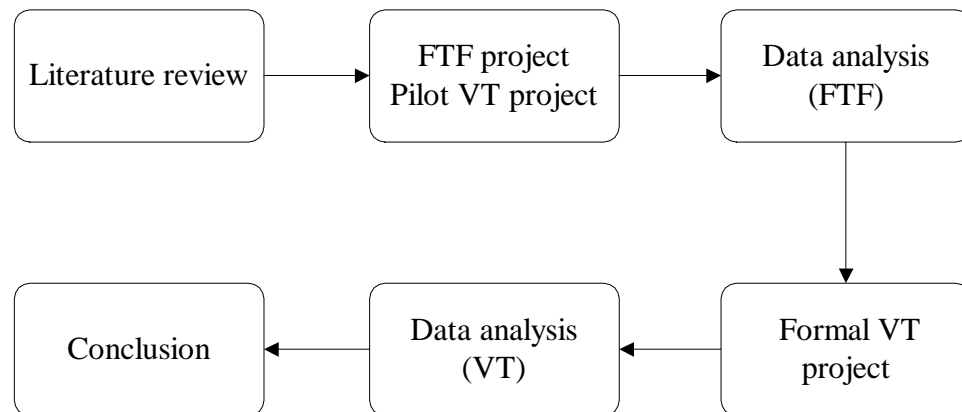


Figure 1.1 The flow of this study

Figure 1.1 shows the rough flow of this study and the detailed flow is shown in Figure 4.1. Firstly, a comprehensive literature review was conducted to establish the theoretical bases and form the framework. Then, a project was executed in a face-to-face setting and followed by the data analysis. A pilot VT project was conducted simultaneously to illuminate the formal VT project. After accomplishing the formal VT project and data analysis, the comparison of FTF and VT was concluded.

1.6 Overview of Thesis

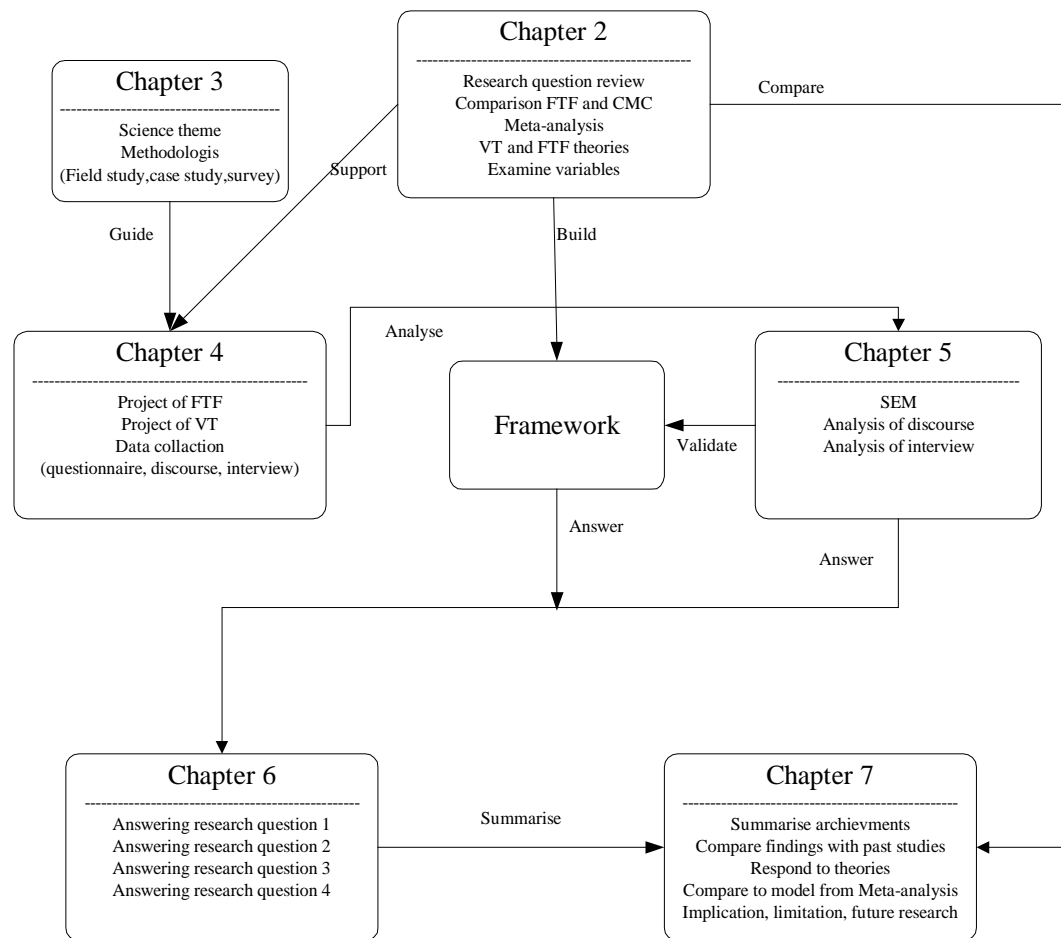


Figure 1.2 Overview of thesis

The final aim of this study is to find methods to improve the performance and satisfaction of virtual teams. Towards this purpose, abundant literature has been reviewed in Chapter 2. Firstly, a review of research question 1 to 4 was conducted. A comparative study on FTF and CMC followed and eleven studies were selected, analysed and compared with a study by Bordia (1997). The issues which were highlighted include: (1) social factors are crucial; (2) caution in using lab experiments; (3) need to integrate the theories; (4) “input” part should be controlled.

Secondly, a meta-analysis was applied to build an initial framework. 47 studies were chosen from 238 which were selected from the electronic database by keywords such

as “virtual teams”, “computer mediated communication” and “decision support”. Then, by using the meta-analysis to aggregate the correlation coefficients provided by these 47 studies, the initial framework was formed. This gave preliminary insight to the factors and their relationships. Afterwards, by combining the discussion of Powell et al’s (2004) framework and the research context of this study, the final framework was formed.

The framework was then evaluated against five existing theories: Matrix of Virtuality, “The Periodic Table”, Media Richness theory, Social Identity and Deindividuation (SIDE) model and Social Information Processing perspective (SIP). “The Periodic Table” gave a whole view of the study; Media Richness theory supported the task process dimension; and Social Information Processing perspective (SIP) sustained the social-emotional process dimension. These three theories formed the theoretical foundation of this study. This was followed by an in depth examination of the six variables in the framework (relationship building, cohesion, communication, collaboration, performance and satisfaction). Each variable was elaborated through definitions, theories, related studies, application and measurements.

Chapter 3 explores the research approach in the context of philosophy, methodology, and tools and technology. This study adopts a very broad view with essences of both positivism and interpretivism. Alavi and Carlson’s (1992) classification of research methodologies frames the methodology discussion. Field study and survey are used as the methodologies in the design and introduced in detail.

Chapter 4 introduces the design of the case study. Students enrolled in a fundamental unit for a bachelor of business course MIS1100 were chosen as the subjects. Two

semesters' case studies were used to collect data. The first semester was for the FTF groups while the second semester was for the VT groups. Methods to collect the four kinds of data (questionnaire, interview, tape recording and Blackboard discussion board) are also evaluated in context.

Chapter 5 analyses the data collected from the case study. Firstly SEM (Structured Equation Model) was applied to explore and validate the best-fit models for FTF and VT individually and it was found that FTF and VT had different routes affecting performance and satisfaction. By comparing the direct and indirect effects of the two models, the influences of each factor on FTF and VT can be explained in detail. The open questions of the questionnaires were analysed to understand students' perceptions of what factors affect their performance and satisfaction. Fifteen interviews of FTF students and 25 interviews of VT students were conducted to reinforce the understanding of the factors' effects on performance and satisfaction. In addition, tape recordings (FTF) and discussion boards (VT) were coded by the TEMPO system and the communication patterns of selected groups were drawn and discussed.

Chapter 6 firstly addresses the research questions and summarises the following findings: (1) The perception of performance and satisfaction by FTF is higher than VT; (2) FTF groups tend to be social-oriented while VT groups tend to be social-oriented and task-oriented. (3) FTF groups would have better performance if the regular communication patterns would form. VT groups would have better performance if the communication pattern follows: process → content → process → content.

Then five methods for improving the performance and satisfaction of VT are

proposed in Chapter 6:

- (1) Posting well-organised information.
- (2) Building strong relationships.
- (3) Increasing “process gain” activities and decreasing “process loss” activities.
- (4) Providing instructions and facilitation for the discussion of process and content equally, and to develop better communication patterns.
- (5) Reducing the absences of members.

Chapter 7 summarises the achievements of this study and presents a comparison of these findings and those from past studies (1985~2002). Then the responses to the three theories which were applied to the framework are discussed. In addition, the final model of VT from SEM and the model from the meta-analysis are compared. Implications, limitations and future research directions are introduced at the end of this thesis.

Chapter 2 Literature Review

2.0. Chapter Introduction and Structure

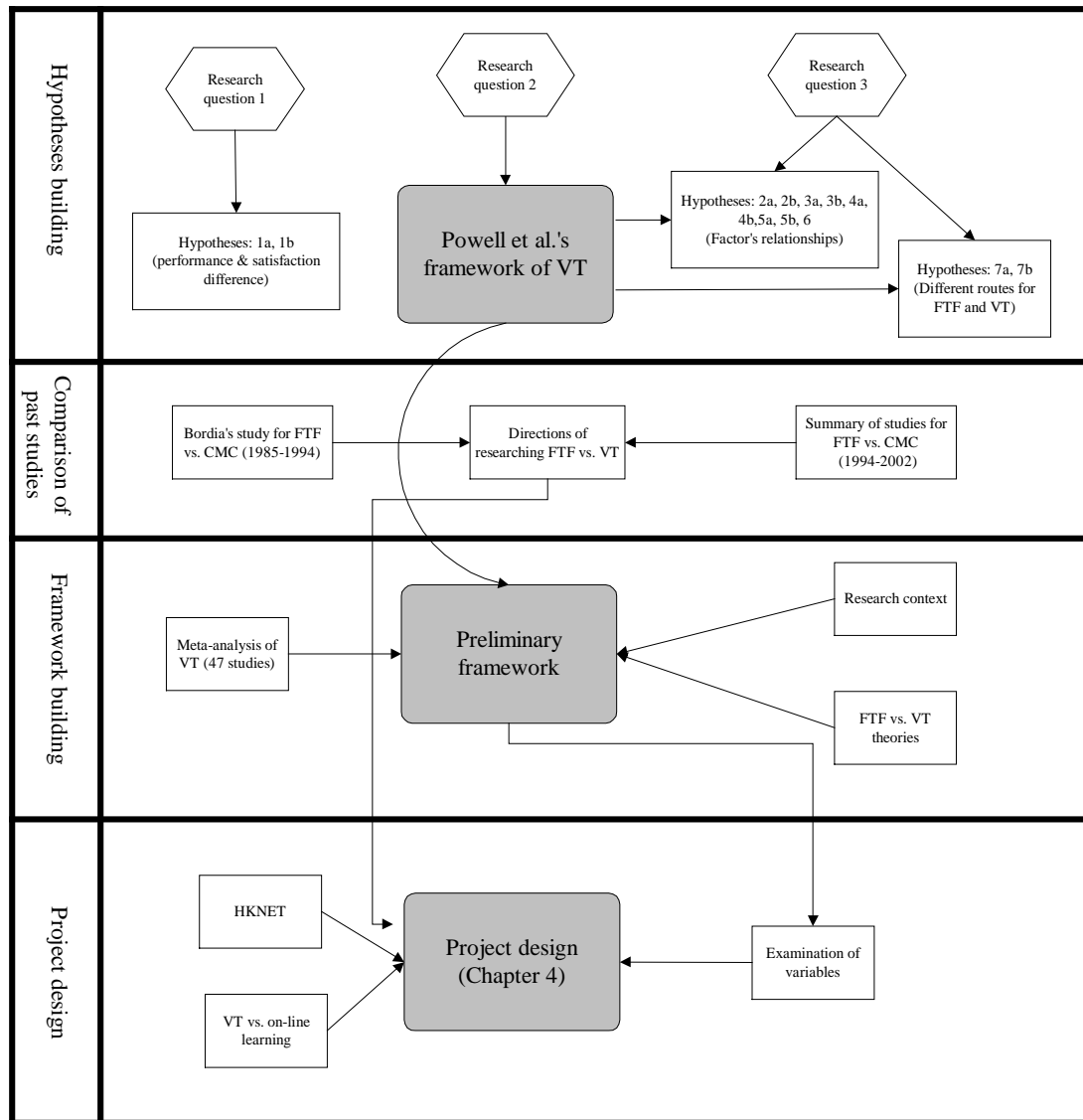


Figure 2.0 The structure of Chapter 2

The purpose of Chapter 2 is to engage in an abundant literature review to support the research questions and build the framework. It is divided into four parts: hypotheses building, comparison of past studies, framework building and project design. Firstly, this chapter reviews the research questions against an overview of prior research results and formulates the hypotheses (section 2.1). Through the discussion of

research question 1, hypotheses 1a and 1b are established. Powell et al's (2004) framework of VT is introduced and forms the basis for a preliminary model in response to research question 2. Hypotheses 2 to 7 are formulated through a review of the issues in relation to research question 3. After the development of the hypotheses, a literature comparison section begins with a synthesis of the findings from studies completed since 1994 focusing on Face-to-Face (FTF) versus Computer-Mediated Communication (CMC). These results are compared with those from an earlier study by Bordia (1997) in section 2.2, which inform the direction of project design. Next, Powell et al's (2004) framework is used as a prototype and examined by a meta-analysis. The results of the meta-analysis are explored within the context of this study and the preliminary framework is formed in section 2.3. Theories about virtual teams are introduced and applied to the framework (section 2.4) for theoretical validation. Each factor within this framework is then further explored within section 2.5. A seven-year virtual team project (HKNET) and characteristics of on-line learning are explored in section 2.6 and 2.7 to illustrate the overall context of this study.

2.1 Justification of Research Questions

This section justifies research questions and builds hypotheses through literature review.

2.1.1 Justification of Research Question 1: Is there any difference in performance and satisfaction between virtual teams and face-to-face teams?

From the previous definition of virtual teams, it can be seen that there are two major differences between FTF and VT: firstly, FTF meetings are absent in VT; secondly,

CMC is the only way through which VT members can convey information and build relationships.

Consequently, another question emerges: are FTF meetings a critical factor influencing performance and satisfaction of teams? In FTF interaction, group members can see, hear, receive messages and give feedback in “real time”. They can see others’ facial expressions (i.e., frown or smile) or gestures (i.e., put thumbs up or wave hands) make eye contact; hear tones of speech and dialect and be aware of who responds to whom. Obviously, the social cue of FTF meetings is richer.

However, do richer social cues make for better performance and satisfaction? According to Social Presence Theory (Short et al., 1976) and Media Richness Theory (Daft et al., 1987), the less information available within a medium, the less attention is paid by other participants. Both theories argue that due to lack of information such as facial expression, posture, dress and nonverbal cues conveyed by CMC, the communication effectiveness is comparatively lower than FTF. According to these theories, richer social cues may lead to more effective communication and better performance and satisfaction. This is reinforced by a study by Kraut et al. (1999) where they also found that the use of electronic communication had negative effects on the performance of virtual teams.

Comparisons of the performance and satisfaction of FTF and virtual teams produce varying results. This study collected and analysed the related research from 1994 to 2002 and listed in appendix 2.1 and compared the findings of research by Bordia (1997) that analysed 18 studies (1985-1994) comparing FTF and CMC in section 2.2. The result shows that a high proportion of past studies found that the performance and

satisfaction of VT was lower than for FTF teams. However, a study by Tidwell and Walther (2002) claimed that the groups using CMC had more direct and intimate communication with reduced uncertainty and demonstrated significantly greater gains and conversational effectiveness. Warkentin et al. (1997) also suggested that VT might have the same level of outcomes as FTF if enough time was given, which is further supported by Walther's (1996) hyperpersonal communication theory. Some studies have even reported that virtual teams had a higher level of participation (Straus, 1997; Valacich & Sarker, 2002), broader discussion (Benbunan-Fich et al., 2001) and more confidence (Tidwell & Walther, 2002). This implies a contradiction in findings since if virtual teams have advantages in some key factors, such as higher participation and broader discussion, why do virtual teams generally have poor performance and satisfaction? Is this due to different environments or different research design? Additionally, the most recent advances in CMC technology may have further impacted on VT performance and result in different findings specifically for VTs. This inspires the researcher's intent to re-examine these results through rigorous design. Therefore, the hypothesis is as below:

Hypothesis 1a: The perception of the performance of VT is lower than FTF

Hypothesis 1b: The perception of the satisfaction of VT is lower than FTF

2.1.2 Justification of Research Question 2: Are there any specific social or task factors that affect the performance and satisfaction of virtual teams and face-to-face teams?

Powell et al. (2004) reviewed 43 articles (1988~2002) about virtual teams and proposed a detailed framework of virtual teams. The framework includes four general constructs: "inputs", "socio-emotional processes", "task processes" and "outputs".

“Inputs” focuses on the pattern and composition of virtual teams, such as design, culture, technical expertise and training. “Socio-emotional processes” concerns the building of social relationships between team members: relationship building, cohesion and trust. “Task processes” represents the processes that team members use to complete a task or reach a goal: communication, coordination and task-technology-structure fit. “Outputs” consists of performance and satisfaction. Performance means the outcome of teamwork while satisfaction relates to the well-being perceived by members. The framework is shown in Figure 2.1.

Driskell and Radtke (2003) found that past research on virtual teams paid too much attention to the development of advanced technological environments instead of the social and psychological dimensions. The advantage of Powell et al’s (2004) framework is that it presents the key issues identified in relation to virtual teams including social factors (such as relationship building, cohesion and trust) and task factors (such as communication, coordination and team structure). Literature pertaining to this framework is examined by a meta-analysis in section 2.3 and issues pertinent to this study further evaluated.

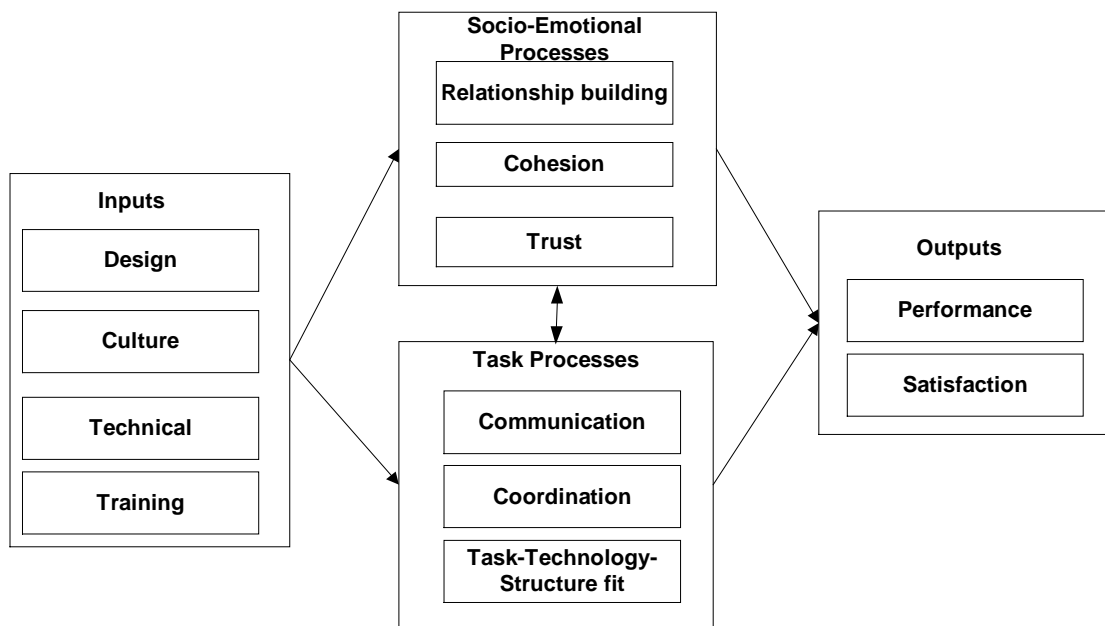


Figure 2.1 Framework of virtual teams (Powell et al., 2004)

2.1.3 Justification of Research Question 3: How do the factors affect each other and what impact do the factors have on the performance and satisfaction of virtual teams and face-to-face teams?

Relationship building can strengthen feelings of inclusiveness or a sense of belonging to teams and further foster cohesion (Powell et al., 2004). Cohesion has been considered to be the most important small group variable (Lott & Lott, 1965). It has been associated with better performance and satisfaction (Lurey & Raisinghani, 2001; Maznevski & Chudoba, 2000). These studies depict a potential path from relationship building to cohesion, and from cohesion to performance and satisfaction.

It is possible that periodic FTF meetings promise the improvement of coordinating members' activities and ensuring the project progress (Maznevski & Chudoba, 2000). However, if FTF meetings are not feasible, exchanging information through CMC fosters coordination and collaboration in virtual teams (Tan et al., 2000). In addition,

collaboration has been linked to performance of teams (Johansson et al., 1999; Maznevski & Chudoba, 2000). This illustrates the potential path from communication to collaboration, and from collaboration to performance and satisfaction.

CMC has also been found to promote interpersonal relationships between team members in the early development of teams (Maznevski & Chudoba, 2000; Robey et al., 2000; Hian et al., 2004), which enables the potential link from communication to relationship building. In addition, a number of studies reported that communication directly links to performance (Walther et al., 2001; Hian et al., 2004).

Figure 2.2 summarizes the results of those studies, showing the connections between relationship building, cohesion, communication, collaboration and performance and satisfaction.

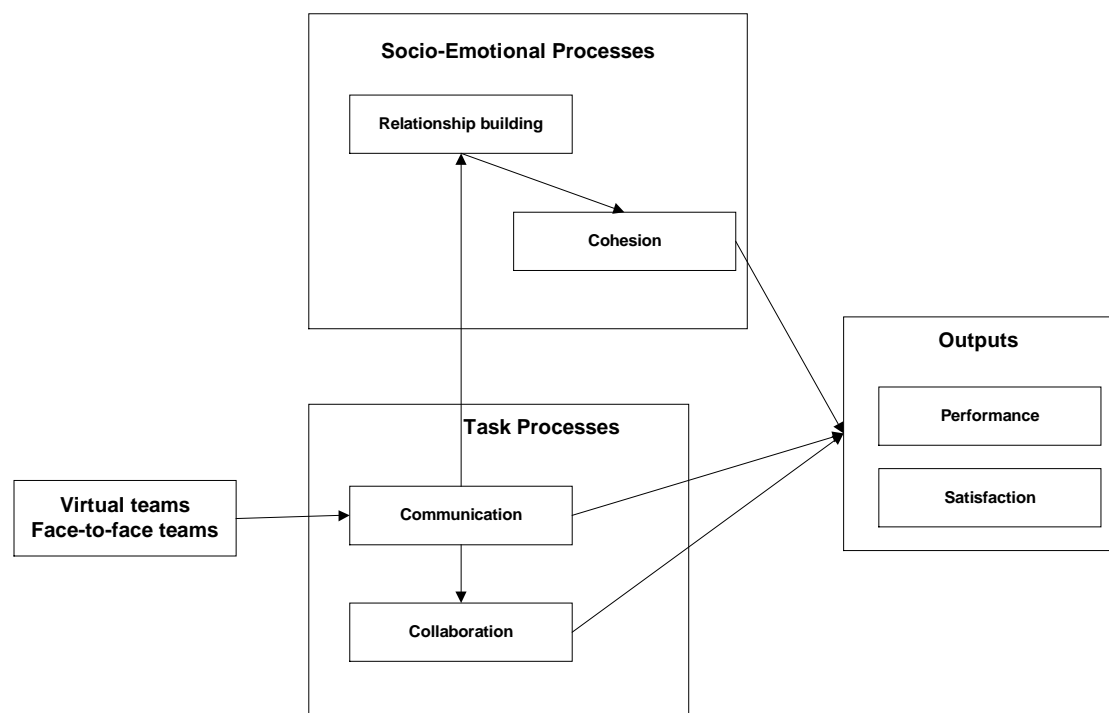


Figure 2.2 The relationships of all concepts

From Figure 2.2, this study proposes a number of hypotheses which will be fully explored in following sections but for the sake of clarity are stated upfront to direct the logical structure of the comparative literature review:

Hypothesis 2a: Cohesion is related to performance

Hypothesis 2b: Cohesion is related to satisfaction

Hypothesis 3a: Communication is related to performance

Hypothesis 3b: Communication is related to satisfaction

Hypothesis 4a: Collaboration is related to performance

Hypothesis 4b: Collaboration is related to satisfaction

Hypothesis 5a: Communication is related to relationship building

Hypothesis 5b: Relationship building is related to cohesion

Hypothesis 6: Communication is related to collaboration

Due to the constraints of CMC and the frustration of using it in VT, VT members “use more task-oriented and fewer social-emotional remarks” (Bordia, 1997, p. 113; Grohowski et al., 1990). Lipnack and Stamps (2000) also regard VT as task-oriented teams. It is possible that VT tends to focus more on the task processes and FTF teams tend to focus on the socio-emotional processes. The different routes hypothesised between VT and FTF are shown in Figure 2.3.

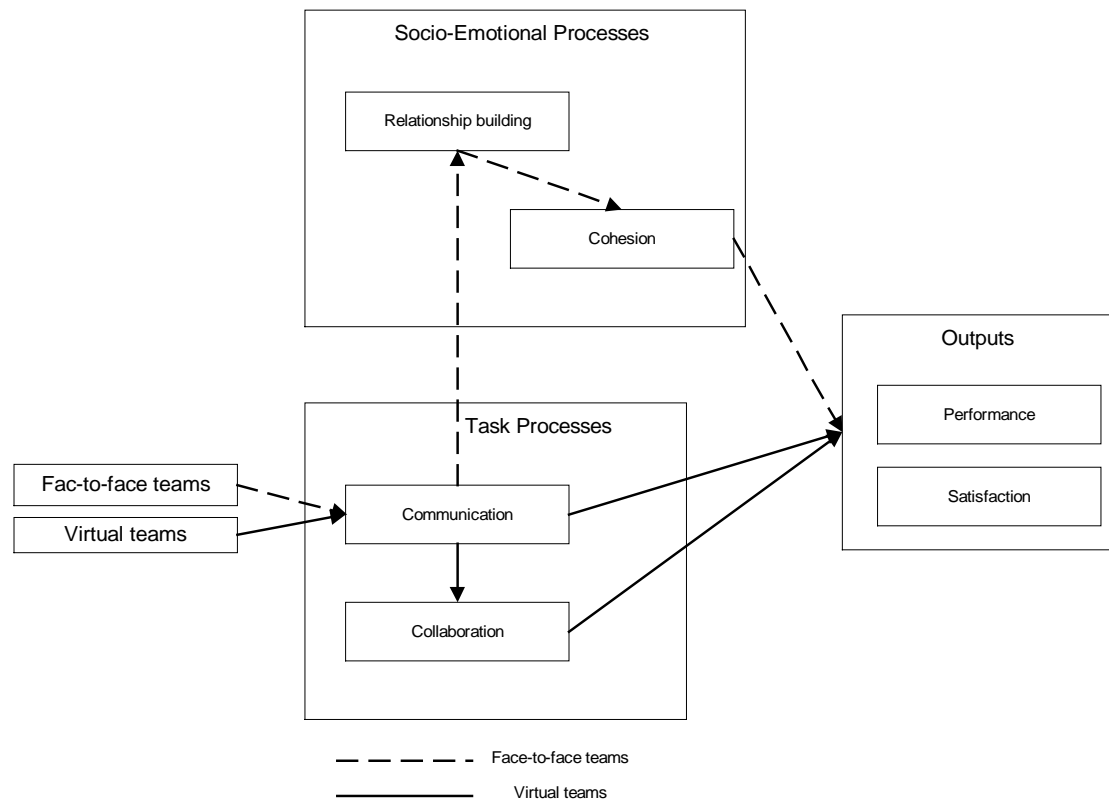


Figure 2.3 The different routes of VT and FTF

From Figure 2.3, the seventh hypothesis is as below:

Hypothesis 7a: The route of VT is “communication → Collaboration → output”.

Hypothesis 7b: The route of FTF is “communication → relationships building → cohesion → output”.

2.1.4 Justification of research question 4: How can we improve the performance and satisfaction of virtual teams?

Research question 4 extends the study using the results from research questions 1 to 3 and a further analysis of prior research. For example, Kirkman et al. (2002) suggest that extensive training helps overcome process loss in leadership, conflict management and meetings management. In addition, using behavioural interviewing techniques and panels to help new members can balance technical and interpersonal

skills to avoid misuse of technology. Solomon (2001) suggests that the provision of proper technology for communication, understanding the needs of the team and creating a sense of shared space can help virtual teams improve their performance and satisfaction. Markus (2004) recommends that better IT support, adhesive relationships and better work practices can improve the performance of virtual teams. Qureshi and Vogel (2001) suggest that a facilitation mechanism is an important issue for enhancing performance. From these studies, it can be seen that task dimensions (such as communication and collaboration) and social dimensions (relationship building and cohesion) are both important for improving the performance and satisfaction of VT. The answers to research question 4 are discussed in Chapter 6.

2.2 A Comparison of Face-to-Face (FTF) and Computer-Mediated Communication (CMC)

Over the last decade the use of computers and electronic networks have become common place in all areas of working and community life. This has facilitated people working over a widely dispersed area but in close communication through computer mediated communication (CMC). As a result, there has been a proliferation of studies that focus on the comparison of face-to-face (FTF) and CMC. Bordia (1997) reviewed eighteen experimental studies (1985~1994) from psychological, sociological, business and communication databases and summarized them into ten major groupings related to the comparison of FTF and CMC. This section reviews these findings and analyses eleven studies (listed in appendix 2.1) that focus on the comparison of FTF and CMC (1994~2002), and compares these results against Bordia's (1997) findings.

2.2.1 Introduction to Bordia's Study

Bordia's (1997) ten findings are as below:

1. CMC groups take longer to complete the allotted task.
2. In a given time period CMC groups produce fewer remarks than FTF groups.
3. CMC groups perform better than FTF groups on idea generation tasks.
4. There is greater equality of participation in CMC groups.
5. When time is limited, CMC groups perform better than FTF groups on tasks involving less, and worse on tasks requiring more, social-emotional interaction.
Given enough time, CMC groups perform as well as FTF groups.
6. There is reduced normative social pressure in CMC groups.
7. Perception of partner and task is poorer in CMC groups.
8. In CMC, evaluation of the communication partner is poorer under conditions of limited time. Evaluation of the medium is influenced by the type of the task.

- 9a. There is a higher incidence of uninhibited behaviour in CMC groups.
- 9b. CMC induces a state of deindividuation, which in turn leads to uninhibited behaviour.
10. CMC groups, as compared to FTF groups, exhibit less choice shift or attitude change.

These ten findings are categorised and matched against to Powell et al's (2004) framework as shown in Figure 2.4.

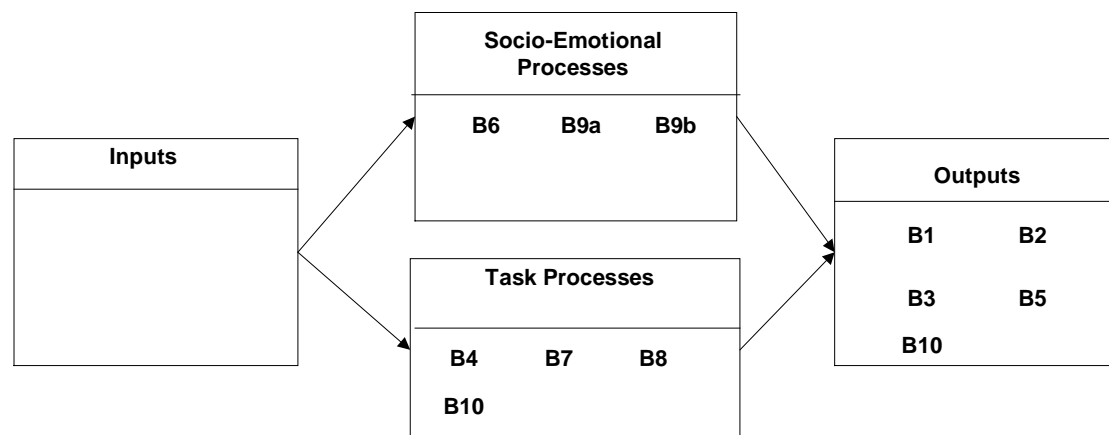


Figure 2.4 Categorizing Bordia's 10 findings against Powell et al's (2004) framework

PS: Bx is Bordia's finding. For example, B6 is Bordia's finding 6

It can be seen that Bordia's (1997) findings are located mainly in the task and output dimensions and further the output part focuses solely on performance instead of satisfaction. This would seem to add support to the conclusion that the social dimension needs more investigation.

2.2.2 The Ten Findings of The Analysis

Eleven studies from 1994 to 2002 focusing on the comparison of FTF and CMC have been chosen as samples for this analysis by using the keywords "computer-mediated communication" and "CMC and FTF" to search in the ProQuest electronic database and listed in appendix 2.1. These have been reviewed and summarised into ten

findings and compared against Bordia's (1997) findings are as below:

(1) The performance of CMC group is worse than FTF groups

According to appendix 2.1, most studies suggested that the performance of CMC groups is worse than FTF groups (Galegher & Kraut, 1994; Warkentin et al., 1997; Dufner et al., 2002) while only one study identified no significant difference between both teams (Burke & Chidambaram, 1996). The result is consistent with Bordia's finding 2.

The causes of why CMC had worse performance vary, such as insufficient training (Dufner et al., 2002) and insufficient time to communicate (Dufner et al., 2002). It seems that time is a crucial issue for performance. If time is enough (for communicating or training), the performance of CMC groups could be the same as FTF groups. This finding is correspondent with Bordia's finding 5.

(2) The satisfaction of CMC group is lower than FTF groups

According to appendix 2.1, most studies found that the satisfaction of CMC groups is lower than FTF groups (Galegher & Kraut, 1994; Straus, 1996; Warkentin et al., 1997; Dufner et al., 2002; Ocker, 2002; Valacich & Sarker, 2002) while only one study stated that CMC members had greater enjoyment during the process (Shen et al., 2001).

These studies did not explain why CMC groups had lower satisfaction. Only Shen et al. (2001) stated that the grading system (including grading criteria) might affect satisfaction. Bordia did not provide any conclusion about satisfaction, which implies that the earlier studies put more focus on performance instead of members' perception

of satisfaction.

(3) CMC groups take longer time to complete the tasks

The speed of typing messages for CMC users is far slower than the speed of speaking for FTF. With less social cue and communication content, CMC groups need a longer time to exchange information and to complete tasks (Stratus, 1996). Stratus (1996) even identified that CMC groups took about twice as long to finish the task. However, CMC groups put more focus on the task itself. Benbunan-Fich et al. (2001) observed the task focus within CMC groups:

“They usually began their discussion by trying to solve their differences and only when the deadline was approaching, they paid attention to the worksheet questions. In asynchronous groups, most of the time was consumed in the solution of the disagreements (discrepancy reduction) or discussion of new issues that came up. During the course of the experiment, asynchronous groups had to decide how and when to proceed if they encountered missing/absent members. The rest of the team identified them when they failed to post their individual position statement by the deadline.” (p. 6)

Straus (1997) studied the relationships between task type and productivity and found that the task focus is positively associated with productivity in idea generation tasks while task focus is not associated with productivity in tasks requiring consensus. This result is consistent with Bordia’s finding 1.

(4) It is more difficult for CMC groups to coordinate tasks

Some studies reported that CMC groups had difficulty in coordinating (Benbunan-Fich et al., 2001; Dufner et al., 2002; Galegher & Kraut, 1994). In

addition, Benbunan-Fich et al. (2001) observed the coordination strategy of FTF groups:

“In order to prepare the final report, every manual group appointed a member in charge of taking notes during the discussion (concurrent). This person had the responsibility to submit the group report at the end of the session. Sometimes, the rest of the group had to wait until the note-taker could write down the important aspects of the discussion (sequential). In a few cases, the note-taker added extra ideas to the final report. This explains why some issues not mentioned in the discussion appeared in a few group solutions.” (p. 6)

Otherwise, Benbunan-Fich et al. (2001) described the coordination strategy of CMC:

“Three groups appointed a representative to compile the individual contributions and develop a group report (pooled), while two groups decided to assign each participant a different part of the final report (parallel). In the pooled collaboration mode, the compiler summarized the individual position statements based on the discussion transcripts, and posted drafts of the final reports to get approval from the rest of the team. In one online group, the compiler exercised some discretion and added extra ideas to the final report. But when the drafts were presented for approval, nobody seemed to detect or object to these extra ideas.” (p. 6)

Benbunan-Fich et al. (2001) noted that CMC groups used parallel and pooled approaches while FTF groups used a combination of concurrent and sequential strategies. However, they also concluded that CMC groups adopted loosely coupled interaction modes with lower levels of interdependence when compared to FTF groups. One interesting phenomenon is that both teams appointed one member to summarise and aggregate others' opinions and finish the reports. In addition, the

representative added his/her opinions to the report without others' agreements.

The coordination strategy is absent from Bordia's findings.

(5) Communication effectiveness is still ambiguous

Communication effectiveness is crucial for group interaction and performance (Fisher & Ellis, 1994). Many studies examined the communication effectiveness between FTF and CMC, but the results varied. Some studies stated that CMC groups had better communication effectiveness (Straus, 1997; Tidwell & Walther, 2002; Benbunan-Fich et al., 2001) while other studies explained that there was no difference in communication effectiveness between the two teams (Burke & Chidambaram, 1996; Warkentin et al., 1997).

Possible factors that affect communication effectiveness are cohesion (Warkentin et al., 1997) and social relationships (Warkentin et al., 1997). Bonding may affect communication effectiveness such that if members feel close and intimate, the communication effectiveness could be better.

This result is consistent with Bordia's finding 8, but the causes are different. Here, the cause affecting communication effectiveness tends to be social relationships while the cause tends to be the medium's inability to convey positive affective information in Bordia's study. Social relationships and the medium's ability are both possible reasons to affect communication effectiveness. However, due to the development of CMC technology, the medium's ability has advanced and it may be not a problem anymore, hence this results in recent studies.

(6) CMC groups present higher participation

CMC groups show higher participation levels (Valacich & Sarker, 2002; Straus, 1997; Straus, 1996). This may be due to the characteristics of CMC. In a FTF environment, members cannot participate simultaneously in the discussion and still be heard. But in a CMC environment, members can type messages and share information simultaneously (Straus, 1996). CMC reduces the obstacles and becomes an enabler that facilitates the participation (Straus, 1996).

This result is consistent with Bordia's finding 4. Bordia suggests that participation is related to proficiency. The more experienced subjects had higher participation level.

(7) Social relationships are not easy to build in CMC

Many studies suggested that cohesion is lower in CMC groups (Straus, 1997; Ocker, 2002; Warkentin et al., 1997) and it is not easy to build friendships in a CMC environment (Shen et al., 2001). This result corresponds to Media Richness theory (Daft et al., 1987). The theory suggests that CMC has narrow channels and carries less social cues, thus it is difficult for CMC members to build social relationships.

The result is consistent with Bordia's finding 6 and 7 where Bordia found that CMC members had poor understanding of each other.

(8) CMC groups show higher conflict

CMC groups have stronger conflict (Valacich & Sarker, 2002; Ocker, 2002). A possible reason is that there are greater differences between the individual decisions and group decisions (Valacich & Sarker, 2002). CMC members can express their own ideas individually more than FTF members and as such more conflict occurs during

the process of opinion convergence and consensus arrival in CMC groups.

This result is indirectly correspondent with Bordia's findings 10. Bordia's finding 10 suggests that CMC groups exhibit less choice shift or attitude change. This means that CMC members tend to hold onto their own view individually more than FTF members.

(9) The decision quality of CMC groups is worse than FTF groups

FTF groups reported better decision quality (Benbunan-Fich et al., 2001) and CMC groups made riskier decisions (Valacich & Sarker, 2002). Thus, the decision quality of CMC groups is inferior to FTF groups. The reason may be due to lack of information (Valacich & Sarker, 2002). This finding is correspondent with the Media Richness theory (Daft et al., 1987) that if there is less information exchanged, the degree of uncertainty is higher, and then the riskier decisions are made.

Although the decision quality of CMC groups is worse, CMC members feel more flexible. Shen et al. (2001) quoted CMC members' feelings in terms of flexibility: "I don't have to go to campus. I communicated actually from India"; "The best was you could really think about the question ahead of time and then post your version of the answer with thorough organizing and proofreading" (p. 8).

Surprisingly, Bordia's findings did not include conclusions in relation to decision quality. But in finding 2, he quoted some studies explaining that the decision report of CMC groups got fewer marks than FTF groups. While in finding 7, he explained that CMC groups made more error in their choices and decisions. Thus, this finding indirectly supports Bordia's finding 2 and 7.

(10) CMC groups are excellent in the idea generation tasks

CMC groups have better performance with idea generation tasks (Benbunan-Fich et al., 2001; Straus, 1997). A possible reason is the nature of CMC which allows members to have sufficient time to think and respond deliberately. Thus, CMC groups have broader discussions and produce longer and better reports than FTF groups (Benbunan-Fich et al., 2001). This finding is correspondent with Bordia's finding 3. Bordia suggested that due to "reduced production blocking" and "evaluation apprehension", CMC groups could produce more ideas than FTF groups.

2.2.3 Summary of the Findings and Comparison with Bordia's Study

When the findings of this analysis are also categorised against Powell et al's (2004) framework (as shown in Figure 2.5), it can be seen that the recent studies still focus on the task and output dimensions.

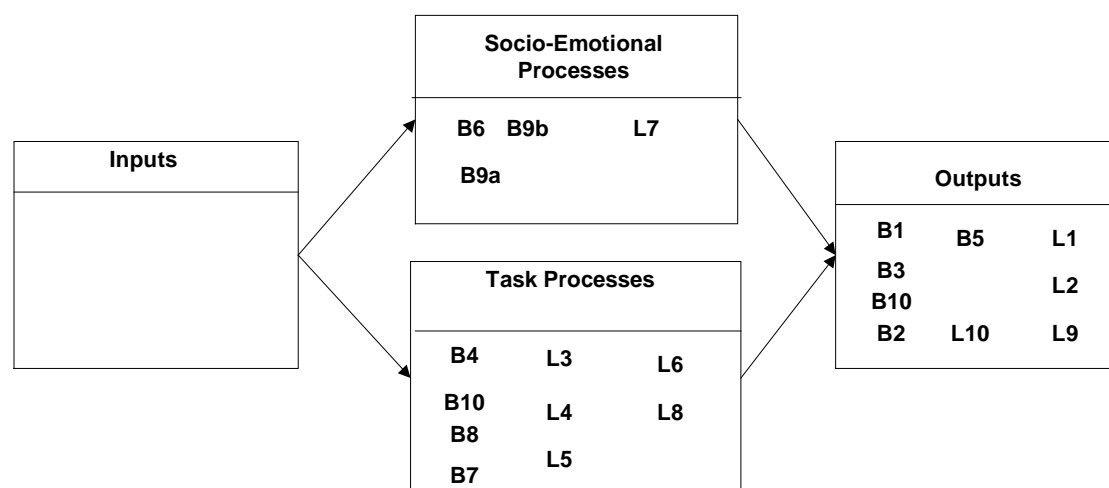


Figure 2.5 Categorising the findings of this analysis and Bordia's study into Powell et al's framework.

PS: Bx is Bordia's finding while Lx is this study's finding.

The following section compares all findings of this analysis and Bordia's study as listed in appendix 2.2. One finding absent from Bordia's study is finding 4 (coordination) and only partly supported is finding 2. This implies that recent studies gradually noticed and extended their antenna to human perception of satisfaction and how group members interact and coordinate. One finding of Bordia's study that is absent from this analysis is finding 9 (uninhibited behaviour and deindividuation). This may be due to the limited samples.

2.2.4 New Trends from Recent Studies

Compared to Bordia's study, this section explores the new trends shown by recent studies:

(1) Increasing attention on social dimensions and human aspects

Researchers have put more focus on social dimensions and human aspects such as satisfaction, cohesiveness, friendship, conflict and participation. Although these social and humanistic factors have begun to be explored, there is still a need to examine the factors' relationships and their impacts on the outcomes of FTF and CMC.

(2) Integrate more theories

With the development of new theories, recent scholars have incorporated more social theories into their studies, such as SIP (Tidwell & Walther, 2002), SIDE (Tidwell & Walther, 2002) and TIP (Warkentin et al., 1997), while still covering previous theories such as Media Richness theory (Baker, 2002). This trend of applying social theories to the research context is gaining credence.

(3) More investigation on the "input part"

Recent studies have begun to focus on "input part", such as training, environmental settings and cultural issues. Due to the complexity of the environment of FTF and CMC, there seems to be no convergence in the conclusions. For example, what is the

optimum group size? How long does the training take? How should tasks be designed? Although some studies have started to explore this, we still need more investigation.

Although these issues have gradually been explored, with the fast advancement of technology and rapidly changing business environment, not only the individual factors of human issues, tasks and technology but also their interactions and relationships need more investigation.

2.2.5 Implications

From the discussion above, some implications and directions are as below:

(1) Social dimension still needs more attention

According to Figure 2.5, it can be seen that both studies suggested that research along the social dimension is inadequate. To know more about the content and process of FTF and CMC, we need to understand more about the social and psychological aspects (Warkentin et al., 1997). Warkentin et al. (1997) also suggest that adding FTF meetings to the CMC teams could improve the development of social relationships and performance and satisfaction of VT. Thus, the success of CMC group may depend on the provision of social content sharing (Warkentin et al., 1997). Social factors, such as friendships and its impact on outcomes (Shen et al., 2001), relationships building and cohesion (Powell et al., 2004) are worthy of further investigation. Additionally, the social factors' relationships and their impacts on the output (performance and satisfaction) are also crucial in the future research.

(2) Researchers should put more focus on “input” part

From Figure 2.5, it is obvious that few studies investigate the “input” part of Powell et al.'s (2004) framework. This includes design, culture, technical expertise and training.

The following section discusses training, culture and setting (includes design and technical expertise):

Training

Dufner et al. (2002) reported that learning how to use the CMC system to finish the problem solving process was more confusing than not using the CMC system. The subjects reported the training time was not enough. Being more familiar with the tools may allow users to concentrate on the interaction with other group members instead of tools (Warkentin et al., 1997). Thus, training could be a crucial issue that affects the outcomes. For example, how long is adequate for training? What kind of training courses should match with different tasks?

Settings

Setting includes design and technical expertise and relates to the subjects, environments and technologies. Valacich and Sarker (2002) suggested that their results should be examined in other settings, for example, different population and different problems. Burke and Chidambaram (1996) suggest the future research should focus more on expertise, authority and power. In addition, the grading systems and instructors' role in the processes need more exploration (Shen et al., 2001). Furthermore, from appendix 2.1, the group size ranges from 3 to 6. Which size is the most appropriate for specific kind of tasks? These topics which relate to subjects' characteristics, project design, evaluation methods and leadership (Warkentin et al., 1997) deserve more attention by researchers.

Culture

Although culture has been a popular topic in other areas, fewer studies have compared

the cultural issues in the settings of FTF and CMC. Most studies just focus on CMC or virtual teams. One such study by Ryssen and Godar (2000) explored the cultural issues in multinational virtual teams (America and Belgium). The result indicates that language and socialization background are important for multinational virtual teams. HKNET which is introduced in section 2.6 also explored eastern and western cultural differences through a project lasting for seven years. Dafoulas and Macaulay (2001) studied global virtual software development teams and discussed how cultural differences between teams or the members may affect activities in different stages of the development cycle. Specifically then, culture may be an important issue in CMC and FTF when the counterparts are in different countries or have different cultural backgrounds.

(3) Time dimension should be taken into consideration

There is a general consensus that CMC groups need more time to communicate with each other and complete tasks (Galegher & Kraut, 1994), yet Burke and Chidambaram's (1996) study found that there were no significant differences between CMC and FTF. A possible reason for this was that time was too short (4 weeks). "If we'd had the opportunity to observe more sessions, we might have seen greater differences among those patterns of change" (Burke & Chidambaram, 1996, p. 99). Otherwise, the Social Information Processing (SIP) theory by Walther (1992) also suggests that if the time is enough for CMC groups, members can build social relationships as effectively as FTF groups. Thus, time may crucially affect the result of research. By observing appendix 2.1, the time across all studies varies from tens of minutes to one month. How much time do CMC members need to communicate adequately? According to Burke and Chidambaram (1996), one month seems inadequate and a longitudinal study is needed (Straus, 1997).

(4) Start to investigate the real world

By observing appendix 2.1, most studies used lab experiments. Students were used as subjects to examine the theories and hypotheses. There are two drawbacks: firstly, there are time limitations associated with lab experiments which may influence the ability for CMC groups to build relationships and secondly, because of the experimental environment of a lab, results may not reflect the real situation and so, the explanatory ability of the results to generalise to the real world is lower.

Some studies recognise this situation and urge natural settings (Ocker, 2002), although the natural environment whereby both FTF and VT groups exist simultaneously is not easily available. Schools that have both on-line and on-campus courses should be a good trial.

(5) New technology needs more investigation

With the rapid advance of new technologies, faster and more convenient tools have been introduced, such as IP phone, Instant Messenger. However, the advantages of new technology do not always outweigh the disadvantages (Warkentin et al., 1997). New technology may hinder the development of social relationships and lower the satisfaction with the members' interaction process (Warkentin et al., 1997). Using different systems may yield different results (Straus, 1996). Therefore, it would be valuable to investigate the impact of new technology on the contents and strategies of group interaction.

2.2.6 Conclusions

Comparing the results of the analysis and Bordia's study, some important issues arise:

- Social dimension could be crucial and must be included in the study.
- Researchers must be cautious when using lab experiments as little distinction of design may influence the diversity of findings.
- It is necessary to integrate theories such as Media Richness theory, SIP, SIDE and TIP (these theories are elaborated in section 2.4) in the study.
- From the literature, “input” part is quite complicated and impacts all other factors (such as collaboration and relationship building). Thus, “input” part is suitable for independent studies in the future, but should be a constant in this study (as far as possible) to eliminate unknown effects.

2.3 Building the Framework of This Study

In this section, the framework is built through a meta-analysis. Firstly, the reasons for using the meta-analysis and the basic principal of the meta-analysis are introduced. Then, the processes and the analysis results are demonstrated. The framework of this study is formed in section 2.3.8.

2.3.1 Why Use Meta-Analysis

A review of previous VT research shows “poor cumulation” (Rosenthal, 1984) of study results. Researchers have typically started anew with each succeeding study. For example, Ancona and Caldwell (1992) explored the relationships between diversity and performance in virtual teams. Anderson and Shane (2002) found that net-centricity contributes to the performance of virtual teams. Driskell and Radtke (2003) studied the relationships between constructs and performance of virtual teams, such as cohesiveness, status processes, counter-normative behaviour and communication. Balthazard et al. (2004) explored the relationships between performance of virtual teams and expertise, extraversion and group interaction styles. While all these studies have generated interesting results they are quite disparate and there is a need to aggregate the studies and develop a holistic picture in relation to factors influencing the satisfaction and performance of virtual teams (Pinsonneault & Caya, 2005).

A meta-analysis is a research method that combines many results from individual studies and applies statistical analysis to retrieve the generalised quantitative conclusions (Hunter & Schmidt, 1990). It is important because it identifies factors of overall significance and results indicate the aggregated findings of the research studies of different studies that have been conducted under different circumstances.

This provides it with the capability to examine causal relationships and theories, and to be used to build theoretical frameworks (Hunter & Schmidt, 1990).

It has several potential strengths. Firstly, it is able to represent the “big picture” of a certain topic by increasing the sample size to strengthen statistical power. Thus, the analysis results can yield more generalisable conclusions than individual studies (Hunter & Schmidt, 1990). Secondly, a meta-analysis enables researchers to become conversant with a specific topic quickly and efficiently. Finally, it can identify inconsistencies between different studies and test hypotheses about factors that may be moderators or mediators.

2.3.2 The Basic Principle of Meta-analysis

The basic principle of a meta-analysis is to calculate the effect size for each study, transform them to a common metric and integrate them to obtain an average effect size. Once the mean effect size is calculated, it can be expressed in terms of standard normal distribution by dividing by the standard error of the mean. A significance value (p-value) can also be retrieved. The significance of the mean effect size can be judged by the confidence interval constructed around the mean effect size.

Fixed versus Random Effects Models

A meta-analysis is used as a way of determining the population effect size by combining the effect size of individual studies. In considering differences between various studies, there are two assumptions: the effect size of the population is assumed to be the same for all studies included in a meta-analysis. This is referred to as a homogenous fixed effects model. Alternatively, the population effect size is

assumed to vary randomly from study to study, this is described as a heterogeneous random effects model. The standard error associated with fixed effects models is smaller than that associated with random effects models (Hunter & Schmidt, 1990).

Heterogeneity Test

A heterogeneity test is a method to determine whether a series of sample effect size is more varied than would be expected on the basis of sample variability if all studies had the same population. The test can decide whether a fixed effects model or random effects model should be used (Hedges & Olkin, 1985).

2.3.3 The Processes of The Meta-Analysis

The aim of this section is to develop a framework to evaluate the performance and satisfaction of virtual teams. For this purpose, the best way is to find a broad, existing framework and then assess the relationships between variables. Correlation coefficients have been used extensively as an index of the relationship between two normally distributed variables. The correlation coefficient is therefore a natural candidate as an index of effect magnitude suitable for accumulation across studies and is used in this study (Hedges & Olkin, 1985). The steps of the meta-analysis applied in this section combine the guidelines proposed by Hedges and Olkin (1985) and Hunter and Schmidt (1990).

(1) Nominate the variables

Powell et al's (2004) framework of virtual teams is used as a prototype shown in Figure 2.1. The framework includes four general constructs (inputs, socio-emotional processes, task processes and outputs) and twelve variables (e.g., design, culture, technical, training, relationship building, cohesion, trust, communication coordination,

task-technology structure fit, performance and satisfaction). Although this framework is holistic and integrates all possible variables affecting virtual teams, Powell et al. (2004) only summarised the literature and the relationships between variables are not tested, confirmed or clarified. Thus, there is a need to examine the relationships between variables to find out if they correlate and how strong their relationships are.

(2) Selection of studies

Once the variables are decided, the next step is to find and choose appropriate studies. Descriptions of these 47 studies are provided in the data collection section.

(3) Arrange correlation coefficient

This step includes the categorization of variables' relationships and the development of frequency distribution tables of variables' relationships (appendix 2.3, 2.4). The detail is explained in the sections of data collection (section 2.3.4) and data analysis (section 2.3.5).

(4) Engage in the meta-analysis

A meta-analysis software "Comprehensive Meta Analysis" is used to analyse the data. The software was developed by Biostat Company (<http://www.meta-analysis.com/index.html>) in 2000. It is a statistical analysis software package for research synthesis. The program combines ease of use with a wide array of computational options and sophisticated graphs. The outcome of the analysis is shown in appendix 2.5.

(5) Heterogeneity Test

Hedges and Olkin (1985) state that the main purpose of a heterogeneity test is to

check the heterogeneity between each effect size and calculate the Q-value. The higher the Q-value is, the higher level the heterogeneity is. The Q-values of each variable's relationship are listed in appendix 2.5.

(6) Calculate fixed effect and random effect

Choosing a fixed effect model implies that samples are from the same population (Egger et al., 2001). Thus, if the sample of each study is unlimited, the effect size of each study will be the same. However, this leads to results with a large Q-value and biases the test. Random effect models assume that the populations of the samples are different. If the sample of each study is unlimited, the effect size of each study will not be the same. It shows the data as a distribution instead of an estimation of single value. The random effect distribution is commonly supposed to be a normal distribution.

(7) Choose fixed effect or random effect model

The choice of models relates to the significance of the Q-value. Differences in results between the fixed effect and random effect models may be caused by differences in quality of studies and it may be necessary to exclude certain publications. If the Q-value is too big, the random effect model should be chosen instead of the fixed effect.

(8) Test the significance of variables' relationships

In the final stage, the significance of variables' relationship is tested by estimating the confidence interval. If the confidence interval includes 0, the two variables' relationship is not significant at the 95% confidence level. If the confidence interval does not include 0, the two variables' relationship is significant at the 95% confidence

level.

2.3.4 The Data Collection Stages of Meta-Analysis

Three types of studies were located:

- Studies examining the factors that affect the effectiveness of VT.
- Studies related to the comparison of FTF and VT operating through Computer-Mediated-Communication (CMC).
- Studies related to Decision Support Systems (DSS).

Some keywords were used to identify the related studies published in the electronic databases: ABI/Inform Proquest, EBSCO, and ScienceDirect, such as “virtual teams”, “computer mediated communication” and “decision support”. A total of 238 studies were found. Then, the following criteria were applied:

- The study must have provided correlation coefficient; and
- The independent and/or dependent variables (in relation to the performance and satisfaction of teams) used in the study must be closely related to the terms defined in Powell et al’s (2004) framework.

As a result, 47 studies were located. Then, the correlation coefficient was abstracted from these studies and categorised into Powell et al’s (2004) framework. Appendix 2.3 shows the 47 collections of studies and the collected correlation coefficient.

Some studies tested multi-variables that correspond to a singular variable in Powell et al’s (2004) framework: Carless and Paola (2000) examined “team effectiveness” and “team work performance” corresponding to the “performance” variable of Powell et al’s (2004) framework. The two variables were regarded as two individual

“performance” variables. Some studies included more than two experiments. In this case, these experiments were considered as separate experiments. For example, Chang and Bordia (2001) engaged in two experiments with different numbers of participants at different times, but with the same procedures. Thus, the two experiments were regarded as two individual experiments.

2.3.5 Data Analysis of the Meta-Analysis

These 47 studies which satisfied the criteria were specified and correlation coefficients extracted as shown in appendix 2.3. A frequency distribution table was developed and 32 relationships were identified between variables as shown in appendix 2.4. It can be seen that half relationships’ frequencies equal to “1”. This implies that research in this area is still dispersed. The relationships with one sample size were removed giving a total of sixteen candidate relationships to be analysed. Figure 2.6 shows the variables’ relationships.

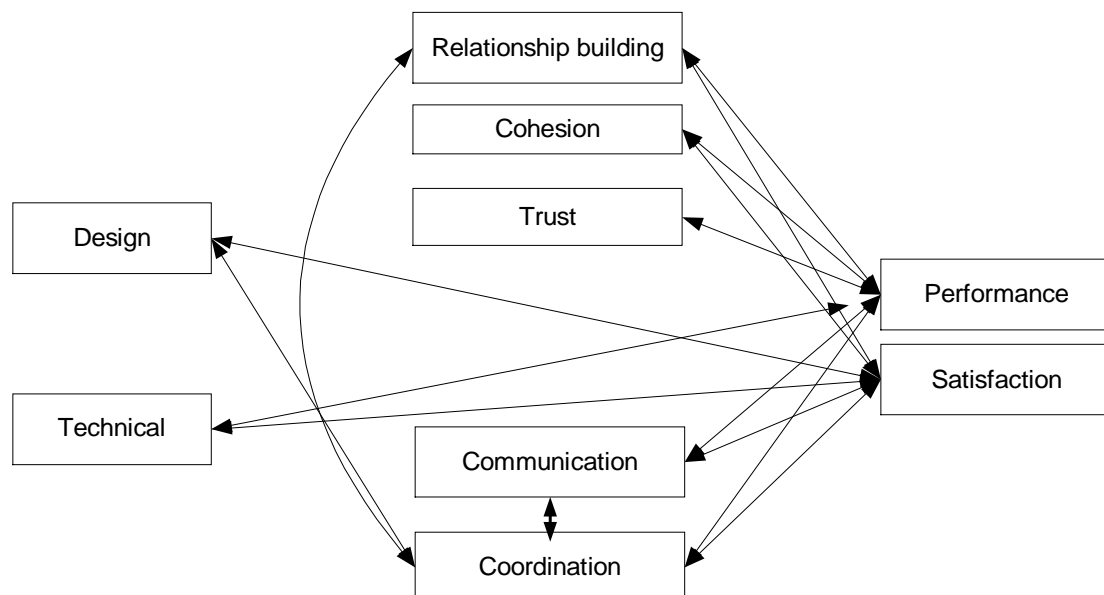


Figure 2.6 Variables’ relationships after excluding relationships with sample size “1”

Comparing Figure 2.5 and 2.6, it can be seen that there are three variables (culture,

training and task-technology-structure fit) which have been removed from Powell et al's (2004) framework. The only relationship between social and task dimension variables is between coordination and relationship building. Other variables' relationships focus on their relationships with performance and satisfaction. This indicates that researchers have been focusing strongly on the factors that affect the performance and satisfaction, but have rarely focused attention on the interaction between social and task dimension variables.

Next, "Comprehensive Meta Analysis" software was applied and the outcome of the analysis is shown in appendix 2.5.

The analysis steps are as follows:

- a. Check if Q-Value is significant (from P-Value(Q); if yes, this means Q-Value is too big), examine the 95% confidence interval of transform random, if not, examine the 95% confidence interval of transform fixed.
- b. If the 95% confidence interval includes 0, the hypothesis that the relationship equals to 0 is accepted. This means that there is no relationship between two variables. If the 95% confidence interval does not includes 0, the hypothesis that the relationship equals to 0 is rejected. This means that there is a significant relationship between two variables. The correlation coefficient between two variables equals to "point estimate" value.

After the analysis, there were eight significant relationships and the other eight relationships were found to be insignificant. Table 2.1 shows the eight significant relationships.

Table 2.1. Eight significant relationships after meta-analysis

Relationship	Point estimate	Relationship	Point estimate
CR-PF	0.531	CH-ST	0.570
CR-ST	0.388	RB-PF	0.208
CM-PF	0.323	RB-ST	0.362
CH-PF	0.358	TR-PF	0.291

- RB-Relationship Building; CH-Cohesion; TR-Trust; CM-Communication; CR-Coordination; PF-Performance; ST-Satisfaction

2.3.6 The Preliminary Framework From Meta-Analysis

According to Table 2.1, the preliminary framework is shown in Figure 2.7.

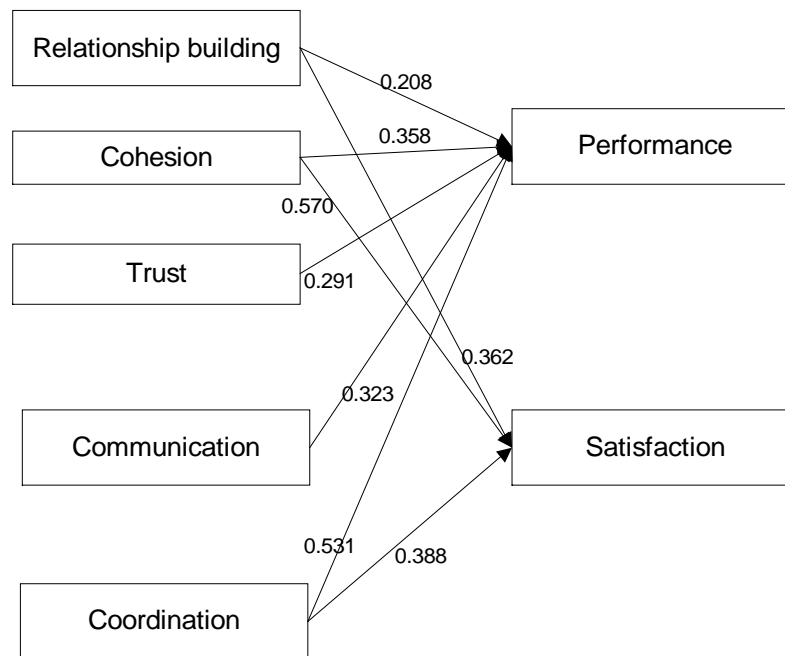


Figure 2.7 The framework after meta-analysis for virtual teams

When compared to Figure 2.6, Figure 2.7 shows that “design” and “technical” have now been removed. There are now only five factors (relationship building, cohesion, trust, communication and coordination) that affect the performance and satisfaction. Further, there is found to be no relationship between these five factors; the previous correlation between relationship building and coordination was found to be insignificant.

2.3.7 Discussion of The Framework from Meta-analysis

The following section compares the framework from the meta-analysis with Powell et al's (2004) framework. Possible explanations are also offered for these differences and some further factors are discussed.

(1) Seven variables remain

There are twelve variables in Powell et al's (2004) framework originally while only seven variables now remain. All four variables (design, culture, technical, training) in the "input" part and one variable (task-technology-structure fit) in "task dimension" have been removed. It does not mean that these variables are not important. However, it shows that there have been inadequate studies or less convergence on these variables.

In Powell et al's (2004) framework, the input part represents the design and composition characteristics of the virtual teams. In the selected studies, "design" has been a frequent topic of discussion. For example, Piccoli et al. (2004) found that self-directed virtual teams reported higher satisfaction and performance (design-satisfaction and design-performance). Statistics from the study by Kirkman et al. (2004) showed that team size had negative relationships with team empowerment, process improvement and satisfaction (design-coordination, design-satisfaction, and design-performance). In appendix 2.4, the total frequency of relationships between "design" and other variables is twenty. There are three relationships with a frequency over 2 (DS-CR: 3; DS-PF: 7; DS-ST: 5). From the observation, "design" would seem to be a crucial factor in the framework, but "design" was excluded in the end. One reason is that the heterogeneity between studies was significant (Q-value was too

large, causing the use of transform random value instead of transform fixed value). This further confirms that research studies have been highly disparate without any convergence or consensus emerging yet. The same explanation led to the exclusion of the 'technical' factor, leaving the input part still ambiguous.

(2) There is no relationship between the five factors of social and task dimensions

According to the discussion of section 2.2, the factors of social and task dimensions may affect each other and further affect the outcome of virtual teams. But according to Figure 2.7, there is no relationship between the five factors (relationship building, cohesion, trust, communication and coordination). A possible reason for this result is the small sample size. This highlights the fact that not only have there been insufficient studies of virtual teams but researchers have focussed either on task or social dimension. Only a limited number of studies have explored the interaction between social and task factors and these factors' interactive effects on the outcomes of virtual teams.

This framework gives an initial view of the relationships between factors. By combining the discussion of Powell et al's (2004) framework in the next section, the framework of this study is formed. In addition, the framework from the meta-analysis is compared with the best-fit model of VT developed by SEM in Chapter 7.

2.3.8 Forming the Framework for This Study

In this section, considering Powell et al's (2004) framework, the framework by the meta-analysis and research context for this study, the final framework for this study is formed.

Considering the learning environment of this study, some factors may not be suitable or have some limitations in this specific environment. Within the “socio-emotional processes” dimension, the concept of “trust” in virtual teams has been widely researched (Morris et al., 2002; Erdem & Ozen, 2003). Indeed this area has taken on a life of its own and appendix 2.6 highlights the extent to which ‘trust’ has been shown to inter-relate with a myriad of other concepts.

In this study “trust” is actually excluded for three reasons:

1. Firstly, past studies show that trust is a not only an extensive but incongruous issue for team research. For example, Li et al. (2004) studied trust over multi-dimensions: cognitive trust, calculative trust and institutional trust; Clases et al. (2003) studied the correlation of trust to personal bonding and shared experiences. Mayer et al. (1995) studied trust in regard to ability, benevolence and integrity factors. Appendix 2.6 aggregates Clases et al. (2003) fifteen studies on trust and shows the multi-dimensions of issues impacting on trust. As yet, there has been little convergence in research studies in this area and while recognised as a critical area it merits individual study.
2. Secondly, this study focuses on a specific environment: students learning. The interaction of students with teachers and other students follows a similar pattern as seller and buyer. There is an obligation and pressure for students to cooperate and finish the tasks that teachers consign. Even if students do not trust others they still have to endeavour to work together. Therefore trust in the socio-emotional sense may be seen to be a less important issue in this environment.
3. Finally, the study uses virtual teams which are pre-selected by the researchers from a single large cohort of students. While ‘trust’ may be a factor it should

impact equally on all teams and so is excluded from the comparison. The emphasis in this study is directed towards the impact of communication processes on the outputs.

In addition, Powell et al. (2004) pointed out that “task-technology-structure fit” is to evaluate the possible fit between task, technology and structure. In other words, it determines the tasks suitable for various technologies, the tasks suitable for a particular structure, and the technology adopted by team members to form a new structure over time. For example, FTF meetings or phone calls fit ambiguous tasks, management of conflicts and external resources, brainstorming and setting strategic direction. CMC is appropriate for more structured tasks such as routine analysis or monitoring project status (Powell et al., 2004). Another study by Wong and Burton (2000) explored the three characteristics (context, composition, structure) of virtual teams that affect the performance. However, in the learning environment of this study, tasks are assigned by lecturers. Students use the tools provided by the school to communicate with each other and structured change is minimal. It means that the factors (tasks, technology and structure) of “task-technology-structure fit” are fixed. As a result, the concept “task-technology-structure fit” can be fixed instead of acting as a variable for this environment.

In regard to the “input” part of Powell et al’s (2004) framework, designing teams is unnecessary because the team structure in this study is also fixed. Next, culture is another expansive and diversified issue like trust and is excluded in this study. The composition of the students is drawn from various countries and cultures. The researcher has no intention to group students by their countries or cultures. Thus, for the intermixture of the students, the culture issue can be regarded as equal among

each team. In addition, due to the fixed tools used by students, the technical issue is a constant variable in this study. Finally, there is a complete course plan for students to learn skills, so training can be also viewed as a constant variable.

Powell et al. (2004) define coordination as “the degree of functional articulation and unity of effort between different organizational parts and the extent to which the work activities of team members are logically consistent and coherent” (p. 11). The Oxford English Dictionary explains coordination as “The action of arranging, or condition of being arranged or combined, in due order or proper relation”. The terminology associated with coordination such as “coordination mechanism” (Montoya-Weiss et al., 2001; Kraut et al., 1999) shows that coordination tends to be more theoretical and complicated. It may include the relationships of components. Otherwise, according to the Cambridge Dictionary Online (<http://dictionary.cambridge.org/>), collaboration is defined as “when two or more people work together to create or achieve the same thing”. Given the terminologies associated with collaboration such as “collaborative style” (Paul et al., 2004) and “distributed collaboration” (Johansson et al., 1999), the researcher believes that collaboration is more suitable compared to coordination for this study.

From the discussion above, the “input” part, “trust” and “task-technology-structure fit” are excluded. Accordingly, and considering the framework built by the meta-analysis, the framework of this study is shown in Figure 2.8.

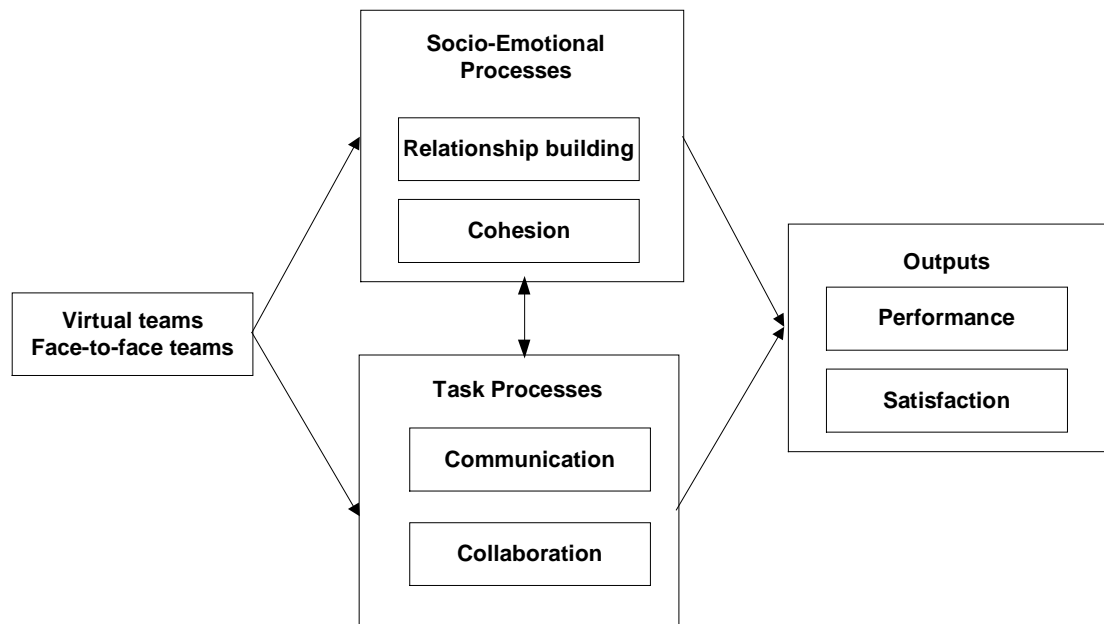


Figure 2.8 The framework of this study

From Figure 2.8, performance relates to students' perception of their outcomes. Satisfaction relates to the perception of satisfaction of team members. Performance and satisfaction are affected by the two constructs "social-emotional processes" and "task processes". "Social-emotional processes" include two variables: relationship building and cohesion while "task processes" include two variables: communication and collaboration. These four variables may affect each other.

2.4 Theories of Virtual Teams and Application

As stated in section 2.2.4 it is important to integrate the theories. The purpose of this section is to introduce theories about VT and apply these to the framework shown in Figure 2.8. Firstly, the theories of VT (Matrix of Virtuality and The Periodic Table) are introduced in section 2.4.1. Then, theories that can fit both FTF and VT (Media Richness theory, Social Identity and Deindividuation (SIDE) model and Social Information Processing perspective (SIP)) are discussed in section 2.4.2. Finally, section 2.4.3 evaluates these theories and their application to the framework of this study.

2.4.1 Theories of Virtual Teams

- **Matrix of Virtuality**

Lipnack and Stamps (2000, p. 62) classified VT into a matrix of virtuality. There are two dimensions of this matrix: spacetime and organisation. The further along the axes, the more virtual and complex the element is. This research focuses on the “Distributed Site” type of VT. “Distributed Sites” comprises members in the same organisation (school) but who work in different places. The subjects of this study do not know each other and can only communicate through CMC instead of meeting each other.

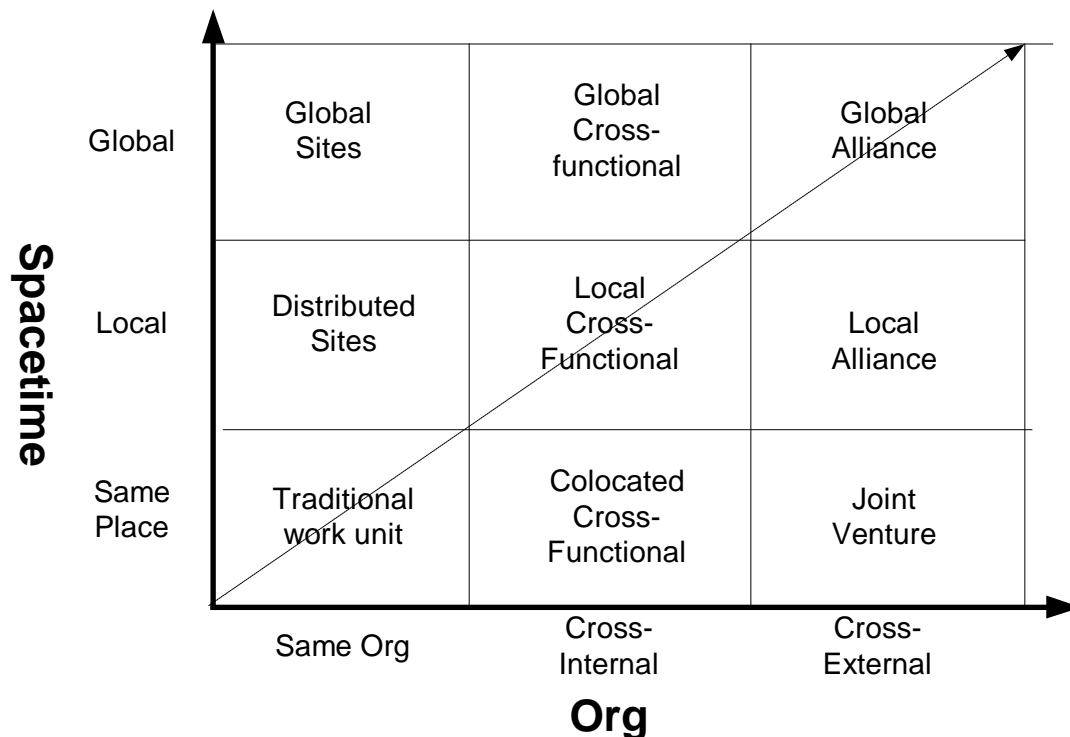


Figure 2.9 A matrix of virtuality

(Source: Lipnack and Stamps, 2000, p. 62)

- The Periodic Table

A VT model “The Periodic Table” was introduced by Lipnack and Stamps (2000, p. 240) (Figure 2.10). On the horizontal dimension, it contains inputs, processes and outputs. The elements on the vertical dimensions are purpose, people, links and time; each of these vertical dimensions follows the procedure illustrated by the flow chart (inputs→system→outputs), and is independent of each other. As the flow chart indicates, the system receives input from one of the horizontal dimensions, and then it processes the element to produce the corresponding output. The output is also directed back to the input to strengthen or weaken the force of the current progression on subsequent inputs. This model presents a holistic view of virtual teams’ working process and is easy to understand. However, some defects in this model are presented. Firstly, the model does not explain the relationships between vertical dimensions, such as the relationships between links with purpose and people; the link’s change by

time; and the relationships between people and purpose. Secondly, the model does not explore the relationships between elements. For example, media and goals may affect the task. Leadership and tasks may influence results.

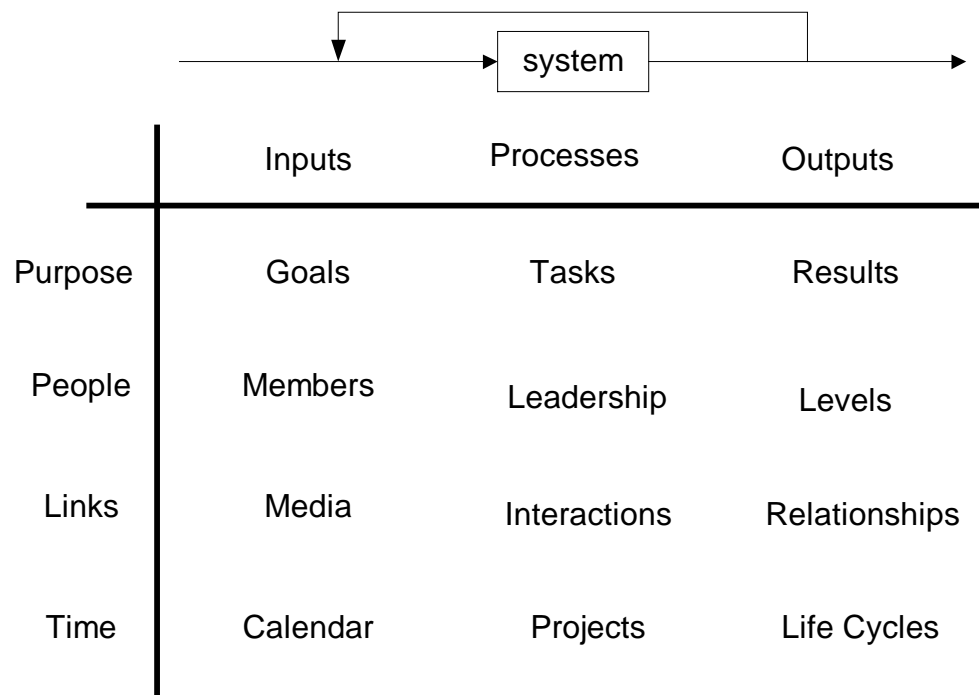


Figure 2.10 The Periodic Table of virtual teams

(By Lipnack and Stamps, 2000, p. 240)

However, this model also supports the two dimensions of the framework: “socio-emotional processes” and “task processes”. “Purpose” focuses on the “task processes”. “People” represents the “socio-emotional processes”; “Links” relates to communication. Communication not only connects people but also links purpose and people. This matches the framework of this study.

2.4.2 Theories of VT and FTF

In earlier theories of CMC, such as Social Presence Model (Short et al., 1976) and Media Richness Theory (Daft & Lengel, 1984, 1986; Daft et al., 1987), the socio-emotional aspect was considered to be inadequate in the virtual environment.

During the last decade, some CMC theories suggested that the relationships could be developed in the virtual environment. This section introduces three theories: Media Richness, SIDE and SIP. These theories are applied to the framework of this study in the next section.

- Media Richness theory

Daft and Lengel (1984, 1986; Daft et al., 1987) developed the Media Richness theory. They proposed that organizational success is based on the organization's ability to process information of appropriate richness to reduce uncertainty and clarify equivocality. Uncertainty means the absence of information. When information increases, uncertainty decreases. Equivocality implies ambiguity (i.e. the existence of multiple and conflicting interpretations about a certain situation). It is thought that a greater quantity of information can resolve uncertainty while better quality of information can resolve equivocality. Limitation of media in a virtual environment may limit the quantity of information. Therefore, providing better information quality (rich information) is a method to reduce equivocality.

Information richness is the information's ability to change the understandings within a time interval. But, what kind of information is regarded as "rich information"? Daft and Lengel (1986) identify that "communication transactions that can overcome different frames of reference or clarify ambiguous issues to change understanding in a timely manner are considered rich" (p. 560). There are three methods to identify the richness of media: immediate feedback, the number of cues and channels utilised, personalisation and language variety (Daft & Wiginton, 1979). According to this definition, FTF is the richest media because it provides immediate feedback, manifold cues (such as body language, eye contact and tone of voice) and messages expressed

in natural language.

Similar to the expectation of the Cuelessness Model (Kemp & Rutter, 1982) and Reduced Social Cues approach (Kiesler, 1986; Siegel et al., 1986), CMC is predicted to be low in richness by Media Richness theory. CMC might have immediate feedback (instant online chat), but it has narrow channels and carries less social cues. Hence, CMC is suitable for task-oriented jobs rather than social-oriented jobs.

The results from testing Media Richness theory vary. For example, Markus (1994) tested the theory by observing the use of electronic mail and found that employees preferred email for informational messages and telephone for personal message. Zack (1994) compared the Electronic Messaging (EM) and traditional communication (FTF, telephone and memo) and reported that EM was not a substitute for FTF interaction. However, EM is an effective communication tool when members shared interpretative context. On the other hand, Schmitz and Fulk (1991) examined the effects of perceived media richness and social influences from organizational colleagues on the uses and assessments of electronic mail. They found that perception of media richness was not dependent on the features of the media but the experience of using computers, such as keyboard skills and experience of software. The more experienced in computer use, the higher the perceived richness of media. D'Ambra et al. (1998) tested Media Richness theory and found that media richness might not be the only predictor of media choice for task equivocality. They concluded that the richness of media is perceived multi-dimensionally in terms of the information carrying capacity of media.

- Social Identity and Deindividuation (SIDE) model

The SIDE model developed by Lea and Spears (1991) provides a more comprehensive model by focusing on Social Identity (SI) theory and a re-conceptualization of de-individuation. The SIDE model believes that the visual anonymity and physical isolation of members in a CMC environment should incur deindividuation and the lessening effects of the individual's social or personal identity. User behaviour in a CMC environment is different and depends on the salient identity in a particular situation. When group norms are strong, identity will be salient and there is coincidence between individual behaviour and group normative behaviour. In situations where group norms are weak, personal identity will become salient and behaviour will be in line with personal norms. To simplify the SIDE theory, in the CMC environment, when participants communicate through visual anonymity, they are deindividuated. In this situation, when a group identity is formed instead of an individual identity, it facilitates social relationships such as shared norms.

The SIDE model suggests that the reduction of social cues in CMC environment does not equate to the reduction of social context. Although there are less social cues, CMC can still support the formation of an impression of partners. It can convey social information, aid in regulating behaviour and provide a social context for communication and relationship building.

Several studies have tested the SIDE model. Postmes and Spears (1998) reviewed studies about the SIDE model to examine the impact of properties of CMC on social influence and summarized that group identity was salient, anonymity increased social identity with group, group attraction, conformity to group norms and stereotyping by depersonalising perceptions of the self and others. They also conducted a meta-analysis of deindividuation theory and the result showed little support for (a) the

occurrence of deindividuated behaviours or (b) the existence of a deindividuated state, but support for a social identity model of deindividuation effects. The researchers explained that this might be caused by situation-specific rather than by general social norms. However, the SIDE theory still informs this study.

- Social Information Processing perspective

Due to the discrepancy between “cues-filtered-out” (Culnan & Markus, 1987) and the findings from field research that personal relationships did develop in a CMC environment, Walther (1992) developed the Social information Processing (SIP) perspective of CMC. SIP is based on the assumption that people seek to affiliate through their communication. People form initial impressions of each other based on the exchange of social information. In a CMC environment, as the amount of textual messages increase, partners are tested and interpersonal impressions adjusted. Interpersonal relationships and personalized communication develop over time and the conversation tends to be personal instead of impersonal. Although with the reduction of social cues conveyed in CMC, SIP suggests that impression formation and relational communication can still be established as long as adequate time is given. This phenomenon was called “hyperpersonal communication” (Walther, 1996). Walther (1996) defined hyperpersonal communication as “CMC that is more socially desirable than we tend to experience in parallel FTF interaction” (p. 17).

For developing social relationships in CMC, members must be motivated to form relationships and impressions through interpreting the available social cues. The reduced social cues in CMC still enable members to manipulate their self-presentation to project a favorable image. In the absence of contradictory information, members may form idealized stereotypical impressions based on the available social

cues and selective self-presentation.

SIP implies that VT and FTF may operate at a different rate instead of a different capability. CMC cannot convey all the information for task and social need in as little time as FTF communication. However, users can adapt towards nonverbal messages and exchange social information over time. A meta-analysis by Walther et al. (1994) provided evidence for this aspect. The study reported a higher percentage of socially-oriented communication and smaller differences between FTF and CMC groups in unlimited time groups than in restricted time groups.

2.4.3 Applying Theories to the Framework

Theories are applied to the framework as follows: “Periodic Table” is applied to the “virtual teams/face-to-face teams”, “Media Richness” to the “task processes” dimension and “SIP” to the “socio-emotional processes” dimension (Figure 2.11).

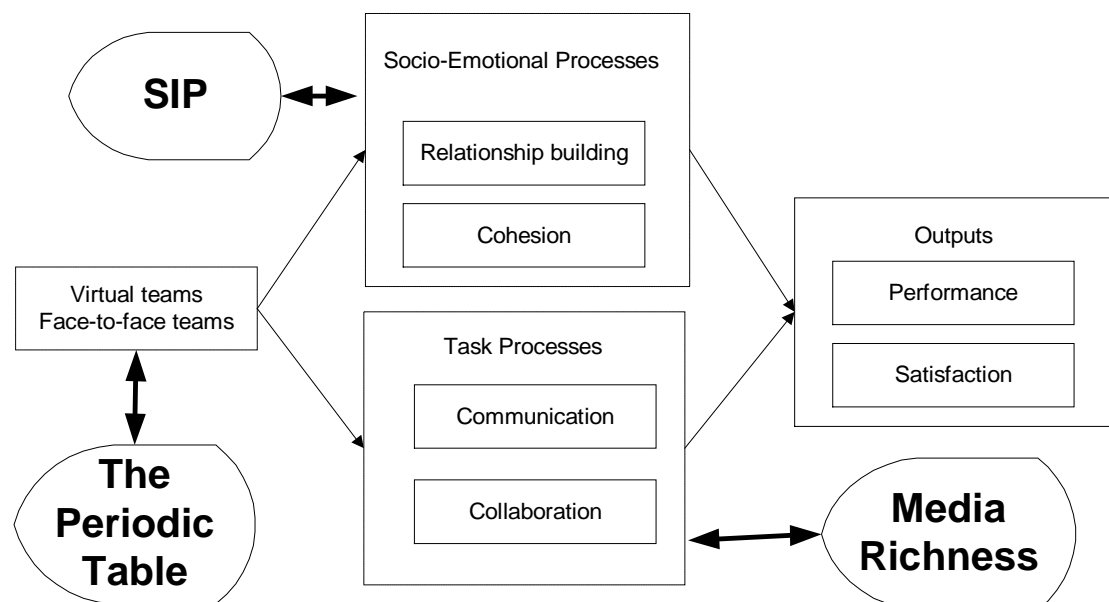


Figure 2.11 The theories applied to this study

Firstly, “The Periodic Table” gives the whole view of the study. It has four factors in

the vertical dimension: purpose, people, links and time. Purpose relates to “task processes” while “people” relates to “socio-emotional processes”. “Links” represents communication and includes three components: media, interactions and relationships. This matches the relationships of all concepts in this study in Figure 2.8. In addition, the horizontal dimension of the table includes three factors: inputs, processes and outputs. Outputs feedback to inputs and the whole process evolves over time.

Next, Media Richness theory suggests that CMC is suitable for task-oriented jobs since they need less social cues. In the virtual environment, members depend on CMC to convey the information needed for the task. The intention of this study in regards to the “task processes” dimension is to examine how members communicate and collaborate and how this affects the teams’ performance and satisfaction in the two kind of settings: VT with lower social cues, FTF with higher social cues.

Finally, SIP states that although less social cues are conveyed in the virtual environment, members can still establish a certain degree of social relationship. There are three key issues of SIP. First of all, members seek for affiliation in their communication. Next, members are motivated by their relationships. The third is the most important one: time. SIP suggests that members of VT can develop social relationships as good as FTF as long as adequate time is available. In regard to the “socio-emotional processes”, the intention of this study is to test if there are any differences in relationship building and cohesion in the two different settings (VT and FTF). The impacts on teams’ performance and satisfaction through relationship building and cohesion are also examined.

2.4.4 Group Process Models

In this section, three group process models are introduced chronologically: Tuckman's model (1965), Punctuated Equilibrium Model (Gersick, 1988, 1898) and Virtual Teams Development Model (Johnson et al., 2002). These models are evaluated in regard to virtual team process.

- **Tuckman's Forming Storming Norming Performing Model**

Tuckman (1965) developed a four-stage model for group process in 1965 as the 'Forming Storming Norming Performing' model. Later, a fifth stage named "Adjourning" was added to the model in 1975. Despite its name this model is an elegant and helpful explanation of team development and member behaviour. The five stages are:

(1) Forming

This stage refers to a period when members are trying to determine their positions in the group, procedures and rules to follow. The characteristics are: (a) high dependence on leader for guidance and direction; (b) individual roles and responsibilities are unclear; (c) leader must be prepared to answer lots of questions about the team's purposes, objectives and external relationships; (d) processes are often ignored.

(2) Storming

This stage is formed when conflicts arises as team members resist the influence of the group and rebel against task accomplishment. The characteristics are: (a) consensus is not easy to reach; (b) members compete for position as they attempt to establish themselves in relation to the leader and other members; (c) increased clarity of purpose yet uncertainties persist; (d) cliques and factions form and there may be power struggles.

(3) Norming

This stage begins when members establish cohesion and commitment to the tasks and find their own way of working together. The characteristics are: (a) agreement and consensus is largely formed among team; (b) roles and responsibilities are clear and accepted; (c) crucial decisions are made by group agreement and minority decisions may be delegated to individuals or small teams within group; (d) commitment and unity is strong; (e) members may engage in fun and social activities.

(4) Performing

This stage occurs when members show proficiency in working together. The characteristics are: (a) the team is more strategically aware; (b) members know clearly why they are doing what they are doing; (c) the team has a shared vision and is able to stand on its own feet with no interference or participation from the leader; (d) the team has a high degree of autonomy; (e) disagreements may occur but are easily resolved.

(5) Adjourning

Adjourning is arguably more of an adjunct to the above four-stage model rather than an extension. It is the termination of the group when the task is completed. The main characteristic is that everyone can move on to new things feeling good about what's been achieved.

This model is a linear progression model. Each stage is an essential step for a team and if the previous stage has not been accomplished, the latter stage would not be successful.

- Punctuated Equilibrium Model

The Punctuated Equilibrium Model of group development by Gersick (1988, 1989) was regarded as an alternate paradigm to Tuckman's (1965) traditional model of group development. Gersick found that all groups move through periods of inertia separated by a brief period of transition. The model includes three brief transition periods at the beginning, midpoint, and the end, and two long work periods between the transition points.

The first transition starts when the group initiates the first meeting and discuss the strategies and approaches to complete tasks. After the first long work period, the midpoint transition concerns a re-examination of the strategies, procedures and goals set up in the first transition. The second long work period is similar to Tuckman's "performing" stage where the consequence becomes the members' focus of attention. The end transition is the completion period when members finish the tasks and adjourn. This is similar to Tuckman's Adjourning stage. Basically, the Punctuated Equilibrium Model is also regarded as a leaner model.

- Virtual Teams Development Model

Johnson et al. (2002) observed seven virtual learning teams for three months to develop a model which evolves from Tuckman's model to depict the process of virtual teams in Figure 2.12.

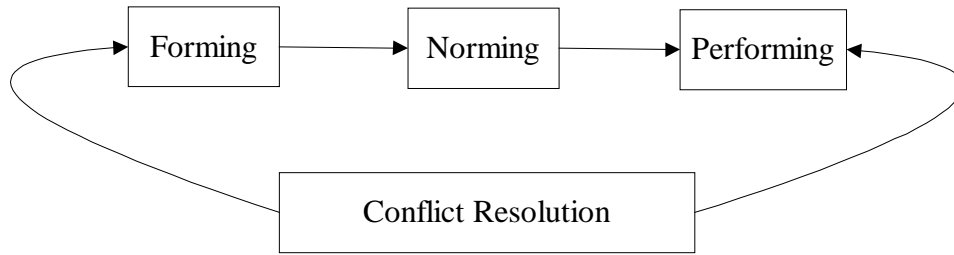


Figure 2.12 Virtual Team Process Model
(From Johnson et al., 2002)

The three stages: forming, norming and performing are inherited from Tuckman's model and the storming stage has been taken out due to the short time allocated to accomplish each assignment (about 2 weeks). A "conflict resolution" stage is added to represent the resolution of arguments and proceeding of forming, norming and performing as and when the conflict occurs.

- The Summary of The Three Models

To summarise the models above, Both Punctuated Equilibrium Model and Virtual Teams Development Model evolved from Tuckman's model which was a fundamental model of group processes. The former develops the transition concept while the latter removes the storming stage and supplements this with a conflict resolution stage. All three are linear models. "The Periodic Table" (Figure 2.10) introduced in section 2.4.1 also has a linear view across the horizontal dimension, but, is essentially multi-functional over purpose, people, links and time. This brief overview suggests that process involved in VT could follow some of these suggested patterns. For example, in Johnson's Virtual Teams Development Model, although the storming stage was not observed, other stages (forming, norming and performing) were still significant in the process of virtual teams.

These models provide a holistic view of group processes, but how do FTF and VT

members really work? Do they follow any process patterns? These issues are explored in greater depth by analysing the actual discourse and interaction of FTF and VT in Chapter 5.

2.5 Examining the Variables in the Framework

In this section, all variables in the framework (Figure 2.8) are discussed in depth. A more detailed understanding of each variable enables a better project design for this study.

2.5.1 Relationship Building

- **Time-Interaction-Performance (TIP) theory**

McGrath's (1991) TIP (Time-Interaction-Performance) theory offers a clear framework to understand the development of relationships in virtual teams. According to TIP theory, there are three functions that are performed by group members: production, member support and group well-being. Members support and group well-being is related directly to relationship development in virtual teams. All functions are realized by activities that are categorised into four modes:

- ✧ Mode 1: Activities related to organization's goals and objectives.
- ✧ Mode 2: Activities related to solution of technical issues with regard to how to reach the organizational goals.
- ✧ Mode 3: Activities related to conflict resolution
- ✧ Mode 4: Activities related to execution of the requirement of organizational task.

		FUNCTIONS		
		Production	Well-being	Member Support
M O D E S	<u>Mode 1</u>	Production	Interaction	Inclusion
	Inception	Demand/ Opportunity	Demand/ Opportunity	Demand/ Opportunity
	<u>Mode 2</u>	Technical Problem	Role	Position/
	Problem Solving	Solving	Network Definition	Status Attainments
	<u>Mode 3</u>	Policy	Power/	Contribution/
	Conflict Resolution	Conflict Resolution	Payoff Distribution	Payoff Relationships
	<u>Mode 4</u>	Performance	Interaction	Participation
	Execution			

Figure 2.13 TIP structure
(By McGrath, 1991, p. 154)

TIP theory suggests that most groups follow the default path for all functions (from mode 1 to mode 4 sequentially). However, a group may use different paths for adapting to different functions (e.g., mode 1 ➔ mode 2 ➔ mode 4), but TIP explains that it uses the simplest path when the purposes, resources and circumstances allow. TIP theory suggests that since members spend more time on goal and task oriented activities and it is more difficult for VT to engage in developing relationships. Thus, the lack of relationship development may result in frustrated team members.

- **Related Studies about Relationship Building**

Research by Sawyer and Guinan (1998) studied 40 software development teams and found that social process skills (such as the level of informal coordination and communication, the ability to resolve conflict) is more important than task skills (such as use of software methodologies and automated development tools) in project quality and team performance. Social process skills account for more than 25 percent of

variation in software product quality. Research by Janz et al. (1997) also studied software development teams. They surveyed 231 IS professionals from 27 systems development teams across thirteen organizations and found that mission clarity, team collaboration and team unity is predictive of improved work outcomes, increased job satisfaction, satisfaction with personal growth and worker motivation.

- **Summary**

TIP theory provides schemas of how group members build relationships. When a group uses different paths to reach a goal, a different pattern can be observed. For example, for group members in mode 1, the situation of production, well-being and member support can be seen. In every stage, the status of every function can be recorded and compared and a pattern of relationships building can obtain.

2.5.2 Cohesion

- **The Definition of Cohesion**

The definition of cohesion varies by time and types of groups. Carron et al. (1985) defined cohesion as “a dynamic process that is reflected in the tendency for a group to collaborate and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs” (p. 245). Chidambaram (1996) explained cohesion as “the extent to which the group members are attracted to the group and each other” (p. 148).

From those definitions, three implications can be observed:

- (1) Cohesion changes over time in both its range and various formats throughout the process of group forming, development, sustenance and dismissal.
- (2) Cohesion has an instrumental implication. All groups are formed for a specific

purpose. For example, musical groups are formed for playing music. Actors gather together for movies.

- (3) Cohesion has an affective implication. The need to belong is a basic human motive. People want to join the group that makes them feel intimate. Thus, social bonding and task unity can produce positive effects.

Models of measurements of cohesion can be classified under two headings: unidimensional models and multidimensional models. The unidimensional model measures cohesion along a single dimension, such as Gross and Martin (1952), Piper et al. (1983) and Budman et al. (1993). The multidimensional model measures cohesion as multi-dimensional, such as Griffith (1988), Yukelson et al. (1984), Carron (1985). Cota et al. (1995) suggested that multidimensional models have more potential than unidimensional models to evaluate what is known about cohesion. They also criticized the fact that most multidimensional models have been driven empirically. Researchers set items and collected data from individual group members. Then, sets of constructs were defined after analysis. That might be problematic because those items were too wide or narrow. If too wide, those variables might correlate highly with each other. If too narrow, it might provide an incomplete perspective of the constructs. Appendix 2.7 shows various definitions and measurements of cohesion.

● Related Studies of Cohesion

Bollen and Hoyle (1990) developed a subjective conceptual model of cohesion. The model proposed that the perceptions of cohesion of group members are important for the members' behaviour. It has two dimensions: sense of belonging and feelings of morale. The measurement items of "sense of belonging" like "I feel a sense of

belonging to _____”, “I feel that I am a member of the _____”, “I feel that I am a member of the _____ community”. The measurement items of “feelings of morale” like “I am enthusiastic about _____”, “I am happy to be at [live in]_____”. PCS (Perceived Cohesion Scale) was developed by the conceptual model. The model provides a different view of cohesion and was used in groups with big population samples such as citizens and colleges.

Chin et al. (1999) used Bollen and Hoyle’s model and adjusted PCS to allow application to small groups. 330 undergraduate subjects, grouped into 70 teams participated in the experiment. Cash prizes and using the latest problem-solving information system were used to encourage students’ motivation. The result supported the validity and reliability of PCS used within small groups.

Carron et al. (1985) realized that various definitions of cohesion could be classified into two major groups: group integration (GI) and individual attraction to group (ATG). GI explains “the individual’s perceptions about what the group believes about the closeness, similarity and bonding as a whole and the degree of unification of the group field”. ATG reflects “the individual’s personal motivations to remain in the group as well as his or her personal feeling about the group”. Furthermore, Carron et al. (1985) stated that both GI and ATG could be fitted into two aspects: task and social concern. Thus, a model that contains four dimensions of cohesion was developed: GI-T, GI-S, ATG-T and ATG-S. GI-T (Group Integration- Task) is GI focused on task (i.e., collective performance, goals and objectives). GI-S is GI focused on social concern (ie., relationship within the group). ATG-T is ATG focused on task. ATG-S is ATG focused on social concern.

Cota et al. (1995) pointed out that there are two advantages in Carron et al's (1985) model of cohesion. Firstly, Carron et al's (1985) model provides a complete view of cohesion. The task-social and individual-group dimensions can be used in many types of groups and has been identified by other researchers (Chang & Bordia, 2001). Secondly, the GEQ (Group Environment Questionnaire) developed by Carron et al. (1985) has a very good explanatory ability to evaluate the issues that are important to group functioning and performance and identified by other researchers (Chang & Bordia, 2001).

Dyce and Cornell (1996) tested the model and GEQ in 315 musicians in 84 groups. The result supports social-task distinctions but not group-individual distinctions. Schutz et al. (1994) tested the model and GEQ in 740 high school varsity athletes to determine the degree of factorial invariance across gender (426 males, 314 females) and across type of sport teams (64 teams). The result did not support Carron et al's (1985) model for gender and type of sport teams.

Against this criticism, Carron and Brawley (2000) suggest that the reason that these studies did not support the model and GEQ is that the varied nature of group and group cohesiveness were not taken into consideration, such as "the need to belong" and "the desire for interpersonal attachments" (Baumeister & Leary, 1995). They suggested that researchers should put more focus on research questions and statistical procedures rather than the nature of group.

● Related Studies of The Relationships Between Cohesion and Performance

Chang and Bordia (2001) used the conceptual framework of cohesion by Carron et al. (1985) to study the relationship between cohesion and performance. The participants

of this study were eighty students from a third-year organizational psychology course. The process lasted for five weeks and two measures were taken. The first measure was taken in the second week while the second measure was taken in the fifth week. Hackman's (1990) three-dimension model of group performance was used to evaluate the performance. The measurements of performance were group grade, subject measurement of group performance, system viability and professional growth. The analysis and relationship between each measurement of this research shown as Table 2.2:

Table 2.2 Hackman's measurements of cohesion

	Group grade	Subject group performance	System viability	Professional growth
Task cohesion	Not sig.	Strong sig.	Partly sig.	Partly sig.
Social cohesion	Partly sig.	Not sig.	Strong sig.	Not sig.

Note: Adapted from the research by Chang and Bordia (2001)

Task cohesion has strong and positive relationship with subject group performance and partly and positive relationship with system viability and professional growth but has weak relationship with group grade. This implies that task cohesion improves personal skill but has no physical improvement in group score. On the contrary, social cohesion has a partly and positive relationship with group grade. It implies that the improvement of relationship might facilitate the quality of work instead of task cohesion.

● Summary

This study adopts Carron et al's (1985) definition. Cohesion is "A dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective

needs”. The definition fits the cohesion’s position in the framework of this study. Furthermore, the GEQ (Group Environment Questionnaire) developed by Carron et al. (1985) is used to examine cohesion and is discussed further in section 4.6.1.

2.5.3 Communication

- **The Challenges of Communication in Virtual teams**

Most studies found that the overall amount of communication in electronic communication is greater than in FTF communication (Hiltz et al., 1986). Although some researchers argued that communication in electronic environment has decreased due to the lack of speech acknowledgements (e.g., “hum?” “Uh-hmm”) and social greetings (O'Connail et al., 1993; Sarbaugh-Thompson & Feldman, 1998), there is no doubt that electronic communication consumes more time and conversation contexts. Others suggest that a problem-solving task is not suitable for electronic communication, even if the task is low in complexity (Straus, 1996; Gallupe & McKeen, 1990). This implies that the efficiency of electronic communication in problem-solving tasks is lower than FTF communication.

Message understanding is a dilemma in VT. Successful communication relies on mutual knowledge and, typically communication patterns use physical and linguistic expressions to make inferences about each other’s knowledge (Hollingshead, 1998). A study by Marshall and Novick (1995) demonstrated that conversation still goes well and message understanding is fine after removing the visual factor. Straus et al. (2001) noted that when visual observation is removed from communication, the evaluation of others is less stereotyped and more valid (e.g., interviewers evaluate the job applicants). Another issue of effective message understanding is time. The individual takes longer time to form impressions of others and decode social cues when

communicating electronically (Sproull & Kiesler, 1986). Many studies showed evidence to suggest that the efficiency and effectiveness of message conveyance of VT should be the same as FTF teams when adequate time is given for VT (Burke & Chidambaram, 1996; Galegher & Kraut, 1994; Warkentin et al., 1997). Thus, the social and normative context may be more crucial in electronic communication (DeSanctis & Monge, 1999). Therefore, when sufficient contextual information is given, message understanding can be very high in electronic communication. Furthermore, message understanding may facilitate the relationship building and coordination in VT.

Research by Roebuck et al. (2004) states there are three challenges of communicating in VT: lack of FTF interaction, difficulty of building relationships and challenge of accessing and leveraging the unique knowledge of each member to reach the team's goal. This research gave a murder mystery to VT of business students and asked them to discuss and cooperate to solve the mystery through CMC in thirty minutes. The result showed that students could overcome the difficulties encountered in communication in a virtual environment.

Despite the absence of FTF communication in VT, asynchronous communication in VT may be more effective in some aspects (Dufner et al., 2002). Communication in VT always takes place over an extended period of time. The delay between response and feedback might provide members with the opportunity to think about the problems and reflect more efficiently.

Kayworth and Leidner (2000) studied the critical factors to succeed in global VT and found communication is one of them. The study suggested four strategies to facilitate

effective communications in VT:

- (1) Virtual teams need to engage in uninterrupted communications through computer communication system.
- (2) Schedule and rules in communication must be set appropriately.
- (3) FTF communication needs to be conducted periodically.
- (4) Getting to know peers in VT leads to effective communication.

● Comparison of communication media

Table 2.3 compares communication media with respect to accessibility, formality, shared interpretive context and social context cues.

Table 2.3 The comparison of communication media

	Face-to-face	Document	Telephone	E-mail	Blackboard	Instant messenger
Accessibility	Synchronous (time and place)	Asynchronous (time and place)	Synchronous (time), Asynchronous (place)	Asynchronous (time and place)	Asynchronous (Time and place)	Synchronous (time), Asynchronous (place)
Formality	Dependent	Formal	Dependent	Informal	Informal	Informal
Shared interpretive context	Facilitates creation of interpretive context	No explicitly considered	No explicitly considered	Facilitates communication within established interpretive context	Facilitates communication within established interpretive context	Facilitates communication within established interpretive context
Social context cues	Strong	Moderate	Moderate	Weak	Weak	Strong

Notes: * Adapted from Wiesenfeld et al. (2004).

The two distinctive communication media are Face-to-Face and Blackboard. In terms of accessibility, Blackboard is more convenient on condition that members are able to access Internet and also Blackboard is informal while the formality of FTF is dependent upon the situation. Through FTF discussion, members are liable to

exchange their opinions and new ideas are easily inspired. Whereas members find it is less easy to express their understanding through Blackboard.

Another comparison of the characteristics of FTF and mediated environments by Clark and Brennan (1991, p. 142) is shown in Table 2.4.

Table 2.4 The comparison of characteristics of FTF and mediated environments

Type of environment	Media characteristics					
	Co-presence	Visibility	Audibility	Contemporality	Simultaneity	Sequentiality
Face-to-face	X	X	X	X	X	X
Real-time audio/video		X	X	X	X	X
Audio-only			X	X	X	X
Blackboard				X		X
E-mail						X

Notes: * Adapted from Clark and Brennan (1991, p. 142)

From the two tables, it can be seen that FTF communication still conveys more social cues and provides more task-oriented capability. Blackboard just surpasses Face-to-Face communication in regard to better accessibility. It is also worthy to note the development of Instant Messenger, such as ICQ, MSN and Yahoo messenger. This kind of software combines synchronous and asynchronous communication methods and can transmit strong social cues. In addition, it provides abundant functions such as Internet phone, videoconferencing and makes communication easier, even substituting for FTF communication.

● Summary

Communication has been studied for a long time from various aspects. In this study, communication is regarded as pivotal to the framework. In VT and FTF, all

participants communicate with each other to build social relationships (socio-emotional dimension) and collaborate (task processes dimension). According to SIP (Walther, 1992) perspective, it is important to provide sufficient time for VT. But, how long will be enough? It could depend on the tasks. Another issue of communication is media. Different media with different characteristics may be suitable for different tasks. There are two key points of media. One is project design and another is how the students use the media. However, in this study, due to the tools provided by the university, the media factor is a constant and the project design is introduced in Chapter 4.

2.5.4 Collaboration

- **The Task Mode and Strategy of Collaboration**

There are three basic types of relationships among tasks: independent, dependent and interdependent (Chen & Lin, 2002). “Independent tasks” means dual tasks have no interaction between them; “dependent tasks” means a task demands data input from another task; “interdependent tasks” means both tasks need information input from each other. To manage an independent task is easy because the task can be finished in any sequence instead of influencing other tasks. To deal with dependent tasks is also simple because the tasks can be completed in order. However, when the environment is more complex and more overlapping tasks exist, interdependent tasks occur. The interlaced input and output relationships of tasks make the coordination more difficult.

Thompson (1967) defined three types of collaborative mode – pool, sequential and reciprocal. Pooled mode occurs when the group members share activities or produce common resources, but otherwise are independent. Pooled mode is best coordinated

through standardization or the development of rules that promote unified action, such as voting or polling. Sequential mode occurs when some activities of group members are dependent on the completion of others before beginning. Group members must work on the same agenda item during any time period. Reciprocal mode arises when each activity requires inputs from the others. This mode is used in more complex situations that need real time and group decision-making.

Turoff and Rana (1993) proposed five different collaborative strategies:

1. Parallel: group members engage in modular sub-tasks that require little or no synchronization
2. Pooled: the whole group may need to cooperate in a loosely coupled fashion to develop a collective group output by combining the outcomes of the parallel activities. In this strategy, interdependence among the activities is low, but not all of the activities can be performed in a pure parallel mode at the individual level.
3. Concurrent: group members work together and interact in a tightly coupled mode.
4. Sequential: the group implicitly or explicitly adopts a plan of action and sequentializes the work process. Some of the activities require to be taken care of before moving on to the next set of activities.
5. Reactive/Reciprocal: the task involves very high levels of interdependence in terms of the effects of previously performed activities and external events. The order of occurrence is not predictable in time, but event oriented.

Among them, parallel and pooled can be categorised as low degree of collaborative strategies, concurrent and sequential can be seen as medium degree of collaborative strategies and reactive/reciprocal can be regarded as high degree of collaborative strategies. These strategies are used to analyse the collaborative strategies of FTF and

VT in Chapter 5.

- Related Studies of Collaboration

Kraut et al. (1999) studied the comparison of using electronic network and personal relationships in the collaboration of relationships of buyers and suppliers. The result shows that collaboration in an electronic network is suitable for routine work. Montoya-Weiss et al. (2001) experimented with global VT with 35 five-person teams in the United States and Japan. This study found that collaboration plays a positive moderation role in conflict management and team performance. Some challenges of collaboration in VT are introduced as below:

- (1) Social cues are not easily conveyed, feedback is delayed and interruptions or long-time suspension in communication occur frequently in virtual environments.
- (2) Many topics might be launched at the same time. When VT members contribute at different times on different topics, the information might be overloaded or inadequate and difficulty in collaboration increases.
- (3) Long duration and interrupted communication may lead to discontinuous and incoherent discussions.

Johansson et al. (1999) studied the distributed collaboration of a student project about engineering software development. The result showed that communication and collaboration are extremely important issues for VT. Poor communication and collaboration between managers and managers and members are the major barriers for VT to achieve the goals. Poor communication causes poor collaboration. Due to the absence of FTF communication, misunderstandings occur easily and hinder common actions. By examining collaboration in greater detail, the study found that implicit expression that is caused by absence of FTF communication might be the major

problem in collaboration. In the project, the members who were not continuously present omitted important development decisions and were left behind. This results in delay or budget overrun. The study also found that collaboration is related to conflict management and commitment. Commitments are based on agreements about what is to be done, who is in charge and the deadline. Through the processes of negotiation, the management of conflict can lead to the achievement of commitment.

Massey et al. (2002) studied the effect of temporal coordination mechanisms on 35 global VT with 175 members and found that temporal coordination mechanism is associated with higher performance. According to McGrath (1991), there are several problems inherent in any group activity: ambiguity, conflict and scarcity of resource. The mechanism includes three approaches to handle the problems: scheduling (deadlines), synchronization (aligning the pace of effort within and between members) and allocation of resources (specifying time spent on specific tasks). This can benefit the nature of members' interaction and outcomes by reducing the uncertainty and chaos associated with tasks of teams.

Baker (2002) compared the performance of sixty-four VT using four different collaborative technologies: text-only, audio-only, text-video and audio-video. The result shows that there is no significant difference between the qualities of the decisions for teams utilizing text-only versus audio-only communication. But adding video to audio-only communication resulted in a significant improvement in the quality of teams' strategic decisions.

- Summary

According to the discussion, there could be relationships between task types and

collaboration models. Different task types may cause different collaboration models. A study by Bordia (1997) also supports this conclusion. Therefore, the task design is important for this study. It may affect the evaluation of data and the results. The task design is discussed in Chapter 4.

2.5.5 Performance and Satisfaction

- **Measurements of Performance and Satisfaction**

The measurements of performance and satisfaction in VT and FTF are diverse. This study collected and analysed ten studies from 1994 that focused on comparison of VT and FTF teams. Methods of evaluating the performance and satisfaction are extracted from these studies and are listed in appendix 2.8.

From appendix 2.8, the methods of appraising performance can be categorised into three types: grader/ranking, discussion board/videotape, questionnaires. Graders are engaged in scoring the outcome (e.g., group report). For example, lecturers or experts scored the students' group assignments (Galegher & Kraut, 1994). Ranking has two sources: individual/group ranking (Straus, 1996; Warkentin et al., 1997) and experts' ranking (Straus, 1996). Individual/group ranking is done by each of members. In Warkentin et al's study, all subjects were ranked by the certainty of their preference on a 7-point Likert scale. Experts' ranking is done by selected experts (e.g., lecturers). Discussion board/videotape is used by Straus (1996) and Benbunan-Fich et al. (2001). In Straus' research, the data from discussion board is analysed for group process of VT. The FTF teams' discussions are transcribed verbatim from the videotapes.

The ways of evaluating performance in questionnaires focus on perceived quality, such as meeting quality and perceived project quality (Galegher & Kraut, 1994),

perception of discussion quality (Benbunan-Fich et al., 2001), perception of learning effects (Shen et al., 2001), decision quality and perceived level of teamwork (Ocker, 2002). Accordingly, questionnaires used in testing performance vary.

To summarise, there are three types of performance data: exact score and ranking (by lecturers, experts or members), transcript data (from discussion board and videotapes) and questionnaire data (from questionnaires). Questionnaire data is quantitative data and can be analysed by statistical software (SPSS, SAS, Excel). Transcript data belongs to qualitative data and can be analysed by qualitative methods (such Nvivo). The exact score/ranking can be secondary data to assist and strengthen the argument.

Ways of examining satisfaction are more in agreement. The data comes from questionnaires even though the questionnaires are diverse. The two mainstreams of satisfaction are “satisfaction with the process” (Straus, 1996; Shen et al., 2001; Ocker, 2002) and “satisfaction with the outcomes” (Galegher & Kraut, 1994; Warkentin et al., 1997; Ocker, 2002). In addition, other measurements of satisfaction are listed in appendix 2.8, such as fairness and solution confidence.

The methods of evaluating performance and satisfaction are discussed in section 4.6.1.

- Process Gain and Process Loss

There have been quite a few studies manifesting that group performance is generally qualitatively and quantitatively superior to the individual performance (Hill, 1982; Johnson & Johnson, 2006). However, group performance is based on individual efforts. It can be regarded as “process gain” when group members interact and

stimulate the development of ideas, insights and strategies and be conducive to the group performance. “Process loss” can be regarded as individual efforts within a group which could not be coordinated effectively nor ideally motivated to contribute to team performance (Watson et al., 1998). Process gain benefits the group performance while process loss exacerbates it. When group members participate and discuss, not only the development of ideas, knowledge and tactics occurs, but also the rejection of incorrect solutions, in a highly motivated, harmonious and obliging atmosphere. “Process gain” facilitates a better performance. However, when group members fail to recognise the uniqueness and necessity of their contribution, the group may function inefficiently and ineffectively and experience process loss (Watson et al., 1998). There are three types of “process loss”: social loafing (Latane et al., 1979), egocentrism and competition (Johnson & Johnson, 2006). Individuals may perceive the dispensability of their efforts and put less effort than others while working in-group as a “free rider”. This is called “social loafing”. Group members may attempt to interfere with others’ efforts or may be unable or unwilling to objectively evaluate others’ opinions. When this egocentrism and competition develops, the group may undergo interference or deterioration of production. When a member dominates the discussion, another member may prevent others’ participation and interfere with the effectiveness of decision-making.

The concept of process gain and loss is used in section 5.2.1 and 5.2.2 to analyse the communication patterns in order to identify the performance of FTF and VT.

2.6 HKNET- A Seven-Year Virtual Team Project

HKNET (Genuchten et al., 2005; Rutkowski et al., 2002; OHKNET, 2005; BOHKNET, 2005) was a VT project that tried to bring realism into Information Systems education lasting for seven years (1998-2004). Over 600 students from six universities in Hong Kong, Florida, Tilburg, Eindhoven, Grenoble and Beijing participated this project. The objective of HKNET was to let students experience global differences and similarities, different cultures and backgrounds, advantages and disadvantages of using a remote Group Support System, and try to make students more sensitive to the cultural richness of international cooperation. The technology used included videoconferencing, email and Blackboard.

Table 2.5 shows the evolution of HKNET.

Table 2.5 The evolution of HKNET

Item	Year	Students(University)	Key issue
HKNET1	1998	HK, Eindhoven	<ul style="list-style-type: none"> ● Initial project, first trial
HKNET2	1999	57 students, 9 teams, HK, Eindhoven, Tilburg	<ul style="list-style-type: none"> ● Six weeks ● Students are better familiar with material and each other ● Class web site ● Use videoconferencing (netmeeting), GroupSystems, email
HKNET3	2000	61 students, 10 teams, HK, Eindhoven, Tilburg	<ul style="list-style-type: none"> ● Six weeks ● Add cross-cultural facilitator and focus on cross-cultural interaction
HKNET4	2001	88 students, 13 teams, HK, Eindhoven, Tilburg, Grenoble	<ul style="list-style-type: none"> ● Blackboard ● Build a website ● Outcome: E-report
OHKNET1	2002	183 students, 22 teams, Hk, Florida, Eindhoven, Tilburg, Groningen	<ul style="list-style-type: none"> ● Students across 13 time zones ● Make a electronic book ● Outcome: E-book
OHKNET2	2003	Hk, Florida, Eindhoven, Tilburg, Dutch	<ul style="list-style-type: none"> ● Put more emphasis on milestones and intermediate deliverables ● More alignment was also achieved between lectures and project ● Outcome: E-book
BOHNET	2004	Hk, Florida, Eindhoven, Tilburg, Beijing	<ul style="list-style-type: none"> ● Use teleconference ● Use animated flash tutorials ● Heighten the commonality of the learning experience ● Outcome: E-book

The HKNET program formed a win-win situation. The students could experience the newest technology and different cultures. The schools and lecturers could test the projects, material and experiments on different ways of teaching and furthermore improve the courses, material and teaching methods. The project observed factors that determined the performance of VT as: technology infrastructure, interaction, professional background and cultural background (Rutkowski et al., 2002). All factors

interacted. Otherwise, project coordination, creating common ground and applying a “sandwich structure” (starting with a same time/place meeting, continue with asynchronous work and finalise with again a same time/place meeting) (Rutkowski et al., 2002; Genuchten et al., 2005) are also important issues for performance. In addition, it found that given sufficient technological support, students could adapt themselves and find ways to overcome the cultural differences in order to solve the problems.

HKNET can be a “template” for this study. The project design, schedule, processes, questionnaires and problems incurred are very useful references.

2.7 Virtual Teams and On-Line Learning

Moore (1989) identified three kinds of interaction for on-line learning: learner-content, learner-instructor, learner-learner. Among them, interaction of students seems to be one of the most influential factors of online learning (Swan, 2001). A study by Fulford and Zhang (1993) suggests that students' perceptions of interaction are important indicators of the satisfaction with instruction. Similar studies (Picciano, 1998; Jiang & Ting, 2000) also found that students' perceived learning from online courses was related to the amount of discussion.

If FTF meetings are infeasible in a virtual environment, the only way to communicate with each other and complete the task for VT members could be on-line discussion. Harasim (1990) noted that students perceived on-line discussion as a fairer evaluation method. That might be due to the fact that asynchronous discussion affords students the chance to reflect on others' contributions. Furthermore, Eastmond (1995) states that the frequency, timeliness and nature of messages posted on the discussion affect the communication results in CMC.

From these on-line learning studies, it can be seen that discussion board is an important component for VT. The members exchange information, build social relationships and finish the task through discussion board. But the issue of how VT members use the discussion board to communicate and affect the teams' performance and satisfaction deserves further exploration and some suggested answers are provided in Chapter 6.

2.8 Summary of Literature

This chapter firstly discusses the research questions and builds the hypotheses. The

FTF and CMC literature is reviewed and evaluated. The result suggests that more research efforts should be focused on the social dimensions. Powell et al's (2004) framework is used as a prototype and examined by a meta-analysis and a revised framework developed. After taking into account the specific environment of this study, a final framework is developed. Next, the theories of virtual teams and CMC and FTF are introduced and applied to validate the framework. In addition, each variable of the framework is examined in depth. Finally, a seven-year virtual team project (HKNET) and characteristics of on-line learning are explored with a view to informing the study design. These theories, concepts and discussions are now applied throughout the study.

Chapter 3 Research Methodology

3.0 Chapter Introduction and Structure

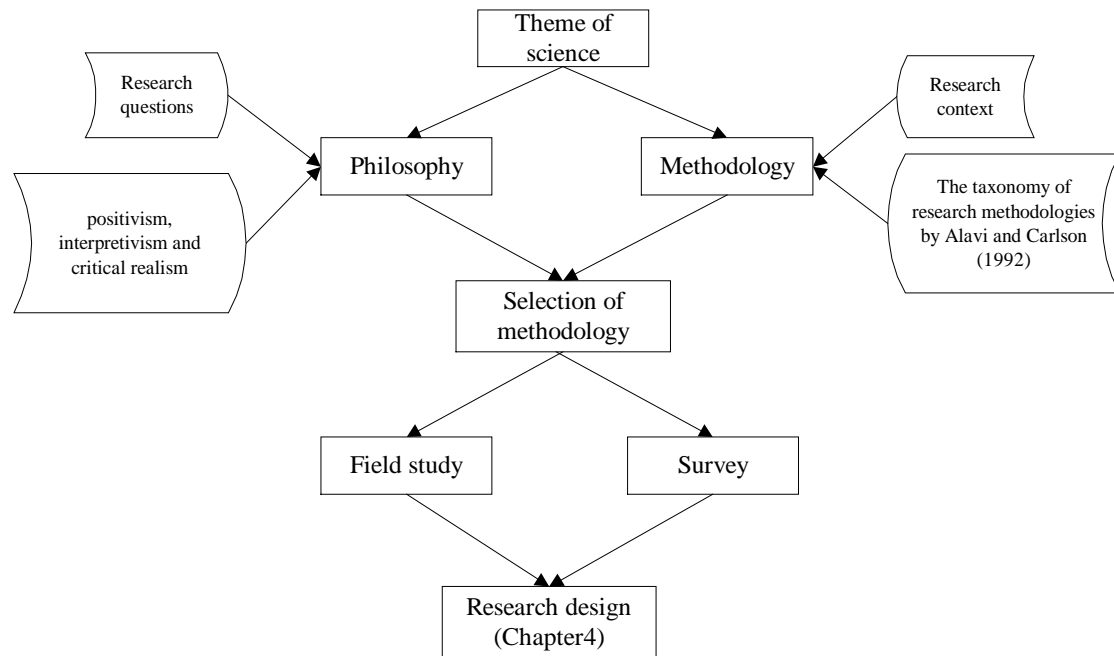


Figure 3.0 The structure of Chapter 3

The purpose of Chapter 3 is to discuss the research methodology to give a support and guidance of research design in Chapter 4. This chapter firstly introduces the theme of science. A review of the philosophies of positivism, interpretivism and critical realism within the context of the research questions, shows that this study encompasses both essences of positivism and interpretivism. A taxonomy of methodologies by Alavi and Carlson (1992) is used as a template for the discussion of methodologies. Given the research context and intentions, this study is categorised as an empirical study and event/process in Alavi and Carlson's (1992) taxonomy. Following from this, a field study and survey are selected as the specific methodologies to be applied in this research using a number of different tools and techniques. The two methodologies are applied to the project design introduced in Chapter 4.

3.1 The Theme of Science

The purpose of science is not to change the belief of people but to discover the relationships between objects. Science does not provide answers of right and wrong but confirms the regular logic of social life and sustained models. Simplistically speaking, science retrieves organizational knowledge by systematic empirical research.

The theme of science could be said to consist of three levels: philosophy, methodologies, tools and techniques, as shown in Figure 3.1.

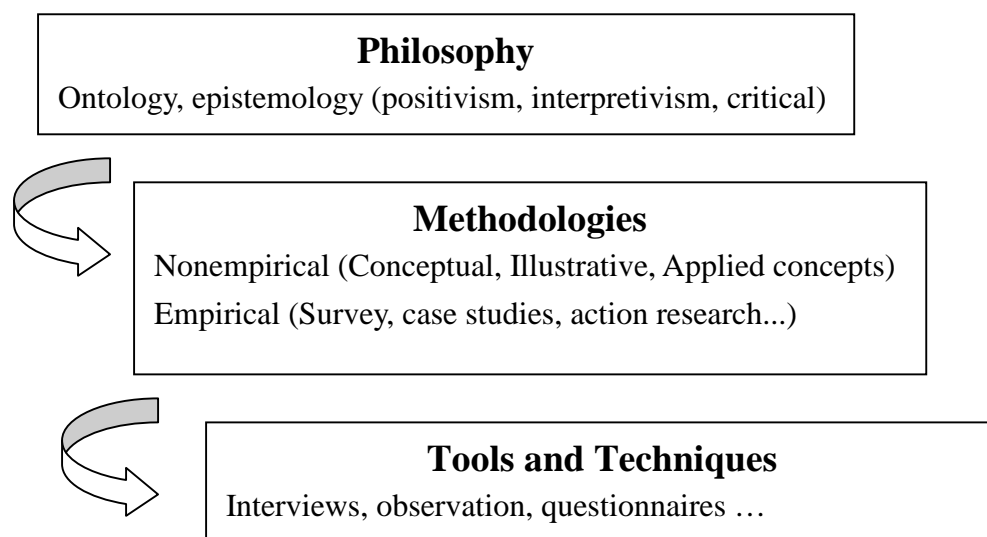


Figure 3.1 The theme of science
(Adapted from Ash, 2003)

The philosophy concerns the point of view within which the research questions are studied. This affects the selection of methodologies. Methodologies engage in structuring and guiding the research. This affects the choices of tools and techniques. The role of tools and techniques is to collect appropriate data for analysis. From the structure, it can be seen that the three parts are highly related. In the following section, philosophy, methodologies and tools and techniques used in this study are introduced

and discussed.

3.1.1 Philosophy

Research philosophy can be classified as: ontology and epistemology. Ontology is concerned with the structure and properties of “what is assumed to exist” (Iivari et al., 1998). In this view, the world is objective and knowledge is discovered, invented or developed by humans. On the other hand, epistemology focuses on the nature of knowledge and the proper methods of inquiry (Iivari et al., 1998). It assumes that knowledge comes from the individual’s experience and observation.

Epistemology is the mainstream of idealism. It consists of three categories: positivism, interpretivism and critical realism (Mingers, 1997; Orlikowski & Baroudi, 1991).

Positivism has been defined as “an organized method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity” (Neuman, 1994, p. 58). Positivists assume that the real world is objective and can be depicted by measurable characteristics that are independent of the researchers and instruments. Positivist studies attempt to build models to test theories and raise the anticipative understanding of phenomena. Therefore, the features of a positivist research are to: (1) tend to formulate hypotheses, models, and causal relationships among constructs; (2) do quantitative research and use experiments, surveys and statistics to examine theories or hypotheses (Neuman, 1994, p. 58); (3) provide objective, value-free interpretation (Chen & Hirschheim, 2004). Positivism has been criticized in that it changes people into figures and is concerned with abstract laws and formulas that are irrelevant to the real lives of humans

(Neuman, 1994, p. 58).

Interpretivism has been defined as “the systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds” (Neuman, 1994, p. 62). Interpretivists are concerned with how people engage in their practical affairs in everyday life or how they get things done (Neuman, 1994). Its main purpose is to understand and describe meaningful human actions. Interpretivists believe that researchers can never be objective (Shanks et al., 1993) and they tend to use rigid and complex methods to collect a variety of qualitative data in the form of specific details (Neuman, 1994). Summarily, the characteristics of interpretive research are: (1) to collect evidence from non-deterministic perspectives; (2) for researchers to be involved in a specific social setting environment; (3) a research based on participants’ perception (Orlikowski & Baroudi, 1991).

Critical realism is interested in prevailing social and power structures and aims at emancipating and empowering its human research subjects (Brook, 2002). It assumes that social reality is historically constituted and that produced and reproduced by people (Myers, 1997). The primary task of critical realism is regarded as one of social critique, whereby the restrictive and alienating conditions of the status quo are illuminated (Myers, 1997). The characteristics of critical research are to: (1) focus on the oppositions, conflicts and contradictions in contemporary society; (2) seek to be emancipatory i.e. it should help to eliminate the causes of alienation and domination; (3) emphasize the dialectical analysis which attempts to reveal historical, ideological and contradictory facets of existing social practices.

Orlikowski and Baroudi (1991) studied 155 U.S based information systems journal articles and found that positivist research accounted for 96.8% and only 3.2% articles were categorised as interpretive research. There was no article categorised as critical research. While these figures are now out of date it is still undoubtedly true that positivism and interpretivism are the two main paradigms in the IS field.

3.1.2 Philosophy Underlying Research Questions

Before deciding upon a valid philosophy for this study, the key issue is to analyse the research questions in greater depth. The research questions as established in Chapter 2 are:

- (1) Is there any difference in performance and satisfaction between virtual teams and face-to-face teams?
- (2) Are there any specific social or task factors that affect the performance and satisfaction of virtual teams and face-to-face teams?
- (3) How do the factors affect each other and what impact do the factors have on the performance and satisfaction of virtual teams and face-to-face teams?
- (4) How can we improve the performance and satisfaction of virtual teams?

The first question aims to reveal the differences between VT and FTF. The practical nature of this question lends itself to longitudinal research using empirical data, which leans toward a positivist solution.

The second question is to answer the “what” context and provide a clear definition of “what we need to know”. The question requires a combination of theoretical and empirical observation to explore unknown knowledge and increase understanding of

“what we need to know”. This implies that both positivist and interpretivist approaches would be suitable.

The third question extends the context of the second question and aims to answer the “how” concept. This question requires the integration of theoretical bases and experimental observations. It formulates models, tests hypotheses and explores the causal relationship between variables. Furthermore, it supplements these with subjective perception such as observation, interviews and discourse analysis. This again lends itself toward both positivist and interpretive stances.

The fourth question is substantially different in nature from the previous three. It summarises the conclusions from the previous three questions and applies the researcher’s interpretations to provide solutions. This necessarily implies an interpretive perspective based on a mix of interpretative and positivist paradigms.

To summarize the philosophy, both essences of positivism and interpretivism are involved in this study. This study not only focuses on hypothetic-deductive testability of theories but also observes and tries to understand human interactions.

3.1.3 Combining Positivism and Interpretivism

Given the radically different philosophies and assumptions that underpin positivism and interpretivism, there has been much debate about the combination of both paradigms. Morey and Luthans (1984) summarised and described the confrontation of two paradigms: objective versus subjective, nomothetic versus idiographic, quantitative versus qualitative, outsider and insider, and etic versus emic. They seem to be opposed and irreconcilable. The following summarises three major differences

between positivism and interpretivism:

- (1) Ontologically, positivists believe that truth exists objectively and independently from the experience and perception of humans while interpretivists highlight the subjective implication of the reality that is perceived by humans and constructed and reconstructed through the social interaction process (Iivari et al., 1998).
- (2) Epistemologically, positivists emphasize hypothetic-deductive testability of theories. Real knowledge should be able to be verified and generalized. Consequently, causal relationships are always presented and a solid conjunction among explanation, prophecy and control of variables is expected (Orlikowski & Baroudi, 1991). On the contrary, interpretivists believe that scientific knowledge should be retrieved through the understanding of human and social interaction. They argue that positivists' concerns with abstract laws and measurement are unrelated to the actual lives of real people (Shanks et al., 1993).
- (3) Methodologically, positivists insist that researchers should take a value-free view and apply objective measurements to gather evidence to test hypothetic-deductive theories. Therefore, a quantitative method such as a survey is a representative instrument for positivist research. On the other hand, interpretivists argue that researchers ought to engage in the social setting investigation and learn how human activities and interaction takes place from the participants' views (Orlikowski & Baroudi, 1991). Thus, a qualitative method such as field study that enables researchers in the real social environment is appropriate for interpretivist research. Positivist researchers precisely measures details of numerous subjects and applies statistics to examine the rules, whereas interpretive researchers are likely to spend a long time on a few people to understand their perceptions in depth (Neuman, 1994, p. 62).

While positivist research has dominated the IS field, interpretive research has been gaining increasing attention as a legitimate alternative (Lee, 1991; Chen & Hirschheim, 2004). Some scholars have endeavored to incorporate the relative strengths and minimize the relative drawbacks of the two perspectives such as the Lakatosian Structured Methodological Falsification (SMF) model proposed by Bharadwaj (2000) which blended both the traditional tenets of positivism and the contemporary interpretive notions to reconstruct IS research. Lee (1991) also built a model to refute the widely held notion that they are opposing and incompatible, and viewed them as mutually supportive rather than mutually exclusive. He further urged that the combination of the two perspectives might promote new opportunities for theoretical refutation and refinement.

When diagnosing the philosophies underlying the research questions, it can be found that positivism and interpretivism are mutually supportive. As discussed in 3.1.2 all the questions benefit from the application of both positivist and interpretivist philosophies.

3.2 Methodology

Methodology has been interpreted as an organised collection of concepts, methods, beliefs, values and normative principles supported by corporal resources (Hirschheim et al., 1995). More specifically, the methodology is a set of goal-oriented procedures that guide the work and cooperation of the various parts involved in the construction of an application (Iivari et al., 1998).

Many scholars have attempted to classify the methodologies of Information Systems in recent years. Each has its own interpretation of classifications, such as qualitative and quantitative (Cash & Nunamaker, 1991), empirical and nonempirical (Chen & Hirschheim, 2004), positivist and interpretivist (Chen & Hirschheim, 2004). Alavi and Carlson (1992) analysed the topics and research methodologies of 918 articles published between 1968 and 1988 and proposed a taxonomy for the IS research. The taxonomy is divided into two parts: empirical and nonempirical. Empirical studies are categorised into event/process and object while nonempirical studies consist of three types: conceptual orientation, illustrative and applied concepts. The taxonomy is shown in Figure 3.2.

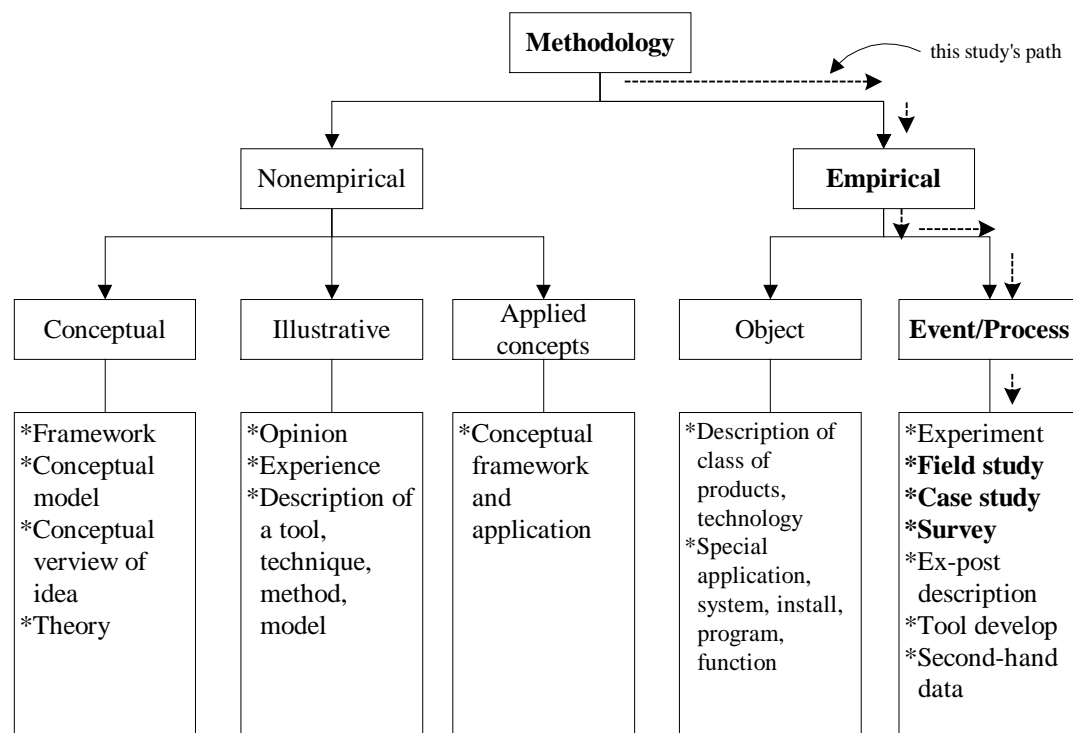


Figure 3.2 The taxonomy of research methodologies

(Amended from Alavi and Carlson, 1992)

From the taxonomy, it can be found that nonempirical research focuses more on descriptions of concepts, framework and deduction instead of systematic observation.

It always emphasizes theory building and explanation, and provides descriptions of tools, techniques, methods and models. Empirical studies are based on humans' perceptions and experiences. Research which emphasizes "object" always describes a system, product or installation. Studies which incline to event/process investigate susceptible experience by human and include research methodologies such as experiment, field study and survey.

3.2.1 The Selection of Methodology

In the selection of a suitable methodology for this study, it is necessary to review the intentions of this study as summarised below:

- To observe the processes of students' dealing with a given project. This includes how they communicate with each other, how they build relationships, how they collaborate on the tasks and how their performance and satisfaction relate to this.
- To collect data to build and verify the frameworks for FTF and VT.
- To provide suggestions to improve the performance and satisfaction of VT from the observation of students' behaviour and the analysis of the collected data.

To realise these intentions, this study needs to design a project for students. When students are engaged in the project, the researcher can observe their behaviours and collect data produced through various processes. After the project, students' perceptions regarding the processes and outcomes will be gathered. The schema is shown as Figure 3.3:

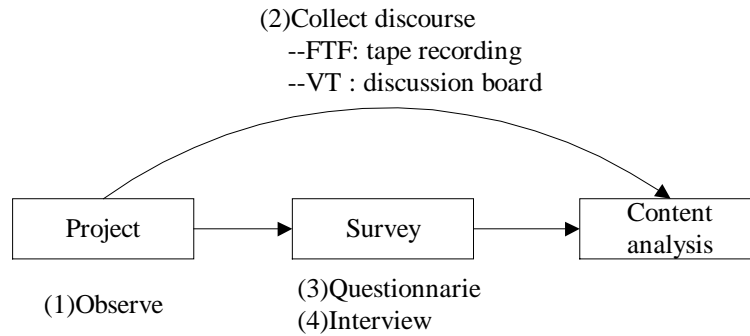


Figure 3.3 The schema of the practical stages of this study

There are three stages: project, survey and content analysis. In the project stage, when students are doing the given tasks, the researcher is able to observe students' behaviours and interactions. During the project, tape recording is collected for FTF teams while discussion board discourse is collected for VT teams. The collected discourse data is analysed in the third stage (content analysis) to understand students' discussion process in depth. After the project, questionnaires are administered and interviews are conducted to understand students' perceptions and feelings about the processes and outcomes. Furthermore, statistical methods were applied to build and verify the frameworks for FTF and VT.

In summary, this study is empirical and can be categorised as an event/process study as shown in Figure 3.2. Then, what kind of research methodology is suitable for this study? Event/process includes research methodologies such as experiment, field study, case study, survey and action research. The discussion of the selection of research methodologies follows.

Galliers (1991, p. 339) adopted Vogel and Wetherbe's (1984) criteria of parsimony and comprehensiveness to classify research methodologies by their impact (society, organization/group, individual), applicability (technology, methodology) and context

(theory building, testing, extension). The taxonomy clearly uses the functions of methodologies to annotate them. The focus of this study is individual small group of students and is concerned with how VT members use technology to communicate and build relationships compared with FTF interventions. As to the context, this study tries to build a framework and test the framework. Thus, it relates to framework building and testing. It is apposite to compare the functions of this study with the taxonomy as Table 3.1.

Table 3.1 The comparison of the requirements of this study with Galliers' taxonomy

Object	Modes for traditional empirical approaches (observations)		Modes for newer approaches (interpretations)		
	Laboratory Experiment	Field Study	Case Study	Survey	Action Research
Society	No	Possibly	Possibly	Yes	Possibly
<u>Organization/group</u>	<u>Possibly</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>
<u>Individual</u>	<u>Yes</u>	<u>Yes</u>	<u>Possibly</u>	<u>Possibly</u>	<u>Possibly</u>
<u>Technology</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>	<u>Possibly</u>	<u>No</u>
Methodology	No	<u>Yes</u>	<u>Yes</u>	Yes	Yes
<u>Theory building</u>	<u>No</u>	<u>No</u>	<u>Yes</u>	Yes	<u>Yes</u>
<u>Theory Testing</u>	<u>Yes</u>	<u>Yes</u>	<u>Possibly</u>	<u>Possibly</u>	<u>Possibly</u>
Theory extension	Possibly	Possibly	Possibly	Possibly	Possibly

(Amended from Galliers 1991, p. 339)

To compare Figure 3.3 with Table 3.1, the second stage “survey” of Figure 3.3 corresponds to “survey” in Table 3.1, and this means that the survey approach is included in this study. The researcher intends to let students engage in the given tasks in a natural setting instead of in an artificial environment along with numerous restrictions. In this context, a laboratory experiment which controls variables and environments precisely and rigidly is not suitable for this study.

Avison et al. (1999) define action research as “an iterative process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning” (p. 94). From this definition, action research emphasizes researchers’ involvement and cooperation with practitioners. In this study, the researcher intends to observe students’ behaviours instead of becoming involved in their interactions and further to generalise the results to the real world. Thus, there are no practitioners in reality. Accordingly, action research is removed from the candidate list leaving field study and case study as possible candidates.

In the next section, field study, case study and survey are reviewed individually and the former two are compared to find the most suitable methodology for the “project” stage in section 3.5.

3.3 Introduction to Field Study

Judd et al. (1991) describe field study as “a study of how people behave in specific organisations, communities, or circumstances and conclude that anyone would behave similarly in those situations” (p. 317). Singleton et al. (1999) state that field study researchers often focus on the subjects’ views toward the world. It has been categorised as a qualitative research methodology (Judd et al., 1991; Singleton et al., 1999). Summarily, field study is a method that evaluates independent variables and dependent variables in a natural setting instead of manipulating variables. It has experimental design but has no experimental control. Researchers need to participate in the real venue and observe and record the data that they intend to collect.

Singleton et al. (1999) state that a field study is versatile in many different research

settings: (1) researchers are able to get an insider's view of reality because they can capture the substance, coherence and maintenance of views that may seem implausible to outsiders; (2) it lends itself well with dynamic or rapidly changing environments due to its flexibility that researchers can take extra actions to deal with unexpected situations; (3) it is suitable for some kinds of substantive problems, such as (a) when it is compulsory to maintain "whole" circumstance in details and immediacy; (b) when a situation is complex, including interrelated phenomena that must be focused simultaneously and as a whole; (c) when the study is focusing on the relationship between the subjects and the settings.

However, Singleton et al. (1999) explain that field study has limitations: (1) it can be costly such as time, labor and money; (2) some ethical constraints could preclude the use of field study, such as studying a riot could be dangerous and creating some medical conditions (e.g., physical disabilities) would be not suitable; (3) researchers need to possess enough knowledge of the subjects and environment to get fruitful outcomes.

3.4 Introduction to Case Study

Yin (2003) describes a case study as "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence". There are several implications in this definition: (1) case studies are set in a natural environment without manipulating variables; (2) case studies can use multiple ways to collect data such as survey and interview; (3) the object of a case study can be one case or more than one case, such as person, group or organization; (4) it provides in-depth exploration to understand

the complexity of each phenomenon.

A case study is suitable for the following situations where: (1) there is no extensive research or theories in the particular area; (2) some special cases are apparently contradictory to theories; (3) it is important to capture the knowledge of people in the cases and develop theories instead of testing hypotheses (Labovitz & Hagedorn, 1981, p. 48); (4) the emphasis is to reveal the problems of “how” and “why”.

Case studies are widely used but there are two limitations acknowledged: (1) since case study focuses on one or a few cases, it is very difficult to generalize the findings; (2) the bias of researchers and subjects, which comes from a mix of individual opinions, loss of memory and distortion and deliberate concealment of facts, may affect the results critically.

3.5 Comparison of Field study and Case study

Through the elaboration of field study and case study in section 3.3 and 3.4, the advantage/application and disadvantage/limitation of both methodologies are presented and discussed along with the influence on this study as Table 3.2 and 3.3:

Table 3.2 Field study and the application to this study

Field study	Influence this study	Applicable to this study
Advantages/Application		
Researchers are able to get an insider's view of reality	It benefits this study because it fits the intentions of this study	Yes
Cope with dynamic or rapidly changing environments	The environment of this study is dynamic and changing rapidly. So, it benefits this study	Yes
Suitable for maintaining "whole" circumstance, complex, focusing on the relationship between the subjects and the settings	It fits the environment of this study	Yes
Disadvantages/Limitation		
Could be costly	The resource is provided by the school, thus, it is not costly	Yes, this study can overcome
Ethical constraints could preclude the use of other research approaches	There is no ethical issues for this study	Yes, it does not affect this study
Fruitful outcomes rely on the knowledge of researchers toward the subjects and environments	The researcher has fruitful knowledge in this area and has observed the students for one semester	Yes, this study can overcome

Table 3.3 Case study and the application to this study

Case study	Influence this study	Applicable to this study
Advantages/Application		
There is no extensive research or theories in the particular area	There have been abundant studies in this area	No
Some special cases are apparently contradictory to theories	There is few special cases contradictory to theories and this study tries to validate theories	No
It is important to capture the knowledge of people in the cases and develop theories instead of testing hypotheses	Capturing knowledge of people and testing hypotheses are equally important for this study	Partly
The emphasis is to reveal the problems of “how” and “why”	This study focuses not only on “how” and “why” but also “what”	Yes
Disadvantages/Limitation		
The problem of generalization	This study uses quantitative data (questionnaire) to validate data. So, this deficit is not existing in this study	Yes, the problem is not existing in this study
Bias of the researchers and subjects	When the researchers observes the subjects and makes conclusion, the bias may happen. But through supplemented by other data (interview, questionnaire, content analysis), it may reduce the bias	This study could reduce the effect of bias
Fruitful outcomes rely on the knowledge of researchers toward the subjects and environments	The researcher has fruitful knowledge in this area and has observed the students for one semester	Yes, this study can overcome

From the two tables above, it can be seen that field study is more appropriate for the “project” stage in this study where:

- (1) It is engaged in a natural setting rather than manipulating variables.
- (2) The researcher is able to get an insider's view to understand students' processes in depth.
- (3) It is flexible to cope with dynamic and rapidly changing environments. The setting of this study is a learning environment with hundreds of students. Students' situation is hard to predict and control. Thus, the plan must be flexible and easy to amend to cope with any accidents.
- (4) As to the disadvantages/limitations, they can be overcome and rarely affect this study.

3.6 Introduction of Survey

The purpose of a survey is to retrieve a vivid picture of practices, procedures, situations and views at a single point in time through questionnaires, interviews or published statistics. By studying representative samples, the survey seeks to discover relationships between constructs and provide generalized statements about the objects of study (Jick, 1983, p. 136). It can precisely document the norm, identify extreme outcomes and depict relationships between variables in a sample (Gable, 1994). Thus, it is suitable for validating research that has had solid theoretical support. It can cover a broad scope and the objects can be visible objects such as individual, group or organization, or invisible objects such as satisfaction, efficiency and stress.

A survey has the following characteristics:

- (1) Survey is the most frequently used method:

According to Chen and Hirschheim (2004), a survey is the most prevalent approach used in IS representing over 40% of studies. As a scientific method it is logical, systematic and objective. These steps consist of setting research questions,

hypotheses, data collection, data analysis and conclusion, and follow logical principles. Furthermore, the results of a survey can be replicated, validated and refined to modify theories or frameworks.

(2) The subjects of a survey can be based on a sample or total population:

According to the scope of sampling, survey consists of sampling and census. Sampling chooses a representative sample to investigate while census focuses on all population.

(3) Surveys focus on general facts instead of special cases:

The purpose of a survey is to discuss the common traits of objects instead of focusing on individual. A survey depicts whole pictures and general facts by analysing the sample and population. Therefore, the findings from a survey can infer the characteristics of a population.

Although a survey is a versatile method, there are still some limitations (Gable, 1994):

(1) Surveys must have solid and clear frameworks:

It is very important for a survey to ask the right questions in the right way. If the survey takes place prior to the existence of a solid and clear framework, it is impossible to get the right data to analyse. Therefore, GIGO (Garbage In Garbage Out) is unavoidable.

(2) A survey is an inflexible approach for discovery of new issues:

Due to the need for a clear and solid framework to follow, it is difficult for a survey to reveal new issues. Once the survey is underway, there is little can do upon comprehending that some crucial items are omitted from the questionnaires, or discovering that questions are ambiguous and that respondents may

misunderstand.

Both questionnaires (written) and interviews (personal) are used in this study. There are two purposes for using questionnaires. The first one is to apply Likert scale to collect students' perceptions of each variable; another is to apply open questions to ask for students' perceptions of what factors affect their group performance and satisfaction. The purpose of the interviews is to delve more deeply into students' feelings about the processes and outcomes.

- **The advantages and disadvantages of questionnaires**

According to Judd et al. (1991), a written questionnaire has the following advantages: low cost; avoidance of potential interviewer bias; less pressure for immediate response on the subject. The disadvantages are low response rates; poor data quality and; possible misunderstanding of the questions.

For the use of questionnaires in this study, the advantages are applicable. It is cheap for distributing questionnaires to students because the researcher can distribute questionnaire in the lectures. A written questionnaire enables the avoidance of the researcher's bias and gives less stress for students. As to the disadvantages, response rate would be high because lecturers and tutors are able to help to distribute and collect questionnaires. Lecturers and tutors can answer students' questions when they have problems in order to avoid misunderstanding of the questions, and check questionnaires roughly to raise the data quality when students hand in questionnaires. Thus, a written questionnaire is highly appropriate to this study.

- **The advantages and disadvantages of personal interview**

According to Judd et al. (1991), the main advantage of personal interviews is the excellent data quality. Personal interviews can attain the highest response rate of any survey methods. The interviewer can notice and correct the respondents' misunderstandings and probe inadequate or unclear responses. The interviewer can also control the order in which the respondents receive the questions and the contents of the interview. Moreover, a face-to-face interview can best establish intimacy and motivate the respondents to answer fully and accurately. Those abilities mean personal interviews can retrieve high quality data. Disadvantages include expense and time consumption and interviewer influences.

The interview is conducted by the researcher. Through personal interview, this study is able to understand students' perceptions in depth, which would not be reflected in questionnaires and discourse analysis.

In summary, this research study will employ a number of different approaches, field study, surveys/questionnaires and interviews. It is felt that this combination of approaches will allow for the deficiencies of each singular approach to be overcome by their combined interactions.

3.7 Summary

This study combines elements of positivism and interpretivism and is an empirical study classified as event/process by Alavi and Carlson's (1992) taxonomy. There are two methodologies applied to this study: field study is applied to the "project" stage to design the tasks for students and collect students' discourse for content analysis. A survey is applied to retrieve students' perceptions and feelings about the processes and outcomes by using questionnaires and interviews. In addition, the data from

questionnaires is used to validate the frameworks for FTF and VT. The properties, advantages and disadvantages of these approaches inform the research design described in Chapter 4.

Chapter 4 Research Design

4.0 Chapter Introduction and Structure

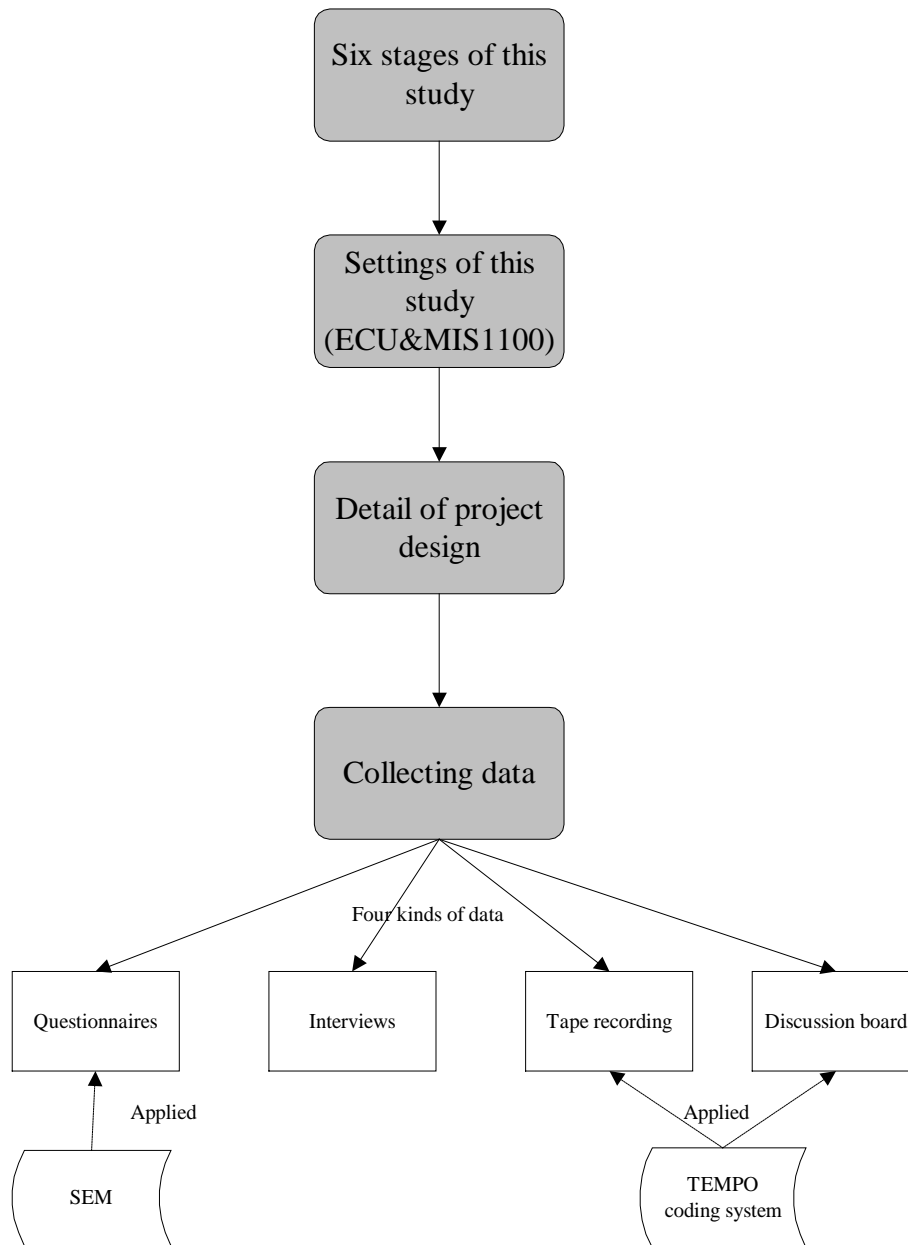


Figure 4.0 The structure of Chapter 4

The purpose of Chapter 4 is to introduce the project design for this thesis. This chapter firstly introduces the six stages of the project design. The preparation stage is presented in Chapter 1~3, thus this chapter focus on the project design of VT and FTF. The specific environment of the university (ECU) and the unit (MIS1100) used in the

project is described, followed by the details of the project design. The methods of collecting the four kinds of data (questionnaire, interview, tape recording and discussion board) are reviewed. The TEMPO coding system which is used for coding the discourse of tape recording and discussion board, and SEM which is used to analyse questionnaires is described.

4.1 Introduction of the six stages of the project design

The six stages of the project design are shown in Figure 4.1.

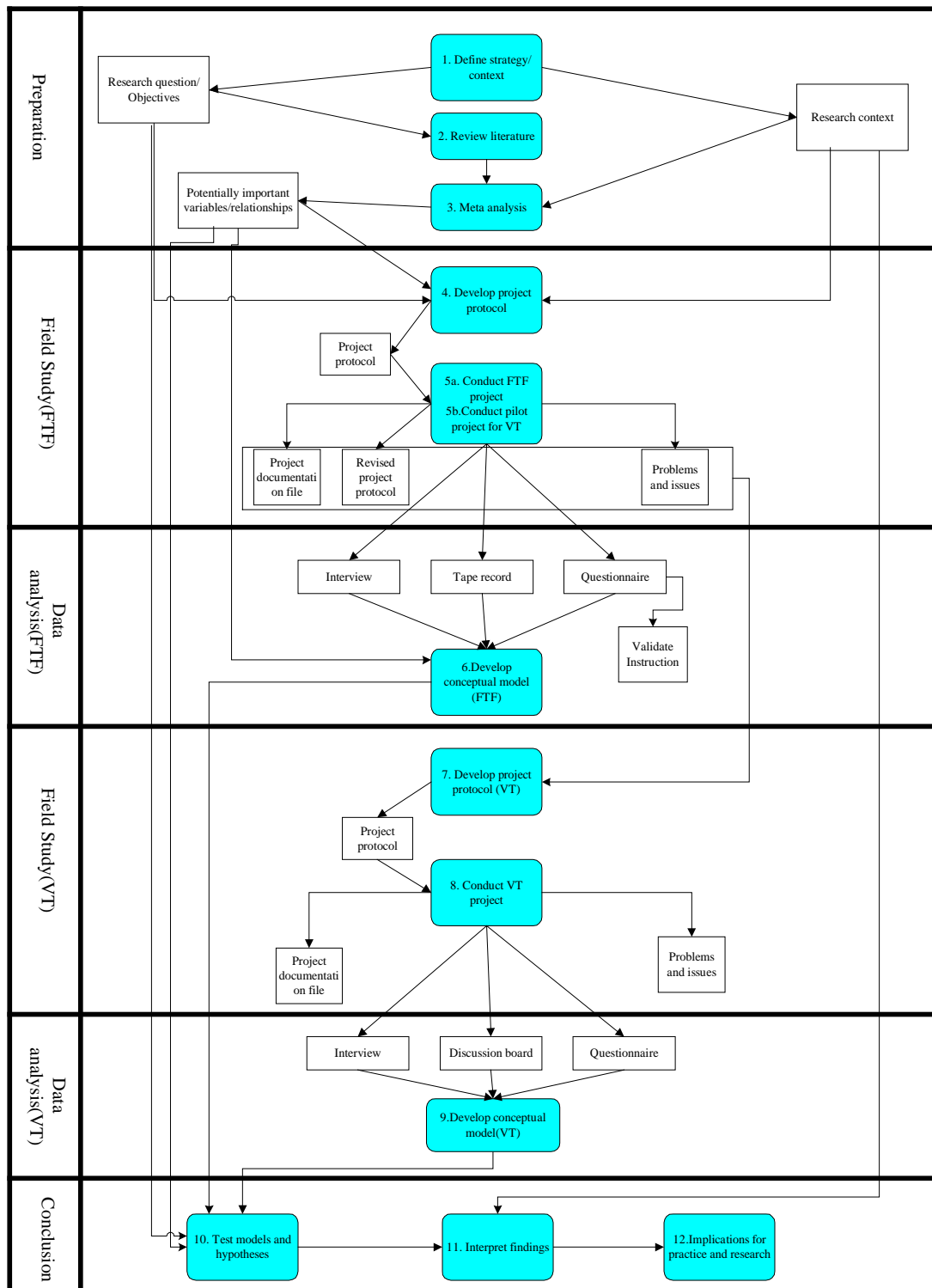


Figure 4.1 The stage diagram of the project design

The project design includes six major phases: preparation, field study (FTF), data analysis (FTF), field study (VT), data analysis (VT) and conclusion. Preparation involved the development of research questions, definition of context, literature

review and meta-analysis. The purpose of the preparation stage is to confirm the research context through extensive literature review and use the meta-analysis to explore the initial framework. The meta-analysis and the development of the initial framework were introduced in section 2.3.

Once the initial framework was built, the FTF project commenced. A protocol presented in section 4.2 was developed according to research context, research objectives and the results of the meta-analysis. The data (interview, tape recording and questionnaire) for the next stage (data analysis) was collected, and the documents which included project document files, revised project protocol and problems and issues were created in order to improve the second semester's project.

Simultaneously, a pilot VT project with 24 students who were enrolled in MIS1100 as on-line learning students was introduced. The procedure is described in section 4.4. The formal VT project was conducted in the light of this.

The purpose of the next stage was to run a project in a virtual environment. A protocol was developed in the light of the documents from the first semester and the pilot project. After the execution of the VT project, the documents (project documents and problems and issues) and the data were collected.

In the last stages, the models and hypotheses were tested through the collected data. Finally, the findings were interpreted and the implications for practice and research were discussed.

4.2 The Environment of This Study

Edith Cowan University is a two-semester university with approximately 23,000 students enrolled in about 330 different units. A semester is a half-year period: 12 weeks for lecture are followed by time for studying and preparation for exams. The “Information Systems I” is a foundation unit for business undergraduate students. The unit aims to make students fully conversant with the role and place of information system and information technology in business. The concepts introduced in this unit include the basic hardware and software of desktop computing, the use of databases, electronic commerce and its impacts, communications, networks and their applications, and the development and management of computer-based information systems. Some important issues are also explained, such as ethical issues, social impacts of information systems and technology. The practical classes help students develop their skills in Word, Excel, Access and Endnote.

There are two types of students enrolled in this unit. One group is on-campus learning while another group is on-line learning. On-campus students have the traditional class when the lecturers teach in the classroom. On-line learning composes of long-distance students from across the world who communicate with lecturers and classmates through a Blackboard system. There are about 200-300 on-campus students and 30-40 on-line learning students each semester.

Ideally the on-campus learning students would have become the FTF teams and the on-line learning students as the VT teams. But, the small sample size of on-line learning students presented a critical problem and so it was decided to use the on-campus students as the main subjects operating in two different environments (FTF and VT). In the first semester, the project ran in a FTF setting. Students could

discuss the given tasks face to face. In the second semester, students had to discuss the given tasks solely through a Blackboard system and hence in a virtual environment. As a result, there were fewer gaps between the sample size of FTF and VT allowing for optimal comparison.

From the discussion of field study in Chapter 3, the more knowledge about the subjects and environments the researcher possesses, the more fruitful outcomes the researcher can obtain. Thus, before the start of the project, the researcher had been sitting in the class and observed the whole processes of MIS1100 for one semester in order to understand the subjects and the unit more. Field study suggests study in a natural setting to capture the knowledge from people's behaviours and so as few variables were manipulated and controlled as possible to keep the setting natural and close to the real world. The unit (MIS1100) has two lecturers, several tutors, hundreds of students, tight schedules and changeable semester plans. It is an extremely complicated environment since students may drop the unit anytime and thus affect the project process or lecturers may change semester plans because of unexpected events. To cope with this dynamic and rapid changing environment, the project design needed to be flexible, and it had to be easy to change procedures and schedules.

4.3 The FTF Project

This section introduces the project conducted in a FTF setting. It includes the characteristics of the subjects, the unit, the project design and the assignment task.

4.3.1 The Subjects

There were 250 students enrolled in MIS1100 on-campus learning in the first semester and 50 students dropped the unit over the period of the semester, which gave

a sample size of 200. Most of these were experiencing their first or second semester in the university. Female proportion was slightly higher than male and the age ranged between 17 and 35, with most between 18 and 22.

4.3.2 Introduction of MIS1100 in the First Semester

MIS1100 combines a two-hour lecture and one-hour tutorial. There are three lecture times and students can choose the most convenient time for them. In addition, it includes four assessments: group assignment (10%), lab work (10%), business essay (20%) and final exam (60%). The group assignment was designed by the researcher (shown in appendix 4.4) and executed over four weeks.

4.3.3 The Project Design for FTF

The project was designed as a writing assignment. It needed students to work together and exchange information to finish a report. A rough schedule is shown in table 4.1 (The detailed schedule is presented in appendix 4.1).

Table 4.1 A rough schedule of the group assignment of FTF

Week (time)	Main Actions
1-3	Prepare the documents and equipment
4	Explain the group assignment to students and request the consent form
5	Request the consent form and release the group assignment
6-9	Conduct the group assignment
9	Students hand in the assignment and evaluation form
10-11	Distribute the questionnaires and conduct interviews
13	Return the assignments

From weeks 1 to 3, the researcher prepared the documents and equipment or facilities (such as tape recorders, tapes, discussion rooms). In week 4, the researcher distributed

an information sheet (appendix 4.2) and explained the group assignment procedures to students and requested the consent form (appendix 4.3) from students in the lecture. In week 5, the group assignment (appendix 4.4) was released and students who did not come to class in week 4 were still asked to fill in the consent form. The assignment were released one week before the start to allow students to assimilate the background.

After preparation, the group assignment activity was held between weeks 6 and 9. Group member lists were distributed at the beginning of week 6. Four students (two males and two females) who were in the same lecture were grouped randomly. Then, after one-hour lecture, students started to get together and went to the assigned discussion rooms with the distributed tape recorders to discuss the assignment. Students were required to record their conversation while they were discussing. After the discussion, students returned the tape recorders to the lecture room. During weeks 7 and 8, students repeated the actions above. Week 9 was the semester break and had no lecture. Students did not need to come to class and could finalize the assignments and submit at the end of week 9. In addition, to help identify whether each group member contributed equally, students were encouraged to submit an evaluation form (appendix 4.5) to represent their contributions, which was used to calculate the individual mark. During week 10 and 11, written questionnaires (appendix 4.6) were distributed in the lectures and students were able to complete them. Fifteen interviews were also conducted during these two weeks.

Figure 4.2 shows the activities during the two-hour lecture between weeks 6 and 8. The problems and issues during the project period were recorded and shown in appendix 4.9. These proved invaluable for the VT project.

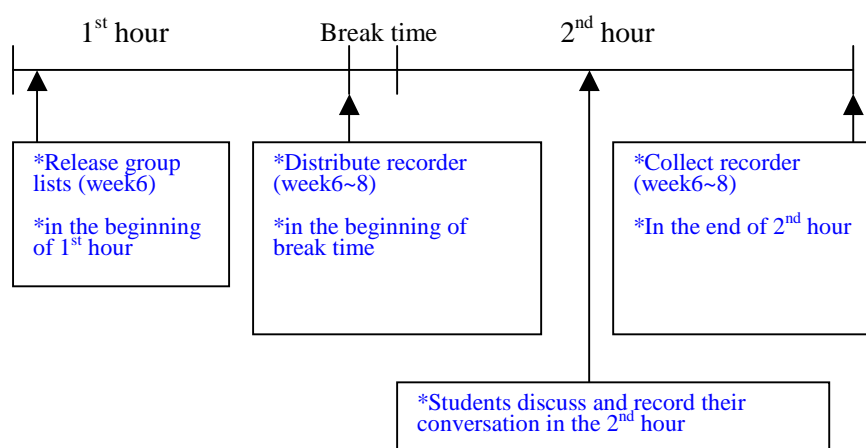


Figure 4.2 The activities during the two-hour lecture between weeks 6 and 8

4.3.4 Assignment Tasks Discussion

By observing the tasks and time columns in appendix 2.1, it can be seen that specific types of task need different amounts of time. If the time is short (less than 1 day), experimental design would be popular and the tasks should focus on specific problem solving, such as Straus (1996) and Valacich and Saker (2002). But if the time is longer (several days or weeks), a group writing assignment would be the most popular task, such as Galegher and Kraut (1994) and Burke and Chidambaram (1996). A group writing assignment is also suitable for this study due to the following reasons:

- (1) The duration of the cause study is four weeks. To solve a specific problem (such as a subarctic survival task) is too short for students. Several tasks can be designed in a group writing assignment and students allowed to finish over four weeks.
- (2) MIS1100 teaching material can be incorporated to the tasks of a group writing assignment in order to improve students' learning outcomes and help students prepare for the final exam.
- (3) When students are discussing the tasks and writing the assignment, the longer time enables the researcher to have enough time to observe their interactions.
- (4) The assignment must be the same for two semesters, so a group writing

assignment has no correct answers (like yes/no) and has more room for students to develop their ideas.

The assignment was selected and adapted from the textbook which had been used for two semesters in MIS1100. It described the problems that an old and famous restaurant had and asked students to design information systems to solve the problems. It included project management, system development and financial planning. The tasks for the VT project were slightly different from those for FTF project to avoid student plagiarism but required the same discussion processes.

As discussed in section 2.5.4, there are three kinds of tasks: independent, dependent and interdependent. For the purpose of observing students' interactions, interdependent tasks lead to more discussion. However, in the light of the tight schedule for the assignment and students' limited knowledge of Information Systems, it was felt that interdependent tasks would be beyond their capabilities and cause high levels of frustration. Thus, independent tasks were used and students could allocate the tasks to each member. After all members finished their parts, these had to be combined together and submitted. This design is also close to reality. In the real world, it is quite common that a big job is divided into many small tasks and each member takes charge of one or more tasks.

4.4 The Pilot VT Project

The pilot VT project progressed simultaneously with the FTF project. On-campus learning and on-line learning had the same unit structure. This meant that both group assignments had to be the same. The only difference between the two group assignments was that on-campus students could meet face-to-face while on-line

learning students could only communicate through the Blackboard system. The purpose of the pilot project was to run the project with a small sample size and hence evaluate the processes which would need to be in place for the formal VT project in the second semester.

4.4.1 The Subjects

There were 24 students enrolled in MIS1100 on-line learning in the first semester and four students dropped the unit leaving twenty in total. Most of them lived near Perth within 100 km and were studying part-time. Because they were all working, the age was older than on-campus students, ranging between 22 and 40. Four people were grouped randomly as a team.

4.4.2 The Pilot VT Project Design

Basically, the schedule and the content were the same as the FTF project. The differences were:

- (1) It was unnecessary to prepare tape recorders and discussion rooms during week 1~3.
- (2) Students were contacted through e-mail to release and explain the group assignment, ask for the consent form and questionnaires.
- (3) It was compulsory to set up a discussion board for each group.
- (4) Students submitted the assignments through posting on individual group discussion board.
- (5) Interviews were not conducted.

The rough schedule is shown as Table 4.2:

Table 4.2 The rough schedule of the pilot VT project

Week	Main actions
1~3	Prepare the documents
4	Explain the group assignment to students and request consent form through e-mail
5	Request consent form and release the group assignment Release group list and set up the discussion board
6-9	Student conducted the group assignment on Blackboard
9	Hand in assignments and evaluation form posting on discussion board
10-11	Distribute the questionnaires
13	Return the assignment

4.5 The Formal VT Project

This section introduces the project conducted in a virtual setting. It includes the characteristics of the subjects, the unit and the project design.

4.5.1 The Subjects

There were 300 students enrolled in MIS1100 on-campus learning in the second semester and 80 students dropped the unit over the period of the semester, which gave a sample size of 220. Most of these were experiencing the first or second semester. Female proportion was slightly higher than male and the age ranged between 17 and 36 with most between 18 and 23. The demographics were similar to the first semester.

4.5.2 Introduction of MIS1100 in the Second Semester

In the second semester, MIS1100 was composed of a two-hour lecture and one-hour tutorial. There were three lecture times and students could choose the most convenient time for them. Furthermore, it included three assessments: group assignment (15%),

lab work (25%) and final exam (60%). The case study was designed by the researcher and ran over four weeks. The unit structure was slightly different from the first semester but did not affect the result of this study.

4.5.3 The Project Design for VT

Basically, the project design was similar to that of the pilot project. The rough schedule is shown as Table 4.3 (the detail schedule is shown in appendix 4.10):

Table 4.3 The rough schedule of the group assignment of VT

Week	Main actions
1~4	Distribute information sheet and ask for consent form
5	Release the group assignment
6	Release group lists and set up the discussion board
6-9	Students discuss on Blackboard
9	Hand in assignments and evaluation form on Blackboard
10-11	Distribute the questionnaires and conduct interviews
13	Return the assignment

From week 1 to 4, the researcher prepared the information sheets (appendix 4.11) and distributed them in the lectures and posted these on Blackboard. In addition, students were asked to sign the consent form (appendix 4.12) for the approval of data collection. In week 5, the researcher explained the group assignment (appendix 4.13) to students in the lectures and posted it on Blackboard.

After the preparation, the assignment was held from week 6 to 9. Group member lists were distributed in the beginning of week 6 both in the lecture and Blackboard. Four students (two males and two females) who attended different lecture sessions at different times were grouped into a team to avoid meeting each other in the lecture time. At the same time, individual discussion boards for each group were set up in

Blackboard. Students could login in Blackboard and enter their own discussion board only instead of accessing other groups' discussion board. They were able to post their ideas and exchange files on the discussion board. In week 9, the finished assignments were posted on the individual group discussion board. Students were encouraged to submit the evaluation form (appendix 4.5) to represent their contributions, which was used to calculate the individual mark. After the submission, the researcher collected the discourse in the discussion board. To raise the return rate, written questionnaires were distributed in the lectures and an online questionnaire system link was also sent to students' email box to ask students to fill in the questionnaire during week 10 and 11. Simultaneously, 25 interviews were conducted.

4.6 Data Collection for FTF and VT

There were four kinds of data to be collected during both semesters: questionnaire (FTF and VT), interview (FTF and VT), tape recording (FTF) and Blackboard discussion board data (VT). The following sections describe each individually.

4.6.1 Questionnaire

The objectives of the questionnaire were to validate the framework and obtain potential variables. The questionnaire was divided into two parts: Likert scale questions and open questions. The open questions asked students' feelings about the factors affecting their group performance and satisfaction in order to confirm the variables and identify potential variables. The Likert scale questions were designed according to the framework of this study and contained eight instruments which represented the six variables of the framework: communication, relationship building, cohesion, collaboration, performance and satisfaction, as shown in Table 4.4.

Table 4.4 The instruments used to test the variables

Concepts	Questionnaire instruments	Source	Reliability
Relationship building	Team member relationships	Lurey & Raisinghani., 2001	0.82
Cohesion	GEQ (Group/Social)	Carron et al,2002	0.76
Communication	Relational communication Scale (Task versus social orientation)	Burgoon & Poire, 1999	0.41
Collaboration	Collaboration	Montoya-Weiss et al., 2001	0.88
Performance	Performance	Lurey & Raisinghani, 2001	0.82
Satisfaction	Perceptions of Process	Chidambaram, 1996	0.89
	Perceptions of Outcomes		0.95
	Solution Satisfaction	Green & Taber, 1980	0.88

The questionnaire can be found at Appendix 4.6. The discussion below about the construction of the questionnaire and it gives details on means for testing the survey instrument.

- Performance and Satisfaction

The instrument assessing performance came from Lurey and Raisinghani's (2001) study. They explored the issues of effectiveness within virtual teams and created several high reliability measurement items. The reliability is 0.82. The purpose of this instruction was to indicate the subjects' feelings about their team performance.

The measurements of satisfaction were divided into three parts: perceptions of process, perceptions of outcomes and solution satisfaction. The first and second parts came from Chidambaram's (1996) study about how group attitudes and outcomes evolve over time with repeated use of a group support system. They are the most frequently used in the comparison of VT and FTF (as discussed in section 2.5.5). The purpose was to examine the perception of the processes and outcomes. The reliability of

perception of processes is 0.89 while the reliability of perception of satisfaction is 0.95. The purpose of the third part (solution satisfaction) was to indicate the perception of the solutions. The instruction came from Green and Taber (1980) study that compared the effects of three groups decision-making schemes, and has reliability of 0.88. Ocker (2002) used the instruction to examine the satisfaction in a virtual and mixed-mode environments (pure FTF, pure CMC, and mix FTF and CMC).

- Relationship building

The instrument used to assess relationship building came from Lurey and Raisinghani's (2001) study. It indicated the team members' level of agreement with their relationships. The original instruction was developed to apply only in a virtual environment. Therefore, some inappropriate items were removed or changed and the reliability is 0.82.

- Collaboration

This instrument came from Montoya-Weiss et al's (2001) study that examined the effects of temporal coordination on global virtual teams supported by CMC. The purpose of this instruction was to indicate the degree of team members' collaboration. The reliability is 0.88.

- Cohesion

The test for cohesion comes from Carron et al's (2002) Group Environment Questionnaire (GEQ). It was initially used in the sports area to test the cohesion of sports team members and comprised four parts: Group Integration-Task (GI-T), Group Integration-Social (GI-S), Individual Attractions to the Group-Task (ATG-T)

and Individual Attractions to the Group-Social (ATG-S). The purpose of this study was to test the group dimension instead of individual attractions, thus ATG dimension (Individual Attractions to the Group) was not suitable for this study. In addition, cohesion is located in “Socio-Emotional Processes” dimension of this study’s framework, GI-T (Group Integration-Task) part was not so applicable for this study. Thus, only GI-S dimension was applied. The reliability is 0.76.

- Communication

The instrument for communication came from Burgoon and Hale’s (1987) study. It focused on the relational communication (i.e., the verbal and nonverbal messages they exchange that define the nature of their interpersonal relationship) and included 60 items in five dimensions: intimacy/similarity, dominance, composure/arousal, formality, task/social orientation. It has been thoroughly tested by Walther (1992, 1995) and Burgoon and Poire (1999) in examining relational communication. Since communication is located in the “task processes” dimension of this study’s framework, only task/social part was chosen and the reliability is 0.41.

- Summary

Hair et al. (1998) suggested the reliability threshold values of 0.60 for exploratory research and 0.80 for confirmatory research. From Table 4.4, all instruments have good reliability except cohesion and communication. Although the reliability value of cohesion (0.76) is slightly below the threshold value of 0.8 it is carefully manipulated by CFA (Confirmatory Factor Analysis) in Chapter 5. This means these items with lower factor loading are removed after CFA. Thus, the impact of cohesion’s lower reliability can be reduced to minimum. These five items in the instrument of communication are not used at the same time. The fifth item is used in exploring the

best-fit model and other four items are used in section 6.3.3 to identify the different routes of FTF and VT. Thus, the overall low reliability of communication (0.41) merits no major concerns.

4.6.2 Introduction to Structural Equation Model (SEM)

The traditional method applied to reveal factors' relationships is to adopt multiple regression analysis to create a path diagram. However, this may cause error inflation and, it is unrealistic to assume that there is no measurement error for observation variables. Furthermore, multiple regression analysis has little power to manipulate implicit behaviours and mental characteristics which are regarded as latent variables.

SEM is composed of two parts: structural model and measurement model (Joreskog & Lee, 1992). The former shows the relationships between latent variables while the latter presents the relationships between latent variables and measurement indices. SEM is a technique that integrates measurement and statistical analysis by conceptualising unobservable concepts as latent variables and formalizing observed results as measurement models. It allows the 'concretising' of unobservable variables. Measurement models not only consider the error caused by measurement items' interactions but also take the relationships between measurement items and latent variables into account (Jaccard & Wan, 1996). Furthermore, the property of emphasizing multiple criteria to examine the goodness of model fit instead of single index makes SEM superior and suitable to apply to build the models for FTF and VT.

There are many commercial statistical packages, such as Lisrel, EQS, AMOS, CALIS, and MPLUS. Among them, Lisrel has been the most frequently used by scholars due to its solid theoretical bases and detailed outputs. Thus, Lisrel is used as the tool to

explore the best-fit models for FTF and VT.

● **The Processes of SEM**

Firstly, Confirmatory Factor Analysis (CFA) was used to identify the contribution of each measurement item. The items with lower contribution were removed to simplify the measurement models. Secondly, as recommended by MacCallum et al. (1992), a saturated model that estimated the paths from latent variables (communication, collaboration, cohesion and relationship building) to performance and satisfaction was examined. In addition, the covariances among all latent variables were estimated in testing the saturated model. Then, the insignificant and inappropriate paths were trimmed from the saturated model. These steps were repeated until the best-fit models were found. After that, the candidate model (Figure 2.2) was tested and compared to the best-fit models. As a result, the final models emerged.

● **The Criteria of Goodness of Model Fit**

Considering the sample size and population, this study combined the suggestions of Bagozzi and Yi (1988) and Joreskog and Sorbom (1996), and chose six figures to evaluate the goodness of model fit: χ^2 , $\chi^2/\text{degree of freedom}$, RMSEA (Root Mean Square Error of Approximation), GFI (Goodness of fit index), AGFI (Adjusted GFI), CFI (Comparative-fit index). Table 4.5 shows the criteria:

Table 4.5 The criteria of goodness of model fit

Index	Purpose	Range	Criteria
X^2 test	The match between observed data and hypothesized model	Smaller	$p > 0.1$
X^2/df	Consider the degree of freedom		< 3
RMSEA	Compare the difference between hypothesized model and saturated model	0-1	< 0.06 good fit < 0.08 acceptable
GFI	The proportion of the explanation of observed data by hypothesized model	0-1	> 0.9
AGFI	Consider the degree of freedom	0-1	> 0.9
CFI	The no-central difference between hypothesized model and independent model	0-1	> 0.95

The Chi-square (X^2) is the most common index to evaluate the model fit in SEM. If the p-value of X^2 is less than 0.1, it presents a good model fit between observed data and the test model. However, the value of Chi-square is influenced by sample size as a large sample size always leads to model rejection (Jaccard & Wan, 1996). Thus, Bagozzi and Youjae (1988) suggest using the value of Chi-square/degree of freedom to test the model fit and an appropriate value of below 3 (Chin & Todd, 1995) if the p-value of X^2 is insignificant. McDonald and Ho (2002) suggested that a RMSEA value less than 0.05 corresponds to a “good” fit while a RMSEA less than 0.08 corresponds to an “acceptable” fit. Hu and Bentler (1999) claimed that GFI and AGFI would be acceptable if the value is greater than 0.9. In addition, there would be a relatively good fit between the hypothesized model and the observed data if CFI value is greater than 0.95 (Hu & Bentler, 1999).

4.6.3 Interview

The procedures for conducting the interview are as below. Firstly, the researcher chose candidate groups dependent on their group assignment grades which had been

categorised in three groups: excellent, moderate and poor performance. Students were not told the basis upon which their selection was made. Next, the researcher contacted them one by one and made appointments. The time and meeting place depended on their convenience. At the beginning of the interview, the interviewees were presented with an information sheet (appendix 4.7) and the interview started if the interviewees agreed to continue.

This interview took approximately fifteen minutes and was audio taped. It included three parts: First, the students were asked for basic information (age, gender, lecture time). Then, students were asked for in-depth feelings about their group processes and outcomes. Finally, students were encouraged to present their suggestions about the group assignment. Students could choose not to answer some questions if they so wished. The script for the interview is shown in appendix 4.8.

4.6.4 Tape Recording and Blackboard Discussion Board Data

Tape recording applied to FTF while Blackboard discussion board applied to VT. There were three meetings for each FTF group, thus there were three tapes in total for one group. Because some groups had problems in recording such as tape recorders failed or the location of tape recorders was too far from the members, the researcher chose the groups with complete and clear recordings as the sample for the FTF analysis. VT groups discussed the group assignment on the Blackboard system. **Blackboard** is a Networked Learning Environment Courseware by Blackboard, Inc. (<http://www.blackboard.com>) that supports course cartridges, discussion board and community. All VT groups were required to use this system to communicate. There was a three-hour class to teach students to become familiar with the system. After students had posted their assignments on Blackboard, the researcher collected their

discourse from each individual discussion board.

Both sets of data were analysed by the “TEMPO” system developed by Futoran et al. (1989). The TEMPO coding system uses two categories: production function categories and non-production function categories. The former includes four sub categories that represent group performance: “Propose content” contributes to the task content (e.g., proposing task solutions, generating ideas for the task product, executing steps in the group’s task); “Propose process” contributes to group process (e.g., proposing group goals, setting strategies and actions); “Evaluate content” contributes to the monitoring and evaluation of task content; and “Evaluate process” contributes to the monitoring and evaluation of group processes. The latter reflects the activities that are not related to group’s implementation of its production functions but involve personal or interpersonal contents. To correspond to this study’s framework, production function categories are regarded as **task dimensions** while non-production function categories are regarded as **social dimensions**.

In addition, a code and number were assigned to each category as shown in Figure 4.3. The codes (pp1, pp2...) were used in Nvivo to code the discourse by the meaning of the contents. A digit (from 1-20) was allocated to each category and used to draw the communication pattern chronologically.

Production Function Categories					
Item	Code	Number	Item	Code	Number
Content		Process			
Propose					
New-task content	cp1	7	Goals	pp1	1
Prior	cp2	8	Strategies	pp2	2
Dictate	cp3	9	Acts	pp3	3
Evaluate					
Agree with/accept	ce1	10	Agree with/accept	pe1	4
Clarify/modify	ce2	11	Clarify/modify	pe2	5
Disagree	ce3	12	Disagree	pe3	6
Reject/Veto	ce4	13			
Non-production Function Categories					
Task digression	npt	14	React to experiment	npr	17
Personal comments	npp	15	Digressions	npd	18
Interpersonal comments	npi	16	Uninterpretable	npu	19
			Silence	nps	20

Figure 4.3 TEMPO Coding System

(arranged from Futoran et. al. (1989, p. 219)

Using the coding system followed the “waterfall” method. First of all, production function and non-production function categories were differentiated by the intention of the discourse. Then, if it belonged to the non-production function category, the sub-categories (npt, npp....) were reviewed and assigned to the content. Otherwise, if it belonged to the production function category, the category “content” or “process” was judged and the sub-categories “process” or “evaluate“ was selected. Then, the action (new-task, prior, agree with....) was chosen to assign to the content. An extensively cited study by Straus (1997) also used TEMPO system to analyse the discourse of group interaction process for the comparison of FTF and VT teams.

Jeong (2005) urged that alternative theories and methods should be applied to the

analysis of CMC to achieve a deeper understanding of VT groups' interaction and performance. Most studies which focused on the comparison of FTF and VT used varying statistical methods, such as Wilson et al. (1997) and Ocker (2002). Only a few studies applied qualitative methods to retrieve deeper understanding of FTF and VT members' interactions, such as Aviv (2000). The TEMPO system enabled the researcher to develop computational models to systematically describe the group interaction patterns based on the characteristics of exchanged messages. This approach generated descriptive frequencies and the communication patterns of discourse. Descriptive frequencies provided information to explain the trend of members' activities (such as tendency towards social or task activities, or towards content or process discussion). Communication patterns helped the understanding of how members communicated and responded to each other during the whole process. By analysing and comparing those groups with excellent, moderate and poor performance, it enabled the researcher to better explore communication patterns and provide suggestions to improve the performance of VT.

4.7 Summary

Section 2.2 highlighted the need to investigate the real world. Although it is difficult to find simultaneous settings of FTF and VT in the real world, the researcher still tried to study in as natural a setting as possible. Further, there was minimal manipulation or control of the variables in order to avoid the disadvantages of laboratory design. The field study enabled a greater depth of explanation in a "real word" educational environment. The results are now examined in depth in the following chapters.

Chapter 5 Data Analysis

5.0 Chapter Introduction and Structure

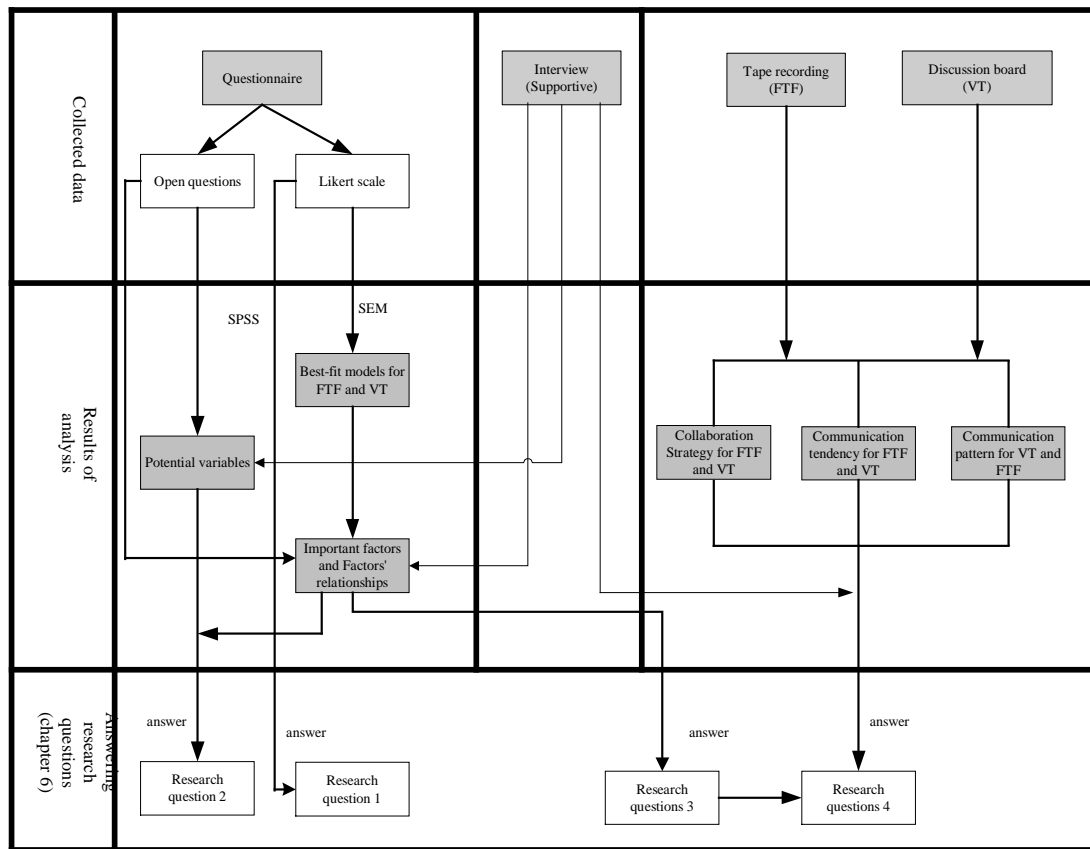


Figure 5.0 The structure of Chapter 5

The purpose of this chapter is to analyse data collected from the field study and provide a basis from which to answer the research questions as discussed in Chapter 6. The diagram above shows the relationships between the analysis results and the research questions. The data can be grouped into three parts: questionnaires, interviews and discourse (tape recordings and discussion boards). The questionnaire comprised questions using a Likert scale and open questions. The results from the Likert scale are used to explore the best-fit models for FTF and VT individually through SEM (Structural Equation Model), and combined with the results of open questions, best-fit models and interviews, the most important factors for both FTF and VT and the factors' relationships are revealed. Additional analysis of interviews and

open questions identifies potential variables so providing answers to research questions 2. By analysing the discourse of FTF (tape recording) and VT (discussion board), the collaborative strategies, communication focus and communication patterns for both teams are presented. Solutions are proposed to answer research question 4 by summarising the result of discourse analysis, interview and research question 3.

This chapter presents the results of analysis in the sequence of questionnaire, tape recording/discussion board and interview, and provides some conclusions and explanations of these results and the comparisons of FTF and VT. Each part is introduced individually.

5.1 Analysis of the Questionnaires

There were 107 validated questionnaires collected in the first semester giving a return rate of 54% while there were 200 validated questionnaires collected in the second semester for a return rate of 90%. The reasons for the low return rate of the first semester were (a) many students did not come to class and tutorial after week 9 and; (b) some students did not fill in the questionnaires seriously and caused a lot of incomplete questionnaires. Thus, in the second semester, the return rate was much higher using an online questionnaire system and by urging students to fill in the questionnaires seriously.

In the next section, CFA is presented followed by the procedures applied to obtain the best-fit models for FTF and VT and then, the analysis of open questions.

This study discusses the models from two aspects: model fit and parameters. Model fit is examined through the criteria explained in section 4.6.2. Parameters include the

rationality of path loadings and the parameters of structural equations. According to literature, they are all expected to be positive instead of negative.

5.1.1 Using SEM to Explore the Best-Fit Model for FTF Teams

- **Confirmatory Factor Analysis (CFA) for FTF**

By observing the questionnaire items in regard to communication, item 1 and item 4 asked respondents' tendency toward the social aspects (I am interested in building/having a good relationship/ social conversation) while item 2 and item 3 asked respondents' tendency toward the task dimension (I wanted to stick to the main purpose of the discussion /I am very work-oriented in this group assignment). Only item 5 (I think our group members had effective communication) represents the perception of how effective respondents think their communication is. For the purpose of exploring the relationships between communication and other factors, item 5 represents the extent of communication effectiveness and the other four items are used to display the respondents' tendency toward social or task dimensions. Thus, only item 5 is used in SEM analysis (fewer items included in SEM analysis can maximise the model fit).

The CFA was applied to the other five latent variables as shown in Table 5.1.

Table 5.1 CFA analysis for FTF

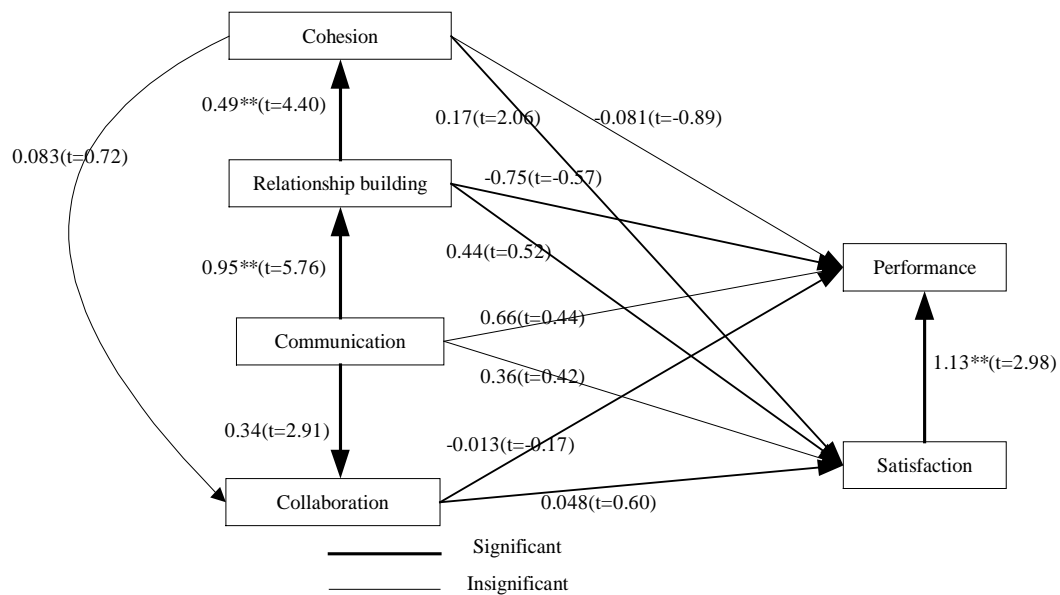
Latent variable	χ^2	RMSEA	GFI	AGFI	CFI	Measure factors
Relationship building	61.15 df=14	0.19	0.85	0.70	0.87	$REL1=0.33, R^2=0.079, t=2.78$ $REL2=0.10, R^2=0.0035, t=0.57$ $REL3=1.09, R^2=0.61, t=9.16$ $REL4=1.14, R^2=0.66, t=9.78$ $REL5=1.03, R^2=0.73, t=10.49$ $REL6=1.13, R^2=0.65, t=9.61$ $REL7=0.52, R^2=0.19, t=4.53$
Cohesion	0	0				$COH1=0.89, R^2=0.31, t=2.88$ $COH2=2.14, R^2=1.79, t=3.24$ $COH3=0.38, R^2=0.043, t=1.79$ Perfect fit
Collaboration	19.42 df=5	0.15	0.94	0.81	0.97	$COL1=0.90, R^2=0.58, t=8.98$ $COL2=0.90, R^2=0.75, t=10.92$ $COL3=0.88, R^2=0.75, t=10.93$ $COL4=0.90, R^2=0.71, t=10.45$ $COL5=0.87, R^2=0.58, t=8.99$
Satisfaction	20.93 df=5	0.18	0.92	0.77	0.96	$SAT1=0.96, R^2=0.59, t=9.12$ $SAT2=0.91, R^2=0.57, t=8.88$ $SAT3=0.92, R^2=0.64, t=9.72$ $SAT4=1.09, R^2=0.88, t=12.38$ $SAT5=0.68, R^2=0.42, t=7.25$
Performance	0	0				$PER1=1.31, R^2=0.73, t=10.50$ $PER2=1.22, R^2=0.79, t=11.18$ $PER3=1.25, R^2=0.73, t=10.51$ Perfect fit

Four items' contributions toward the latent variables were too low: items 1, 2 and 7 (REL1, REL2 and REL7) for relationship building and item 3 for cohesion. Thus, the four items were removed from the measurement model. Performance and cohesion were found to be a perfect fit.

- Model 1 for FTF (Saturated model, full relationships)

In the first instance, all relationships between each latent variable were put into the

model, but the model was not convergent. After removing the relationships that caused dispersion and considering the MI (Modification Indices) value provided by Lisrel (MI >20), the saturated model incorporating all paths between latent variables is shown as Figure 5.1:



df=168, $X^2=275.57$, $p=0.00$, $X^2/df=1.64$, RMSEA=0.077, CFI=0.98, GFI=0.80, AGFI=0.73

Figure 5.1 Model 1 for FTF

Structural Equations:

$$\text{rel} = 0.95 * \text{com}, \text{Errorvar.} = 0.099, R^2 = 0.90$$

$$\text{coh} = 0.49 * \text{rel}, \text{Errorvar.} = 0.76, R^2 = 0.24$$

$$\text{col} = 0.083 * \text{coh} + 0.34 * \text{com}, \text{Errorvar.} = 0.85, R^2 = 0.15$$

$$\text{per} = -0.75 * \text{rel} - 0.081 * \text{coh} - 0.013 * \text{col} + 1.13 * \text{sat} + 0.66 * \text{com}, \text{Errorvar.} = -0.047, R^2 = 1.05$$

$$\text{sat} = 0.44 * \text{rel} + 0.17 * \text{coh} + 0.048 * \text{col} + 0.36 * \text{com}, \text{Errorvar.} = 0.18, R^2 = 0.82$$

Model fit

From the figures provided, the indices partly support a good model fit. X^2/df (1.64) and CFI (0.98) show a good model fit while RMSEA (0.077) presents an acceptable model fit. But GFI (0.80) and AGFI (0.73) are too far from the criteria value (0.9).

Parameter discussion

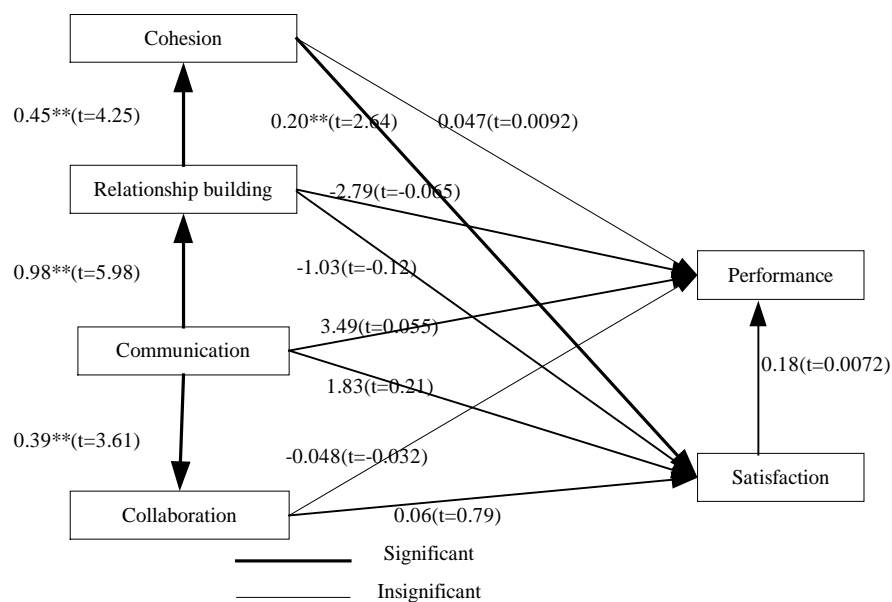
From the path model, it can be seen that there are just four significant relationships between the latent variables: communication and relationship building, relationship building and cohesion, communication and collaboration and satisfaction and performance. There are no significant relationships between collaboration and cohesion, collaboration and relationship building. The performance equation has an abnormally high explanatory power ($R^2=1.05$) but satisfaction equation is well explained.

Removal of relationships between latent variables

The relationship between collaboration and cohesion is removed.

● Model 2 for FTF (Reduced model)

The reduced model is shown as Figure 5.2:



$df=167$, $X^2=263.55$, $p=0.00$, $X^2/df=1.57$, $RMSEA=0.075$, $CFI=0.98$, $GFI=0.81$, $AGFI=0.73$

Figure 5.2 Model 2 for FTF

Structural Equations:

$$rel = 0.98 * com, \text{Errorvar.} = 0.041, R^2 = 0.96$$

$$coh = 0.48 * rel, \text{Errorvar.} = 0.77, R^2 = 0.23$$

$$\text{col} = 0.39 * \text{com}, \text{Errorvar.} = 0.85, R^2 = 0.15$$

$$\text{per} = -2.79 * \text{rel} + 0.047 * \text{coh} - 0.048 * \text{col} + 0.18 * \text{sat} + 3.49 * \text{com}, \text{Errorvar.} = -0.25, R^2 = 1.25$$

$$\text{sat} = -1.03 * \text{rel} + 0.20 * \text{coh} + 0.060 * \text{col} + 1.83 * \text{com}, \text{Errorvar.} = 0.049, R^2 = 0.95$$

Model fit

From the figures provided, the indices partly support a good model fit. X^2/df (1.57) and CFI (0.98) show a good model fit and RMSEA (0.075) presents an acceptable model fit. But GFI (0.81) and AGFI (0.73) are too far from the criteria value (0.9). It seems that the hypothesized model cannot fit the collected data to an acceptable degree. Compared to Figure 5.1, there is a slight improvement of model fit and so removing the relationship between collaboration and cohesion helps the model construction.

Parameter discussion

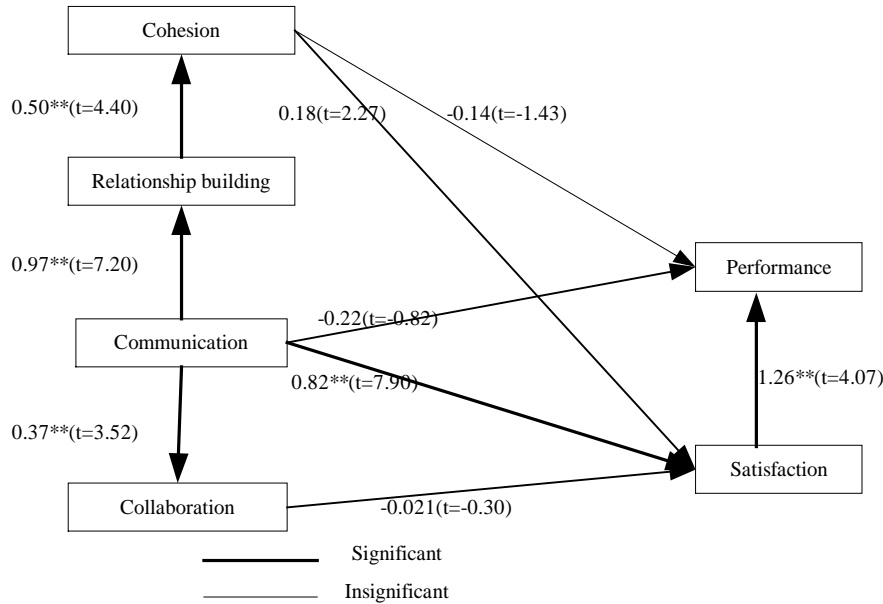
From the path model, it can be seen that there are four significant relationships between latent variables: communication and relationship building, relationship building and cohesion, communication and collaboration, and cohesion and satisfaction. However, the three negative values between relationship building and performance, relationship building and satisfaction, and collaboration and performance are unexpected, but these relationships are insignificant. Performance has an abnormally high explanatory power ($R^2=1.25$) but the equation of satisfaction is well explained.

The removal of relationships between latent variables

The three negative relationships (relationship building and performance, relationship building and satisfaction, and collaboration and performance) are removed from the model.

- Model 3 for FTF (Reduced model)

The reduced model is shown as Figure 5.3:



$df=153$, $X^2=243.66$, $p=0.01$, $X^2/df=1.59$, $RMSEA=0.074$, $CFI=0.98$, $GFI=0.81$, $AGFI=0.75$

Figure 5.3 Model 3 for FTF

Structural Equations:

$$rel = 0.97 * com, \text{Errorvar.} = 0.061, R^2 = 0.94$$

$$coh = 0.50 * rel, \text{Errorvar.} = 0.75, R^2 = 0.25$$

$$col = 0.37 * com, \text{Errorvar.} = 0.86, R^2 = 0.14$$

$$per = -0.14 * coh + 0.085 * col + 1.26 * sat - 0.22 * com, \text{Errorvar.} = -0.030, R^2 = 1.03$$

$$sat = 0.18 * coh - 0.021 * col + 0.82 * com, \text{Errorvar.} = 0.16, R^2 = 0.84$$

Model fit

Comparing the figures of Figure 5.3 and Figure 5.2, it can be seen that the model fit is similar and so the removal of the three negative relationships (relationship building and performance, relationship building and satisfaction, and collaboration and performance) from Figure 5.2 is not very helpful.

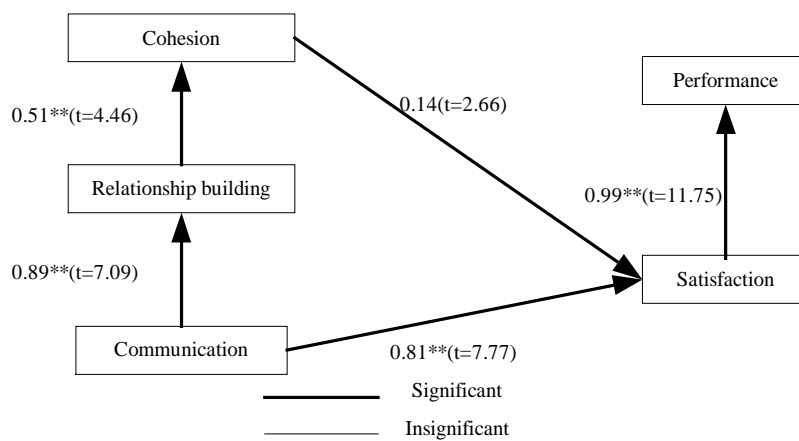
The removal of relationships between latent variables

From further observation of the path diagram and structural equations, the three

negative relationships (cohesion and performance, communication and performance, collaboration and satisfaction) are removed from the model.

- Model 4 for FTF (Reduced model)

The reduced model is shown as Figure 5.4:



$df=79$, $X^2=133.60$, $p=0.01$, $X^2/df=1.69$, $RMSEA=0.075$, $CFI=0.98$, $GFI=0.86$, $AGFI=0.79$

Figure 5.4 Model 4 for FTF

Structural Equations:

$$rel = 0.89 * com, \text{Errorvar.} = 0.20, R^2 = 0.80$$

$$coh = 0.51 * rel, \text{Errorvar.} = 0.74, R^2 = 0.26$$

$$per = 0.99 * sat, \text{Errorvar.} = 0.014, R^2 = 0.99$$

$$sat = 0.14 * coh + 0.81 * com, \text{Errorvar.} = 0.22, R^2 = 0.78$$

Model fit

From the figures provided, the indices support a better model fit than Figure 5.3. The indices X^2/df (1.69), CFI (0.98) show a good model fit while RMSEA (0.075) presents an acceptable degree. GFI (0.86) is close to the criteria value (0.9) but AGFI (0.79) is still far from the criteria value (0.9).

Parameter discussion

From the path model, it can be seen that all relationships are significant. The explanatory power of the equation model of performance and satisfaction is also good (performance is 0.99 and satisfaction is 0.78).

● The Comparison of the Four Models

Table 5.2 lists the comparison of the four FTF models above:

Table 5.2 The comparison of the four models for FTF

Model	X ² df	X ² /df	RMSEA	GFI	AGFI	CFI	Performance Power (*1)	Satisfaction Power (*2)
Model 1	275.57 df=168	1.64	0.077	0.80	0.73	0.98	1.15	0.82
Model 2	263.55 df=167	1.57	0.075	0.81	0.73	0.98	1.25	0.95
Model 3	243.66 df=153	1.59	0.074	0.81	0.75	0.98	1.03	0.84
Model 4	133.6 df=79	1.69	0.075	0.86	0.79	0.98	0.99	0.78

*1: The explanatory power of performance (percentage of independent variables can explain the dependent variable “performance”)

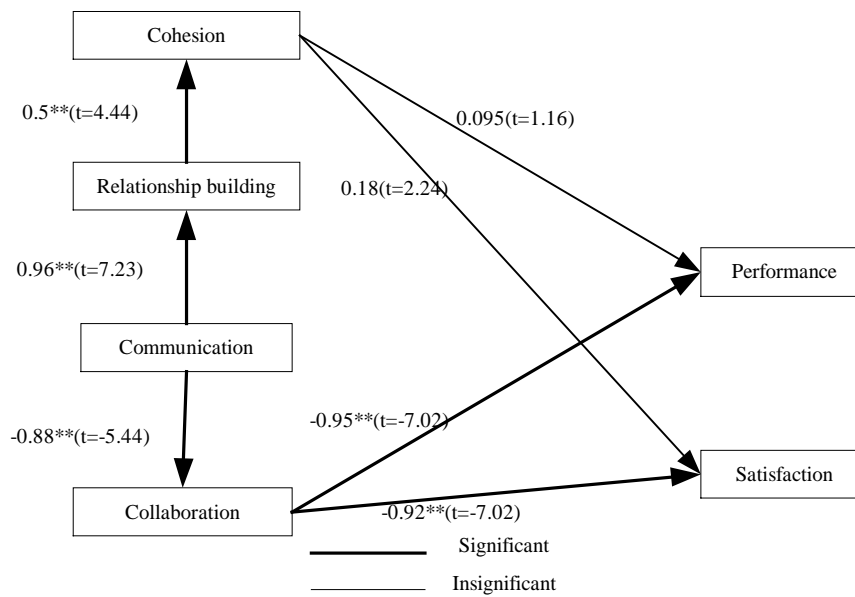
*2: The explanatory power of satisfaction (percentage of independent variables can explain the dependent variable “satisfaction”)

From the comparison above, model 4’s model fit indices GFI (0.86), AGFI (0.79) are the highest and RMSEA is low. In addition, the explanatory abilities of performance and satisfaction are reasonable. Overall, model 4 is the best choice.

● The Independent Model and The Hypothesized Model for FTF

Next, the Independent model (Figure 2.2) is tested. After removing the insignificant measurement factors similar to model 3 and 4 and adjusting according to MI values

provided by Lisrel, the model is shown as Figure 5.5:



$df=78$, $X^2=133.77$, $p=0.01$, $X^2/df=1.715$, $RMSEA=0.076$, $CFI=0.98$, $GFI=0.86$, $AGFI=0.79$

Figure 5.5 The independent model for FTF

Structural Equations:

$$rel = 0.96 * com, \text{Errorvar.} = 0.087, R^2 = 0.91$$

$$coh = 0.50 * rel, \text{Errorvar.} = 0.75, R^2 = 0.25$$

$$col = -0.88 * com, \text{Errorvar.} = 0.23, R^2 = 0.77$$

$$per = 0.095 * coh - 0.95 * col, \text{Errorvar.} = 0.014, R^2 = 0.99$$

$$sat = 0.18 * coh - 0.92 * col, \text{Errorvar.} = -0.029, R^2 = 1.03$$

The comparison of Model 4 and independent model is shown as Table 5.3:

Table 5.3 The comparison of model 4 and independent model for FTF

Model	X^2 df	X^2/df	RMSEA	GFI	AGFI	CFI	Per Power (*1)	Sat Power (*2)
Model 4 (Hypothesized model)	133.6 df=79 p=0.01	1.69	0.075	0.86	0.79	0.98	0.99	0.78
Independent model	133.77 df=78 p=0.01	1.715	0.067	0.86	0.79	0.98	0.99	1.03

From Table 5.3, it would seem that the candidate model is slightly better, but the

negative loadings on collaboration and the overly high explanatory power of satisfaction (1.03) are unsatisfactory. Thus, model 4 is deemed to be better than the candidate model and becomes the best-fit model for FTF teams.

5.1.2 Using SEM to Explore The Model For VT

● Confirmatory Factor Analysis (CFA) for VT

The CFA was applied to the five latent variables as shown in Table 5.4.

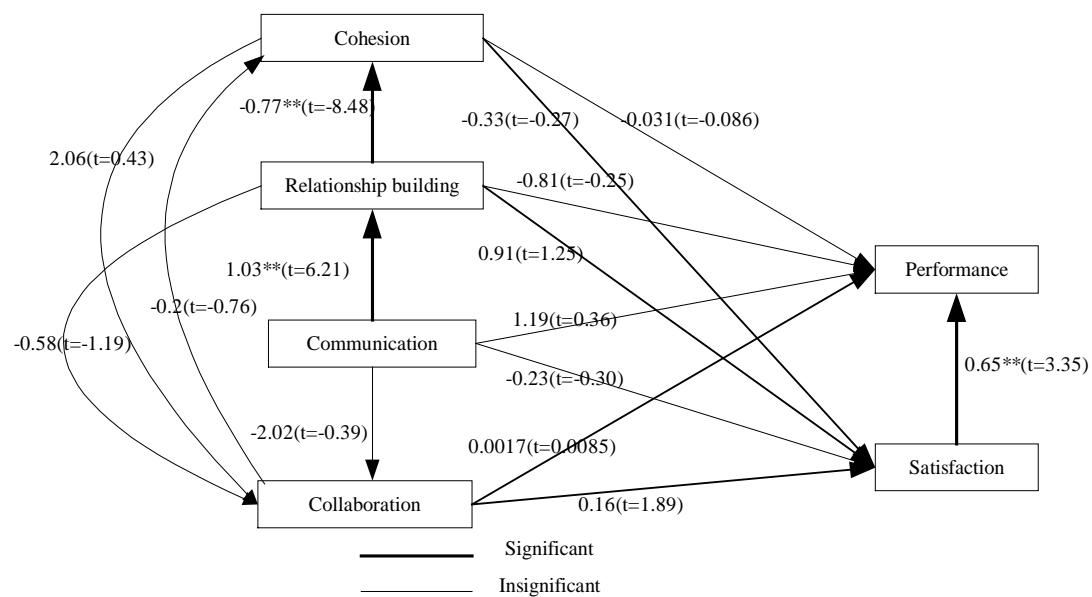
Table 5.4 CFA analysis for VT

Latent variable	X^2	RMSEA	GFI	AGFI	CFI	Measure factors
Relationship building	28.21 df=14	0.071	0.96	0.92	0.99	$REL1=0.46, R^2=0.088, t=4.14$ $REL2=0.068, R^2=0.0018, t=0.58$ $REL3=1.40, R^2=0.71, t=14.53$ $REL4=1.44, R^2=0.77, t=15.47$ $REL5=1.52, R^2=0.81, t=16.11$ $REL6=1.44, R^2=0.73, t=14.74$ $REL7=1.19, R^2=0.62, t=13.14$
Cohesion	0	0				$COH1=4.51, R^2=6.76, t=0.39$ $COH2=0.48, R^2=0.066, t=0.39$ $COH3=0.078, R^2=0.0026, t=0.34$ Perfect fit
Collaboration	0.6 df=3	0.0	1.0	0.99	1.0	$COL1=0.88, R^2=0.41, t=9.50$ $COL2=0.89, R^2=0.44, t=9.85$ $COL3=0.93, R^2=0.56, t=11.59$ $COL4=1.05, R^2=0.67, t=13.20$ $COL5=1.14, R^2=0.74, t=14.12$
Satisfaction	6.48 df=4	0.056	0.99	0.95	0.99	$SAT1=0.96, R^2=0.44, t=9.90$ $SAT2=0.84, R^2=0.47, t=10.31$ $SAT3=1.22, R^2=0.85, t=15.22$ $SAT4=0.94, R^2=0.54, t=11.3$ $SAT5=0.63, R^2=0.31, t=8.03$
Performance	0	0				$PER1=1.64, R^2=0.76, t=14.85$ $PER2=1.28, R^2=0.69, t=13.82$ $PER3=1.63, R^2=0.77, t=14.97$ Perfect fit

Three items' contributions toward the latent variables are too low: factor 1 and 2 (REL1 and REL2) for relationship building and factor 3 for cohesion (COH3). Thus, the three items are removed from the measurement model. Performance and cohesion were found to have a perfect fit.

● Model 1 for VT (Saturated model, full relationships)

All relationships between each latent variable were put into the model, but the model was not convergent. After removing the relationships causing dispersion and considering the MI (Modification Indices) value provided by Lisrel ($MI > 20$), the saturated model incorporating all paths between latent variables is shown as Figure 5.6:



$df=353$, $X^2=752.65$, $p=0.00$, $X^2/df=2.13$, $RMSEA=0.079$, $CFI=0.98$, $GFI=0.79$, $AGFI=0.74$

Figure 5.6 Model 1 for VT

Structural Equations:

$$rel = -0.20 \cdot col + 1.03 \cdot com, \text{Errorvar.} = 0.14, R^2 = 0.86$$

$$coh = -0.77 \cdot rel, \text{Errorvar.} = 0.46, R^2 = 0.54$$

$$\text{col} = 2.06*\text{rel} - 0.58*\text{coh} - 2.02*\text{com}, \text{Errorvar.} = 0.88, R^2 = 0.12$$

$$\text{per} = -0.81*\text{rel} - 0.031*\text{coh} + 0.0017*\text{col} + 0.65*\text{sat} + 1.19*\text{com}, \text{Errorvar.} = 0.0076, R^2 = 0.99$$

$$\text{sat} = 0.91*\text{rel} - 0.033*\text{coh} + 0.16*\text{col} - 0.23*\text{com}, \text{Errorvar.} = 0.36, R^2 = 0.64$$

Model fit

From the figures provided, the indices do not support a perfect model fit. Although CFI (0.98) shows a good model fit (>0.95), RMSEA (0.079) and X^2/df (2.13) show an acceptable model fit, but GFI (0.79) and AGFI (0.74) are too far from the criteria value (0.9).

Parameter discussion

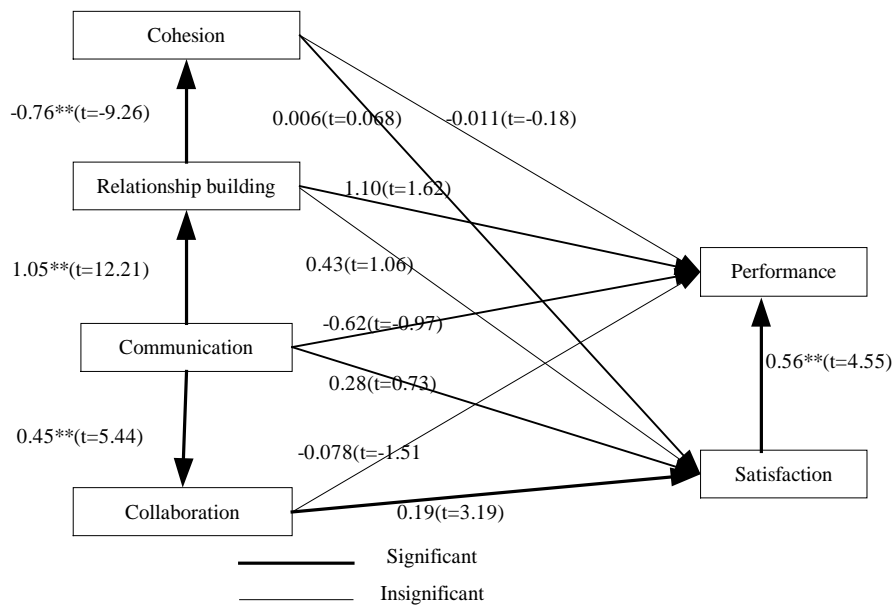
There are just three significant relationships between latent variables: communication and relationship building, relationship building and cohesion, and satisfaction and performance. Among them, the negative value between relationship building and cohesion is unexpected. Additionally most explanatory power (R^2) is not high suggesting that model 1 is not applicable.

The removal of relationships between latent variables

From observation of the path diagram and structural equations, it can be inferred that there may be no relationships between collaboration, cohesion and relationship building. So, these relationships are removed.

● Model 2 for VT (Reduced Model)

The reduced model is shown as Figure 5.7:



$df=353$, $X^2=748.53$, $p=0.00$, $X^2/df=2.12$, $RMSEA=0.082$, $CFI=0.98$, $GFI=0.78$, $AGFI=0.73$

Figure 5.7 Model 2 for VT

Structural Equations:

$$rel = 1.05 * com, \text{Errorvar.} = -0.11, R^2 = 1.11$$

$$coh = -0.76 * rel, \text{Errorvar.} = 0.43, R^2 = 0.57$$

$$col = 0.45 * com, \text{Errorvar.} = 0.80, R^2 = 0.20$$

$$per = 1.10 * rel - 0.011 * coh - 0.078 * col + 0.56 * sat - 0.62 * com, \text{Errorvar.} = 0.15, R^2 = 0.85$$

$$sat = 0.43 * rel + 0.0060 * coh + 0.19 * col + 0.28 * com, \text{Errorvar.} = 0.33, R^2 = 0.67$$

Model fit

From the figures provided, the indices do not support a perfect model fit. Although CFI (0.98) shows a good model fit (>0.95), RMSEA (0.082) and X^2/df (2.12) show an acceptable model fit, but GFI (0.78) and AGFI (0.73) are too far from the criteria value (0.9). The data does not explain the hypothesized model well and is similar to model 1, so removing the relationship between collaboration, cohesion and relationship building does not help the model fit.

Parameter discussion

From the path model, it can be seen that there are five significant relationships between latent variables: communication and relationship building, relationship

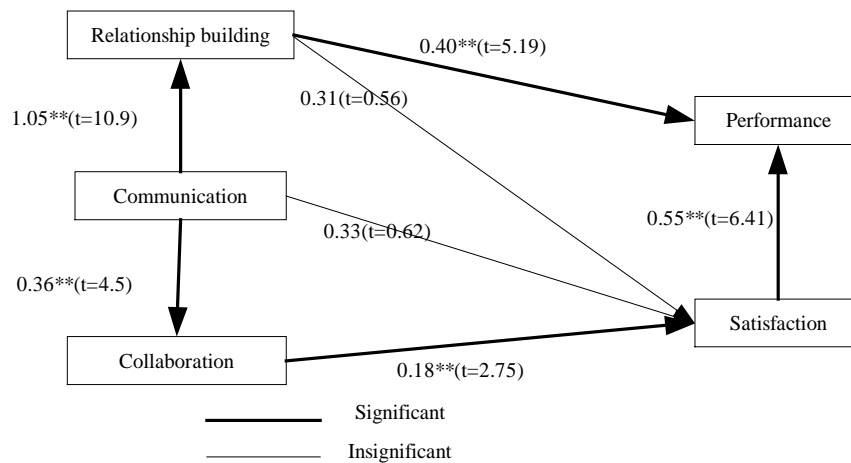
building and cohesion, communication and collaboration, collaboration and satisfaction, and satisfaction and performance. Among them, the four negative values between relationship building and cohesion, cohesion and performance, communication and performance, and collaboration and performance are unexpected, especially the significant negative value between relationship building and cohesion.

The removal of relationships between latent variables

The four negative relationships (relationship building and cohesion, cohesion and performance, communication and performance, and collaboration and performance) are removed from the model as was cohesion.

● Model 3 for VT (Reduced model)

Through the analysis processes, it was found that the contributions of three measurement factors are comparatively lower (<0.5): SAT2 ($R^2=0.21$), SAT3 ($R^2=0.38$) and COM1 ($R^2=0.004$). To simplify the model, the three measurement items were removed. In addition, it was found that the model did not lose significant explanatory ability, and further GFI and AGFI increased dramatically if the two measurement sets (procedure and outcome) were removed from the measurement model. Thus, the model is shown as Figure 5.8:



$df=87$, $X^2=158.2$, $p=0.01$, $X^2/df=1.818$, $RMSEA=0.064$, $CFI=0.99$, $GFI=0.91$, $AGFI=0.86$

Figure 5.8 Model 3 for VT

Structural Equations:

$$rel = 1.05 * com, \text{Errorvar.} = -0.11, R^2 = 1.11$$

$$col = 0.36 * com, \text{Errorvar.} = 0.87, R^2 = 0.13$$

$$per = 0.40 * rel + 0.55 * sat, \text{Errorvar.} = 0.21, R^2 = 0.79$$

$$sat = 0.31 * rel + 0.18 * col + 0.33 * com, \text{Errorvar.} = 0.46, R^2 = 0.54$$

Model fit

From the figures provided, the indices support a better model fit than models 1 and 2. The indices X^2/df (1.818), CFI (0.99) and GFI (0.91) show a good model fit. Although RMSEA (0.064) is slightly greater than the criteria value (0.06) and AGFI (0.86) is slightly less than the criteria value (0.9), the model does present a better model fit.

Parameter discussion

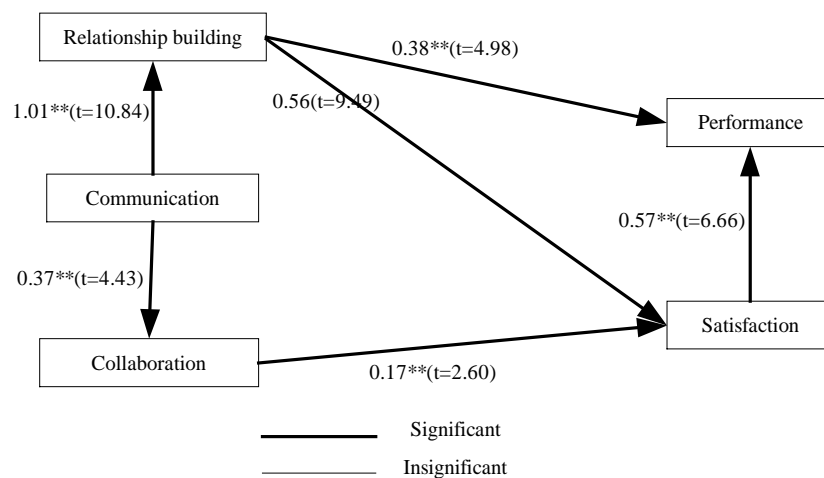
From the path model, it can be seen that there are just two insignificant relationships between latent variables: communication and satisfaction, and relationship building and satisfaction.

The removal of relationships between latent variables

The insignificant relationship between communication and satisfaction was removed from the model.

● Model 4 for VT (Reduced model)

The reduced model is shown as Figure 5.9:



df=87, $X^2=140.93$, $p=0.01$, $X^2/df=1.619$, RMSEA=0.057, CFI=0.99, GFI=0.92, AGFI=0.87

Figure 5.9 Model 4 for VT

Structural Equations:

$$\text{rel} = 1.01 * \text{com}, \text{Errorvar.} = -0.019, R^2 = 1.02$$

$$\text{col} = 0.37 * \text{com}, \text{Errorvar.} = 0.86, R^2 = 0.14$$

$$\text{per} = 0.38 * \text{rel} + 0.57 * \text{sat}, \text{Errorvar.} = 0.21, R^2 = 0.79$$

$$\text{sat} = 0.65 * \text{rel} + 0.17 * \text{col}, \text{Errorvar.} = 0.45, R^2 = 0.55$$

Covariance Matrix of Latent Variables

	rel	col	per	sat	com
rel	1.00				
col	0.38	1.00			
per	0.79	0.39	1.00		
sat	0.72	0.42	0.85	1.00	
com	1.01	0.37	0.80	0.73	1.00

Model fit

From the figures provided, the indices support an excellent model fit. The indices χ^2/df (1.619), RMSEA (0.057), CFI (0.99) and GFI (0.92) show a good model fit. Although AGFI (0.87) is slightly less than the criteria value (0.9), the model still presents a good model fit.

Parameter discussion

From the path model, it can be seen that all relationships are significant. The explanatory power (R^2) of structural equations of performance and satisfaction is average (Performance's R^2 is 0.79 and satisfaction's R^2 is 0.55).

● The Comparison of The Four Models

Table 5.5 lists the comparison of the four models.

Table 5.5 The comparison of the four models for VT

Model	X ² df	X ² /df	RMSEA	GFI	AGFI	CFI	Per Power (*1)	Sat Power (*2)
Model 1	752.65 df=353	2.13	0.079	0.79	0.74	0.98	0.99	0.64
Model 2	748 df=353	2.12	0.082	0.78	0.73	0.98	0.85	0.67
Model 3	158.2 df=87	1.818	0.064	0.91	0.86	0.99	0.79	0.54
Model 4	140.93 df=87	1.619	0.057	0.92	0.87	0.99	0.79	0.55

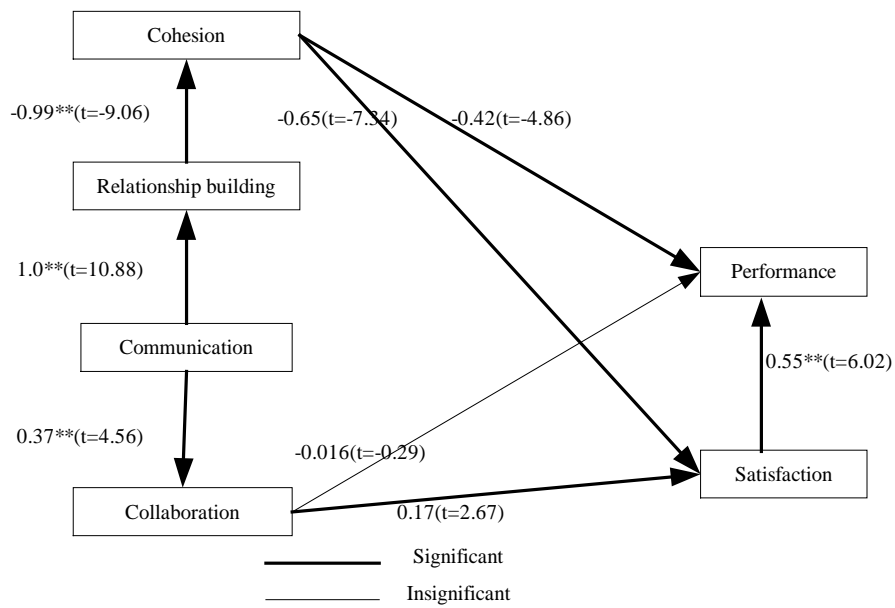
*1: The explanatory power of performance (percentage of independent variables can explain the dependent variable “performance”)

*2: The explanatory power of satisfaction (percentage of independent variables can explain the dependent variable “satisfaction”)

From the comparison above, model 4’s model fit indices GFI (0.92), AGFI (0.87) are the highest and RMSEA is the lowest. In addition, the explanatory abilities of performance and satisfaction are at a reasonable level. Overall, model 4 is the best choice.

● The Independent Model and The Hypothesized Model for VT

Next, the Independent model (Figure 2.2) was tested. After removing the insignificant measurement items similar to models 3 and 4 and adjusting according to MI values provided by Lisrel, the model is shown as Figure 5.10:



$df=128$, $X^2=207.21$, $p=0.01$, $X^2/df=1.618$, $RMSEA=0.056$, $CFI=0.99$, $GFI=0.90$, $AGFI=0.85$

Figure 5.10 The independent model for VT

Structural Equations:

$$rel = 1.09 * com, \text{Errorvar.} = -0.18, R^2 = 1.18$$

$$col = 0.37 * com, \text{Errorvar.} = 0.87, R^2 = 0.13$$

$$coh = -0.99 * rel, \text{Errorvar.} = 0.014, R^2 = 0.99$$

$$per = -0.016 * col - 0.42 * coh + 0.55 * sat, \text{Errorvar.} = 0.19, R^2 = 0.81$$

$$sat = 0.17 * col - 0.65 * coh, \text{Errorvar.} = 0.46, R^2 = 0.54$$

The comparison of model 4 and the independent Model is shown as Table 5.6

Table 5.6 The comparison of Model 4 and hypothesized Model for VT

Model	X^2	X^2/df	RMSEA	GFI	AGFI	CFI	Per Power (*1)	Sat Power (*2)
Model 4 (Hypothesized Model)	140.93 $df=87$ $p=0.01$	1.619	0.057	0.92	0.87	0.99	0.79	0.55
Independent model	207.21 $df=128$ $p=0.01$	1.618	0.056	0.9	0.85	0.99	0.81	0.54

From the table above, it seems that the independent model is slightly better. But negative loadings on cohesion and collaboration cast doubts on this and so model 4 is selected as the model to evaluate the performance and satisfaction of VT.

5.1.3 Comparison of FTF and VT Models

Figure 5.11 combines the best-fit models for FTF and VT.

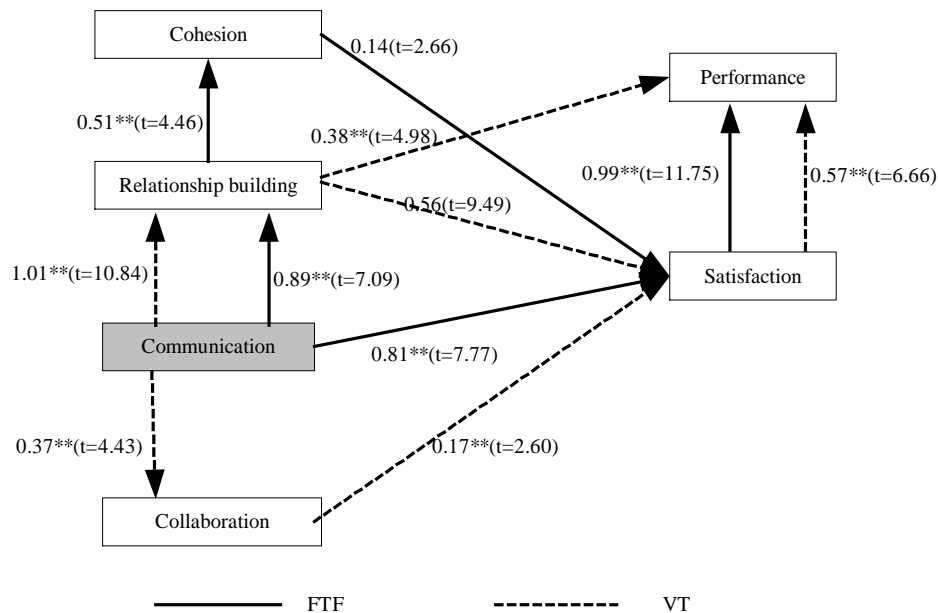


Figure 5.11 The comparison of FTF and VT models

From Figure 5.11, it can be seen that:

- (1) There is no factor “collaboration” in FTF model while there is no factor “cohesion” in VT model.
- (2) Comparing both models’ figures between “communication” and “relationship building”, FTF ($0.89, t=7.09$) and VT ($1.01, t=10.84$) have similar positive strength. This implies that communication has a positive effect on relationship building in both FTF and VT.
- (3) Satisfaction has positive effects on performance for both teams. This implies that the higher degree of satisfaction that the members have, the higher the performance they can obtain in both environments.
- (4) The paths of FTF and VT affecting the performance and satisfaction are different. FTF has two paths: one is communication → relationship building → cohesion

→satisfaction → performance. Another is from communication to satisfaction directly, and then affects performance. VT has two paths as well: one is communication→ collaboration→satisfaction →performance; another is communication→relationship building→satisfaction and performance. According to the paths described, it can be seen that FTF is social-oriented while VT is both task and social-oriented.

(5) Direct, indirect and total effects of FTF and VT

One of the advantages of path analysis is that it is easy to discern the independent variables' direct, indirect and total effects on dependent variables. Table 5.7 presents the four variables' (communication, relationship building, cohesion and collaboration) direct, indirect and total effects on satisfaction and performance. Through this analysis, the effects of each independent variable (communication, relationship building, cohesion and collaboration) toward dependent variables (satisfaction and performance) can be clearly quantified. It is then easier to provide a comparison and discussion of each variable's contribution in FTF and VT.

Table 5.7 Direct and indirect effects on satisfaction and performance

Factors	Direct/indirect/total effects	FTF		VT	
		Satisfaction	Performance	Satisfaction	Performance
Communication	Direct effect	0.81	--	--	--
	Indirect effect 1: (com→rel→coh→sat→per)	0.063	0.062		
	Indirect effect 2: (com→rel→per)				0.383
	Indirect effect 3: (com→rel→sat→per)			0.566	0.322
	Indirect effect 4 (com→col→sat→per)			0.063	0.036
	Total effect	0.873	0.062	0.629	0.741
Relationship building	Direct effect	--	--	0.56	0.38
	Indirect effect 1: (rel→coh→sat→per)	0.071	0.070		
	Indirect effect 2: (rel→sat→per)				0.319
	Total	0.071	0.070	0.56	0.699
Cohesion	Direct effect	0.14	--		
	Indirect effect (coh→sat→per)	--	0.138		
	Total	0.14	0.138		
Collaboration	Direct effect	--	--	0.17	--
	Indirect effect (col→sat→per)	--	--		0.097
		--	--		
	Total effect			0.17	0.097

Communication

Communication has a strong direct effect on satisfaction but weak indirect effect on performance for FTF. It can be inferred that communication affects satisfaction directly in the FTF environment. That is, if there is good communication for FTF team members, the degree of satisfaction of the members will be higher. Then, if they

have a higher degree of satisfaction, there is a stronger possibility of obtaining higher performance. For VT, communication has a strong indirect effect on satisfaction and performance. This implies that communication must affect satisfaction and performance through other factors instead of affecting them directly in a virtual environment. This is understandable since virtual team members communicate through typing and rarely in real time hence communication affects other factors which in turn affects satisfaction and performance.

Relationship building

Relationship building has a weak and indirect effect on satisfaction and performance for FTF while relationship building has a strong and direct effect on satisfaction and performance for VT. These results are surprising. A possible reason is that relationship building becomes an intermediate factor in a FTF environment since it affects cohesion and then cohesion affects performance and satisfaction. But in a virtual environment, cohesion is a less important factor and hence relationship building becomes a direct factor to affect performance and satisfaction.

Cohesion

Cohesion has impact only in the FTF environment and not in the virtual environment. But its effect is weak, direct on satisfaction and weak, indirect on performance. It would seem as if VT members found it difficult to conceptualize themselves as a “team” and they rather focused on building relationships with other members. FTF teams found it was easier to develop relationships and so they focused on creating a team with some emphasis on cohesion.

Collaboration

Collaboration only has an impact in the virtual environment and not in the FTF environment. Similar to cohesion, its effect is weak, direct on satisfaction and weak, indirect on performance. One of the reasons for this finding could relate to the nature of the independent tasks set in the group assignment. Due to the time limitation, the tasks were independent rather than inter-dependent and so there was very little need for coordination across the tasks. Collaboration was only required for task allocation, reviewing and collating activities. These activities are easily completed in a FTF environment but require some greater co-ordination efforts in a virtual environment.

5.1.4 Analysis of Open Questions

The two open questions in the questionnaire asked the students' perceptions of what factors affected their performance and satisfaction. The purpose of open questions is to confirm the models for FTF and VT and discover new potential variables. For this purpose, the four variables: communication, relationship building, cohesion, collaboration were used to categorise the factors that students believed to affect performance and satisfaction. Additionally three factors that did not belong to the framework were identified and categorised as commitment, participation and time.

● Frequency and Percentage of Open Questions for FTF

Table 5.8 shows the frequency and percentage of open questions from FTF members:

Table 5.8 The frequency and percentage of the open questions for FTF

	Performance (Frequency)	Satisfaction (Frequency)	Total (Frequency)
Communication	23(22%)	15(20%)	38(21%)
Relationship Building	17(16%)	13(18%)	30(17%)
Cohesion	5(5%)	6(8%)	11(6%)
Collaboration	7(7%)	9(12%)	16(9%)
Participation	26(25%)	12(16%)	38(21%)
Commitment	16(15%)	19(26%)	35(20%)
Time	10(10%)	0(0%)	10(6%)
Total	104(100%)	74(100%)	178(100%)
Others factors: language, age, culture, technology, design			

* Other factors means factors with frequency less than two

According to Table 5.8, it can be seen that the two factors: communication and relationship building are regarded as important factors that affect performance and satisfaction along with participation and commitment whereas collaboration and cohesion are only seen as minor influences.

Communication

Communication is regarded as a crucial factor. Students expressed the term “communication” precisely such as “Lack of communication”, “Had good communication” and “Good communication was the key”. Additionally, “Miss communication in terms of extra time to work on group assignment”, “We needed to stay in touch” and “Meet up more” also expressed the importance of communication.

Relationship Building

Relationship building is also one of the major factors that affect the performance and satisfaction. Students commented such as “Understanding each other is important”, “Great relationship built at the start”, “Friendly people and good atmosphere helped a

lot” and “Friendliness of the members”.

Cohesion

Cohesion is not regarded as an important factor from Table 5.8. The percentage of cohesion is just 5% on performance and 8% on satisfaction. A possible reason is the incidence of absenteeism (not all members attended all meetings). So, some students felt that they were not in a team. Another reason could be that cohesion is a kind of “recessive” factor. It is hard for people to sense cohesion directly. For example, people build relationships through communication and gradually feel they are in a team and sense cohesion.

Collaboration

While some studies emphasized collaboration as an important factor, here it just accounts for 7% on performance and 9% on satisfaction. Students commented such as “Great cooperation helped us do a good job” and “Being able to discuss what was required”. A possible reason for a low percentage is that the FTF environment makes the collaboration easy and they spent little time allocating the tasks and coordinating the processes in FTF meetings.

Participation

The term “participation” does not belong to the framework of this study. The term came from the researcher’s observation and summary of students’ answers. Comments such as “absence in the meeting” highlighted a crucial issue for a group to finish the tasks in a FTF environment. Many students indicated that the absence of other members affected their performance. Students commented “Only two people showed up”, “The lack of participation and input of various members”, “I didn’t hear from my

other group member until the day before the assignment” and “Several members never turning up and the other had poor dedication to turning up at schedule time”. From the comments above, it could be implied that participation is an implicit part of collaboration due to group members cannot collaborate without participation.

Commitment

Commitment could be potentially an important variable. Students commented “People who didn't commit to work”, “All committed to the task and equal contribution” and “Not all members of the group made a contribution. Commitment from two members was extremely poor”. Students thought that if other members had finished what they had promised on time, their performance would have been better.

Time

Quite a few students stated that limited time restricted their performance. Students commented “Not enough time”, “Time management” and “Time constraints”. Again this may be due to members’ absence. It is also the case, however, that students typically complain about time allocation for assessments. FTF and VT groups had the same time for the group assignment and the same complaints so time is not regarded here as a potential new variable.

● The Frequency and Percentage of Open Questions for VT

Table 5.9 shows the frequency and percentage of open questions from VT members:

Table 5.9 The frequency and percentage of the open questions for VT

	Performance (Frequency)	Satisfaction (Frequency)	Total (Frequency)
Communication	82(48%)	56(35%)	138(42%)
Relationship Building	6(3%)	20(13%)	26(8%)
Cohesion	8(5%)	2(1%)	10(3%)
Collaboration	28(16%)	28(18%)	56(17%)
Participation	22(13%)	28(18%)	50(15%)
Commitment	20(12%)	21(13%)	41(12%)
Time	6(3%)	3(2%)	9(3%)
Total	172(100%)	158(100%)	330(100%)
Others: motivation, technology, help each other			

*Other factors means factors with frequency less than two

According to Table 5.9, it can be seen that the two factors: communication and collaboration are regarded as the most important factors. In addition, the effect of relationship building on satisfaction is significant. Participation and commitment are also considered as important factors. Relationship building (toward performance) and cohesion are comparatively minor.

Communication

Communication is regarded as the crucial factor in VT. Almost half the respondents stated that communication was important for their performance. The respondents commented “more communication”, “productive communication“, “indirect communication hindered the progress of the group”. Furthermore, quite a few respondents indicated that FTF meetings might help the performance.

Relationship Building

The respondents did not consider relationship building as an important factor affecting performance but as an important factor affecting satisfaction. Their

comments tended to the social emotional aspects such as “friendly attitudes made me happy”, “good relationship built increased the satisfaction”, “Friendly people made the good air and helped more” and “Knowing others more”. Relationship building and satisfaction belong to social dimension innately and so perhaps the result is not too surprising.

Cohesion

Cohesion is not regarded as an important factor in VT. Students commented “cannot see each other”, “no knowing others made not a team”, “do not feel cohesive in this group”. It would seem that without “visual” knowledge of their team members they found it difficult to see themselves as a team. Another possible reason is similar to the explanation for FTF: cohesion is a kind of “recessive” factor.

Collaboration

Collaboration is regarded as an important factor in VT. Students commented “we each relied on each other very much”, “everyone put in their team effort and the output was really good”. It can be seen that collaboration is one of the keys for better performance and satisfaction.

Participation

In this study, “participation” specifies the situation where group members participated in the discussion board. Similar to FTF members, some VT members did not attend the discussion at the beginning or absented themselves from the discussion during the group assignment period. Students commented “just three people in my group”, “The lack of participation and input from other members”, “I heard from one member until one week before the due day” and “one member disappeared one week before the due

day”.

Commitment

Commitment could potentially be a very important variable. Students expressed “We were all committed and all did what we said we would”, “Commitment is important” and “If they did what they promised, we would have better performance”. These respondents considered if other members could finish what they promised on time, their performance would be better.

Time

Time is not considered as an important factor. Similar to FTF, if the group members could collaborate well and participate fully, time would not be problematic.

Some minor factors appeared in FTF which did not emerge in VT such as language, age and culture. Because people do not meet each other in a virtual environment, the personal properties (such as language, age and culture) are not easily perceived to affect the performance and satisfaction.

5.2 Analysis of the Discourse of FTF and VT

The purpose of this analysis is to compare the communication patterns, processes and strategies of both FTF and VT and from this to derive more effective methods of communication to improve the performance of VT, and hence address research question 4. In addition, the analysis method also incorporates a unique approach to the presentation of the qualitative discourse, from which it is easier to explore the underlying factors hidden in the discourse (introduced in section 7.1 D).

There are two types of data for the analysis. In FTF, their conversation was recorded by tape recorders when they were discussing face-to-face. Fifteen groups with complete three-week meetings and clear recordings were chosen as the data source. Within these fifteen groups, five groups belonged to the groups with excellent performance; five groups belonged to the group with moderate performance and another five groups belonged to the groups with poor performance. In VT, the data came from the discussion board. Fifteen groups were again chosen. Among them, five groups had excellent performance, five groups were categorised as middle performance and five groups belonged to poor performance. Both sets of data were analysed by “TEMPO” system introduced in section 4.6.4.

5.2.1 Analysis of The Discourse of FTF

- **Summary of Discourse of FTF groups**

Table 5.10 shows the summary of the discourse of fifteen FTF groups (ranked by performance, details are shown in appendix 5.1).

Table 5.10 The summary of the frequency distribution and percentage of the discourse of FTF groups

Group	Per	Time (min)	Codes	Codes/Time	pp_sub	pe_sub	p_total	cp_sub	ce_sub	c_total	np_sub
1	Exc	105	131	1.25	34(26%)	22(17%)	56(43%)	42(32%)	21(16%)	63(48%)	12(9%)
2	Exc	65	71	1.09	14(20%)	10(14%)	24(34%)	13(18%)	16(23%)	29(41%)	18(25%)
3	Exc	125	211	1.68	44(21%)	34(16%)	78(37%)	79(37%)	39(18%)	118(56%)	15(7%)
4	Exc	70	147	2.1	13(9%)	23(16%)	36(24%)	33(22%)	35(24%)	68(46%)	43(29%)
5	Exc	80	137	1.71	24(18%)	26(19%)	50(36%)	32(23%)	35(26%)	67(49%)	20(15%)
Sub/Average		89	139.4	1.57	129(19%)	115(16%)	244(35%)	199(29%)	146(21%)	345(49%)	108(15%)
6	Mod	100	155	1.55	18(12%)	17(11%)	35(23%)	44(28%)	39(25%)	83(54%)	37(24%)
7	Mod	72	102	1.42	17(17%)	6(6%)	23(23%)	21(21%)	14(14%)	35(34%)	44(43%)
8	Mod	75	133	1.77	17(13%)	13(10%)	30(23%)	47(35%)	45(34%)	92(69%)	11(8%)
9	Mod	77	178	2.31	24(13%)	29(16%)	53(30%)	41(23%)	31(17%)	72(40%)	53(30%)
10	Mod	115	103	0.89	15(15%)	71(11%)	162(24%)	48(47%)	12(12%)	60(58%)	22(21%)
Sub/Average		87.8	134.2	1.59	91(14%)	71(11%)	162(24%)	201(30%)	141(21%)	342(51%)	167(25%)
11	Poor	110	206	1.87	35(17%)	23(11%)	58(28%)	73(35%)	35(17%)	108(52%)	40(19%)
12	Poor	67	105	1.57	20(19%)	20(19%)	40(38%)	25(24%)	17(16%)	42(40%)	23(22%)
13	Poor	65	131	2.01	17(13%)	23(18%)	40(31%)	49(37%)	25(19%)	74(56%)	17(13%)
14	Poor	75	81	1.08	22(27%)	19(23%)	41(51%)	16(20%)	9(11%)	25(31%)	15(19%)
15	Poor	75	104	1.39	18(17%)	16(15%)	34(33%)	33(32%)	12(12%)	45(43%)	25(24%)
Sub/Average		78.4	125.4	1.58	112(18%)	101(16%)	213(34%)	196(31%)	98(16%)	294(47%)	120(19%)

Per: Performance (excellent/moderate/poor), codes/time: how many codes per minute, pp_sub: sub-total of

Process-Propose, pe_sub: sub-total of Process-Evaluate, p_total: total of Process, cp_sub: sub-total of

Content-Propose, ce_sub: sub-total of Content-Evaluate, c_total: total of Content, np_sub: Non-production categories

From Table 5.10, it can be found:

(1) Longer discussion time and more information exchanged affect the performance positively

From the two columns: time and codes, the excellent and moderate performance groups had slightly longer discussion time and exchanged more information than the poor performance groups. But from the column: codes/times, there is no significant difference between the three groups as the sub-averages of each group were almost

the same (1.57~1.59). Teams exchanged similar amounts of information per minute regardless of excellent, moderate and poor performance groups.

(2) FTF groups focused on content more than process

From the two columns: p_total and c_total, the latter is higher than the former and accounts for 50% of the codes. FTF groups focused more on content discussion than process discussion. However, there is no significant difference between excellent, moderate and poor performance groups in respect of the proportion of p_total and c_total. This implies that the amount of discussion (content or process) does not affect the performance.

(3) The amount of social activities does not reflect the degree of performance

By observing the column: np_sub, group 9 had the highest proportion of social activities (43%) but just had a moderate performance. Group 11 had the second highest percentage of social activities (40%) but was placed in the poor performance group. However, group 3 with an excellent performance had the lowest proportion of social activities. From these figures, it can be implied that social activities do not affect the group performance significantly.

● The Communication Pattern of FTF

The communication patterns of fifteen FTF groups drawn by the TEMPO system are shown in appendix 5.2. Figure 5.12 shows an example from FTF group 3. X-axis stands for time (three-week recordings) and Y-axis shows the codes from the TEMPO system (please refer to section 4.6.4). Each point represents the group's focus during a short time. For example, this group focused on a “process propose” activity at the

beginning, then moved to a “process evaluate” activity. After linking all points together, the communication pattern can be easily observed.

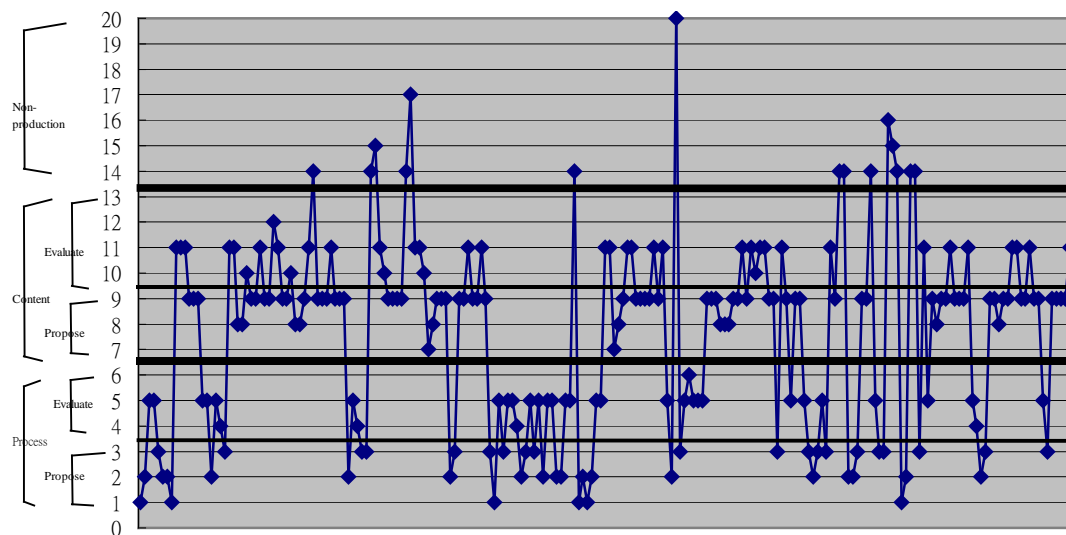


Figure 5.12 Communication pattern of FTF group 3

By observing these FTF group communication patterns, there are some findings below:

(1) There is no fixed successive discussion pattern but well-organised communication could lead to better performance

Group 1 and 3 (in excellent performance group) had well-organised communication. They focused on one topic at a time only moving to the next topic when consensus had been reached. A similar phenomenon can be also found in groups 5, 6 and 10 (in moderate performance group). However, there is no extremely regular or fixed communication pattern in these groups rather it can be found that the “process” and “content” interlaced. Well-organised communication resulted from full participation and strong leadership. When all of the group members were well prepared, fully participated in the discussions and accurately recorded the consensus, a

well-organised pattern emerged. This was further stimulated in cases where there was a well-organised leader.

(2) More “process gain” activities led to higher performance

The discourse analysis showed that where team members were willing to help each other and gave time towards the development of ideas, insights and strategies, a better performance resulted. These “process gain” behaviours kept the groups more cohesive and motivated. For example, group members would arrive on time for discussion, felt embarrassed if they were not well prepared, encouraged and helped each other when upset, and even became good friends in the end. This happened in groups 2 and 4 (both belonged to excellent group), despite a lack of well-organised communication. The key to their success was that the members contributed fully. Both group members prepared well, sending emails to others to ask for advice before their meetings. During the meetings, all members participated and contributed unselfishly. They helped and advised each other. One member recorded the conclusions and emailed this to all after the meetings. As a result, the proportion of social activities in the two groups were higher than others in the excellent performance group, accounting for 25% and 29% respectively.

(3) Social loafing (Free rider) accounts for the biggest proportion of the “process loss” behaviours affecting the performance

Some members opted to act as a “free rider”, allowing other members to do all the work. They always shirked responsibility and either kept silent in the meetings or were absent from meetings. The “free rider” members provoked a chain reaction of de-motivation and discouragement among other members and further affected the group performance.

This phenomenon can be found extensively in the groups with poor performance and some groups with moderate performance. There was little evidence of egocentrism or competition, possibly because all students had a lot of other assignments to do and so, if there were someone who could take charge of the team management (including the distribution of jobs, direction leading ...etc), they would happily accept this and have more time to do other assignments.

(4) Other factors that may downgrade the performance

There are other factors that may affect the group performance. Some members failed to attend the group meetings due to illness, business travel, and family or other matters. Their absence caused a gap in communication (no one knew what happened to these members, should others take over their jobs? or wait for their appearance or contact?) and sometimes incomplete results. Also, it was noticeable that the FTF groups were more likely to lose focus even when a lot of information was exchanged. Without someone consciously in charge of progress, the discussion would deviate easily and consensus and conclusions rarely reached.

5.2.2 Analysis of the Discourse of VT

- Summary of The Discourse of VT

Table 5.11 shows the summary of the postings of VT (ranked by performance, details are in appendix 5.3):

Table 5.11 The summary of the frequency distribution and percentage of the postings of VT

group	per	posts	codes	codes/ posts	pp_sub	pe_sub	p_total	cp_sub	ce_sub	c_total	np_sub
1	Exc	172	181	1.05	53(29%)	35(19%)	88(49%)	32(18%)	31(17%)	63(35%)	30(17%)
2	Exc	103	155	1.50	36(23%)	25(16%)	61(39%)	46(30%)	34(22%)	80(52%)	14(9%)
3	Exc	77	84	1.09	26(31%)	16(19%)	42(50%)	26(31%)	10(12%)	36(43%)	6(7%)
4	Exc	72	101	1.40	24(24%)	13(13%)	37(37%)	26(26%)	26(26%)	52(51%)	12(12%)
5	Exc	58	63	1.09	14(22%)	10(16%)	24(38%)	14(22%)	19(30%)	33(52%)	6(10%)
Sub/Average		96.4	116.8	1.23	153(26%)	99(17%)	252(43%)	144(25%)	120(21%)	264(45%)	68(12%)
6	Mod	213	241	1.13	34(14%)	27(11%)	61(25%)	85(35%)	90(37%)	175(73%)	5(2%)
7	Mod	114	148	1.30	28(19%)	32(22%)	60(41%)	24(16%)	24(16%)	48(32%)	40(27%)
8	Mod	114	141	1.24	41(29%)	30(21%)	71(50%)	23(16%)	24(17%)	47(33%)	23(16%)
9	Mod	112	113	1.01	32(28%)	26(23%)	58(51%)	23(20%)	21(19%)	44(39%)	11(10%)
10	Mod	75	105	1.40	157(21%)	142(19%)	299(40%)	172(23%)	177(24%)	349(47%)	100(13%)
Sub/Average		125.6	149.6	1.22	22(21%)	27(26%)	49(47%)	17(16%)	18(17%)	35(33%)	21(20%)
11	Poor	71	89	1.25	23(26%)	17(19%)	40(45%)	18(20%)	27(30%)	45(51%)	4(4%)
12	Poor	62	81	1.31	34(42%)	20(25%)	54(67%)	7(9%)	9(11%)	16(20%)	11(14%)
13	Poor	46	59	1.28	21(36%)	19(32%)	40(68%)	5(8%)	9(15%)	14(24%)	5(8%)
14	Poor	34	45	1.32	19(42%)	10(22%)	29(64%)	4(9%)	5(11%)	9(20%)	7(16%)
15	Poor	25	34	1.36	7(21%)	8(24%)	15(44%)	11(32%)	6(18%)	17(50%)	2(6%)
Sub/Average		47.6	61.6	1.31	47(34%)	37(27%)	84(61%)	20(14%)	20(14%)	40(29%)	14(10%)

Per: Performance (excellent/moderate/poor), pp_sub: sub-total of Process-Propose, pe_sub: sub-total of Process-Evaluate, p_total: total of Process, cp_sub: sub-total of Content-Propose, ce_sub: sub-total of Content-Evaluate, c_total: total of Content, np_sub: Non-production categories

From Table 5.11, it can be found:

(1) The groups with more discussion had better performance

Comparing the postings (column: posts) of the three groups (excellent/moderate/poor performance), it can be seen that the groups with excellent and moderate performance had more postings than the groups with poor performance. Moreover, the code quantities (column: codes) of the groups with excellent and moderate performance are higher than the group with poor performance. But there is no evidence to suggest that postings with more contents (with higher ratio of codes/posts) would cause higher

performance.

One exception was group 6 with the highest number of codes (213) but in the moderate performance group. It would appear from an analysis of content that competition between the members caused this process loss. The members did their best to contribute and kept on posting new ideas and advising others but to excess - they each believed that their ideas were better than others and had continual arguments about the assignment with constant revision. They rarely reached conclusions and many “broken end” discussions resulted.

(2) Groups that focused on “process” and “content” equally, had better performance
By observing the two columns “p_total” and “c_total”, it can be seen that the groups focusing on both process and content equally had better performance. In the poor performance groups, they paid more attention to process instead of content. A possible reason was poor time management when they spent too much time on discussing how to do and distribute the jobs and not enough time on the actual tasks.

(3) Non-production activities (social activities) accounted for a smaller proportion of time when compared with FTF groups

Non-production codes (“np_sub” column) just accounted for 10~20 percentage for each group showing that VT groups focused more on task activities. However there is no evidence to show any relationship between the quantity of non-production activities and group performance.

● The Communication Pattern of VT

The communication patterns of fifteen groups drawn by TEMPO system are shown in

appendix 5.4. Figure 5.13 shows an example from VT group 1. X-axis stands for time (From the beginning to the end of the group assignment, about 4 weeks) and Y-axis shows the codes from the TEMPO system (please refer to section 4.6.4). Each point represents a main intention of postings. For example, the members focused on “Non-production” activity at the beginning, then moved to a “Process-propose” activity. After linking all points together, the communication pattern can be easily observed.

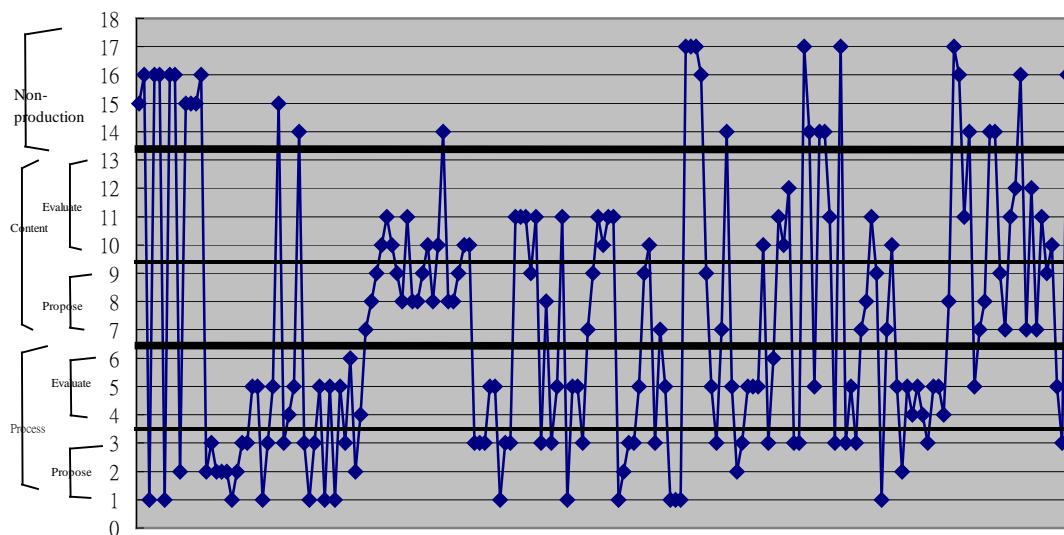


Figure 5.13 Communication pattern of VT group 1

By observing these VT group communication patterns, there are some findings below:

(1) Best communication pattern is process→content→process→content

In the groups with excellent and moderate performance, there was a tendency towards a regular pattern. Firstly, members discussed the processes needed to proceed to the group assignment. This included the distribution of the tasks, the means of communication and the frequency needed to check the discussion board. This was followed by a discussion of content and where to retrieve information of quality and how to make documents amendments. Next, some process issues might arise, such as

members missed some interactions because of travel, sickness. In this case, members had to re-discuss or re-arrange the allocation of the tasks. Another situation was where new members joined the group or members finally showed up and so group members needed to discuss processes again. When the processes were confirmed, the content was discussed again to focus on the completion of the tasks. The main jobs were to review and revise all documents, and combine all into a complete assignment. Additionally, the contribution of all members was discussed.

From the description above, a communication pattern can be drawn: process→content→process→content. This pattern can be observed in groups with better or moderate performance. On the contrary, groups with poor performance did not display this pattern.

In relation to the process models discussed in section 2.4.4, the pattern is similar to the Punctuated Equilibrium Model: members discuss the process in the beginning and started to work; then they go back to review and change the process in the midpoint transition and finish the task in the second working period. The process finishes in the end transition. The observed communication pattern is shown as Figure 5.14:

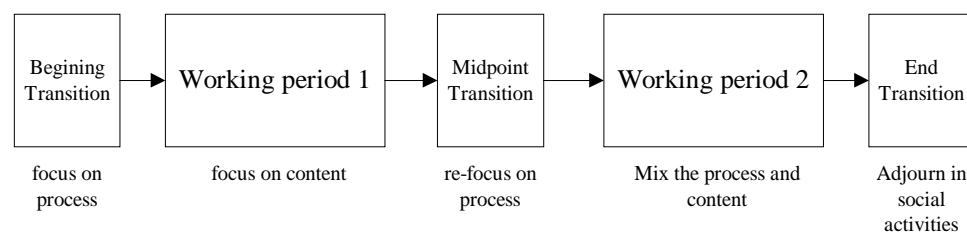


Figure 5.14 A better communication pattern for VT

(2) “Interlace communication” diminished the efficiency of communication

From the analysis of VT discourse, there was a communication pattern of “interlace communication” that interfered with the efficiency of communication. This was made more noticeable in the discussion board environment where more “interlace communication” directly affected communication efficiency.

There is an example of “interlace communication” as below:

No	Poster	Contents
1	A	i say 10 each! i rekon we desereved it!:) im not being hot headed, but we did WELL:)
2	B	can u all please check it so far for any final corrections, i will finish it off compleletly tommorow morning!! so dont stress, but any ideas, pleas throw at mE!
3	B	yeah i agree.
4	C	Hi B, I'll revise it and put it in the file exchange. If anyone has problems you are welcome to post and I will try my best.
5	D	Yes, I agree that we all get 10

From these postings, the third and fifth posts responded to the first post while the fourth post responded to the second post. Responders replied in an interval of two or more than two postings instead of responding to the next posting. With this situation, a discussion topic was usually terminated inexplicably instead of fully discussed (became “broken end”). The lack of immediate response to communication made it more difficult to continue conversation and to lead to conclusions.

(3) The more “process gain” activities the group had, the higher the performance

The amounts of postings during the beginning period are important for VT. In the commencement of the discussion, members did not know each other and felt nervous and adrift. But, these negative emotions could be eliminated through frequent postings.

This centred on discussion of process where rapid and abundant responses to others' postings facilitated an efficient distribution of jobs or the process of how to do the tasks. If the process was confirmed and agreed by all members quickly, the group had an excellent beginning. In the following stages, similar to FTF groups, "process gain" behaviours kept the group moving on to finish the tasks.

(4) Other factors affecting the performance

There were three groups with technology issues. Some members failed to connect to the Internet or some problems occurred to their computers. Although the hurdles were removed, this affected the communication slightly. In addition, some members were absent themselves from the group for all kinds of reasons (such as illness, business travel, and family or finance matters) affecting the performance. However, because of the innate characteristics of VT, members could recognize the problem easily and quickly, and supplement it. Because the discussion board was working for 24 hours and 7 days a week, they were aware of when members did not respond for several days and tackled the problem instead of waiting for the next meeting as for FTF.

5.2.3 Collaborative Strategies of VT and FTF

The communication patterns of fifteen groups for FTF and VT have been analysed in section 5.2.2. This section focuses on the analysis of their collaborative strategies. From this analysis, the different collaborative strategies between FTF and VT can be identified. Furthermore, compared to a study by Benbunan-Fich et al. (2001), the result strengthens the inference of research question 4 in section 6.4.

Five collaborative strategies have been discussed in section 2.5.4. Parallel and pooled

are classed as a low degree of collaborative strategy, concurrent and sequential are grouped as a medium degree of collaborative strategy and reactive/reciprocal are regarded as a high degree of collaborative strategy. The discourse of each group was reviewed and the collaborative strategies were categorised into one of these three types. In order to identify the collaborative strategy the degree of each member's interdependence was examined in detail. If members relied on each other more, the collaborative strategy is located in the higher group. The researcher analysed the collaborative strategy of each group and summarised the comparison of FTF and VT shown as Table 5.12.

Table 5.12 The categorization of collaborative strategies of FTF and VT

	Low		Medium		High
	Parallel	Pooled	Concurrent	sequential	(Reactive/ Reciprocal)
FTF	6	6	3	0	0
VT	10	3	2	0	0

● Collaborative Strategies for FTF

Among the fifteen FTF groups, three groups were categorised as concurrent strategy. Six groups were categorised as pooled strategy while another six groups were categorised as parallel strategy. These figures show the fact that FTF groups focused on the strategies with lower degree of interdependence. Three teams were selected from each of excellent, moderate and poor performance groups and their collaborative strategies were reviewed.

Group 1 – concurrent:

Group 1 belonged to the excellent performance group and its collaborative strategy

was categorised as concurrent. In the first meeting, two members who had read the group assignment led the discussion and proposed their ideas. Although few conclusions were drawn but extensive ideas were presented. In the second meeting, the members showed some degree of intimacy and had an enthusiastic discussion. All members had read the group assignment and the textbook in detail and two members had even sought some information from the Internet. They first discussed the tasks sequentially, and then changed to extensive random discussion. When one topic was discussed, everyone contributed as much as they could and someone volunteered to take over the task. Everyone took notes and asked for others' input to correct their notes. Before the last meeting, most of them had sent their parts to others and got feedback. In the last meeting, they focused on helping each other. Everyone took it in turn to identify concepts which were still unclear and others tried to find answers. During the meetings, group members not only contributed adequately but also focused on clarifying the problems and arriving at a convergence of ideas. The atmosphere was cohesive and intimate.

Group 10 - Pooled:

Group 10 belonged to the moderate performance group and its collaborative strategy was categorised as pooled. Only two members attended the first meeting. One was very active and had already listed the key points of each task (called student A in the following description). So, they focused on the key points and discussed the procedures to engage in the tasks. Three members attended the second meeting and they spent time on discussing another missing member and concluded they would leave some tasks for her. They discussed the conclusions of previous meeting and the suggestions by their tutors. Student A played a very strong leadership in discussion and debated with others if they did not agree with his ideas. Three members attended

the third meeting. One member had not done any work and one member had just finished an outline, only student A finished all his parts. So, student A helped them during the meeting. This group had a lot of discussion but less collaboration. Most of the time, two members just reacted to input from student A and there was even less discussion between both of them. Therefore, it caused single way communication (from student A to other two members).

Group 12 - Parallel:

Group 12 belonged to the poor performance group and its collaborative strategy was categorised as pooled. A member proposed to distribute tasks for each member at the beginning of the first meeting and other members agreed. They also nominated a member to combine all members' parts to complete the assignment. Thus, they just came to the meetings and reported their progress, and discussed some of their questions in the following two meetings. Because everyone had their own parts and they just finished their own parts and sent to the nominated member, there was a low degree of interdependence shown in their collaboration.

● Collaborative Strategies for VT

Among the fifteen VT groups, two groups were categorised as concurrent strategy. Three groups were categorised as pooled strategy while the other ten groups were grouped as parallel strategy. The figures show that VT groups also focused on the strategies with a lower degree of interdependence. Three teams were selected from each of excellent, moderate and poor performance groups and their collaborative strategies are analysed as follows.

Group 1 - concurrent:

Group 1 was categorised as an excellent performance group and its collaborative strategy was categorised as concurrent. At the beginning of the discussion, they introduced themselves and explained their current situation. Then, they spent a lot of time discussing how to distribute the tasks. The procedure took a long time because not every member posted when the project started. Because of without any experience to work virtually, they tried to learn how to work in a virtual environment during the first week. After the learning period, they finished the distribution of the tasks and they decided to login in and check everyday. Some members put their writings onto the discussion board and asked for advice and other members read it and gave comments or revised enthusiastically. They found that they needed others' inputs to make a better assignment so they explained their problems and asked for help frequently. In this group, everyone was willing to contribute, help each other and respond to others' problems. When members posted their questions, other members responded quickly. They showed a high level of collaboration.

Group 6 - pooled:

Group 6 was categorised as a moderate performance group and its collaborative strategy was categorised as pooled. One member was very active and she became the leader in the beginning. She led the discussion of the processes and the contents and also distributed jobs for everyone. Although other members posted a lot of information but they posted little of their work to ask for others' review and revision. However, they got some useful information from others' postings. Although group 6 had the most amounts of postings, they just got moderate performance. The reason was that they did not collaborate closely despite exchanging information to make the assignment better.

Group 11 - parallel:

Group 11 was categorised as a poor performance group and its collaborative strategy was categorised as parallel. This group was a typical team with poor participation and poor collaboration. At the beginning, one member urged the need to start the assignment but he got no reply until three days later. The response speed was too slow and it made all members lose motivation. The focus was located on waiting for members and discussing if others would not appear. Because the first two members responded to each other at the beginning, they planned to finish the group assignment by their own. When the third member appeared, they gave her a part of the jobs. One member put all parts together when everyone finished and sent to him. There was little collaboration between members.

● The Comparison of Collaborative Strategies of FTF and VT

The comparison of the collaborative strategies of FTF and VT is as below:

- (1) The interaction at the beginning is different. Most VT members introduced themselves at the beginning while FTF members introduced themselves and exchanged personal detail at the end of the first meeting.
- (2) VT groups discussed the distribution of the tasks at the beginning of discussion while FTF groups discussed the distribution of tasks late at the first meeting or in the second meeting.
- (3) VT groups did not follow the tasks sequence while FTF groups followed the tasks sequence in the beginning of discussion.

VT groups focused more on loosely coupled collaborative strategies than FTF. The

possible reason for this finding is that the absence of FTF meetings makes it difficult for VT members to communicate to exchange abundant information and understand each other. Without rich information and frequent communication, tightly coupled collaborative strategies are not formed easily.

Benbunan-Fich et al. (2001) studied the comparison of Face-To-Face and Asynchronous Learning Network (ALN) teamwork and explored collaborative strategies of five FTF and five ALN teams. It was found that the collaborative strategy of FTF teams all presented medium level collaboration (concurrent or sequential) while the collaborative strategy of ALN teams all presented low-level collaboration (parallel or pooled). This finding does not fully support the analysed collaborative strategies listed in Table 5.12. In this study, just three FTF teams were found to have a medium level collaborative strategy while twelve teams had low-level collaborative strategy (six for pooled and six for parallel). A possible reason is the different explanation and measurement for categorising the strategies. Turoff and Rana (1993) did not propose a precise quantitative method to categorise the degree of collaboration but just brought the ideas of five collaborative strategies ranked by their extent of interdependence. The concept of “interdependence” is abstract and qualitative instead of concrete and quantitative. Therefore, it is unavoidable that researchers will find different explanations and perceptions of “interdependence”. However, Benbunan-Fich et al’s study found that ALN teams displayed low-level collaborative strategies (parallel or pooled). This result corresponds with this study’s finding. In this study, only two VT groups presented medium collaborative strategy (concurrent) and the other thirteen teams presented low-level collaborative strategies (three for pooled, ten for parallel).

Taking into account this study and Benbunan-Fich et al's study, it may be implied that FTF groups have a higher degree of coupling in their collaborative strategies than VT. However this is a finding that needs more investigation to be sustainable.

5.3 Analysis of the Interviews

The purpose of the interview is to promote a deeper understanding of students' perceptions about the processes, outcomes and the interactions with other members and support the results obtained previously from analysing the questionnaire and discourse. The results mainly support and verify the answers for research question 2: are there any specific social or task factors that affect the performance and satisfaction of FTF and VT? (shown in Figure 6.0 and section 6.2) In addition, the results also provide some potential factors for future study as stated in section 7.7.

Fifteen students who belonged to four FTF groups were interviewed. Two groups' performance was excellent, one was moderate and one was poor. Furthermore, 25 students who belonged to thirteen VT groups were interviewed. Four groups had excellent performance; six groups with average performance and three groups had poor performance.

5.3.1 Analysis of Interview of FTF Groups

The findings are as below:

(1) The processes of the three-week meetings

The general description of the processes is as below: in the first week, most students just read through the group assignment and had less discussion. They introduced each other and exchanged personal information such as email and phone. Some faster

groups started to discuss the contents and distribute the tasks. Then, they went home to engage in their parts individually. Some groups emailed to each other. In the second week, they brought and discussed their outcomes in the meeting. In the third week, one member collected others' results and put them together. The result is not so surprising and fits the original assumptions in this study.

(2) FTF communication is more important than email

All groups used both ways to communicate. Most respondents confirmed that FTF communication was more important than email. The former was used to discuss and distribute tasks while the latter played an important role in the last stage to exchange data and put all parts together.

One respondent commented "We used both. But I feel FTF communication is more important than email, because it is more efficient to discuss face-to-face. But, email is important in the last stage. I sent my part to other members for asking review and revision through email. And others also sent back to me through email. It is more convenient than to discuss face-to-face".

(3) Leadership is not an important factor

One group had a leader, one group was not clear and other two groups had no leaders. The reason that a leader emerged was that the leader had greater task related knowledge than the others. So the leader could give ideas and guide the direction. Most respondents thought that even without a leader in their group, they could still finish the job but it could be slower and the quality could be worse.

The respondents commented "Our leader knows a lot about the assignment but I think

we still can finish the assignment without him. But without him our speed may be slower”, “I am not sure we had leaders in our group, but I do not think it is important”.

(4) There are no conflicts and arguments in the whole process

This result is quite surprising. All interviewees expressed that there were no conflicts or arguments during their meetings. One possible reason is that time was too short to lead to conflicts so they all tried to focus on the process and outcomes. Another possible reason is the independent tasks designated for this study. Students needed to do their own parts instead of relying on input from other members' outcomes. Without reciprocal data input and output, conflicts were less likely to occur.

(5) Relationship is important

Most respondents expressed the view that relationship was important. One commented “If we cannot get along well, it will be much more difficult for us. Because it will be more difficult to decide what we are going to do”. Two students further expressed that this kind of relationship was different from friendship. One said that it was difficult to build relationship in a short time but it was important for their performance.

(6) Most respondents were happy and satisfied with their outcome and worked with their members

When asked their feelings about working with other members, most respondents expressed “It is fine”, “Yes, I am happy to work with them”, “Most of them are good”. When asked about the outcomes (prior to formal grading), most respondents were confident that their outcomes were good, but, when asked to mark their own

assignments, most displayed hesitant and uncertain attitudes. Interestingly, when compared to the exact marks of their assignments, their predictions were close and even absolutely correct. This implies that students were aware of the extent of effort they had made and the quality of output produced.

(7) What factors affect your group performance and satisfaction?

This was a very important question. Ten respondents talked about commitment (people did what they have promised), good communication (8) and good relationships (8). In addition, six respondents stated that helping each other is important. However, no one mentioned trust or leadership.

5.3.2 Analysis of the Interview of VT

There were two group assignments for students in the second semester. One is the group assignment used in this research which operated in a virtual environment while another was a FTF group assignment. The group members for the two assignments were not the same. So in the interview, students were asked about their feelings in regard to the comparison of the two assignments.

The findings are as below:

(1) Communication is the crucial factor affecting the group performance

Most of the interviewees commented that communication affected their performance. Due to the lack of FTF meetings, they were not sure if other members would finish what they have promised. What they could do was to post and check it frequently. One interviewee commented “I do not know when and how others will post and respond. I just can wait. That is frustrating”. Quite a few interviewees expressed that

the assignment with FTF meetings was easier. One commented “in that FTF assignment, I knew my members. When I saw them, I could know if they have done their jobs; in VT assignment, I could not see them, I could not know if they have done their jobs. I was unable to control the progress or help them. I felt insecure”.

(2) Difficulties of communication led to a difficulty of collaboration

Interviewees commented “through the discussion board, it is difficult to discuss the distribution of the jobs and it is hard to control the progress”, “What you can do is to wait if the members do not respond or post their parts”. It can be seen that lack of communication caused an obstacle to collaboration.

(3) More postings led to better relationships and cohesiveness

When the interviewees were asked their feelings about the social aspects, a conclusion can be summarized as: if they posted more, they felt that they had better relationships with other members and they felt that they were more cohesive and worked like a team. This is not so surprising. If they got more responses from other members, they certainly had higher motivation to post continually and also respond to others’ postings. With frequent postings, intimacy developed and they gradually felt they worked like a group.

However, one interviewee explained that this kind of relationship was different from normal friendship. It is temporary and fragile. Although there is a possibility that they may become good friends, most relationships are terminated when the assignment has been submitted. But there was a group with high performance and good relationships who met each other after submitting the assignments and continued their relationships.

(4) Discussion board has both advantages and disadvantages

In spite of the disadvantages of the discussion board identified by the interviewees, such as slow responses, poorer level of communication and difficulties to engender collaboration, it still has positive aspects. Firstly, the information on the discussion board is well-organised. VT members can carefully consider their opinions and post them on the discussion board. Therefore, the information quality could be better than FTF verbal conversation. Such as comments by interviewees “although typing caused more time, I can organise my thinking better. Then, I can post more valuable things”, “It is a better way to share the information like the website contents or some articles”. In addition, it is easy to find information. An interviewee commented “it is handy to find the past information and see other’s postings”. The information is always there and the members are able to check it any time and repeatedly.

Secondly, the discussion board could be a good environment to practice and improve social skills. A study by Roberts (2001) explains that users in a virtual environment feel safe and they can practice social skills, and then they can transfer those skills to a FTF environment. Interviewees commented “I do not need to meet each other in the certain time and place, I can post anytime and anywhere as long as Internet is available. It saves my time and I feel comfortable”, “My English is not so good, I do not feel nervous when I communicate through discussion board”. This proved that members feel safe and more comfortable in a virtual environment. Furthermore, they are able to learn and build social skills and apply these skills to a FTF environment.

Finally, the discussion board can be a kind of “buffer” to avoid the occurrence of conflicts. Interviewees commented “I have less stress because I can post anytime I

want. As to FTF, I need to finish my parts before the meeting, that makes me nervous”, “I feel relaxed while I am doing the assignment in discussion board because I don’t need to see one of my group members”. From the expressions, when members are not willing or unable to contribute, discussion board can create a space to procrastinate or moderate possible conflicts. Such as if a member has not finished his part, he can just post “sorry, I cannot post today because I had an accident” or just pretend “sorry, I forgot to post because I was busy”. They do not need to see others’ eyes and tell a lie. This reduces members’ mental burden to meet the deadline and avoids embarrassment and possible fights.

(5) Females prefer FTF meetings and most think relationship is important

There is an interesting phenomenon that females showed a stronger tendency to have FTF meetings. Although the lecturers did not support the ideas to have FTF meetings, most females still felt the desire to meet their members face-to-face. In addition, they tended to build a better relationship with other members. Also when asked if the relationship affected the group performance, most considered that relationships affected their group performance.

(6) Leadership results from more knowledge or higher motivation

Seven groups admitted that there were one or more leaders in their groups. The origin of the leadership came from two sources: more knowledge and higher motivation. If a member is conversant with the area or has more related knowledge or experience, the member is proposed to become the leader to distribute the jobs or lead the discussion. The emergence of this kind of leader is developed gradually through the discussion. Another originated from the beginning of the discussion. The member who has higher motivation to finish the jobs quickly or obtain higher marks and posts actively in the

start of the discussion easily becomes the leader.

However, when asked the influence of the leadership on the group performance, most groups explained that leadership could help a smoother progression but they could still finish the tasks without the leader.

5.4 Summary of the Results

Table 5.13 shows the summary of the results of all analyses (includes SEM model, open questions, communication pattern and interview). For SEM model column, the findings are summarised by the final models and the discussions for FTF and VT. For open questions column, each factor is categorised as three types ranked by their importance: crucial, important and not important. The judgments depend on the summary of the frequency table shown in section 5.1.6. Communication pattern column summarizes the findings in section 5.2 while interview column lists the findings in section 5.3. The summarized information is used in Chapter 6 to answer research questions.

Table 5.13 The summary of the results of the analysis

Items	Group	SEM model	Open questions	Communication pattern	Interview
Communication	FTF	<p>*Communication has a positive effect on relationship building</p> <p>*Communication has a strong direct effect on satisfaction but weak indirect effect on performance</p>	*Important factor	<p>*The longer discussion time and the total exchanged information could affect the performance positively</p> <p>*FTF groups focused on content more than process</p> <p>*The amount of social activities could not reflect the degree of performance</p>	<p>*The processes of the three-week meetings</p> <p>*FTF communication is more important than Email</p> <p>*Communication is a very important issue</p>
	VT	<p>*Communication has a positive effect on relationship building</p> <p>*Communication has a strong, indirect effect on satisfaction and performance.</p> <p>*Communication must affect satisfaction and performance through other factors instead of affecting directly in VT</p>	*Crucial factor	<p>*The group with more discussion had better performance</p> <p>*The group focused on “process” and “content” averagely had better performance</p> <p>*Non-production activities (social activities) accounted for less proportion</p>	<p>*Communication is the crucial factor to affect the group performance</p> <p>*More Postings lead to better relationship and cohesiveness</p>

Items	Group	SEM model	Open questions	Communication pattern	Interview
Collaboration	FTF	*There is no factor “collaboration” in FTF model	*Not regarded as an important factor	<p>*There is no fixed successive discussion pattern appeared but well-organised communication could lead better performance</p> <p>*The more “process gain” activities the group had, the higher performance the group had</p> <p>*Social loafing (Free rider) accounts for the biggest proportion of the “process loss” behaviours to affect the performance</p>	*There are no any conflicts and arguments in the whole process
	VT	*Weak, direct effect on satisfaction and weak, indirect effect on performance	*Important factor	<p>*Better communication pattern is process→ content→ process→ content</p> <p>*“Interlace communication” may deteriorate the efficiency of communication</p> <p>*The more “process gain” activities the group had, the higher performance the group had</p>	*Due the difficulties of communication, the collaboration is difficult as well
Relationship	FTF	*Relationship building has a weak and indirect effect on satisfaction and performance	*Crucial factor		*Relationship is important

Items	Group	SEM model	Open questions	Communication pattern	Interview
	VT	*Relationship building has a strong and direct effect on satisfaction and performance	*Not an important factor to affect the performance but a crucial factor to affect satisfaction		*Females prefer FTF meeting and most think relationship is important
Cohesion	FTF	*Weak, direct effect on satisfaction and weak, indirect effect on performance	*An important factor		
	VT	*There is no factor “cohesion” in VT model	*Not an important factor		
Satisfaction	FTF	*Satisfaction has a positive effect on performance			*Most people are happy and satisfied with their outcome and work with their members.
	VT	*Satisfaction has a positive effect on performance			
Participation	FTF		*Important		
	VT		*Important		
commitment	FTF		*Important		*Important
	VT		*Important		
Others	FTF	*The paths of FTF and VT that affect the performance and satisfaction are different	*Time is not important	*Other factors: members escaped, easy to lose focus	*Leadership is not a crucial factor

Items	Group	SEM model	Open questions	Communication pattern	Interview
	VT	*The paths of FTF and VT that affect the performance and satisfaction are different	*Time is not important	*Other factors: technology issues (but not serious), escape from the groups	*Discussion board has both advantages and disadvantage *Leadership results from more knowledge or higher motivation

Chapter 6 Research Questions Discussion and Implication

6.0 Chapter Introduction and Structure

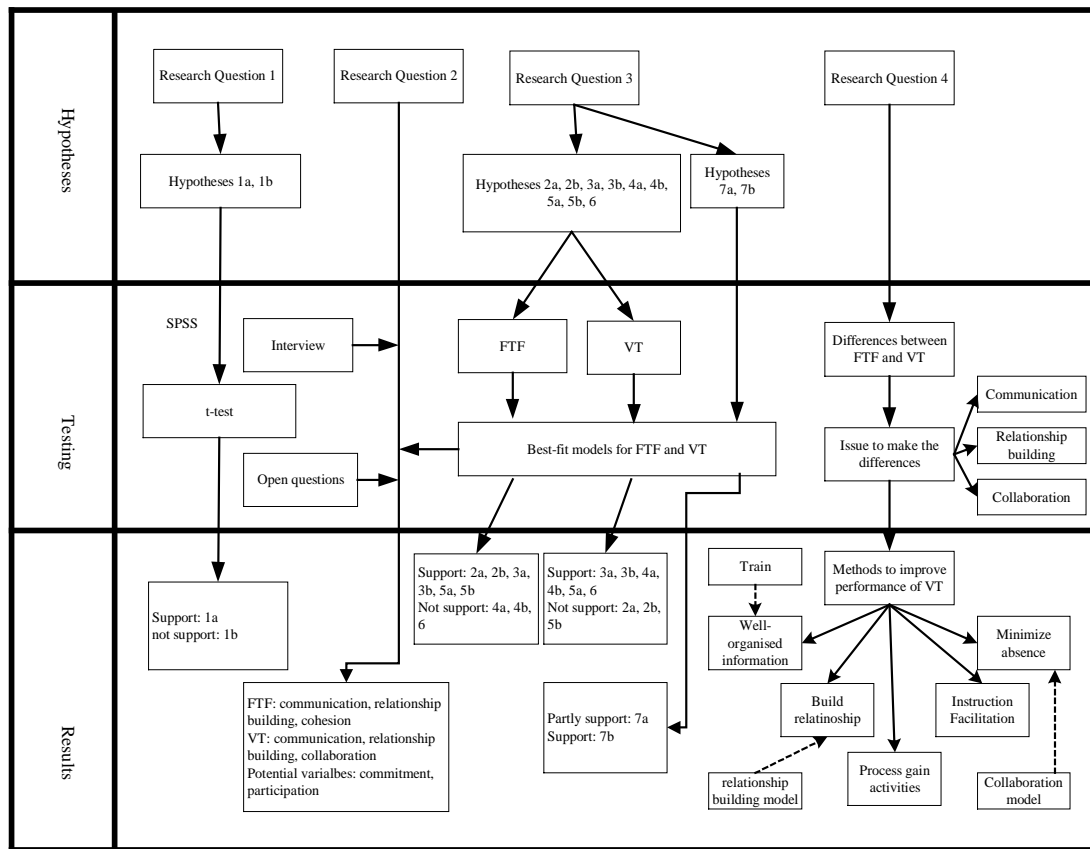


Figure 6.0 The structure of Chapter 6

The purpose of this chapter is to review the research questions and hypotheses against the analysis results in Chapter 5. Firstly, hypotheses 1a and 1b developed from research question 1 is answered by a t-test. Research question 2 is supported by the best-fit models for FTF and VT, interview and open questions. Two groups of hypotheses developed from research question 3 (one group: 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6; another group: 7a, 7b) are tested by the best-fit models for FTF and VT. From this, five approaches are suggested to resolve research question 4 and further supported by theory and literature.

6.1 Research Question 1

Research question 1 is “Is there any difference in performance and satisfaction between virtual teams and face-to-face teams?” Hypothesis 1a and 1b are proposed in accordance with the literature:

Hypothesis 1a: The perception of the performance of VT is lower than FTF.

Hypothesis 1b: The perception of the satisfaction of VT is lower than FTF.

In order to test the hypotheses, a t-test is applied to examine the differences of performance and satisfaction between FTF and VT by SPSS. The result is shown as Table 6.1:

Table 6.1 A t-test result of the difference in performance and satisfaction between VT and FTF

Item	Group	Size	Mean	Deviation	t-value	Degree of Freedom	P-value
Performance	ftf	107	5.2461	1.3281	2.226	253.363	.027**
	vt	200	4.8650	1.6013			
Process Satisfaction	ftf	107	4.9603	1.1086	1.648	255.316	.101
	vt	200	4.7238	1.3500			
Outcome Satisfaction	ftf	107	5.1659	1.2816	.184	241.741	.854
	vt	200	5.1363	1.4573			
Solution Satisfaction	ftf	107	5.2897	.9667	-.952	226.644	.342
	vt	200	5.4020	1.0182			
Total Satisfaction*	ftf	107	5.1386	.9802	.408	251.454	.684
	vt	200	5.0873	1.1704			

*Satisfaction is divided into three parts: process satisfaction, outcome satisfaction and solution satisfaction. Total satisfaction is the total of the three parts.

From the table above, performance is significant. Thus hypothesis 1a is supported. This implies that FTF groups perceive a higher degree of performance than VT groups.

The satisfaction part (process, outcome, solution and total satisfaction) is not significant and so hypothesis 1b is not supported. It should be noted that however the means for the FTF groups were higher than that for VT groups suggesting that, despite a lack of statistical support, FTF members sensed a higher degree of satisfaction over VT members. Thus, the test results of hypotheses 1a and 1b are shown in Table 6.2.

Table 6.2 The test results of the hypothesis 1a and 1b

No	Hypothesis	Support
1a	The perception of the performance of VT is lower than FTF	Yes
1b	The perception of the satisfaction of VT is lower than FTF	No statistical support, but it can be inferred that VT has a lower degree of satisfaction

- **Comparing the assignment marks of FTF and VT**

VT perceives a lower degree of performance compared to FTF but, how about the actual performance? There were 56 FTF teams and 67 teams in VT. Because the assignment mark was 10% in the FTF setting while the one was 15% in VT setting, for a fair comparison base, the assignment marks for each FTF teams were raised to 15% based in proportion. Table 6.3 shows the t-test result of testing the mark difference between FTF and VT.

Table 6.3 A t-test result of the difference in the assignment marks between VT and FTF

Item	Group	Sample size	Mean	Deviation	t-value	Degree of Freedom	P-value
Assignment marks	FTF	56	12.014	2.675	6.416	118.386	.00
	VT	67	10.085	2.855			

The result shows the fact that null hypothesis ($FTF=VT$) is rejected, which means the mark of FTF is higher than VT at the significant level $\alpha=0.05$.

Also from the marker's comments, the assignment quality of VT is worse than FTF mainly in two areas as follow:

(1) The structure of VT assignments was looser

The questions of the assignment are consequential and relate to each other. This means that the latter questions need to incorporate the results from the former questions. VT assignments showed a looser coupling without a tight connection between each question.

(2) The inconsistency ratio was higher

There was a serious problem in the VT assignments with a higher ratio of inconsistency between the results and arguments of all questions. One such example is the conclusion to adopt system A in question 1, but in question 2, they applied system B to the business. It is possible that VT members just did their own part and ignored others' parts; or the member who combined all the parts together did not check for consistency.

Summarily, the performance of VT is lower than FTF in terms of the perception, actual marks and the marker's comments toward the assignment quality.

By observing the studies comparing CMC and FTF in appendix 2.1, the result of testing hypothesis 1a is consistent with studies by Galegher and Kraut (1994), Straus (1997) and Warkentin et al. (1997). Although there is no statistical evidence to support hypothesis 1b, the researcher believes that VT members perceive a lower degree of

satisfaction than FTF members. This result is also supported by prior studies Galegher & Kraut (1994), Straus (1996), Straus (1997), Warkentin et al. (1997), Dufner et al. (2002), Ocker (2002) and Valacich and Saker (2002).

6.2 Research Question 2

The answer to research question 2 “Are there any specific social or task factors that affect the performance and satisfaction of virtual teams and face-to-face teams?” can be observed in the best-fit models for FTF and VT. Figure 6.1 shows the factors and their relationships for both teams.

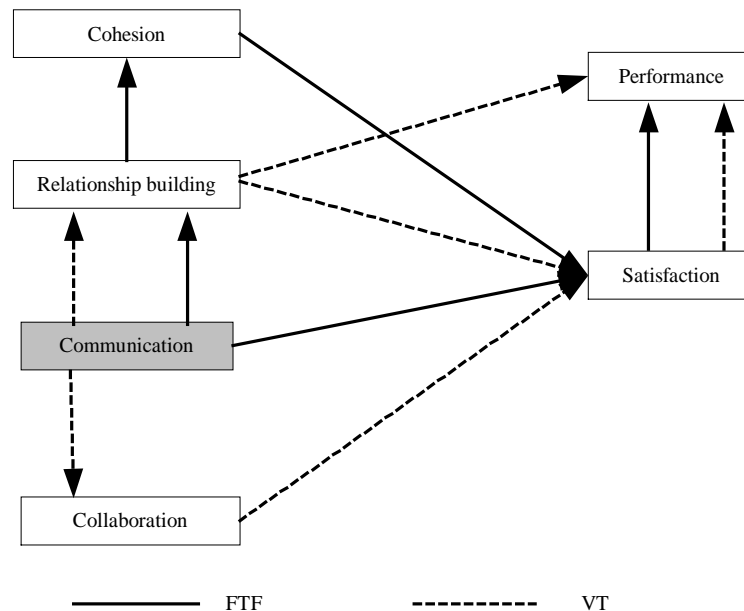


Figure 6.1 The factors and their relationships for FTF and VT

The factors that affect the performance and satisfaction of FTF are communication, relationship building and cohesion. Among them, communication is a task dimension factor while relationship building and cohesion are social dimension factors.

The factors that affect the performance and satisfaction of VT are communication, collaboration and relationship building. Among them, communication and

collaboration are task dimension factors while relationship building is a social dimension factor.

Then, are there any other factors affecting the performance and satisfaction for both teams? By summarising the open questions and interviews, commitment and participation could be potential factors. Participation could be regarded as a prerequisite and implicit part of collaboration, because collaboration is infeasible without participation. Some researchers have studied participation. Straus (1996) explored the relationships between media and information distribution, participation and performance. Another study by Tillquist (1996) observed members' interaction and participation in a bulletin board system. Burgos et al. (2007) introduced incentive mechanisms and face-to-face meetings to facilitate the participation in online learning network. These studies regarded participation as an individual variable rather than relative to collaboration. Therefore, the relationships between participation and collaboration need more investigation. Few studies have put participation (a task dimension factor) and social dimension factors (such as relationship building and cohesion) together. Only Yoo and Alavi (2001) studied the relationships between social presence, task participation and group consensus. Thus, participation is an interesting topic for further research.

In this study, commitment was found to focus on agreement that members do what they have promised. But past research emphasized this more at an organisational level instead of in teams or at an inter-personal level. For example, a study by Hooff and Ridder (2004) focused on organisational commitment. Another study by Ryssel et al. (2004) examined commitment in business relationships. Geyskens et al. (1996) researched mutual commitment among exchange partners in a market channel. Only a

few studies paid attention to the team level, such as Arnold et al. (2001) studied the relationships between leadership, trust, commitment and team efficacy. A notable study by Powell et al. (2007) investigated commitment in depth in FTF and VT and found that FTF had stronger relationship between members' effort and trust, and trust and commitment than VT. Therefore commitment at a team or inter-personal level deserves more research.

6.3 Research Question 3

Research question 3: "How do the factors affect each other and what impact do the factors have on the performance and satisfaction of virtual teams and face-to-face teams?" can be divided into three parts. Section 6.3.1 answers the FTF part while section 6.3.2 answers the VT parts. In addition, section 6.3.3 examines the different routes for FTF and VT.

6.3.1 How Do the Factors Affect Each Other and What Impact Do they Have on the Performance and Satisfaction of Face-To-Face Teams?

According to the best-fit model of FTF (Figure 5.4) and the factors' direct/ indirect effects table for performance and satisfaction (Table 5.7), the results of testing hypotheses (hypothesis 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6) are shown as Table 6.4:

Table 6.4 The test results of the hypothesis 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6 for FTF

No	Hypothesis	Support
2a	Cohesion is related to performance	Yes
2b	Cohesion is related to satisfaction	Yes
3a	Communication is related to performance	Yes
3b	Communication is related to satisfaction	Yes
4a	Collaboration is related to performance	No
4b	Collaboration is related to satisfaction	No
5a	Communication is related to relationship building	Yes
5b	Relationship building is related to cohesion	Yes
6	Communication is related to collaboration	No

Their relationships can be summarised as below:

- (1) Communication strongly and directly affects relationship building and satisfaction, but affects performance slightly and indirectly.
- (2) Relationship building affects cohesion strongly and directly but affects satisfaction and performance indirectly and slightly.
- (3) Cohesion affects satisfaction directly and affects performance slightly and indirectly.
- (4) Satisfaction affects performance positively and strongly.
- (5) There is no evidence showing that collaboration affects performance and satisfaction significantly
- (6) There is no relationship between collaboration and relationship building, and collaboration and cohesion.

6.3.2 How Do the Factors Affect Each Other and What Impact Do they Have on the Performance and Satisfaction of Virtual Teams?

According to the best-fit model of VT (Figure 5.9) and the factors' direct/ indirect

effects table for performance and satisfaction (Table 5.7), the results of testing hypotheses are shown as Table 6.5:

Table 6.5 The test results of the hypothesis 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6 for VT

No	Hypothesis	Support
2a	Cohesion is related to performance	No
2b	Cohesion is related to satisfaction	No
3a	Communication is related to performance	Yes
3b	Communication is related to satisfaction	Yes
4a	Collaboration is related to performance	Yes
4b	Collaboration is related to satisfaction	Yes
5a	Communication is related to relationship building	Yes
5b	Relationship building is related to cohesion	No
6	Communication is related to collaboration	Yes

Their relationships can be summarised as below:

- (1) Communication has no direct effects on satisfaction and performance but affects them indirectly. There are two paths: communication → relationship building → satisfaction, performance;
communication → collaboration → satisfaction → performance. The two paths show the fact that social and task dimensions are important in VT.
- (2) Relationship building affects satisfaction and performance strongly and directly. It means that relationship building is important in VT.
- (3) Collaboration affects satisfaction directly and affects performance indirectly.
- (4) Satisfaction affects performance positively and strongly.
- (5) There is no evidence showing that cohesion affects performance and satisfaction significantly
- (6) There is no relationship between collaboration and relationship building, and collaboration and cohesion.

6.3.3 The Routes for FTF and VT

Hypothesis 7 examines the different routes of FTF and VT:

Hypothesis 7a: The route of VT is “communication → Collaboration → output”.

*Hypothesis 7b: The route of FTF is “communication → relationships
building → cohesion → output”.*

Hypothesis 7a is based on the assumption that VT focuses on task dimension while hypothesis 7b is based on the assumption that FTF focuses on social dimension.

Items 1 and 4 of the communication questionnaire are about the respondents' tendency toward social relationships while items 2 and 3 relate to the respondents' tendency toward task dimensions. A t-test was applied to test the hypotheses and the results are shown as Table 6.6.

Table 6.6 The statistics of the hypothesis 7a and 7b

Group	Item	Sample Size	Mean	Variance	t-value	P-value
FTF	Communication_task	107	4.0514	.938	8.102	P<0.01
	Communication_social	107	5.1822	1.101		
VT	Communication_task	200	5.4075	1.141	15.856	P<0.01
	Communication_social	200	3.6550	1.302		

From Table 6.6, it can be seen that t-value (8.102) is greater than the criterion ($z=2.33$, $\alpha=0.01$) and it statistically supports the fact that the mean of “communication_social” is greater than that of “communication_task” in the FTF environment. Thus, it can be inferred that FTF tends toward social dimension. In the virtual environment, t-value (15.856) is greater than the criterion ($z=2.33$, $\alpha=0.01$) and it statistically proves the fact that the mean of “communication_task” is greater than that of “communication_social”. It can be inferred that VT tends toward task dimension.

Furthermore, by observing the best-fit models of FTF and VT shown in Figure 6.1, FTF does have a stronger tendency toward social dimension. But VT tends to be both social and task oriented.

By summarising the evidence, the results of testing hypothesis 7 are shown as Table 6.7:

Table 6.7 The results of testing hypothesis 7a and 7b

No	Hypothesis	Support
7a	The route of VT is “communication→Collaboration→output”	Partly support. VT has both social and task routes.
7b	The route of FTF is “communication→relationships building→cohesion→output”	Yes

6.4 Research Question 4

Research question 4 “How can we improve the performance and satisfaction of virtual teams?” is to summarise the findings in order to explore methods to improve the performance and satisfaction of VT.

Before answering research question 4, a fundamental question needs to be solved. That is: what caused the differences in performance between FTF and VT? From the results of testing research question 1, FTF groups’ perception of performance is higher than that of VT groups. The only difference between the two groups is that FTF groups are allowed to meet face-to-face but VT groups are not. Normally, human beings need visual contacts to build relationships. However, does a FTF meeting cause a different perception of performance and different models of operation? To answer the questions, section 6.4.1 summarises the differences between both teams. Section 6.4.2 proposes the issues that cause the differences both teams. From the discussion of these issues, section 6.4.3 proposes five methods to improve the performance and satisfaction of VT.

6.4.1 The Differences between FTF and VT

The following summarises the differences between both teams according to Table 5.13:

- (1) Communication affects satisfaction directly in FTF but communication indirectly affects satisfaction through other factors in VT.
- (2) It is found that VT groups’ better communication pattern is process → content → process → content. But there is no obvious communication pattern observed for FTF.
- (3) “Interlace communication” phenomenon may interfere with effective

communication in the virtual environment but it does not appear in the FTF environment.

- (4) There is no factor “collaboration” in FTF model while “collaboration” plays an important role in VT.
- (5) Relationship building is an intermediary factor affecting the satisfaction of FTF while it is a direct factor affecting the satisfaction and performance of VT.
- (6) Cohesion plays a necessary but not strong role in FTF while it is absent in VT.
- (7) The paths of FTF and VT that affect the performance and satisfaction are different.

6.4.2 Issues That Make the Differences between FTF and VT

Then, what issues make differences in performance and satisfaction between FTF and VT? From section 6.4.1, it can be seen that communication, relationship building and collaboration are the key issues. However, how do these factors decrease the performance and satisfaction in VT? Suggested reasons are as follow:

(1) Communication

Among the three factors, the most important factor is communication. Good collaboration depends on excellent communication. Relationship building is also based on communication. Without communication, VT members cannot coordinate tasks and build relationships and now we need to look at the reasons for poor communication:

(a) The flow and speed of exchanging information is slow:

Absence of face-to-face communication does hinder the flow and speed of exchanging information. This can be seen from the analysis of section 5.2.1 and 5.2.2. VT groups do exchange less information than FTF groups, and the speed is slower.

(b) Difficulties in arriving at conclusions:

From the analysis of the communication pattern of VT, “interlace communication” causes an obstacle to effective communication and difficulties in arriving at conclusions for VT.

(2) Relationship building

In a virtual environment, members find it difficult to build relationships via the discussion board. Members cannot see each other and this causes difficulties in getting to know each other or become more intimate and this poor relationship causes lower perceptions of performance and satisfaction.

(3) Collaboration

Difficult communication results in poor collaboration, such as a respondent expressed “indirect communication hindered the progress of the group”. The fact that members were absent from groups causes difficulties in collaboration, but through interview, VT members feel no guilt in this regard and there is no norm or sanction to force members to engage in tasks.

6.4.3 Methods to Improve the Performance and Satisfaction of VT

From the discussion of section 6.4.2, the researcher suggests the following methods to improve the satisfaction and performance of VT:

(1) Posting well-organised information

Although the speed and flow of information exchanged in VT groups is slow, the communication method (discussion board) of VT still has an advantage. That is,

well-organised and rich-content postings can overcome the defects in communication. When VT members posted to the discussion board, it was found that the postings were better arranged than in face-to-face conversation. In spite of less information exchanged, it contained better quality information due to the prior deliberation of the posters. In addition, the properties of the postings on the discussion board can be easily searched and read repeatedly and also facilitates discussion and promotes information exchange.

To ensure well-organised postings, the training is required on how to use the systems and how to post effectively. A study by Warkentin and Beranek (1999) examined the role of training on virtual teams and found that training has positive links to team performance. Participants were introduced to a bulletin board system “MeetingWeb” to learn the skills to communicate by “posting” messages in a hierarchical manner (threaded discussion). They were also introduced to “rules of netiquette” and given examples of abbreviation to assist in effective communication and to avoid misunderstanding and misinterpretations. For example, “BTW” means by the way; “FEIW” represents for what it is worth. They are also instructed not to type comments which may be misinterpreted as inflammation. Another study by Tan et al. (2000) applied dialogue technique to develop a team mental model on electronic communication practices and suggested that applying dialogue technique to train and guide VT can achieve a better communication and further improve the performance. A fairly dated study by Rosen et al. (2006) investigated 440 training and development professionals and proposed a training program prototype for virtual team leaders and members. For leaders, the program focuses management of virtual teams, such as fitting the technology to the task, setting expectations, measuring, and rewarding team contributions, coaching and mentoring, modelling members’ behaviors and managing

external relations. For members, it focuses on the execution and application. Such as establishing team identity, mastering technology and communications skills and resolving conflicts.

(2) Building strong relationships

Relationship building has been confirmed as a critical factor for the performance and satisfaction of VT. The key to build a strong relationship is to endeavour to post at the beginning of the discussion. Teams that posted abundantly at the beginning reduced tenseness and uneasiness, and built intimacy quickly. When members can sense intimacy at the beginning, they build better relationships afterwards. Clear instructions and guidance can help VT members to achieve an excellent beginning then build better relationships subsequently.

But in practice, how do managers help improve the relationships of VT members? Pauleen (2003) studied seven VT leaders from a variety of New Zealand organisations and built a framework involving actions to facilitate the relationships of VT members. The subjects of his study were leaders who were involved in the operation of VT, so the model was built from leaders' view who were engaged in practical tasks. However, from the researcher's observation, not all VT has a leader and not all VT needs a leader. Thus, it is more appropriate to see this question from a manager/instructor's view. In addition, the model shows no stages relate to the project life cycle as VT always has limited project time. Thus, the researcher amended Pauleen's work and combined a group progress model by Tuckman (1965) named "Forming Storming Norming Performing Model" to form a new model to improve the relationships of VT members as Figure 6.2.

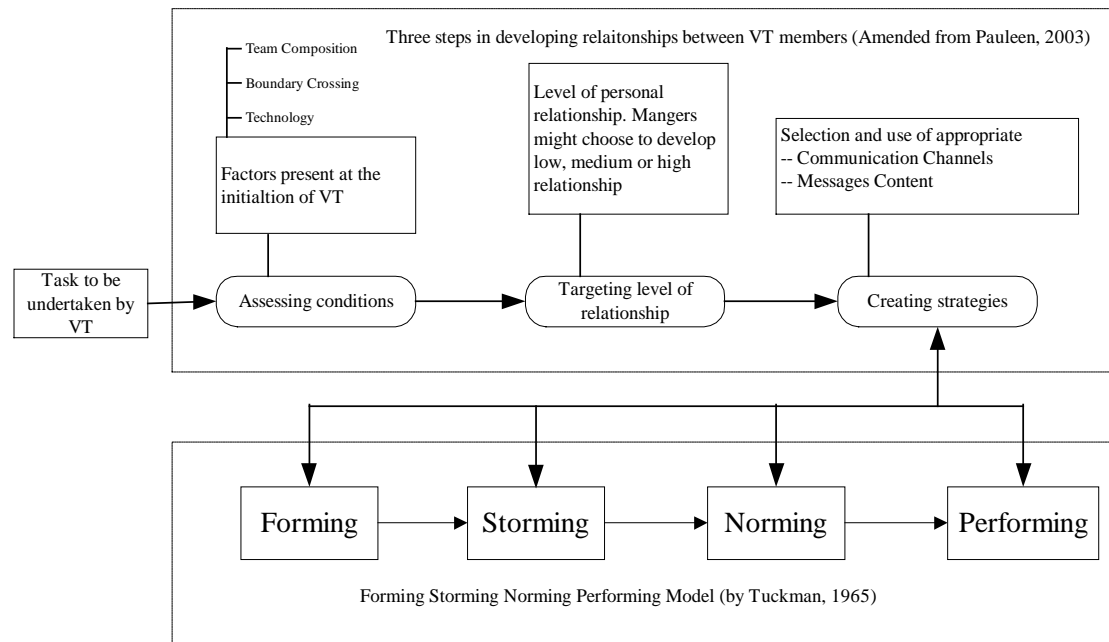


Figure 6.2 A model for developing relationships between VT members

Pauleen's model focuses on the preparation prior to the project commencing. At the assessing condition stage, the properties of VT and tasks need to be considered. Team composition involves the way in which team members are selected and their professional expertise. The composition and members' training could influence the degree of relationship. Time and distance are the major boundaries. According to the matrix of virtuality presented in section 2.4.1, the greater distance and the more cross organisational the more difficult the VT project. In addition, culture could be another boundary causing difficulties in relationship building. Time difference may cause a communication obstacle; culture difference may cause a discourse misunderstanding. It stands to reason that VT members use ICT (Information Communication Technology) to communicate and so the availability and compatibility of ICT influences the process of facilitating relationships of VT members. Thus, managers/instructors must ensure the regular and smooth operation of ICT.

In the next step of Pauleen's model, managers have to decide the level of relationship

that VT members need to enjoy. There are three levels of relationship: low, medium and high. Low relationship is when VT members need only to complete tasks and share basic information, such as name, position and company. Medium relationship is defined as sufficient familiarity to establish effective two-way communication followed by the completion of tasks. VT members know more detailed personal information about each other, such as hobbies, working style and families. Pauleen believes that medium relationship is the most commonly required in VT and results in benefits such as less attribution bias, increased morale, better decision and better outcomes. High-level relationship is found to be an essential component when the tasks are extremely complicated and members cross significant boundaries. Members know each other very well, just like intimate friends. This relationship needs a longer time to cultivate. Since most VT projects are time-limited, forming a high-level relationship is a significant challenge for managers. Managers should choose the appropriate level of relationship based on the tasks, resources and the properties of VT members.

The third step of Pauleen's model is to create strategies to achieve the targeted level of relationship. Communication channels and message content need to be taken into consideration. Communication channels mean the communication tools provided for VT members, such as email, telephone, Instant Messenger, videoconferencing and discussion board. The channel is selected by the properties of step one, such as tasks, different culture and team composition. The message content relates to the discourse of VT members and is decided by the targeted relationship level in step two. The higher the relationship the more private information is shown in the message content. Managers can provide detailed personal information in preparatory documentation for VT members to satisfy this requirement.

The first stage (Forming) of Tuckman's model refers to a period when members are trying to determine their positions in the group, procedures and rules to follow; The second stage (Storming) is formed when conflicts arise as team members resist the influence of the group and rebel against task accomplishment; The third stage (Norming) begins when members establish cohesion and commitment to the tasks and find their own way of working together; The fourth stage (Performing) occurs when the group shows proficiency in working together. According to the result of this research, the researcher believes that most important stage to build the relationship for VT members is the first stage: Forming. The managers must create the strategies to encourage VT members to discuss more in Forming stage. If not, the following stages will be not easy to form or function appropriately. Moreover, the managers need to change strategies depends on different stages. For example, if conflicts arise in Storming stage, the managers may make an arbitration; but if the team steps to Norming stage, the managers may just need to ensure the communication remain unhindered.

(3) Increasing "process gain" activities and decreasing "process loss" activities

Providing instructions and guidance to facilitate the "process gain" activities, such as encouraging the members to post more (even irrelevant content), fast response to others' ideas and to be willing to help others.

"Interface communication" causes "process loss" to a certain degree but training members to use the discussion board effectively could be the best method to solve this problem. Another issue which causes "process loss" is social loafing. It is perhaps unavoidable that some members are content to be "free riders" but this behaviour also affects and demotivates other members in the VT group. Asking the members to sign

a group contract in order to increase the sense of honour and responsibility could be a way to solve the issue. In addition, a study by Dineen (2005) found that social loafing is lower in fluid teams than in stable teams. He explained that members tend to be on “better behaviour” and more inhibited in the presence of strangers. Thus, a mechanism to rotate team members across different projects could keep the teams fluid and reduce social loafing.

(4) Instructions and facilitation to promote the discussion of process and content

equally and facilitate better communication patterns

From the finding in section 5.2.2: “the groups focused equally on “process” and “content” had better performance”, it can be implied that the discussion of process and content are important equally. Another important finding has been explained in section 5.2.2: “Better communication pattern is process→ content→ process→ content”. VT groups can obtain better performance if their communication starts from the discussion of the process, followed by the discussion of content, goes back to the discussion of process next and ends at the discussion of content. This pattern not only can satisfy the former condition (focus on both process and content) but also enables members to revise the steps and procedures to adapt to unexpected events to gain a better performance in a limited project time.

The solution is to provide clear instructions before the start and align with the facilitators (Casper-Curtis, 2002) or instructors (Swan, 2001) to guide members to form structured communication patterns.

Rourke et al. (2001) explained that there are three forms of interaction in on-line learning environment: interaction with content, interaction with instructors and

interaction with classmates. Among them, interaction with instructors has been validated to positively relate to students' learning outcomes (Picciano, 1998; Swan, 2001) in on-line learning. Instructors in traditional face-to-face classrooms are able to give immediate social assistance (such as encouragement and inspiration) and task guidance (such as procedures to finish tasks, how to deal with difficulties). In social assistance aspect, educational researchers have found that instructors' verbal and nonverbal behaviours can reduce psychological distance and lead to a better learning result (Christophel, 1990; Rodriguez et al., 1996). But lack of physical contact and immediate feedback in a virtual environment leads to less capability to represent the social presence. Thus, instructors are able to form only a "hyper-personal" social presence (Walther, 1996).

It stands to reason that the relationships between instructors and VT members are inclined to task guidance. Hiltz (1994) asserts that instructors in virtual environments have three duties: cognition, affection and management. From the observation of the researcher, management is the crucial function for instructors. Combining five major responsibilities in managing virtual teams proposed by Alexander (2002) and the conclusions by the researcher, managing virtual teams includes the set of the goals, the preparation of documents, the confirmation of each member's situation, management of time and techniques and the guidance of the processes. It is extremely important for members to understand and recognise the common goals of VT. Confirming each member is prepared to proceed with the tasks can ensure a smooth process. Reminders of the deadline for changing to the next phase makes the tasks finish on time. This type of guidance can make sure that VT members have better communication patterns and achieve better performance.

In an interesting study, Limayem (2006) used the Adaptive Structuration Theory to investigate the tradeoffs associated with human facilitation and automated facilitation. This study found that automated facilitation embedded in the GSS was as effective as human facilitation. This gives an idea to use computer system to facilitate the interaction of VT instead of human instructors. Normally the facilitators or managers of VT are human with some defects, such as working hour limitation and facilitators' emotional affects. These are possible to reduce to minimum with an automated facilitation mechanism controlled by a computer system.

(5) Minimising members' absences

According to the analysis of chapter 5, members' absence from the group discussion affected the performance severely. It not only reduced the morale of the groups but also disturbed the groups' collaboration and led to worse or incomplete outcomes.

Two reasons have been found that account for the phenomena. One is VT members do not feel guilty when they miss the discussion and secondly schedule can be difficult to coordinate. A reason that members do not feel guilty could be due to their lack of strong relationships. Thus, they do not feel sorry or embarrassed if they have not finished their parts or are absent in the discussion. One solution to the problem is to ask members to sign a group contract. The purpose is to increase the sense of honour and responsibility (a contract example by Caspersz et al. (2006) is in appendix 6.1).

Another reason is the difficulty in coordination of members' schedules. In practice, VT members always gather together temporarily and each member has his specific jobs to do. Coordinating members' schedule is a tough task. Through the researcher's observation, many members vanished for a period of time because they had other

important things to do. There are two issues regarding this: one is the length of missing time and another is if other members have been informed. The longer the time the member leaves the more serious effect on the outcomes. While it is hard to control the length of members' missing time, it could be solved according to a collaboration model proposed by Qureshi et al. (2006).

Qureshi et al. (2006) used grounded theory to build a collaboration model for VT. The data was collected from 21 distributed VT comprising of students from Erasmus University in Netherlands and City University in Hong Kong over a period of three months. Observations by the researchers and logs of electronic collaboration system (eRoom) were analysed to form the model shown in Figure 6.3.

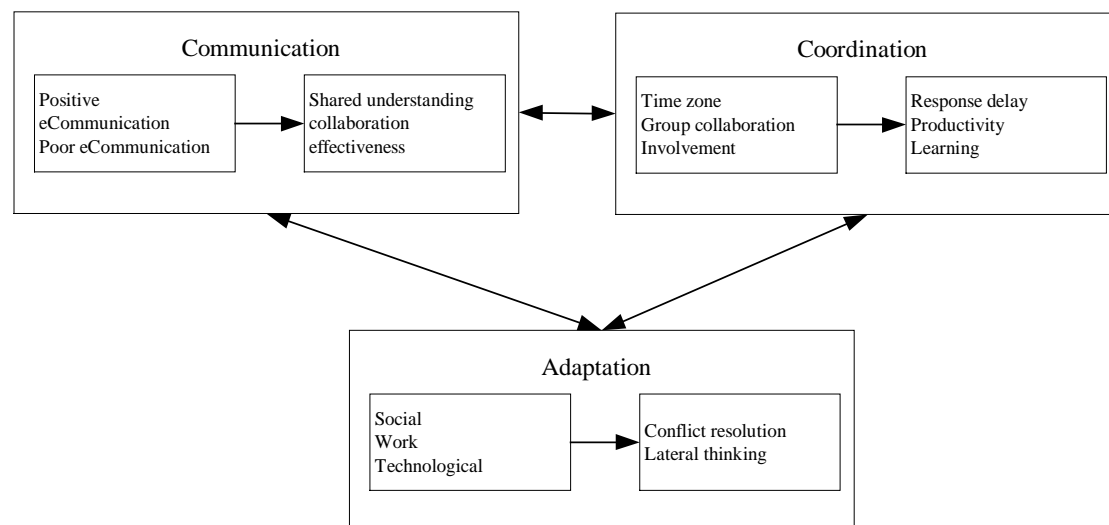


Figure 6.3 Model of collaboration
(From Qureshi et al., 2006)

This model includes three categories: communication, adaptation and coordination. Communication includes the actions that not only pass information to other members but also members are able to understand and utilise the information. Coordination represents how members have to overcome the boundaries to share ideas and

outcomes through three project stages: planning, sourcing and execution. Adaptation is the group process learning from three dimensions: social activities, tasks and technologies. VT members adapt themselves to the virtual environment to solve conflicts. The three categories interact reciprocally and affect each other.

This model suggests that collaboration of VT members is improved by exchanging information on each member's schedule. Sharing project schedules and task related information can help VT members to conquer their individual adaptation problems and reduce conflicts. For example, if a member knows the time to leave for a business trip, he could inform other members in advance. Other members can change their schedules to fit the change or even take over his jobs. This reduces the influence of member's leaving.

6.4.4 Implication

By implementing the solutions above, it can be implied that VT could achieve significant improvements in performance from the start. Instructions and guidance should be provided for VT members on how to engage in tasks, deal with difficulties and how to avoid process loss. Training VT members to develop the necessary skills to communicate and use the systems to avoid "interlace communication" is another prerequisite for success. Using a group contract to raise the sense of honour and responsibility can minimise members' absence from the groups and the occurrence of social loafing. These actions should be reviewed comprehensively and taken prior to the commencement of the VT project.

Chapter 7 Conclusions

7.0 Chapter Introduction and Structure

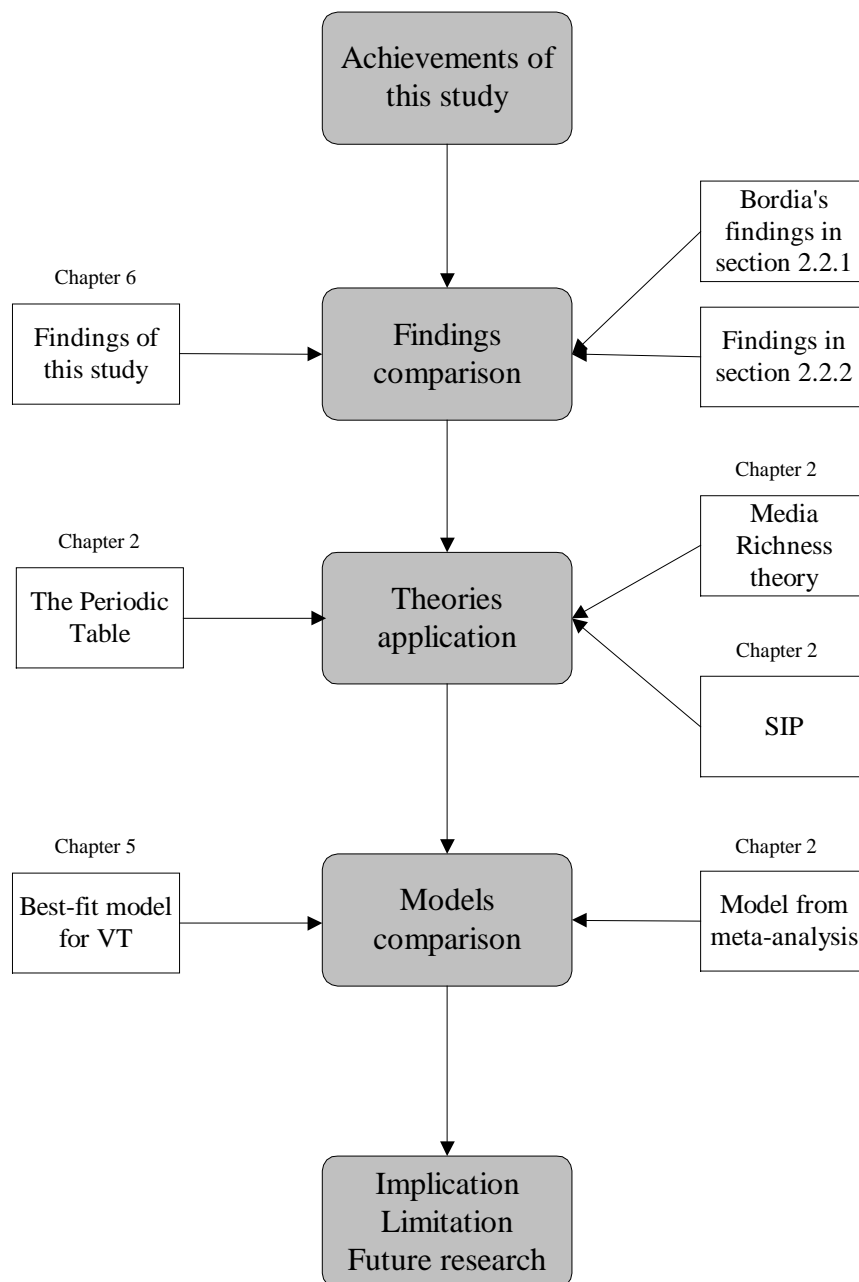


Figure 7.0 The structure of Chapter 7

The purpose of Chapter 7 is to finalise this thesis. A summary of achievements of this study is introduced in section 7.1, followed by a comparison of the findings of this study with Bordia's findings (introduced in section 2.2.1) and a comparative study shown in section 2.2.2. Section 7.3 re-examines the three theories that were applied to

the research framework and the model from the meta-analysis is compared to the best-fit model for VT in section 7.4. Implications, limitations and future research directions are proposed in sections 7.5, 7.6 and 7.7.

7.1 Summary of Achievements

Theoretically, the findings of this research support both Media Richness theory and SIP theory, which is elaborated in section 7.3. Furthermore, Walther's (1996) hyperpersonal communication theory is also supported implicitly. This means that both social and task dimension are important for VT. From a practical aspect, this study provides a direction of project design for future researchers and proposes methods to manage VT where no face-to-face meetings can be arranged.

The achievements can be divided into two parts: theoretical and applied contribution. Theoretical contribution focuses on building and validating frameworks, and the application of both quantitative and qualitative methods. The second contribution focuses on the application of the findings and project design. Figure 7.1 shows these components:

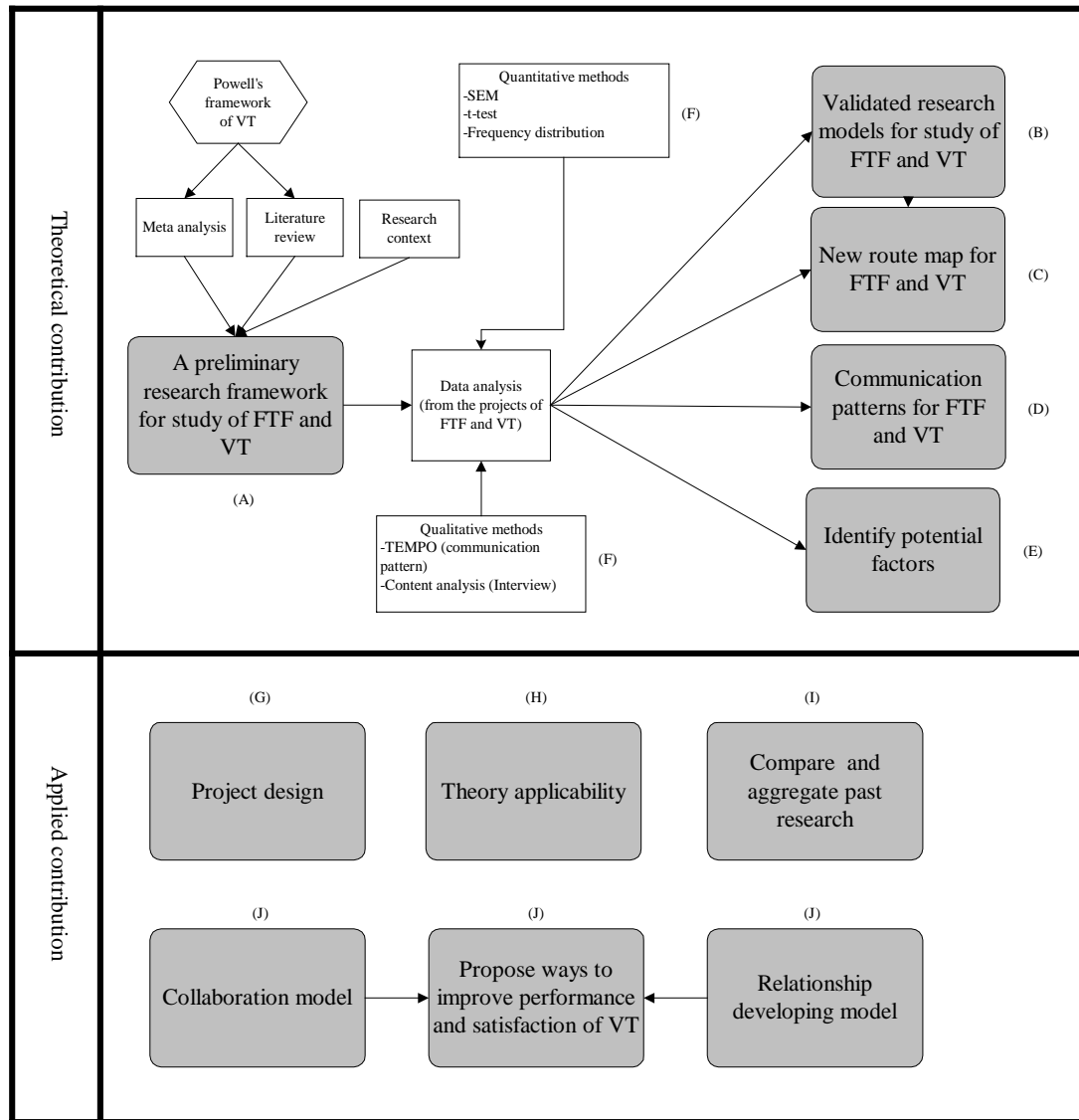


Figure 7.1 The summarised achievements of this study

● Theoretical contribution

(A) Preliminary framework

Powell et al's (2004) framework for VT was used as a basis to develop the research framework. By combining meta-analysis, literature review and the context of this research, a preliminary framework was formed. This framework aggregates statistical evidence from 47 studies about VT and presents a holistic view of VT. It provides a foundation for future research based on a strong statistical and solid theoretical support.

(B) Validated models

Through the data analysis, best-fit models for FTF and VT were validated by SEM which is a synthesis of many different statistical techniques and research methods. These models developed from saturated models with full relationships. Through the discussion of the coefficients and structural equations, inappropriate relationships and factors were discarded to form the competitive models. As a result, a comparison of these models was conducted to nominate the best-fit models. Thus, there are two advantages of these nominated models. Firstly, these models were extracted from saturated models and evolved step by step. All factors and their relationships were considered and each relationship was validated with a solid statistical method. Secondly, the best-fit models were selected by the comparison of models avoiding the researcher's bias. Therefore, the best-fit models give both consideration of integrity and efficiency.

The preliminary framework has strong support from the literature while the validated models give a deeper understanding of FTF and VT in a specific educational environment. Future researchers can adapt any of these to replicate the group assignment according to their research context and specific environments.

(C) Route maps

The different route maps are innovative and different routes give a substantial view of how FTF and VT interact and how different factors affect the performance and satisfaction of both teams.

(D) Communication patterns

The development of communication pattern is a new and successful attempt to present the qualitative group interactions. The TEMPO system was used to code the discourse and the communication pattern was drawn by the code. This converts the intangible conversation into a meaningful pattern of waves. By analysing the patterns and quantitative figures (such as frequency tables) of these waves produced from the TEMPO system, it is far easier to discern the hidden knowledge underlying patterns in the discourse.

(E) Identify potential factors

By analysing the open questions and interviews, participation and commitment were found to be additional potential factors. Participation can be regarded as a prerequisite and implicit part of collaboration due to the need for participation to effect collaboration. Commitment in a team or at an inter-personal level deserves further study.

(F) Combined qualitative and quantitative methods

This study combines qualitative and quantitative methods to validate the research framework. By mainly applying quantitative methods and supplementing this with qualitative methods, this framework gains both greater richness and reliability.

● **Applied contribution**

(G) Project design

This study engaged in projects lasting over two semesters. The first semester was for the FTF project while the second semester was for the VT project. In reality, it is not easy to obtain a real environment to conduct such a comparative study for FTF and VT. In the future, this kind of study may still be conducted in educational settings. In

addition, the projects were designed according to the unit outline of MIS1100 and became part of the unit. This reduced the resistance from lecturers and students, and the complexity of project design. It made the procedure simple and data collection easier. The environment is similar to the “normal world view” of the participants rather than being seen as an experiment, and it enabled better reliability and explanatory power to generalise the findings. All processes and documents which are presented in Chapter 4 and appendices should be valuable for future researchers when designing similar projects.

(H) Theory applicability

Three theories which were applied to the research framework described in Chapter 2 are re-examined in section 7.3. The relationships are drawn between the components of “The Periodic Table” and Media Richness theory is examined in the context of the task dimensions and SIP is in the context of the social dimensions. This substantiates the framework, extends the theories and integrates theory and practice in a manner quite distinct from previous studies. This suggests a need for future research to include validation of existing theories more vigorously.

(I) Compare and aggregate past research

Despite decades of developing communication technology, people still have not overcome the defects of using information technology to communicate. Thus, research in this area needs to continue. This study aggregated and examined past research and gave a holistic view for future researchers and the results are capable of enlightening and illuminating the paths for future studies.

(J) Methods to improve the performance and satisfaction for VT

This study proposed five methods to improve the performance and satisfaction of VT. These methods also gain supports from Pauleen's (2003) relationship developing model and Qureshi et al's (2006) collaboration model. Combining practicability and theorization, the proposed methods are more applicable and valuable.

7.2 Comparing This Study's Findings with Past Studies in Section 2.2

Bordia (1997) collected eighteen experimental studies (1985~1994) from psychological, sociological, business and communication databases and summarized these into ten major findings related to the comparison of FTF and CMC shown in section 2.2.1. Comparing the findings of this study with Bordia's ten findings, only one finding is supported: the performance of VT is worse than FTF. Other findings have no homogeneous properties.

Section 2.2.2 reviewed eleven experimental studies (1994~2002) that also focused on the comparison of FTF and CMC, and summarised ten findings. Comparing the findings of this study with the summarised findings in section 2.2.2, there are four similar findings: (a) VT members perceive lower performance than FTF; (b) VT members perceive lower satisfaction than FTF; (c) VT members find it more difficult to coordinate the tasks than FTF; (d) VT members find it more difficult to build social relationships. Only one finding of this study is contradictory to that of section 2.2.2: this study confirms the fact that communication effectiveness of VT is lower than FTF.

Table 7.1 shows the findings discussed above. Appendix 7.1 and 7.2 show the detailed comparison.

Table 7.1 Comparing the findings of this study with past studies shown in section 2.2

Bordia's Findings	This Study's Findings
The performance of CMC is worse than FTF	VT members' perception of performance is lower than FTF
The Findings of Section 2.2.2	This Study's Findings
The performance of CMC is worse than FTF	VT members' perception of performance is lower than FTF
The satisfaction of CMC is lower than FTF	VT members' perception of satisfaction is lower than FTF
It is more difficult for CMC to coordinate the task	From the analysis of interview and the discourse, it is difficult for VT to coordinate the tasks
Social relationships is not easy to build in CMC	From the analysis of interview and the discourse, social relationship is more difficult to build in VT rather than FTF
Communication effectiveness is still ambiguous	From the analysis of interview and the discourse, communication effectiveness for VT is worse than FTF (confirm VT < FTF)

Summarily, this study validated the fact that VT is weaker than FTF in communication effectiveness, coordination, social relationships building, performance and satisfaction. This means that while technology has advanced over the last 20 years, people have still not overcome the barriers of communicating through computer networks. Thus, methods to improve the performance and satisfaction of VT still need more investigation.

Another implication of the longitudinal comparison is that the factors that affect the performance and satisfaction of VT are multitudinous. Most of Bordia's findings and half the findings of section 2.2.2 cannot be mapped to the findings of this study. The reason is that past studies focused on different dimensions such as time, task type,

participation, normative social pressure, incidence of uninhibited behaviour, choice shift and attitude change. This implies that VT may be influenced by different factors in different scenarios, settings and environments. Different factors may affect VT when different task types are given or different technologies are used. Therefore, further studies to explore what factors and their interactions affect the performance and satisfaction of VT is necessary.

7.3 Response to The Theories

In section 2.4.3, three theories were applied to the research framework. This section re-examines these theories through this study's findings. "The Periodic Table" is used as a map to draw the factors' relationships. Media Richness theory is applied to the task dimension route and SIP is to the social dimension route.

"The Periodic Table" was applied to provide a holistic view of this study. One of the deficits of "The Periodic Table" is the lack of the relationships between these components. According to the virtual team model built in Chapter 5 (Figure 5.9), the relationships between these components can now be drawn as Figure 7.2:

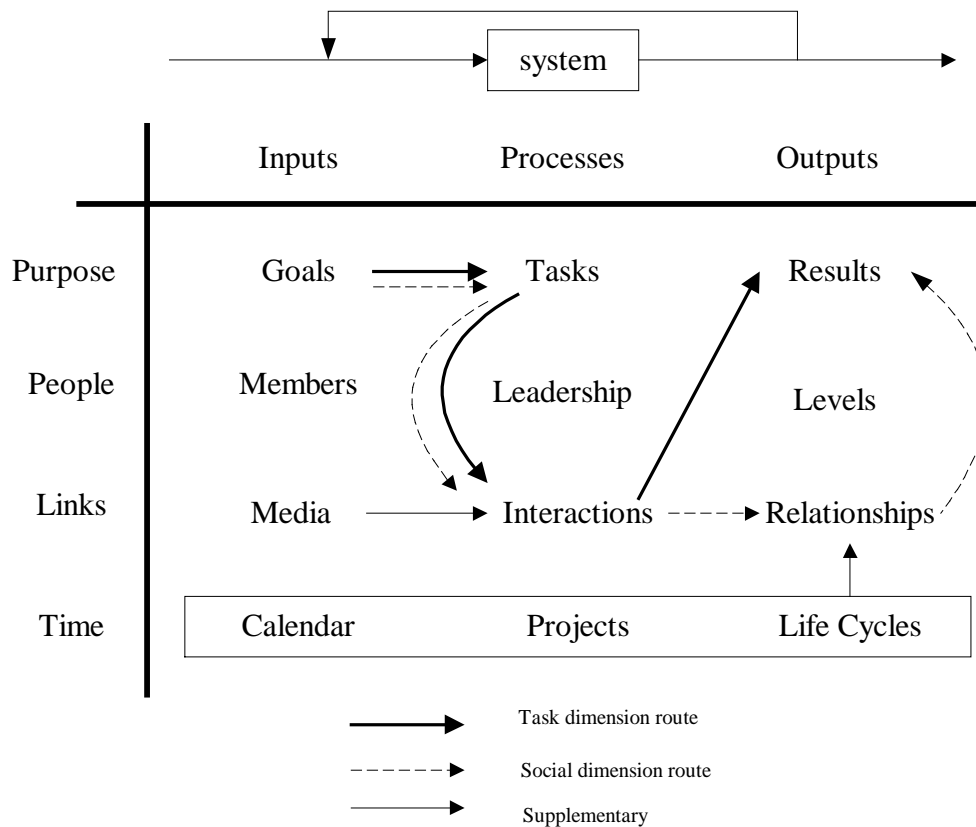


Figure 7.2 The modification of The Periodic Table

According to this study' findings, both task and social dimensions affect the performance and satisfaction of VT. After applying the results to The Periodic Table, Figure 7.2 shows the components' relationships as follows:

(1) Task dimension route: goals→tasks→interactions→results

In this route, members of VT depart from the goal (finish the assignment on time) and then they discuss the tasks (how to do the tasks, how to distribute the tasks). During the discussion, they interact through media (discussion board) and finish the assignment at the end.

This route corresponds to Media Richness theory. In this route, VT members only exchange information through electronic communication. Media plays a supplementary role to interaction. This means that interaction cannot be effective

without excellent communication. In addition, Media Richness theory further proposes that greater quantity of information can decrease uncertainty and better quality of information can reduce equivocality. The findings of the communication pattern correspond with the former. More postings can help improve the performance of VT. For the latter, this is a suggestion to improve the performance and satisfaction of VT.

(2) Social dimension route: goals→tasks→interactions→relationship→results

Compared to the task dimension route, VT members build relationships through interaction along the social dimension route and this leads to the outcomes. Time dimension becomes a supplementary factor. This means that VT members need time to develop relationships.

This conclusion corresponds to SIP theory which urges that impression formation and relational communication can still be established as long as adequate time is given. VT members do find it difficult to build relationships but they can still accumulate social cues little by little. It was noted that some VT groups gathered together to celebrate and got to know each other after the submission of the assignments, and even became good friends. This relates to SIP theory.

7.4 Comparing the Models from Meta-Analysis and SEM

In section 2.3, the meta-analysis was used to build a preliminary framework (Figure 2.7, called model 1 below) of VT through the review and abstract of 47 studies. SEM was used to explore a best-fit model (Figure 5.9, called model 2 below) for VT in section 5.1.2 through the questionnaires collected from students. The former is

grounded in literature while the latter is based on statistical examination. Comparing the two models can clarify the differences between past studies and this study. This section reviews the two models and proposes two differences as below:

- (1) From the composition of the two models, model 1 has two more factors than model 2: cohesion and trust. Trust has been omitted for the study as previously explained. Cohesion did not show significant impact on performance and satisfaction in model 2.
- (2) It was found that there is no relationship between independent factors (coordination, communication, trust, cohesion, relationship building) in both models. But communication has significant impacts on relationship building and collaboration in model 2. For the factors' impacts on performance and satisfaction, relationship building affects only performance in model 1 while it affects performance and satisfaction in model 2. Communication has direct impact on performance in model 1 but indirect impact on performance in model 2. Coordination in model 1 has significant impact on performance and satisfaction while collaboration in model 2 has significant impact only on satisfaction. Moreover, satisfaction does show a strong and positive relationship on performance in model 2 but is absent in model 1.

From the discussion above, it can be seen that the model from the meta-analysis (model 1) contains more general ideas because it aggregates numerous studies to produce a generalised framework. The merit of this model is to give a preliminary idea of how these factors interact. However, the model from SEM (model 2) is more specific to the environment of this study and depicts deeper relationships between factors because the data is collected through a comprehensive design. The merit of

this model is to provide a further understanding of VT in an educational environment. For future research, both models are applicable in different circumstances. If researchers intend to adopt a different non-educational setting, model 1 could be a better starting point. However in studies with the educational environment, adapting model 2 could be beneficial to accelerate and accumulate the achievements of this research.

7.5 Implications

(1) The key to VT success lies at the beginning stage

From the suggestions for improving performance and satisfaction stated in section 6.4.3, it can be seen that design and preparation are the keys to success for VT. Most VT projects are temporary and time-limited in reality. Members may not be familiar with each other or it could be the first time that they cooperate as a team. It is crucial that they feel capable as quickly as possible and so members know how to communicate, distribute the tasks, and cope with unexpected events. This requires good documentation and training. It should be noticed however, from the discussion of the meta-analysis, that different settings and different circumstance may need different designs.

(2) Helping VT members build social relationships is critical

Scholars have started to put their focus on the social dimension of VT and as seen from this research, building relationships does affect the performance and satisfaction of VT. Improving social relationships is a key issue for practitioners or VT managers. Many studies suggest that regular FTF meetings could improve this (Warkentin et al., 1997; Kirkman et al., 2002; Kirkman et al., 2004). In the global economy, a regular

FTF meeting could be infeasible due to high cost, different time zones, or difficulties in technology. Relying on face-to-face meetings could cause failure in VT projects. Adequate planning, training (Grohowski et al., 1990) and an excellent mechanism (Qureshi & Vogel, 2001; Dean et al., 2000) to ensure members follow the rules and build their relationships imperceptibly could be the most appropriate answer.

(3) Tips for improving an online course

From the research design and participation in MIS1100 online course, a stable platform, a well-planned pedagogy (Chua & Lam, 2007) and skilled and enthusiastic instructors are crucial to the success of an online course. A stable platform includes a reliable host and immediate useful technical support, such as helping students gain access to the Internet (Sivunen & Valo, 2006). A well-planned pedagogy represents clear and achievable objectives supported by well-organised documents and suitable delivery methods. The instructors have to continue monitoring and supervising the processes in order to help students or groups solve their problems. Absenteeism in the group is one issue that deserves special mention. According to the conclusions of this study, group members' absence leads to poor group performance and satisfaction. Once the instructors sense a problem in attendance or participation, it is necessary to take positive actions to cope with it, such as changing the group composition, asking others to take over the missing members' jobs, and re-scheduling the tasks or deadline.

7.6 Limitations

There are a number of limitations in this research. Firstly, the environment of this research was confined to a specific unit MIS1100 in ECU and the task was designed for this unit. Although the researcher tried to engage in a natural setting to reflect the

real world, the particular environment may still cause bias in the findings. Groups which were distributed across international boundaries may well have introduced far more issues although to some extent cross-cultural views were represented given the nature of student populations at ECU with around 50% overseas students.

Secondly, students were not strictly forbidden from other communication means in addition to FTF meetings (FTF groups) and Blackboard discussion board (VT groups). Students might still use email, SMS, Instant Messenger (IM) and telephone to communicate. This uncontrolled phenomenon may have produced bias and affected the results. It should be noted that whilst VT could conceivably meet FTF they were asked not to do so and a pilot trial of online students (from different geographical locations) showed similar results to those found by the main study.

Also, the nature of the task as a student assignment clearly limits the generalisability of the findings to other VTs employed in 'paid for work' activities. Further the value of the assignment – 10% and 15% affects motivation and could easily have skewed participation.

A major factor – trust, was not investigated in this study partly due to its lower level of relevance in the online educational environment but also due to the complexity of the study required for this single variable. This is an area which merits further individual study and the author has provided a detailed 'route map' of the relevant literature and interconnections between the many factors which have evolved in this area (Appendix 2.6).

Technology was regarded as a constant variable and not considered in the research

framework. However, different communication platforms may lead to different conclusions. In particular, a single platform (i.e. Blackboard) was used and hence the full potential of recent improvements to CMC (such as video, online conferencing etc.) could not be exploited

Finally, it is noticeable that the lower reliability of the instruments of cohesion and communication may bias the findings. Although the researcher has manipulated the instruments carefully and interpreted the results cautiously, the readers need to pay attention when using these results.

7.7 Future Research

(1) More scenarios should be investigated

From the results of the meta-analysis and the conclusion of section 7.1, it can be observed that many areas have not been convergent, such as technology, training, culture and design. Those parts belong to “input part” of Powell et al’s (2004) framework. A comparative study in section 2.2 also supports this idea. Varied scenarios with different combinations of technology, training, culture, design and tasks may affect the members’ task coordination and social relationship building. For example Instant Messenger (IM) is getting popular nowadays and so how IM software can be applied to the VT project could be an interesting topic. To cope with the complicated and complex situations in the real world, studies combining more scenarios and varied factors are necessary.

(2) Investigate more factors

From the conclusions of section 7.2, the factors that affect the performance and satisfaction of VT can be inferred as multitudinous. Two potential factors proposed in

Chapter 6 deserve more investigation: participation and commitment. Trust has been studied extensively but without consensus. A recent study by Newell et al. (2007) concluded that trust among VT members is problematic and difficult to achieve. Culture is another expansive and diversified issue like trust. Table 7.2 summarises the dimensions of cultural models by scholars. It can be seen that each model uses different dimensions to test culture and there is little convergence in this area. Thus, culture could be suitable for individual study and it deserves more extensive exploration.

Table 7.2 Multi-dimensions of culture

No	Model	Year	Dimensions
1	Fukuyama	1995	Trust
2	Hall	1990	Space, Material goods, Friendship, Time, Agreement
3	Hofstede	1991	Power distance, Individualism, Masculinity, Uncertainty avoidance, Long-term orientation
4	Lessem	1994	Pragmatism, Rationalism, Idealism, Humanism
5	Lewis	1992	Time
6	Trompenaars	1993	Universalism, Collectivism, Emotional, Specific, Status, Sequential, Inner-directed

(Cited from Dafoulas and Macaulay (2001, p. 7))

- (3) More longitudinal studies are required across a variety of different scenarios. This study was restricted by time limitations and scope of study size which could be managed by a single researcher.
- (4) In summary, this research study has uncovered a number of interesting factors in relation to the performance and satisfaction of VT and at the same time identified some areas which are rich for future studies.

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Appendices

Appendix 2.1. The comparison of CMC and FTF team

Year	Author	Result (CMC compares to FTF)	System	Task	Subjects	Time
1994	Galegher & Kraut	<ul style="list-style-type: none"> ● Performance lower ● Satisfaction lower 	ICOSY(Computer-mediated system)	Group writing(business dilemma)	117 students, 67 teams,GS (Group Size) =3	2 Weeks
1996	Burke & Chidabaram	<ul style="list-style-type: none"> ● No significant differences in the patterns of change in their perception over time (Social presence, communication effectiveness and communication interface) 	GroupLink, GroupWriter	Group writing	127 students, 33 teams	4 weeks
1996	Straus	<ul style="list-style-type: none"> ● Participation associates with extraversion ● Media had few effects on information sharing or performance ● Process satisfaction is lower 	Electronic Conference System	Subarctic Survival situation (Problem solving task)	54students, (VT:28; FTF: 26) GS=3	< 1hour

Year	Author	Result (CMC compares to FTF)	System	Task	Subjects	Time
1997	Straus	<ul style="list-style-type: none"> ● Less productive ● Low satisfaction ● Low cohesiveness ● Higher proportions of task communication and disagreement ● Greater equality of participation 	Synchronous computer conferencing system	Three tasks: A idea generation task An intellective task A judgment task	243 undergraduate students (VT:36; FTF:36) GS=3	<1 hour
1997	Warkentin et al.	<ul style="list-style-type: none"> ● Performance lower. ● Satisfaction lower. ● Communication effectiveness same 	MeetingWeb (Web-based conference system)	Murder mystery	72Undergraduate(VT:39; FTF:33) GS=3	FTF:25min VT:3weeks
2001	Benbunan-Fich et al.	<ul style="list-style-type: none"> ● More broader discussions, complete reports, focus on solving problem ● Coordination is worse ● No different transferring information discussion to report 	Asynchronous Learning Network (ALN)(text-based)	A case(no detail)(discussion and report writing)	53undergraduate (VT:25; FTF:28) GS=4-6	FTF:2hous VT:no mention

Year	Author	Result (CMC compares to FTF)	System	Task	Subjects	Time
2001	Shen et al.	<ul style="list-style-type: none"> ● Develop new friendship lower ● Flexibility higher ● Enjoy process higher ● Learn from other same 	Asynchronous Learning Network (ALN). Virtual Classroom and Webboard	Collaborative exam	138 graduate-level students Semester 1:63(VT:21, FTF:41) Semester 2:75(VT:15, FTF:60)	2 semester
2002	Dufner et al.	<ul style="list-style-type: none"> ● Coordination lower ● Satisfaction lower ● Less efficient ● More confusing ● Less fair 	Cybercollaboratory system	Vendor selection task Parking lot allocation problem	153 students	Train: 1 week Experiment: 1 week
2002	Ocker	<ul style="list-style-type: none"> ● Cohesion lower ● Manage conflict lower ● Satisfaction lower 	FirstClass Computer conferencing system	Computerized Post Office (CPO) task	83 MBA students (47 in VT, GZ=4, 36 in FTF, GZ=4-6)	17 days
2002	Tidwell & Walther	<ul style="list-style-type: none"> ● Uncertainty reduction higher. ● More confidence ● Greater conversational effectiveness 	CMS system	No mention	students(158)	No mention

Year	Author	Result (CMC compares to FTF)	System	Task	Subjects	Time
2002	Valacich & Sarker	<ul style="list-style-type: none"> ● Make riskier decisions ● Lower process satisfaction ● Higher and more even participation ● Higher intra-group conflict 	NetMeeting	Business dilemma	274 financial accounting students, GS=3	<1 day

Appendix 2.2 Comparing the findings of this study and Bordia's study

Bordia's study This study	1	2	3	4	5	6	7	8	9	10	Comments
1		S			S						
2							P				
3	S										
4											N
5								S			
6				S							
7						S	P				
8										P	
9		P					P				
10			S								
Comments									N		

PS: S: Support P: Partly support N: No mention

N means both studies did not find the issues. For example, in the cell (5, Comments), the "N" means there is no corresponding finding of this study to Bordia's study

Appendix 2.3 The Collection of Correlation of Studies

Author	Year	Sample	Correlation (r)			
Abdul-Gader	1997	102	<i>CM-ST:0.14</i>	<i>CM-PF:0.17</i>		
Agarwal & Prasad	1997	73	<i>TC-PF:0.14</i>			
Arnold et al.	2001	117	<i>TR-PF:0.62</i>	<i>CR-TR:0.7</i>	<i>CR-PF:0.47</i>	
Aubert et al.	2003	68	<i>TR-PF:0.333</i>	<i>RB-TR:-0.23</i>		
Balthazard et al.	2004	248	<i>CR-PF:0.69</i>	<i>CH-PF:0.45</i>	<i>CR-CH:0.23</i>	<i>CH-ST:0.62</i>
			<i>CR-ST:0.19</i>	<i>CH-PF:0.24</i>		
Benbunan-Fich et al.	2000	1048	<i>CR-PF:0.3</i>	<i>DS-PF:0.46</i>	<i>RB-PF:0.29</i>	<i>TC-PF:0.54</i>
			<i>CM-PF:0.46</i>			
Blomquist et al.	2005	287	<i>CR-PF:0.155</i>	<i>CR-PF:0.242</i>		
Caballer et al.	2005	124	<i>CR-ST:0.492</i>			
Carless & Paola	2000	120	<i>CR-PF:0.67</i>	<i>CH-ST:0.31</i>	<i>CM-CR:0.62</i>	<i>TC-ST:-0.069</i>
			<i>CR-PF:0.69</i>	<i>CH-PF:0.36</i>	<i>CM-CH:0.49</i>	<i>TR-ST:0.448</i>
			<i>CR-ST:0.49</i>	<i>CH-PF:0.15</i>		
Chang & Bordia	2001	25	<i>CH-PF:0.03</i>	<i>CR-PF:0.68</i>		
Chang & Bordia	2001	22	<i>CR-PF:0.77</i>			
Edwards & Sridhar	2005	201	<i>TC-PF:0.049</i>	<i>TT-PF:0.077</i>	<i>TR-PF:0.172</i>	<i>CU-PF:-0.138</i>
			<i>DS-PF:-0.017</i>			
Gil et al.	2005	268	<i>CH-PF:0.54</i>	<i>CH-ST:0.84</i>	<i>DS-PF:0.26</i>	<i>ST-PF:0.55</i>
Harrison et al.	1998	443	<i>CH-ST:0.35</i>			
Hooff & Ridder	2004	417	<i>CM-PF:0.03</i>	<i>CR-PF:0.14</i>		
Hostager et al.	2003	550	<i>DS-PF:0.02</i>			
Jarvenpaa et al.	2004	136	<i>CH-ST:0.705</i>	<i>CH-PF:0.707</i>	<i>ST-PF:0.702</i>	
Jiang et al.	2002	186	<i>RB-PF:-0.2</i>			
Kahai & Cooper	1999	94	<i>CR-ST:0.289</i>	<i>RB-ST:0.276</i>	<i>CM-CR:-0.370</i>	

Author	Year	Sample	Correlation (r)			
Kettinger & Grover	1997	613	<i>DS-RB:-0.027</i>	<i>CR-RB:0.124</i>	<i>DS-CR:0.007</i>	
Kirkman et al.	2004	280	<i>DS-PF: -0.02</i>	<i>DS-CR:-0.06</i>	<i>RB-TT:-0.17</i>	<i>CR-RB:0.22</i>
			<i>DS-ST:-0.02</i>	<i>DS-RB:0.05</i>	<i>TT-PF:-0.2</i>	<i>CR-PF:0.39</i>
			<i>DS-TT:-0.28</i>	<i>CR-TT:0.19</i>	<i>TT-SF:-0.1</i>	<i>CR-ST:0.44</i>
Kraut et al.	1999	250	<i>RB-PF:0.15</i>	<i>TC-PF:-0.17</i>	<i>TC-ST:0.07</i>	<i>RB-ST:0.2</i>
Lu et al.	2006	787	<i>CM-PF:-0.05</i>	<i>CR-PF:-0.025</i>	<i>RB-PF:0.02</i>	<i>TR-PF:0.04</i>
Luo	2002	255	<i>TR-PF:0.25</i>	<i>CU-PF:-0.11</i>	<i>CU-TR:-0.19</i>	
Lurey & Raisinghani	2001	67	<i>PF-ST:0.73</i>	<i>RB-PF:0.62</i>	<i>RB-ST:0.64</i>	<i>CM-PF:0.48</i>
			<i>CM-ST:0.37</i>	<i>DS-ST:0.36</i>	<i>TC-PF:0.26</i>	<i>TC-ST:0.42</i>
Montoya-Weiss et al.	2001	175	<i>DS-PF:-0.32</i>			
Morris et al.	2002	158	<i>DS-ST:-0.024</i>	<i>DS-TR:-0.058</i>	<i>DS-TC:0.286</i>	
Ocker	2002	83	<i>CH-ST:0.35</i>	<i>CR-ST:0.32</i>		
Olaniran	1996	116	<i>TC-CR:0.49</i>	<i>TC-ST:-0.19</i>	<i>CR-ST:0.048</i>	
Paul et al.	2004	63	<i>CR-PF:0.4</i>	<i>CR-ST:0.8</i>		
Pavlou	2002	102	<i>RB-ST:0.58</i>	<i>CR-RB:-0.47</i>		
Piccoli et al.	2004	201	<i>DS-CR:0.071</i>	<i>CR-PF:0.073</i>	<i>CM-PF:0.226</i>	<i>DS-PF:0.040</i>
			<i>DS-CM:0.120</i>	<i>CR-ST:0.289</i>	<i>CM-ST:0.226</i>	<i>DS-ST:-0.140</i>
Potter & Balthazard	2002	272	<i>CH-PF:0.243</i>			
Purdy & Nye	2000	73	<i>CR-ST:0.31</i>			
Sargent & Sue-Chan	2001	42	<i>CH-PF:0.47</i>			
Siegel et al.	1986	42(exp1)	<i>CR-PF:0.84</i>	<i>RB-PF:0.11</i>		
Siegel et al.	1986	24(exp2)	<i>CR-PF:0.35</i>	<i>RB-PF:0.25</i>		
Siegel et al.	1986	36(exp3)	<i>CR-PF:0.97</i>	<i>CH-PF:0.01</i>	<i>RB-PF:0.08</i>	
Staples et al.	1999	631	<i>TC-PF:0.265</i>	<i>TC-ST:0.224</i>	<i>TR-TC:0.201</i>	
Straus	1997	216	<i>CM-PF:0.47</i>	<i>CM-PF:0.58</i>	<i>CM-PF:0.64</i>	
Sussman & Sproull	1999	117	<i>CM-ST:0.389</i>			
Swan	2001	1406	<i>CR-ST:0.440</i>	<i>DS-ST:0.333</i>	<i>CM-ST:0.761</i>	
Tillquist	1996	73	<i>CR-RB:0.213</i>			

Author	Year	Sample	Correlation (r)			
Warkentin et al.	1997	72	<i>CM-PF:0.01</i>	<i>TC-PF:0.4587</i>	<i>TC-CH:0.6023</i>	
Yoo & Alavi	2001	135	<i>CH-RB:0.75</i>	<i>CH-CR:0.32</i>	<i>CR-PF:0.7</i>	<i>RB-PF:0.07</i>
Yoo & Kanawattanachai	2001	146	<i>RB-PF:0.36</i>	<i>RB-PF:0.45</i>		
Zolin	2004	216	<i>CU-TR:0.01</i>			

DS: Design; CU: Culture; TC: Technical; TA: Training; RB: Relationship building; CH: Cohesion; TR: Trust; CM: Communication; CM: Coordination; TT: Task-Technology structure fit; ST: Satisfaction; PF: Performance

Appendix 2.4 Frequency Distribution of Variables' relationships

Item	DS-CR	CR-PF	CR-ST	CM-PF	CM-ST	DS-PF	DS-ST	CR-RB	CH-PF	CH-ST
Frequency	3	18	11	10	5	7	5	4	10	6
Item	RB-PF	TC-PF	CM-CR	TC-ST	RB-ST	TR-PF	CR-CH	CM-CH	CR-TT	CU-PF
Frequency	11	7	2	5	4	5	1	1	1	1
Item	CU-TR	DS-TT	DS-RB	DS-TR	DS-TC	DS-CM	RB-TT	TR-ST	TT-PF	TT-SF
Frequency	1	1	1	1	1	1	1	1	1	1
Item	TC-CR	TR-TC								
Frequency	1	1								

Appendix 2.5 Meta-analysis of correlation of variables

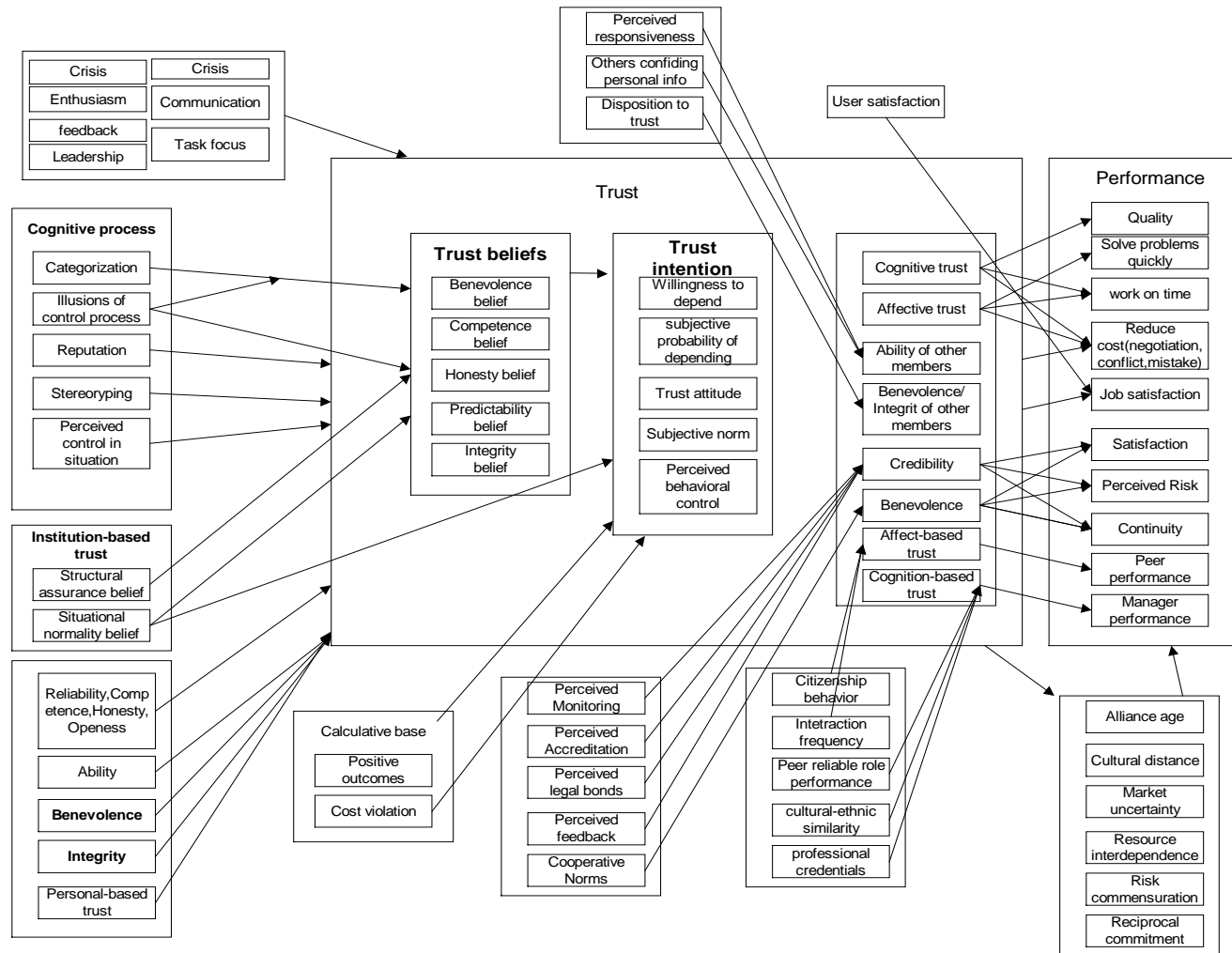
	Fixed / Random	N	Effect	95% confidence interval		Ntotal	P-Value	Point estimate	Q-Value	Df(Q)	P-Value(Q)
				Low	High						
DS-CR	Transform Fixed	3	0.002	-0.058	0.061	1094	0.959	0.001	2.02828	2	0.36272
	Transform Random	3	0.002	-0.059	0.061	1094	0.959	0.001			
CR-PF	Transform Fixed	18	0.314	0.287	0.341	4259	0.000	0.314	453.90584	17	0.000
	Transform Random	18	0.531	0.397	0.644	4259	0.000	0.531**			

	Fixed / Random	N	Effect	95% confidence interval		Ntotal	P-Value	Point estimate	Q-Value	Df(Q)	P-Value(Q)
				Low	High						
CR-ST	Transform Fixed	11	0.400	0.368	0.430	2808	0.000	0.400	69.45272	10	0.000
	Transform Random	11	0.388	0.283	0.485	2808	0.000	0.388**			
CM-PF	Transform Fixed	10	0.293	0.262	0.324	3342	0.000	0.293	260.59305	9	0.000
	Transform Random	10	0.323	0.129	0.493	3342	0.000	0.323**			
CM-ST	Transform Fixed	5	0.673	0.647	0.697	1893	0.000	0.672	190.32367	4	0.000
	Transform Random	5	0.411	-0.029	0.718	1893	0.066	0.411			
DS-PF	Transform Fixed	7	0.201	0.164	0.237	2723	0.000	0.200	184.93989	6	0.000
	Transform Random	7	0.073	-0.162	0.299	2327	0.546	0.073			
DS-ST	Transform Fixed	5	0.222	0.181	0.262	2112	0.000	0.222	74.83522	4	0.000
	Transform Random	5	0.104	-0.148	0.342	2112	0.770	0.103			
CR-RB	Transform Fixed	4	0.097	0.037	0.156	1068	0.002	0.097	42.39098	3	0.000
	Transform Random	4	0.018	-0.264	0.298	1068	0.902	0.018			
CH-PF	Transform Fixed	10	0.386	0.342	0.429	1515	0.000	0.386	71.44047	9	0.000
	Transform Random	10	0.358	0.213	0.488	1515	0.000	0.358**			
CH-ST	Transform Fixed	6	0.579	0.541	0.614	1298	0.000	0.579	149.35921	5	0.000
	Transform Random	6	0.571	0.303	0.755	1298	0.000	0.570**			
RB-PF	Transform Fixed	11	0.181	0.145	0.217	2867	0.000	0.181	101.80470	10	0.000
	Transform Random	11	0.208	0.069	0.338	2867	0.003	0.208**			
TC-PF	Transform Fixed	7	0.343	0.307	0.379	2342	0.000	0.343	161.36229	6	0.000
	Transform Random	7	0.232	-0.017	0.453	2342	0.067	0.231			

	Fixed / Random	N	Effect	95% confidence interval		Ntotal	P-Value	Point estimate	Q-Value	Df(Q)	P-Value(Q)
				Low	High						
TC-ST	Transform Fixed	5	0.135	0.079	0.191	1184	0.000	0.135	29.69368	4	0.000
	Transform Random	5	0.092	-0.100	0.277	1184	0.347	0.092			
RB-ST	Transform Fixed	4	0.362	0.284	0.436	513	0.000	0.362**	25.66314	3	0.000
	Transform Random	4	0.437	0.165	0.647	513	0.002	0.437			
TR-PF	Transform Fixed	5	0.165	0.114	0.215	1428	0.000	0.165	52.20279	4	0.000
	Transform Random	5	0.291	0.065	0.488	1428	0.012	0.291**			
CM-CR	Transform Fixed	2	0.062	-0.025	0.148	511	0.161	0.062	22.55149	1	0.000
	Transform Random	2	-0.108	-0.637	0.491	511	0.743	-0.108			

PS: N is the number of correlation statistic value; Ntotal is the total sample size of correlation; P-Value is the P-value of Effect; P-Value(Q) the P-value of Q-Value. ** means that it is significant.

Appendix 2.6 The Diagram of Trust



Appendix 2.7 Definitions and measurements of cohesion

Year	Author	Definition	Measurement	Area
1950	Festinger et al.	The total field of forces which act on members to remain in the group	<ul style="list-style-type: none"> ● The attractiveness of the group ● The ability of the group to help its members achieve their goals 	Housing
1952	Gross & Martin	The resistance of a group to disruptive forces	<ul style="list-style-type: none"> ● Intimate friends ● Dislike ratio ● Isolate ratio 	Students
1983	Stokes	A combination of risk taking, instrumental value of the group and attraction of one group member to other members	<ul style="list-style-type: none"> ● Risk taking ● Attraction to group member ● Instrumental value 	Students
1984	Yukelson et al.	An adhesive property or force that binds group members together	<ul style="list-style-type: none"> ● Quality of team work ● Player's satisfaction ● Commitment to the norms ● Value roles 	Sports
1985	Carron et al.	A dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs	<ul style="list-style-type: none"> ● Task-social ● Individual-group 	Sports
1987	Goodman et al.	The commitment of members to the group task	No mention	Organization
1988	Griffith	No specific definition	<ul style="list-style-type: none"> ● Quality of instrument ● Quality of relationships 	American soldiers

Year	Author	Definition	Measurement	Area
			<ul style="list-style-type: none"> ● Soldier value ● Soldier confidence 	
1990	Bollen & Hoyle	An individual's sense of belonging to a particular group and his or her feelings of morale associated with membership in the group	<ul style="list-style-type: none"> ● A sense of belonging ● Feelings of morale 	Conceptual model (Students)
1991	Olson	The emotional bonding members have with one another and the degree of individual autonomy a person experiences in the family system	<ul style="list-style-type: none"> ● Adaptability ● Cohesion 	Family functioning
1993	Budman et al.	Group connectedness, demonstrated by working together toward a common therapeutic goal, constructive engagement around common themes, and openness to sharing personal material	<ul style="list-style-type: none"> ● Withdrawal and Self-Absorption VS Interest and involvement ● Mistrust vs trust ● Disruption vs Cooperation ● Abusiveness vs. Expressed Caring ● Unfocused vs. Focused 	CRinical
1999	Chin et al.	An individual's sense of belonging to a particular group and his or her feelings of morale associated with membership in the group (Bollen & Hoyle,1990)	<ul style="list-style-type: none"> ● A sense of belonging ● Feelings of morale 	Students and citizen

Appendix 2.8 The measurements of performance and satisfaction

Year	Author	Measurement	Scale
1994	Galegher & Kraut	<u>Performance:</u> <ul style="list-style-type: none"> ● Graders ● Meeting quality ● Perceived project quality 	Developed by this study Developed by this study
		<u>Satisfaction:</u> <ul style="list-style-type: none"> ● Perceived fairness ● Satisfaction with workgroup 	Developed by this study Developed by this study
1996	Straus	<u>Performance:</u> <ul style="list-style-type: none"> ● Group and experts' rankings ● Group process 	Transcripts of the group discussions
		<u>Satisfaction:</u> <ul style="list-style-type: none"> ● Satisfaction with the process ● Satisfaction with the task 	Straus & McGrath (1994) and O'Reilly & Roberts (1976)
1997	Straus	<u>Performance:</u> <ul style="list-style-type: none"> ● Productivity 	Number of nonredundant ideas, questions answered, issues resolved
		<ul style="list-style-type: none"> ● <u>Satisfaction</u> 	Reflect positive and negative reaction

Year	Author	Measurement	Scale
1997	Warkentin et al.	<u>Performance:</u> <ul style="list-style-type: none"> ● Individual ranking ● Information exchange effectiveness 	Hightower & Sayeed (1995,1996)
		<u>Satisfaction:</u> <ul style="list-style-type: none"> ● Satisfaction with group outcomes 	Chidambarum (1996)
2001	Benbunan-Fich et al.	<u>Performance:</u> <ul style="list-style-type: none"> ● Discussion record ● Group report ● Perception of discussion quality 	Gouran et al. (1978)
2001	Shen et al.	<u>Performance</u> <ul style="list-style-type: none"> ● Perception of learning effects 	No mention
		<u>Satisfaction:</u> <ul style="list-style-type: none"> ● Satisfaction with the examination process 	No mention
2002	Dufner et al.	<u>Performance:</u> <ul style="list-style-type: none"> ● Perception of problem solving ability 	Dufner & Kwon (1998)
2002	Ocker	<u>Performance:</u> <ul style="list-style-type: none"> ● Decision quality ● Perceived level of teamwork 	Gouran et al. (1978) Davison (1997)

Year	Author	Measurement	Scale
		<u>Satisfaction:</u> <ul style="list-style-type: none"> ● Solution satisfaction ● Solution confidence ● Process satisfaction 	Green & Taber (1980) A six-item scale Green & Taber (1980)
2002	Valacich & Sarker	<u>Performance</u> <ul style="list-style-type: none"> ● Decision outcomes (individual and group recommendation) ● Perceptual outcomes (participation and satisfaction) ● Task and group conflict 	Green & Taber (1980) Green & Taber (1980) Miranda & Bostrom (1993-1994)
2002	Tidwell & Walther	<u>Performance:</u> <ul style="list-style-type: none"> ● Conversational effectiveness 	Canary & Spitzberg (1987)

Appendix 4.1 The Detail Schedule Group assignment of FTF

Week	Detail items
Week 1-3 (preparation)	
1	Prepare the information sheet and consent form
2	Hard copy questionnaire
3	Get the students' name list and student id
4	Cassette recorders borrow (32)
5	Cassette tape buy (150)
Week 4 (preparation)	
1	Explain the detail to students (15 min)
2	Request students to sign the consent form
Distributed data (1) <u>Information Sheet</u> (2) <u>Consent form</u> (3) <u>Peer evaluation</u>	
Week 5 (preparation)	
1	Request the consent form (10 min)
2	Release the case (2 nd hour)
3	Group students (name list not sure, rooms are not enough)
4	Borrow discussion rooms and cassette recorders for students (Ch,Jo)
5	Prepare group assignment sample answer for lecturers
Distributed data (1) <u>Information Sheet</u> (2) <u>Consent form</u> (1) <u>Peer evaluation</u> (2) <u>Group assignment and instruction</u> (3) <u>Group assignment sample answer (not for students but for lecturers)</u>	
Week 6~8 (group assignment period)	
1	Release the student group (1 st hr, week 6)
2	Students record their conversation (2 nd hr, week6-8)
3	Students hand in assignment
4	Collect peer evaluation form (before 2/10)

Distributed data:	
(1) Group member sheets(include <u>Monday</u> , <u>Tuesday</u> and <u>Thursday</u>). Students who signed consent forms get together into one group, group size is 4 basically.	
(2) Tape recorder with a tape inside	
(3) Students' name contact email or phone (for students inquiry)	
(4) During the project period, it is necessary to prepare group assignment, consent form, students' contact email and phone for inquiry.	
Week 9 (semester break)	
1	Students hand in the assignments and consent form through email and some students hand in consent form through lecturers.
2	Arrange tapes (total is about 56 groups), after filtering complete tapes (clear and with 3 meeting tapes), just 15 groups left (total 45 tapes)
Week 10~11	
1	Distributed questionnaire
2	Had Dennis help distribute questionnaire in the lab (got 20 questionnaires back). Total students about 250 at the beginning (after week 3). At the end, just 200 students left, got 117 questionnaires back.
3	Interview 15 students
Distributed data	
(1) <u>Questionnaire</u>	
(1) <u>Interview information sheet</u>	
(2) <u>Interview consent form</u>	
(3) <u>Interview script</u>	
Week 10~13 (Marking assignment)	
1	Mark the assignments (week 10~13)
2	Return the assignments (week 13)
Distributed data	
<u>Marking sheet (sample)</u> (attached on assignments)	
<u>All marking</u>	
<u>General comments and suggestions</u>	

Appendix 4.2 Information Sheet for FTF

Comparing The Performance and Satisfaction of Face-to-Face and Virtual Teams in a Learning Environment

Research Participant Information Sheet

Thank you for your participation in this research. This research is being undertaken by Ying-Chieh Liu, a PhD student in the School of Management Information Systems at Edith Cowan University in Western Australia and forms part of the requirements of Liu's PhD degree. This study has been approved by the Edith Cowan University Human Research Ethics Committee. Participation in this research will not adversely affect your study in MIS1100. Thus, if you choose not to participate in this research at any time, you will not be penalized in any way. Even during the course of this project, you are free to withdraw without any reason and penalty.

Purpose of Research

The Purposes of this research are stated below:

- (1) To identify the different performance and satisfaction of face-to-face and virtual teams.
- (2) To find out the factors that influence the performance and satisfaction, and the relationships between the factors.
- (3) To find ways that can improve the performance and satisfaction of virtual teams.

Why are you chosen to participate in this research?

MIS1100 contains on-campus learning and on-line learning units. On-campus learning is a traditional way of teaching and learning. Students gather in classrooms and lecturers teach by material. On-line learning uses computer and network technology to engage in the activities of teaching and learning. On-campus learning students can be the face-to-face teams of this research while on-line learning students can be the virtual teams of this research. Thus, if you are enrolled as on-campus students, you will be the members of the face-to-face team of this research. If you are enrolled as on-line learning students, you will be the members of the virtual team of this research.

What will taking part in the research involve?

If you decide to take part in this research, you will be asked to do two extra tasks with your group members:

- (1) Record your conversation when you are discussing the group assignments during week 6 to 8:
The tape recorder will be ready for you and distributed before your discussion in the break time of the lecture (second hour) during week 6 to 8. All the recorders will be equipped with one tape. What you need to do is to find a good place and make yourself comfortable and press the record button to record your conversation (map will be provided). After discussion, please return the

recorder and tape to the classroom. The researcher will be there to collect all things.

(2) Fill in a questionnaire:

A questionnaire will be distributed along with the recorder in week 8. The questionnaire will take you 20 minutes to finish. It asks you about your feelings about the process and outcomes of group assignments.

Effects on you of the research

- (1) All data (tapes and questionnaires) is just for this research and **will not** become assessment criteria of MIS1100.
- (2) The participation will not affect your mark of MIS1100. **That means, even if you do not want to participate in this research, it will not affect your mark in MIS1100.**

Confidentiality

All data (tapes and questionnaires) supplied by you will be treated confidentially and only accessed by the researcher. In addition, the data will only be used in this research or future publications such as conference and journal, but **will not** be used to evaluate your mark in MIS1100. The data you provide in the consent form will just be used for urgent contact. In the transcribing of tapes, your name or other private information will be replaced by codes. The tapes and questionnaires will be locked in the filing cabinet in the Web centre at ECU, Joondalup for 5 years. Only authorized people can access it. After 5 years, they will be destroyed in accordance with the State Records Retention and Disposal Policy.

What should I do now?

Please fill in the participant consent form and return to the researcher. If you are under 18 years of age, you will also need to obtain consent from your parents/guardian.

What is next?

The case will be released in week 5. In week 6, you will be put in a group with 4 people whether you participate in this research or not and start to engage in the group assignment (from week 6~8). Your group has to submit a report by 25/9 24:00 through email: a.liu@ecu.edu.au. If your group is participating, you will receive a cassette recorder and please record your conversation while you are discussing. After finishing discussion, please return to the classroom. And in week 8, questionnaires will be distributed with the cassette recorder, please fill in and return with the recorder. In addition, for the fairness of marking, everyone will receive a peer evaluation form to clarify the contribution of each group members. Please submit it before 2/10 by email or hard copy. If your group is not participating, you will not receive anything except the peer evaluation form.

Need Further Information?

Should you desire further details about the study, either before, during or after the study, you may contact

Ying-Chieh Liu at the School of Management Information System, Edith Cowan University in Perth Western Australia. Ying-Chieh can be contacted:

Email: a.liu@ecu.edu.au

Phone: [REDACTED]

Principal Supervisor: Janice Burn, Adjunct Professor of School of MIS, FBL

Email: j.burn@ecu.edu.au

Associated Supervisor: Sue Stoney, School of MIS, FBL

Email: s.stoney@ecu.edu.au

Phone: (08) 6304 5260

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Craig Standing

Head of School of Management Information Systems Edith Cowan University

100 Joondalup Drive

JOONDALUP WA 6027

Phone: (08) 6304 5545 Email: c.standing@ecu.edu.au

Thanks again for your interest.

Appendix 4.3 Consent Form for FTF

PARTICIPANTS' FORM OF CONSENT

Project: Comparing The Performance and Satisfaction of Face-to-Face and Virtual Teams in a Learning Environment

I (the participant) have read the information in the statement of disclosure and any questions I have asked have been answered to my satisfaction.

My intention toward this research is:

(If you do not want to participate in this research, you do not need to fill in the form)

☐ **I agree** to participate in this research and authorize the researcher to use the data obtained in this research and I agree that the data may be published in understanding that I will not be identified individually. My E-mail and phone, if provided, are for follow-up enquiries in relation to this study or any further study of relevant issues.

Name:

Signature:Date: / /

E-mail address:

Phone:

*PS: If you are under 18, please have your guardian or parents sign the form below and return it back.

Guardian/Parents agreement

Ihave fully understood the project and

☐ **I agree**(name) to participate in this project

Signature.....Date: / /

Instruction of the group assignment

The group assignment is shown in the next page. The purposes of this group assignment are:

- (1) To test if students understand the business role of information systems.
- (2) To demonstrate if students understand SDLC (Systems Development Life Cycle) and how to apply it in analysing demand, design and implement automated solution.

It needs communication and brainstorming for students to accomplish the group assignment. In addition, using Word/Excel and writing clear and concise English in a style appropriate for formal business reports are essential.

It is suggested that you start to read the chapter 1, 2, 3, 6 and 7 of the textbook, and start to collect information (journal, books, newspaper or website) and think about how to solve the problems of the group assignment. From the next week (week 6), you will be grouped and start to discuss with your group members in the second hour of lecture until week 8 (three times in total). It is necessary for you to prepare in advance before your discussion. You should discuss with your group members about your ideas or data you collected and write the conclusion down. In the end of each discussion, you should allocate the tasks to each member for the next discussion. Your group should hand in a report **before 29 September 24:00** by email: a.liu@ecu.edu.au. Late submission incurs 1% mark deduction for each day.

In addition, you should fill in the peer/self evaluation form and submit it by email: a.liu@ecu.edu.au, or hard copy (in the information sheet) to your lecturer **before 2 October**. The peer/self evaluation form is available in Blackboard as well.

If you have questions or queries, you are welcome to contact Allan Liu: a.liu@ecu.edu.au

Good Luck!

The Group assignment

Al's Barbeque Restaurant, located in Denver, Colorado, has successfully been in business for over 20 years. Al specializes in barbeque chicken and beef and includes scrumptious side dishes of potato salad, coleslaw and baked beans. Customers come from all around for a good old-fashioned barbeque dinner. On a Friday night you can expect the line to be out the door and then wait close to an hour. It is estimated that Al's serves more than 500 barbeque dinners every day.

There are a total 12 waitstaff workers, five of whom have been working at the restaurant since it opened. Al cooks and prepares all of the special barbeque sauce himself along with three other cooks. The restaurant runs today the same as it did 20 years ago. Al can call many of his customers by name. This is definitely part of the charm of the restaurant, but it is also one of the biggest problems with the restaurant. Everything in the restaurant is performed manually from taking orders to ordering inventory.

Al's daughter, Alana, has just graduated from college and has come home to help run the family-owned business. Alana is amazed at how long it takes to perform all of the manual processes required to run the business. Every night she must manually count all of the money in the cash register and compare it to the paper sales tickets that the waitstaff fills out representing the customer orders.

Alana also manually counts the inventory from cans of beans to slices of cheese. Deciding what to order each day is a complete mystery to Alana. Some days the restaurant sells tons of chicken dinners and other days the restaurant sells tons of beef dinners. There doesn't seem to be any pattern to which one is going to sell the best. She continually finds herself ordering too much of one item and not enough of the other. Each week she has to calculate the employee paychecks by reviewing each employee's cardboard handwritten time card. At the end of each month she calculates the sales tax reports. This is an incredibly difficult activity since the reports must match all of the monthly paper tickets, which total close to \$45,000.

Alana quickly comes to the conclusion that the restaurant must be automated. Building an information system to support all of these manual processes will not only help the restaurant operate more efficiently but will also give Alana more time to spend talking and dealing with her customers. Al has not used computer and knows nothing about the information system. Although Alana learned some knowledge from

school but still inadequate. In addition, Al is going to extend a branch restaurant in another town located 30 miles away next year. (Amended from Haag et al., 2005)

Task

Assume your group is running a small software company. Al and Alana asked you to design and implement an information system for them. Please write a report to show how you are going to design and implement the system according to the SDLC (Chapter 6). The report must include the following details (not more than 2000 words):

- (1) Explain the roles of each group member in the company and in the project (e.g., programmer, sales, project manager....) (2%).
- (2) Detail activities of every stage (1%).
- (3) Detail the expected difficulties of every stage and how you are going to deal with them (2%).
- (4) How system and network infrastructure will be allocated for the future branch (2%).
- (5) Itemise a proposed budget (2%).
- (6) Format and references (1%).

In addition, a cover page with group number and the details of all group members (student id, full name) and the table of content are required in the report (excluded in the 2000 words.)

Appendix 4.5 Evaluation Form

Peer/Self Evaluation Form

The purpose of this form is to assess a group member's contribution to the group effort. There are various dimensions along which group members may have contributed to the group. These include their *attendance at group meetings, their level of preparedness for group meetings, the quality of their contributions to group discussions, whether they delivered what they promised to the group in a timely manner, and their ability to work towards consensus*. Use the **0~3** rating scale given below to rate yourself and members of your group. Please be as objective as possible, taking behaviours rather than personal style into consideration.

0 = person did not contribute to group activities

1 = person contributed to group activities, but his/her contributions were poor

2 = person contributed to group activities, and the contributions were limited

3 = person contributed to group activities, and the contributions were satisfactory

The scores given by all the members of the group will be averaged to compute an average peer evaluation score for each student. The following scale will be considered when determining the credit each student will get for the group project.

Average peer evaluation score:	0	0% of group grade
	>0 - 1	30% of group grade
	>1 - 2	70% of group grade
	>2 - 3	100% of group grade

There are two parts of this form. The first part is your peer evaluation of other group members, please fill in student id, name and the score you think his/her contribution. The second part is self evaluation. Please fill in your student id, name and the score you think your deserve. The form can be available in Blackboard. Please submit this form **before 2/10 by email or hard copy** confidentially. If you choose email, please send to a.liu@ecu.edu.au. If you choose hard copy, please send to your lecturers.

Lecture Time:		Group number:	
Student id (other members)	Names (other members)	Score (peer evaluation)	
Your student id	Your Name	Score (Self valuation)	

Appendix 4.6 Questionnaire

This questionnaire asks how you felt about the process and outcome of your group assignment. Please circle or tick the number that most closely reflects your feelings. Thank you very much for your participation in the exercise.

Your group number is _____ Your gender is: ☐male ☐female

[Communication]

No	Item	Strongly Disagree Strongly Agree						
1	I am as interested in building a good relationship as in completing the group assignment	1	2	3	4	5	6	7
2	I wanted to stick to the main purpose of the discussion	1	2	3	4	5	6	7
3	I am very work-oriented in this group assignment	1	2	3	4	5	6	7
4	I am more interested in having a social conversation than completing the group assignment	1	2	3	4	5	6	7
5	I think our group members had effective communication	1	2	3	4	5	6	7

[Relationship building]

No	Item	Strongly Disagree Strongly Agree						
1	During the group's meeting, I was dedicated to group-building exercises such as meeting other group members, creating effective group communication, and/or discussing conflict solutions	1	2	3	4	5	6	7
2	I relied upon other group members to complete the group assignment	1	2	3	4	5	6	7
3	My group members relied on each other and consulted each other when they needed support	1	2	3	4	5	6	7
4	My group members experienced a sense of shared goals and objectives	1	2	3	4	5	6	7
5	Knowledge and information sharing was understood to be a group norm within my group	1	2	3	4	5	6	7
6	My group was a very cohesive unit	1	2	3	4	5	6	7
7	When disagreements occurred, we usually addressed them promptly in order to solve them	1	2	3	4	5	6	7

[Cohesion]

No	Item	Strongly Disagree Strongly Agree						
		1	2	3	4	5	6	7
1	My group members went their own way rather than get together as a group during the period of the group assignment	1	2	3	4	5	6	7
2	I feel my group members rarely worked together	1	2	3	4	5	6	7
3	My group members spent time together outside the group assignment work	1	2	3	4	5	6	7

[Collaboration]

When my group experienced some conflict....

No	Item	Almost never Almost always						
		1	2	3	4	5	6	7
1	I collaborated with my group members to come up with satisfactory decisions	1	2	3	4	5	6	7
2	I tried to bring all our concerns out in the open so that the issues could be resolved in the best possible way	1	2	3	4	5	6	7
3	I tried to work with my group members to find solutions that satisfied our expectations	1	2	3	4	5	6	7
4	I exchanged useful information with my group members to solve the problem together	1	2	3	4	5	6	7
5	I tried to investigate an issue with my group members to find a solution acceptable to us	1	2	3	4	5	6	7

[Performance]

No	Item	Strongly Disagree Strongly Agree						
		1	2	3	4	5	6	7
1	I think my group worked efficiently	1	2	3	4	5	6	7
2	I think my group met our objectives	1	2	3	4	5	6	7
3	I think my group generally worked on schedule	1	2	3	4	5	6	7

[Perceptions of Process]

No	Item	Not at all Very great extent						
		1	2	3	4	5	6	7
1	Were your group members well committed to the goals and objectives?	1	2	3	4	5	6	7
2	Did your group members have a strong sense of belonging to your group?	1	2	3	4	5	6	7
3	Did your group members recognize and respect individual	1	2	3	4	5	6	7

	differences and contributions?							
4	Were your group members open-minded and frank in expressing their ideas and feelings?	1	2	3	4	5	6	7

[Perceptions of Outcomes]

No	Item	Strongly Disagree Strongly Agree						
1	Overall, I was personally satisfied with the outcomes of my group	1	2	3	4	5	6	7
2	My group produced effective and valuable results during this group assignment	1	2	3	4	5	6	7
3	I agree with the final decision of my group	1	2	3	4	5	6	7
4	I think the quality of my group outcome was good	1	2	3	4	5	6	7

[Solution Satisfaction]

No	Item	Not at all Very great extent						
1	To what extent are you satisfied with the quality of your group's solution?	1	2	3	4	5	6	7
2	To what extent does the final solution reflect your inputs?	1	2	3	4	5	6	7
3	To what extent do you feel committed to the group solution?	1	2	3	4	5	6	7
4	To what extent are you confident that the group solution is correct?	1	2	3	4	5	6	7
5	To what extent do you feel personally responsible for the correctness of the group solution?	1	2	3	4	5	6	7

Open questions:

1. Based on your experiences of this group assignment, what factors do you think affected your group's performance?
2. Based on your experiences of this group assignment, what factors do you think made (or would have made) you satisfied with working with your group members?

This is the end of the questionnaire. Thanks for your time and cooperation!

4.7 Information sheet for interview

Comparing The Performance and Satisfaction of Face-to-Face and Virtual Teams in a Learning Environment

Interview Information Sheet

Dear MIS1100 students:

Thank you for your participation in this interview. This research is being undertaken by Ying-Chieh Liu, a PhD student in the School of Management Information Systems at Edith Cowan University in Western Australia and forms part of the requirements of Liu's PhD degree. This study has been approved by the Edith Cowan University Human Research Ethics Committee. Participation in this research will not adversely affect your mark in MIS1100. Thus, if you choose not to participate in this interview at any time, you will not be penalized in any way. Even during the course of this interview, you are free to withdraw without any reason and penalty.

The reason for this sheet is to invite you to participate in this interview. This interview is intended to take approximately 15 minutes. It asks questions in relation to the feeling of process and outcome of MIS1100 group assignment. **The interviews will be audio taped, however you may choose not to answer some of the questions and are free to withdraw your participation at any time if you wish. The time and place of the interview is subject to the your choice.**

Any information given to the researcher by the participant in the interview will be kept strictly confidential and will only be used for the purpose of the project. Names or ranks of the participant(s) are kept secret and each participant is given a serial code to be used in the transcripts. Upon transcribing the interview, the audiotapes will be erased.

If you have any questions about this interview, you may contact Ying-Chieh Liu at the School of Management Information System, Edith Cowan University in Perth Western Australia. Ying-Chieh can be contacted:

Email: a.liu@ecu.edu.au

Phone: [REDACTED]

Principal Supervisor: Janice Burn, Adjunct Professor of School of MIS, FBL

Email: j.burn@ecu.edu.au

Associated Supervisor: Sue Stoney, School of MIS, FBL

Email: s.stoney@ecu.edu.au

Phone: (08) 6304 5260

If you have any concerns or complaints about the interview and wish to talk to an independent person, you may contact:

Craig Standing

Head of School of Management Information Systems Edith Cowan University

100 Joondalup Drive

JOONDALUP WA 6027

Phone: (08) 6304 5545

Email: c.standing@ecu.edu.au

You can keep this information sheet. If you agree to participate in this interview, please sign the consent form.

Thanks again for your interest!

Interview Questions

You are assured that the information obtained from this study will be kept strictly CONFIDENTIAL and will be only used for research purposes. Data will not be made available to any third party or used in any published material, except as a component in aggregated statistics.

General Information

- Please tell me your name.
- Who is your lecturer? What time is your lecture?
- How old are you?
- What is your gender?

1.Process

- Can you tell me what you feel about the process of group assignment?
 - If good, how good it is?
 - If not good, how not good it is?
 - Can you briefly describe how your group conducted the group assignment week by week?
 - Was there any leader in your group? How did she/he become your leader?
 - Do you think the leader is very important in your group? Why?
- Did your team members have conflict in the process?
 - If yes, what kind of conflict do you have?
 - If no, why?
 - How did you manage the conflict?
- Do you think building relationships is important for your team members to finish the task?
 - If yes, why?

- If no, why?
- How did your team members build relationships?
- How can you communicate with each other?
- Do you think face-to-face communication is important for the group assignment?

2. Outcomes:

- Are you satisfied with your team outcomes?
 - If no, why not?
 - If yes, how?
 - If you mark your group report from 1 to 10, how many marks will you give?
Why?
 - Are you happy to work with your group member?
 - If no, why not?
 - If yes, why?
- What factors affect your group performance do you think?
 - Do you think relationships affect your outcomes?
 - Do you think even you have a bad relationship with your group members, you still can finish the group assignment? And get high mark?

Do you have any suggestion for the group assignment? And for the MIS1100?

This is the end of interview. Thanks for your time!

Appendix 4.9 Problems and Issues for the Project (FTF and Pilot VT) in The First Semester

Item	Problems	Cope
General		
1	If students are absent during the period of the project, how to manage it? Students will complain and how to mark?	Ask students to sign the Self/Peer evaluation form. → it seems that students are happy with it.
2	Should I provide a sample of assignment?	No, but give it to lecturers for answering students' questions
3	Off campus delay to week 9, week 9 is mid semester break, is there any problem?	Both have almost the same long duration, no problem.
4	Sue's way to encourage the use of discussion board , even gives candy for reward.	Good, last to next semester
5	Sue's recap last week (with good map)	Good, last to next semester
Preparation Week 1-3		
1	Students' name list maybe not correct (VT and FTF)	There is no better way to solve it. Even after the week 3, students still drop the course.
2	Need the peer evaluation?	Need to make peer evaluation sheet for marking and prevented students not to contribute.
3	Need to write a short introduction sheet for on-line course	Need to make a initial information sheet → Next semester, should communicate with lecturers to write into course outline
4	On-campus mark (10%) is different from off-campus (20%/3)	Roger said that I can use 10% to mark.
5	Churchlands is hard to find a place to discuss	Using the staff identification to borrow Chur discussion rooms for 10 and Joo discussion rooms for 21 for group assignment. → Staff identification is very important

Item	Problems	Cope
6	Thursday's class is too late for students to discuss (8:30~ 9:30 pm) may affect students' willing to discuss?	There are seldom students attend Thursday's class, but the reason seems not be the late discussion. It may due to they all have job in the daytime. And it may due to their personality (you just give me the assignment, I just finish it because I have job to do)
Week4		
1	Provide an instruction for using the recorder (on-campus)	No need. But must remind them (1)remember to reverse the tape when one side ends (2)put the recorder in the middle of members (3)return the cassette recorders to lecturer room
2	Make Joo and Churlands map for FTF teams	No need. Room number is in the group list, students can find it.
Week 5		
1	Students are not enthusiastic to sign the consent form	With Sue's help, it is better. I got about 79 consent form in total.
2	For on-line learning (VT): I can't send email through Blackboard, then, I can't send information sheet to external MIS1100 students (serious problems)	Solved (became instructor of MIS1100 E)
3	The students name list can't make sure now (CH is easier, JO is very difficult). It causes hard to group students. The list from Callista SMS seemed not to be correct 100%	There is no solution for solving the problem.
Week 6		
1	The discussion room is not enough for Monday (total are 32 groups, but borrowed 21 discussion rooms)	Put two, even three groups in one room
2	The cassette recorders are not	Just can give up some groups

Item	Problems	Cope
	enough for Monday students (total are 32 groups, but borrowed 28 cassette recorders)	
3	Some groups just have 1 student showed up	This is exactly a big problem. There are two ways: (1) suggest them to join other group (2) provide email or phone for them to contact. But the first solution is not too good because when other members show up in the next week, they may lose the members and the group may dismiss. This made the situation more complicated. The best solution may provide the email and contact phone number for them to contact.
4	Many students haven't read the group assignment, so they just read and had less discussion	It may distribute two weeks earlier than the group assignment starts.
5	Moving 30 cassette recorders is very tiring	Borrow trolley
Week 7		
1	Other students occupy some discussion rooms.	Put a post on the discussion room. It says that the room is booked for group assignment from XX~XX.
2	Some groups still have 1 student only. They return cassette recorders and complain about their group members and ask how they can do	It is a difficult problem. Just provide the group members' contact email or phone. Or even introduce them to other groups.
3	Some students don't like their group and want to change their group or even want to write assignment by their own	Introduce them to other groups or permit that they can write by their own.
4	3 cassette recorders were broken	Can't help, just keep them and tell the librarian
Week 8		
1	There are still some groups haven't found their group	Provide the contact email or phone. If they want to write by their own, they

Item	Problems	Cope
	members or they never met their members	can do it.
2	Some groups complain some members never show up	Advise them to fill in the evaluation form. It works very well.
Week 9		
1	Students continue to send assignments and consent form, it takes time to reply the mail (over hundreds)	Cant' help, just do it.
2	To arrange tapes are very time-consuming	It is difficult to analyse the tape content (1 min based or 30s based)
Week 10-11		
1	VT return rate is too low (4 students until 4/9), email reminder again. At the end, just 8 questionnaires back.	It is a big problem. It may conduct the group assignment into virtual team next semester to solve the problem that the sample size is too small.
2	Marking about 70 assignments took about one month. Students still have a lot of problems, such delay, complain other group members, query the mark etc. It takes a lot of time to reply	Can't help, just do it. Must be patient.

Appendix 4.10

On-campus (Sue)		
Action Item List		Status
Week 1-4 (preparation)		
1	Prepare the information sheet, consent form and evaluation form	
2	Build on-line questionnaire system	
3	Get the students' name list and student id	
4	Set a group assignment discussion board to answer students' questions	
5	Ask for the consent form (Tue:66/97, Thur: 26/29, Fri: 86/127)	
6	Prepare group assignment sample answer for lecturers	
	Distributed data: (1) <u>Information Sheet</u> (Week 1~4) (Hard copy, BB) (2) <u>Consent form</u> (Hard copy, BB) (3) <u>Evaluation form</u> (Hard copy, BB)	
Week 5 (preparation)		
1	Release the group assignment (2 nd hour of lecture) and put on BB	
2	Ask for the consent form (Tuesday 65/89, Thur 25/25, 87/121, total 177/235)	
	Distributed data (4) <u>Information Sheet</u> (5) <u>Consent form</u> (6) <u>Evaluation form</u> (7) Group assignment and instruction (Hard copy and BB) (8) Frequently asked questions (BB)	
Week 6 ~ 28 April 24:00 (Project period: week 6,7,mid-break, 8), 4 weeks in total		
1	Release the group list (2 April, Sunday, 22:00)- Set BB discussion board and put group list on BB	
2	Print out the group list and distribute in the lecture	
3	Students start to discuss in BB	
	Until 11 April, 50/235 students haven't posted (21%), with external students, total is 71 students (26%)	
4	Call students to start to do the group assignment	
	Distributed data (1) Group List	
28 April (Fri) 24:00		
1	Hand in the assignment (put on BB)	

2	Hand in the evaluation form (put on BB)	
28 April ~ week 12		
1	Mark assignments	
2	Students fill in the questionnaire (on-line and hard copy)	
3	Conduct interview	
4	Collect the discussion board data	
Week 12		
1	Return the assignments	

Comparing The Performance and Satisfaction of Face-to-Face and Virtual Teams in a Learning Environment

Research Participant Information Sheet

Thank you for your participation in this research. This research is being undertaken by Ying-Chieh Liu, a PhD student in the School of Management Information Systems at Edith Cowan University in Western Australia and forms part of the requirements of Liu's PhD degree. This study has been approved by the Edith Cowan University Human Research Ethics Committee. Participation in this research will not adversely affect your study in MIS1100. Thus, if you choose not to participate in this research at any time, you will not be penalized in any way. Even during the course of this project, you are free to withdraw without any reason and penalty.

Purpose of Research:

The Purposes of this research are as below:

- (4) To identify the different performance and satisfaction of face-to-face and virtual teams.
- (5) To find out the factors that influence the performance and satisfaction, and the relationships between the factors.
- (6) To find ways that can improve the performance and satisfaction of virtual teams.

Benefits of this research to the community

According to the ECU policy, it is necessary for you to learn the six generic attributes of political, social, ethical and cultural issues, communication, problem solving, teamwork and the use of technology from the course (http://www.ecu.edu.au/GPPS/policies_db/tmp/ac053.pdf). This research can help you develop the ability to communicate and work in teams with others and use knowledge and computer skills to solve problems. Furthermore, by your participation, this research can provide an understanding of the factors that affect the performance and satisfaction of students. It can help lecturers improve the curriculum design.

What will taking part in the research involve?

If you decide to take part in this research, you will be asked to:

- (1) Authorize the researcher to use your conversation data in Blackboard discussion board:

To finish the group assignment, you need to discuss and exchange information in the Blackboard discussion board during week 6 to 8 (28 April). This research will

analyse the content of discussion. Thus, you need to sign the consent to authorize this research to use your conversation in the Blackboard discussion board.

(2) Fill in a questionnaire:

A questionnaire link will be emailed to you after handing in assignments. What you need to do is to click on the link and fill in the on-line questionnaire. It asks you about your feelings about the process and outcomes of group assignments.

The relationship between MIS1100 group assignment and this research

The data for this research comes from the processes of MIS1100 group assignment. It is compulsory for you to get a mark (15%) by engaging in the group assignment in MIS1100 and handing in the assignments. That means whether you take participate in this research, you have to hand in the assignment to pass the unit. If you do not agree to participate in this research, the researcher will not use your data in the future publication.

Effects on you of the research

- (3) The participation will not affect your mark of MIS1100. **That means, even if you do not want to participate in this research, it will not affect your mark in MIS1100.**
- (4) The questionnaire is just for this research and will not become assessment criteria of MIS1100.

Confidentiality

All data supplied by you will be treated confidentially and only accessed by the researcher. In addition, the data will only be used in this research or future publications such as conference and journal, but **will not** be used to evaluate your mark in MIS1100 (except the contribution of discussion board 3%). The data you provide in the consent form will just be used for urgent contact. With respect to the conversation contents in the discussion board, your name or other private information will be replaced by codes while analyzing. Except the MIS1100 unit related people (such as instructors and group members), only the researcher can access the discussion board data. After the project has been completed, the data will be maintained by the Blackboard system administrators. No one can access the data except the authorized people. In addition, only the researcher can access the questionnaire data. After 5 years, all data will be destroyed in accordance with the

What should I do now?

Please fill in the participant consent form (appendix 2) and hand in to the researcher. If you are under 18 years of age, you will also need to obtain consent from your parents/guardian (in the bottom part of consent form).

What is next?

The detailed timetable of the group assignment is as below:

No	Item	Date	Comments
1	Release the information sheet and collect consent form	Week1~4	
2	Release group assignment	Week5	Also available in Blackboard
3	Engage in the group assignment	Week 6~ 28 April	The discussion board will be set up at 2 April
4	Students hand in the assignments	28 April 24:00	Post on Blackboard
5	Students hand in the evaluation form	28 April 24:00	Post on Blackboard
7	Fill in the questionnaire	28 April ~ week 12	Email the questionnaires link
8	Return the assignments	Week 12	Post on the Blackboard

During week 1~4, you will get this information sheet and be asked to sign the consent form in the lecture. In the week 5, the group assignment will be released in the lecture and posted on Blackboard. You can start to think about how to answer the questions. In the week 6, you will be formed into a group with 4 people, and a new group discussion board will be set up for you on 2 April. After that, you can discuss with your group members in the discussion board until 28 April. Your group should post the assignment on the Blackboard discussion board before 28 April 24:00. Late submission incurs 1% mark deduction for each day. In addition, your group has to discuss to reach the consensus to fill in an evaluation form to demonstrate individual contribution and post on the Blackboard discussion board before 28 April 24:00. The Individual mark will be calculated by the evaluation form (Please find the detail in the evaluation form).

Then, you will receive an email with a link toward the questionnaire that asks about

your feelings on the process and outcome. Please click on the link and fill in the questionnaire. The reports will be returned in week 12 by posting on Blackboard. There is a discussion board on Blackboard for any questions about the group assignment. You are welcome to post your questions and the researcher will answer your questions.

About the Evaluation Form

It is important that everyone contributes equally in one group. People who contribute more should get higher marks. The evaluation form (appendix 1) reflects the contribution of each member. Each group should discuss on Blackboard, reach the consensus, fill in the evaluation form (one for each group) and post it on Blackboard by 28 April 24:00. Each group just needs one evaluation form. Individual mark will be calculated by the credit on the evaluation form.

Need Further Information?

Should you desire further details about the study, either before, during or after the study you may contact Ying-Chieh Liu at the School of Management Information System, Edith Cowan University in Perth Western Australia. Ying-Chieh can be contacted:

Email: a.liu@ecu.edu.au

Phone: [REDACTED]

Principal Supervisor: Janice Burn, Adjunct Professor of School of MIS, FBL

Email: j.burn@ecu.edu.au

Associated Supervisor: Sue Stoney, School of MIS, FBL

Email: s.stoney@ecu.edu.au

Phone: (08) 6304 5260

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Craig Standing

Head of School of Management Information Systems

Edith Cowan University

100 Joondalup Drive

JOONDALUP WA 6027

Phone: (08) 6304 5545

Email: c.standing@ecu.edu.au

Thanks again for your interest.

Appendix 4.12

PARTICIPANTS' FORM OF CONSENT

Project: Comparing The Performance and Satisfaction of Face-to-Face and Virtual Teams in a Learning Environment

I (the participant) have read the information in the statement of disclosure and any questions I have asked have been answered to my satisfaction.

My intention toward this research is:

(If you do not want to participate in this research, you do not need to fill in the form)

☐ **I agree** to participate in this research and authorize the researcher to use the data obtained in this research and I agree that the data may be published in understanding that I will not be identified individually. My E-mail and phone, if provided, are for follow-up enquiries in relation to this study or any further study of relevant issues. I agree that the researcher can conduct an interview with me if there is a need.

Name:

Signature:Date: / /

E-mail address:

Phone:

*PS: If you are under 18, please have your guardian or parents sign the form below and return it back.

Guardian/Parents agreement

Ihave fully understood the project and

☐ **I agree**(name) to participate in this project

Signature.....Date: / /

Instruction to The Group assignment

The purposes of this group assignment are:

- (1) To test if students understand how information systems help business.
- (2) To help students understand e-commerce and how e-commerce can help business.
- (3) To demonstrate that students are able to use Porter Five Forces Model to analyse a business environment and make a decision.
- (4) To examine students' ability of using the evidence (reference) to support their ideas.

It needs communication and brainstorming for students to accomplish the group assignment in Blackboard. In addition, using Word/Excel and writing clear and concise English in a style appropriate for formal business reports are essential.

It is suggested that you read the chapters 2, 5 and 6 of the textbook, collect information (journal, books, newspaper or website) and think about how to solve the problems of the group assignment. From week 6, you will be grouped and start to discuss with your group members in Blackboard. Your group will have an exclusive discussion board for you to discuss the group assignment. Your contribution in Blackboard will be regarded as a part of the group assignment mark (3%). You should discuss with your group members in your group discussion board. Your group should hand in a report **before 28 April 24:00** by **posting on Blackboard discussion board**. Late submission incurs 1% mark deduction for each day.

If you have questions or queries, you are welcome to post on Blackboard "Assignment 1-case study Q&A" or contact Allan Liu: a.liu@ecu.edu.au

Important dates:

No	Item	Date	Comments
1	Release the information sheet and collect consent form	Week1~5	
2	Release group assignment	Week5 (27 march)	Email and put on Blackboard (this document)
3	Engage in the group assignment	Week 6 (3 April)~ Week 8 (28 April)	
4	Hand in the assignment	28 April 24:00	Post on the Blackboard discussion board

5	Fill in the questionnaire	28 April ~ week 12	Email the questionnaires link
6	Return the assignments	Week 12	Post on the Blackboard discussion board

After students hand in assignments, an email with questionnaire link will be sent to each student. Please click the link and fill in the on-line questionnaire. In week 12, a marking sheet will be posted on each group's discussion board.

The Group assignment

Al's Barbeque Restaurant, located in downtown Sydney, Australia, has successfully been in business for over 20 years. Al specializes in barbeque chicken and beef and includes scrumptious side dishes of potato salad, coleslaw and baked beans. Customers come from all around for a good old-fashioned barbeque dinner. During the night you can expect the line to be out the door and then wait close to an hour. It is estimated that Al's serves more than 500 barbeque dinners every day.

There are a total 12 waitstaff workers, five of whom have been working at the restaurant since it opened. Al cooks and prepares all of the special barbeque sauce himself along with three other cooks. The restaurant runs today the same as it did 20 years ago. Al can call many of his customers by name. This is definitely part of the charm of the restaurant, but it is also one of the biggest problems with the restaurant. Everything in the restaurant is performed manually from taking orders to ordering inventory. Of course, some customers have complained that they wait too long.

Al's daughter, Alana, has just graduated from university and has come home to help run the family-owned business. Alana is amazed at how long it takes to perform all of the manual processes required to run the business. Every night she must manually count all of the money in the cash register and compare it to the paper sales tickets that the waitstaff fills out representing the customer orders.

Alana also manually counts the inventory from cans of beans to slices of cheese. Deciding what to order each day is a complete mystery to Alana. Some days the restaurant sells tons of chicken dinners and other days the restaurant sells tons of beef dinners. There doesn't seem to be any pattern to which one is going to sell the best. She continually finds herself ordering too much of one item and not enough of the other. In addition, the incorrect inventory makes it worse. Even Alana checks the inventory monthly, the figure of inventory record and the real inventory are rarely corresponding. Besides, each week she has to calculate the employee paychecks by reviewing each employee's cardboard handwritten time card. At the end of each month she calculates the sales tax reports. This is an incredibly difficult activity since the reports must match all of the monthly paper tickets, which total close to \$45,000.

Alana quickly comes to the conclusion that the restaurant must be automated. Building an information system to support all of these manual processes will not only help the restaurant operate more efficiently but will also give Alana more time to

spend talking and dealing with her customers. Al has not used a computer and knows nothing about information systems.

Task

Assume your group is running a small software and IT consultancy company. Please write a report to answer the following three questions. There is no word count limitation for each question, but the total word count should not exceed 2000 words.

(1) Al needs a computer system to make the process in his restaurant more efficient.

There are two approaches to this problem:

- i. Find an existing restaurant system and introduce it to Al's restaurant or;
- ii. Your company writes a new system specifically designed for Al's business.

Your first action is to analyse Al's problems and list the business requirements. Next, you investigate two existing restaurant systems and summarise the advantages and disadvantage to Al's business of adopting either of the two existing systems or of adopting one developed by your company. Therefore you would do a three way comparison between System A, System B and the system developed by your company.

Using your analysis to make a decision which solution would best suit Al's business from the three options and write a report for Al to convince he and Alana to adopt your solution. (Your report may include following aspects: budget implications, the timing and process of introducing the system, if the system functions match the Al's requirement, the difficulties of future maintenance ...etc). (4%)

- (2) Alana had learned Electronic Commerce and wants to use e-Commerce to improve the restaurant business. As experts in e-Commerce adoption, your group needs to draw up B2B (Business to Business) and B2C (Business to Customer) business model (The sample is in Fig 5.3, p241) for Al's restaurant and elaborate how you would use B2B and B2C to help improve the business. What kind of benefits would Al's restaurant gain through using e-commerce? Are there any issues that they should take into account when they are using e-commerce? (4%)
- (3) Al is planning to extend his business into Perth market. Please apply Porter's Five Forces Model to analyse Perth market and provide suggestions of the business strategies for Al to develop his restaurant in Perth (3%).
- (4) References and format. (1%) (Please include at least five references and using the

Microsoft Word's function to format the report well. (For example, table of content, page number, page header and footer)

(5) Discussion board contribution. (3%)

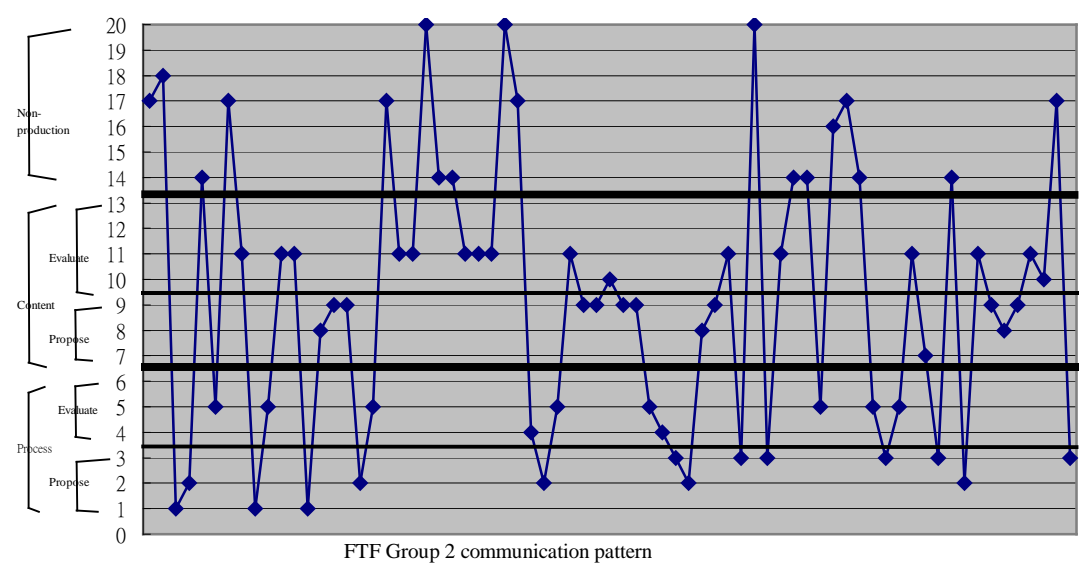
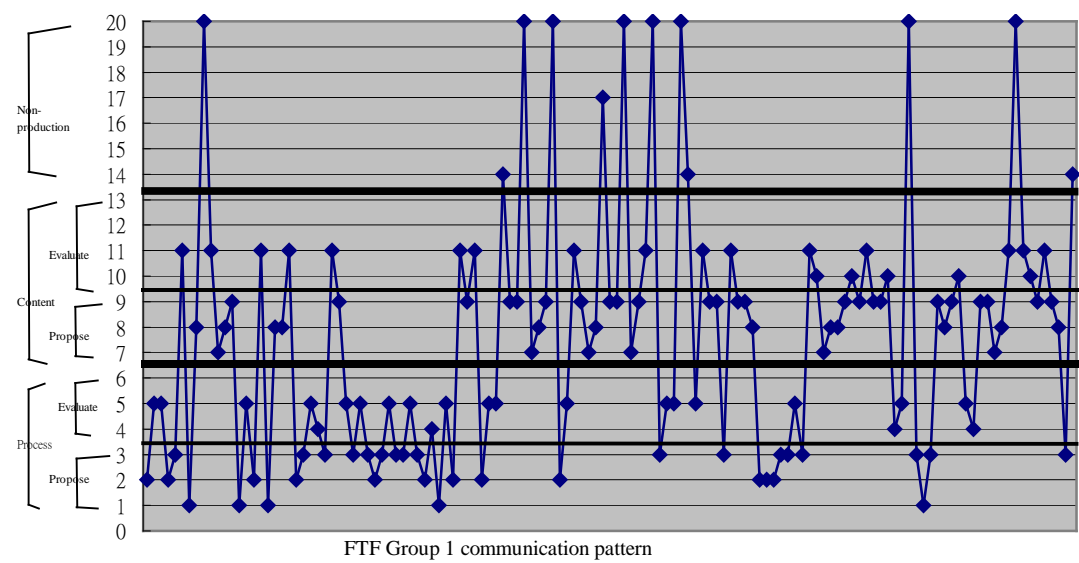
In addition, a cover page with group number and the details of all group members (student id, full name) is compulsory.

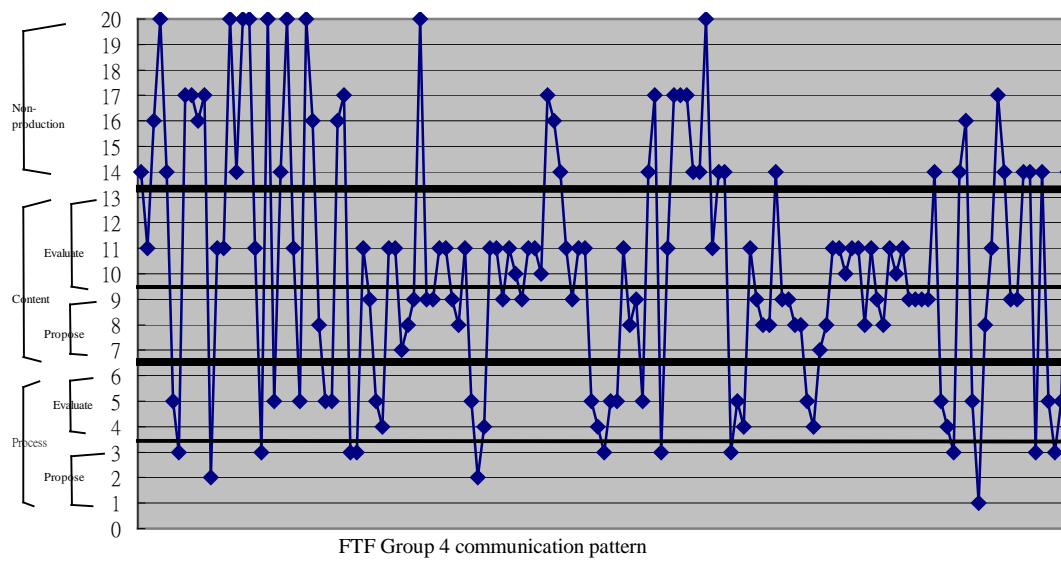
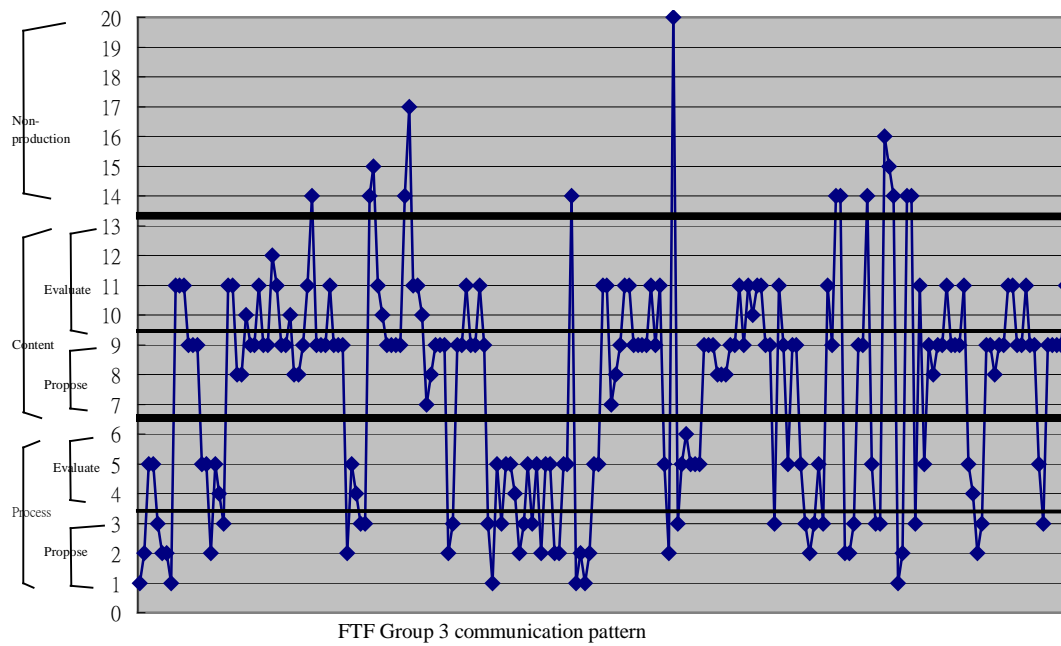
Appendix 5.1 The details of the frequency distribution and percentage of the postings of FTF

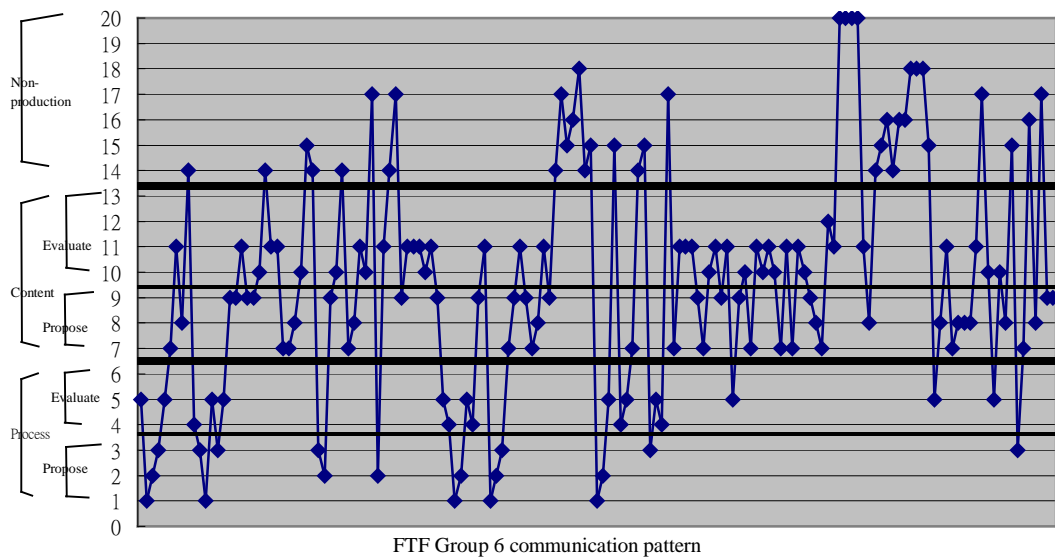
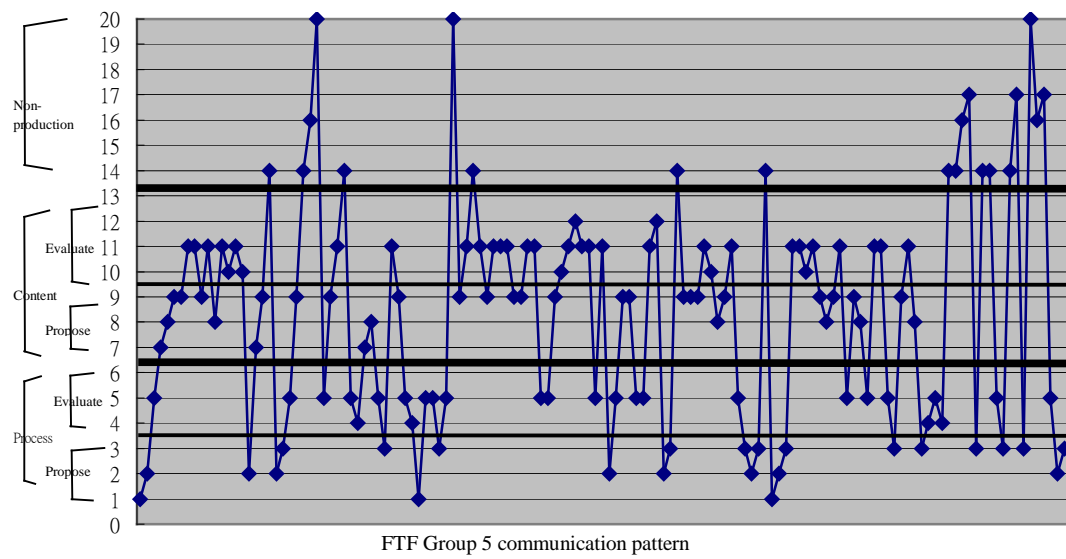
group	per	Time (min)	codes	codes/ time	pp1	pp2	pp3	pp_sub	pe1	pe2	pe3	pe_sub	p_total	cp1	cp2	cp3	cp_sub	ce1	ce2	ce3	ce4	ce_sub	c_total
1	Exc	105	131	1.25	5(4%)	12(9%)	17(13%)	34(26%)	4(3%)	18(14%)	0(0%)	22(17%)	56(43%)	6(5%)	12(9%)	24(18%)	42(32%)	5(4%)	16(12%)	0(0%)	0(0%)	21(16%)	63(48%)
2	Exc	65	71	1.09	3(4%)	5(7%)	6(8%)	14(20%)	2(3%)	8(11%)	0(0%)	10(14%)	24(34%)	1(1%)	3(4%)	9(13%)	13(18%)	2(3%)	14(20%)	0(0%)	0(0%)	16(23%)	29(41%)
3	Exc	125	211	1.69	6(3%)	18(9%)	20(9%)	44(21%)	4(2%)	29(14%)	1(0%)	34(16%)	78(37%)	2(1%)	11(5%)	66(31%)	79(37%)	5(2%)	33(16%)	1(0%)	0(0%)	39(18%)	118(56%)
4	Exc	70	147	2.10	1(1%)	2(1%)	10(7%)	13(9%)	6(4%)	17(12%)	0(0%)	23(16%)	36(24%)	2(1%)	12(8%)	19(13%)	33(22%)	4(3%)	31(21%)	0(0%)	0(0%)	35(24%)	68(46%)
5	Exc	80	137	1.71	3(2%)	8(6%)	13(9%)	24(18%)	4(3%)	22(16%)	0(0%)	26(19%)	50(36%)	3(2%)	7(5%)	22(16%)	32(23%)	5(4%)	28(20%)	2(1%)	0(0%)	35(26%)	67(49%)
Sub/Average		89	139.4	1.57	18(3%)	45(6%)	66(9%)	129(19%)	20(3%)	94(13%)	1(0%)	115(16%)	244(35%)	14(2%)	45(6%)	140(20%)	199(29%)	21(3%)	122(18%)	3(0%)	0(0%)	146(21%)	345(49%)
6	Mod	100	155	1.55	5(3%)	6(4%)	7(5%)	18(12%)	5(3%)	12(8%)	0(0%)	17(11%)	35(23%)	15(10%)	12(8%)	17(11%)	44(28%)	12(8%)	26(17%)	1(1%)	0(0%)	39(25%)	83(54%)
7	Mod	72	102	1.42	5(5%)	6(6%)	6(6%)	17(17%)	0(0%)	6(6%)	0(0%)	6(6%)	23(23%)	9(9%)	2(2%)	10(10%)	21(21%)	2(2%)	12(12%)	0(0%)	0(0%)	14(14%)	35(34%)
8	Mod	75	133	1.77	3(2%)	2(2%)	12(9%)	17(13%)	2(2%)	11(8%)	0(0%)	13(10%)	30(23%)	8(6%)	9(7%)	30(23%)	47(35%)	6(5%)	38(29%)	1(1%)	0(0%)	45(34%)	92(69%)
9	Mod	77	178	2.31	2(1%)	6(3%)	16(9%)	24(13%)	9(5%)	20(11%)	0(0%)	29(16%)	53(30%)	5(3%)	6(3%)	30(17%)	41(23%)	0(0%)	31(17%)	0(0%)	0(0%)	31(17%)	72(40%)
10	Mod	115	103	0.90	5(5%)	6(6%)	4(4%)	15(15%)	16(2%)	55(8%)	0(0%)	71(11%)	162(24%)	42(6%)	44(7%)	115(17%)	48(47%)	22(3%)	117(17%)	2(0%)	0(0%)	12(12%)	60(58%)
Sub/Average		87.8	134.2	1.59		26(4%)	45(7%)	91(14%)	16(2%)	55(8%)	0(0%)	71(11%)	162(24%)	42(6%)	44(7%)	115(17%)	201(30%)	22(3%)	117(17%)	2(0%)	0(0%)	141(21%)	342(51%)
11	poor	110	206	1.87	6(3%)	14(7%)	15(7%)	35(17%)	4(2%)	19(9%)	0(0%)	23(11%)	58(28%)	8(4%)	7(3%)	58(28%)	73(35%)	6(3%)	29(14%)	0(0%)	0(0%)	35(17%)	108(52%)
12	poor	67	105	1.57	2(2%)	6(6%)	12(11%)	20(19%)	4(4%)	16(15%)	0(0%)	20(19%)	40(38%)	1(1%)	4(4%)	20(19%)	25(24%)	3(3%)	14(13%)	0(0%)	0(0%)	17(16%)	42(40%)
13	poor	65	131	2.02	2(2%)	4(3%)	11(8%)	17(13%)	3(2%)	20(15%)	0(0%)	23(18%)	40(31%)	4(3%)	11(8%)	34(26%)	49(37%)	1(1%)	23(18%)	1(1%)	0(0%)	25(19%)	74(56%)
14	poor	75	81	1.08	4(5%)	8(10%)	10(12%)	22(27%)	2(2%)	17(21%)	0(0%)	19(23%)	41(51%)	2(2%)	2(2%)	12(15%)	16(20%)	1(1%)	8(10%)	0(0%)	0(0%)	9(11%)	25(31%)
15	poor	75	104	1.39	1(1%)	5(5%)	12(12%)	18(17%)	5(5%)	11(11%)	0(0%)	16(15%)	34(33%)	3(3%)	3(3%)	27(26%)	33(32%)	1(1%)	9(9%)	2(2%)	0(0%)	12(12%)	45(43%)
Sub/Average		78.4	125.4	1.58	15(2%)	37(6%)	60(10%)	112(18%)	18(3%)	83(13%)	0(0%)	101(16%)	213(34%)	18(3%)	27(4%)	151(24%)	196(31%)	12(2%)	83(13%)	3(0%)	0(0%)	98(16%)	294(47%)

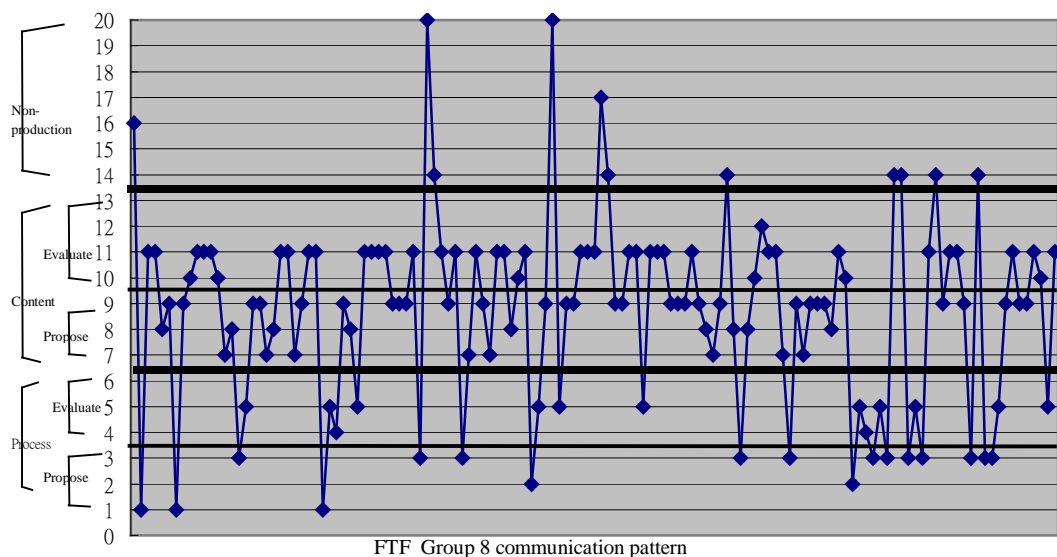
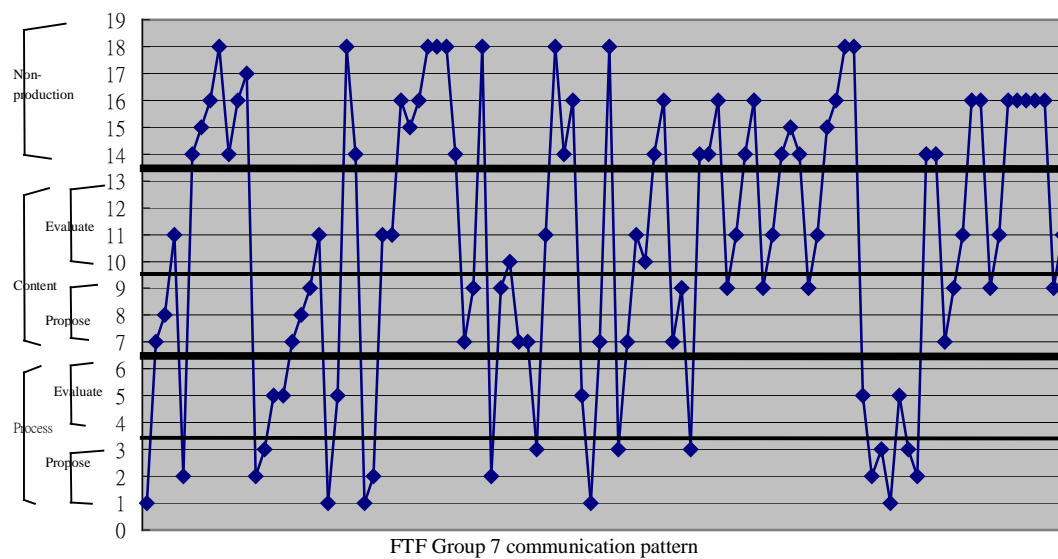
group	per	Time (min)	codes	codes/ time	npt	npp	npi	npr	npd	npu	nps	np_sub	total
1	Exc	105	131	1.25	3(2%)	0(0%)	0(0%)	1(1%)	0(0%)	0(0%)	8(6%)	12(9%)	131(100%)
2	Exc	65	71	1.09	7(10%)	0(0%)	1(1%)	6(8%)	1(1%)	0(0%)	3(4%)	18(25%)	71(100%)
3	Exc	125	211	1.69	10(5%)	2(1%)	1(0%)	1(0%)	0(0%)	0(0%)	1(0%)	15(7%)	211(100%)
4	Exc	70	147	2.10	18(12%)	0(0%)	6(4%)	10(7%)	0(0%)	0(0%)	9(6%)	43(29%)	147(100%)
5	Exc	80	137	1.71	11(8%)	0(0%)	3(2%)	3(2%)	0(0%)	0(0%)	3(2%)	20(15%)	137(100%)
Sub/Average		89	139.4	1.57	49(7%)	2(0%)	11(2%)	21(3%)	1(0%)	0(0%)	24(3%)	108(15%)	697(100%)
6	Mod	100	155	1.55	10(6%)	8(5%)	5(3%)	6(4%)	4(3%)	0(0%)	4(3%)	37(24%)	155(100%)
7	Mod	72	102	1.42	13(13%)	4(4%)	16(16%)	1(1%)	10(10%)	0(0%)	0(0%)	44(43%)	102(100%)
8	Mod	75	133	1.77	7(5%)	0(0%)	1(1%)	1(1%)	0(0%)	0(0%)	2(2%)	11(8%)	133(100%)
9	Mod	77	178	2.31	21(12%)	1(1%)	23(13%)	4(2%)	1(1%)	0(0%)	3(2%)	53(30%)	178(100%)
10	Mod	115	103	0.90	7(7%)	0(0%)	7(7%)	1(1%)	1(1%)	0(0%)	6(6%)	22(21%)	103(100%)
Sub/Average		87.8	134.2	1.59	58(9%)	13(2%)	52(8%)	13(2%)	16(2%)	0(0%)	15(2%)	167(25%)	671(100%)
11	poor	110	206	1.87	29(14%)	0(0%)	5(2%)	1(0%)	3(1%)	0(0%)	2(1%)	40(19%)	206(100%)
12	poor	67	105	1.57	11(10%)	1(1%)	7(7%)	2(2%)	0(0%)	0(0%)	2(2%)	23(22%)	105(100%)
13	poor	65	131	2.02	10(8%)	0(0%)	3(2%)	2(2%)	0(0%)	0(0%)	2(2%)	17(13%)	131(100%)
14	poor	75	81	1.08	6(7%)	0(0%)	1(1%)	5(6%)	1(1%)	0(0%)	2(2%)	15(19%)	81(100%)
15	poor	75	104	1.39	12(12%)	0(0%)	1(1%)	4(4%)	0(0%)	0(0%)	8(8%)	25(24%)	104(100%)
Sub/Average		78.4	125.4	1.58	68(11%)	1(0%)	17(3%)	14(2%)	4(1%)	0(0%)	16(3%)	120(19%)	627(100%)

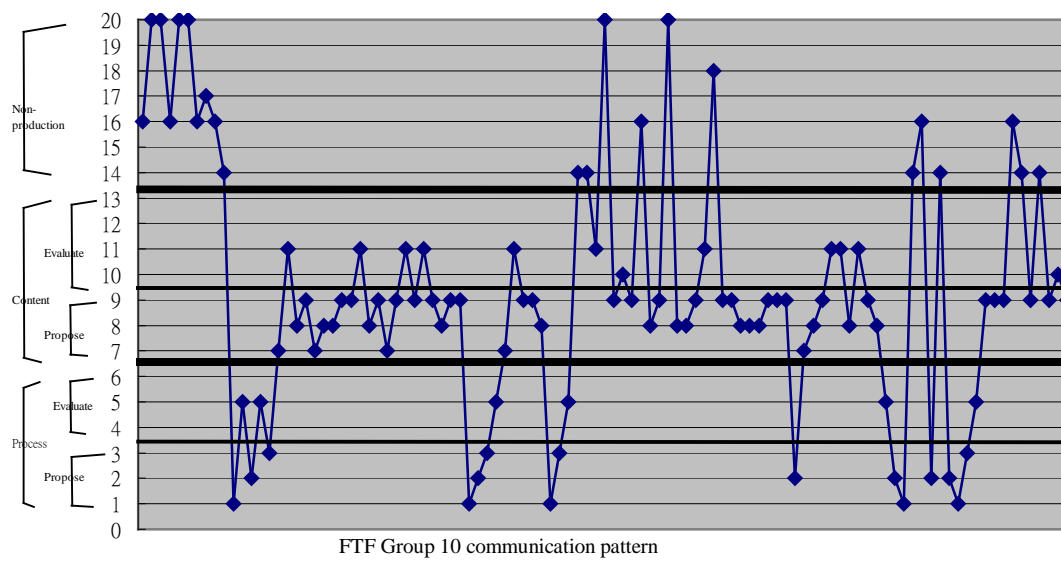
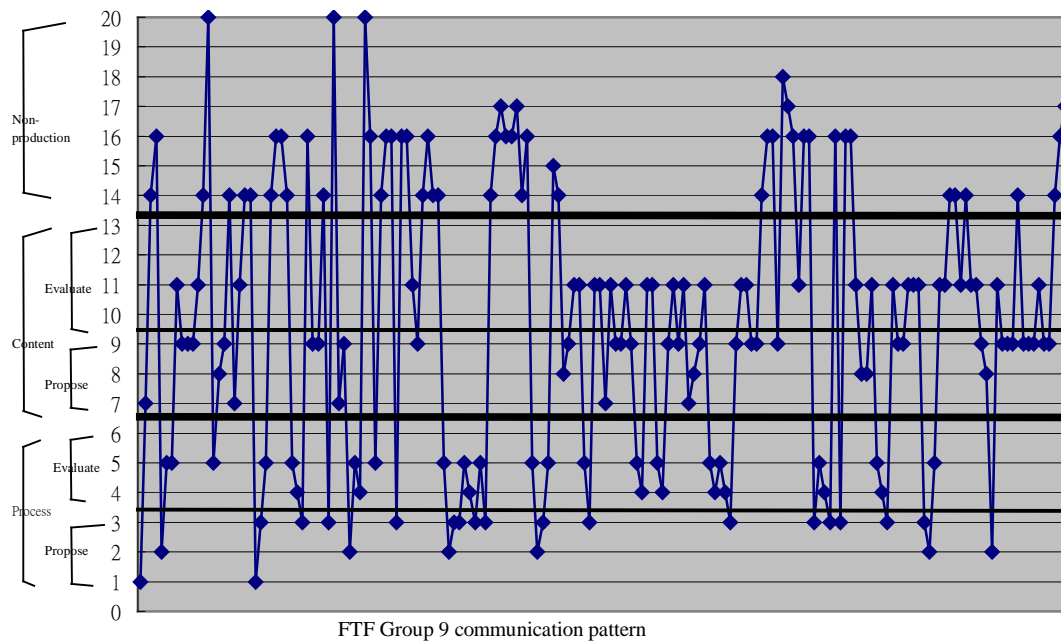
Appendix 5.2 The communication pattern of FTF

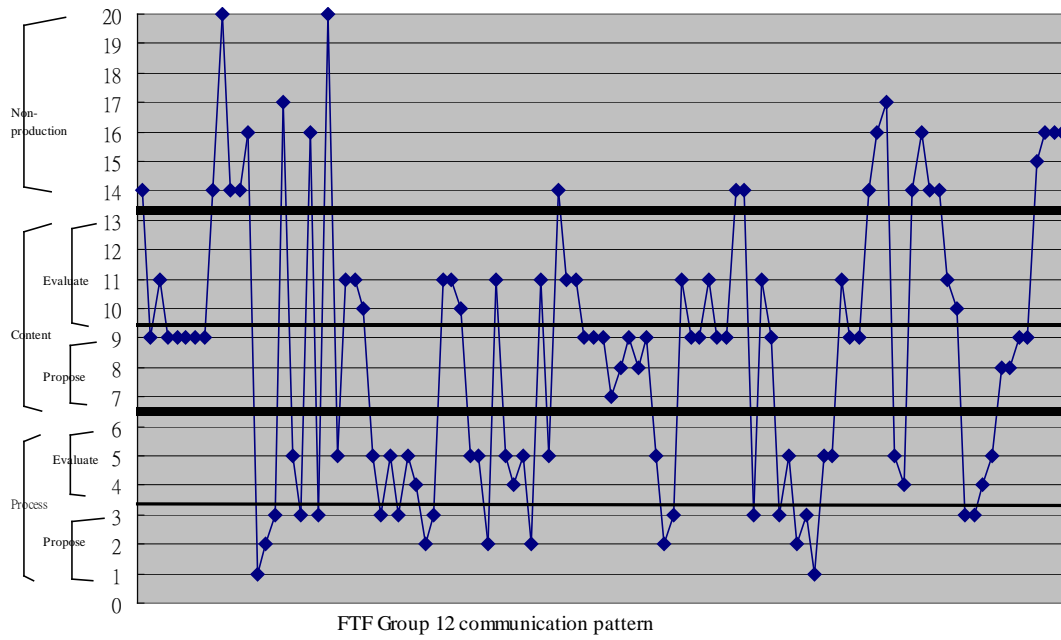
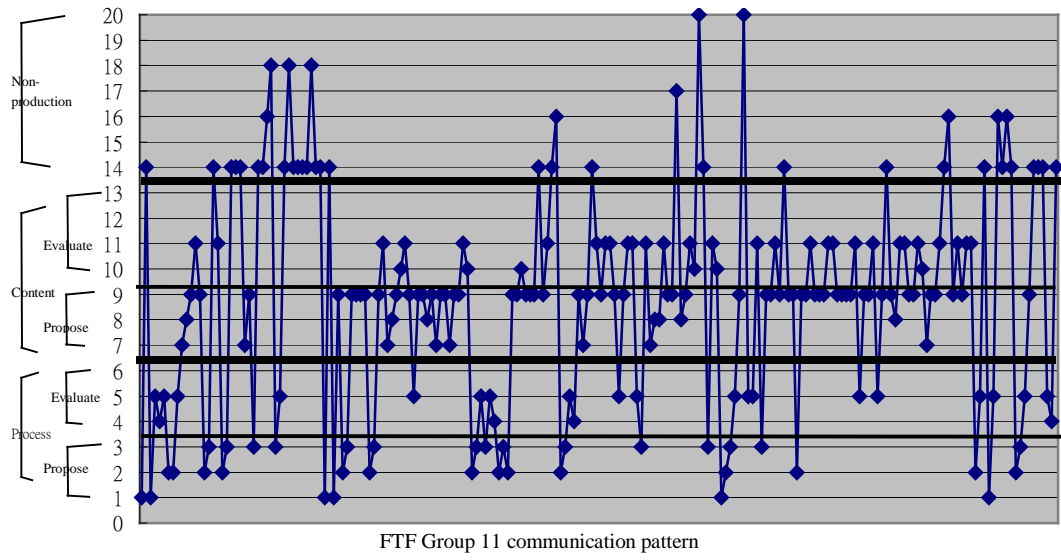


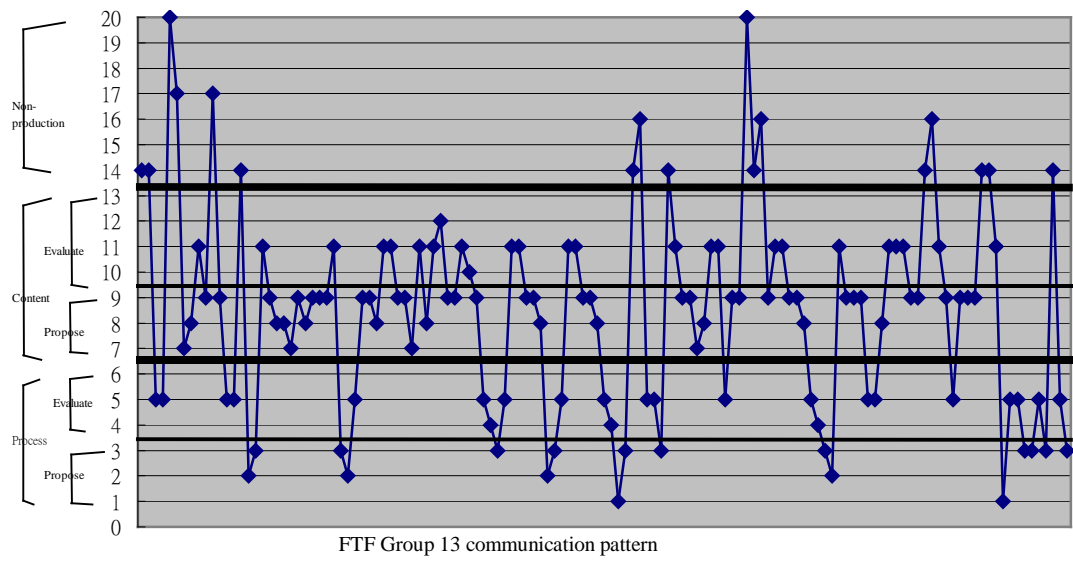


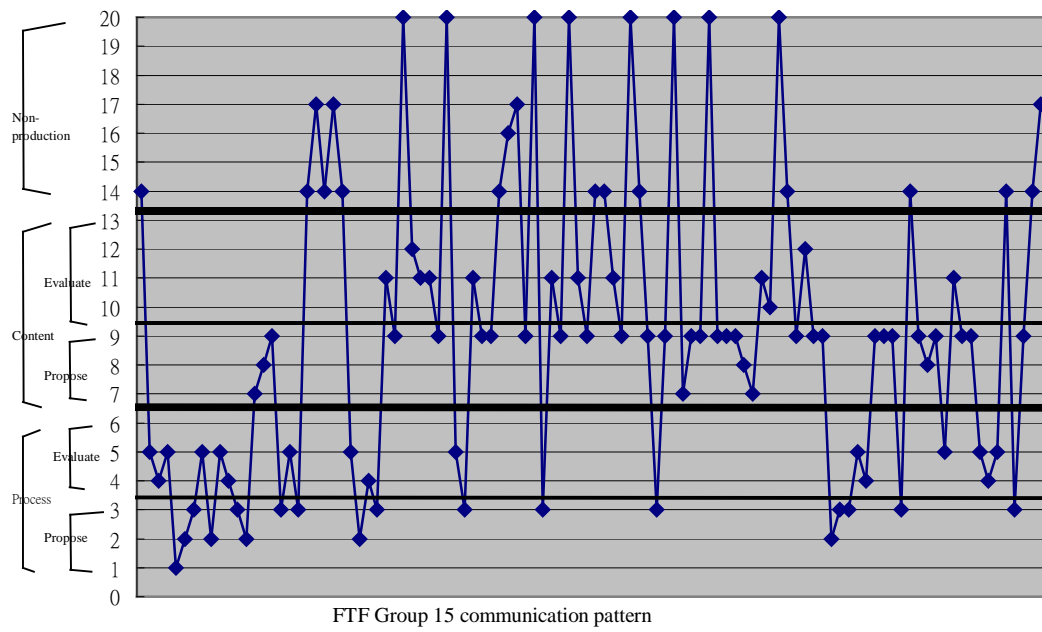










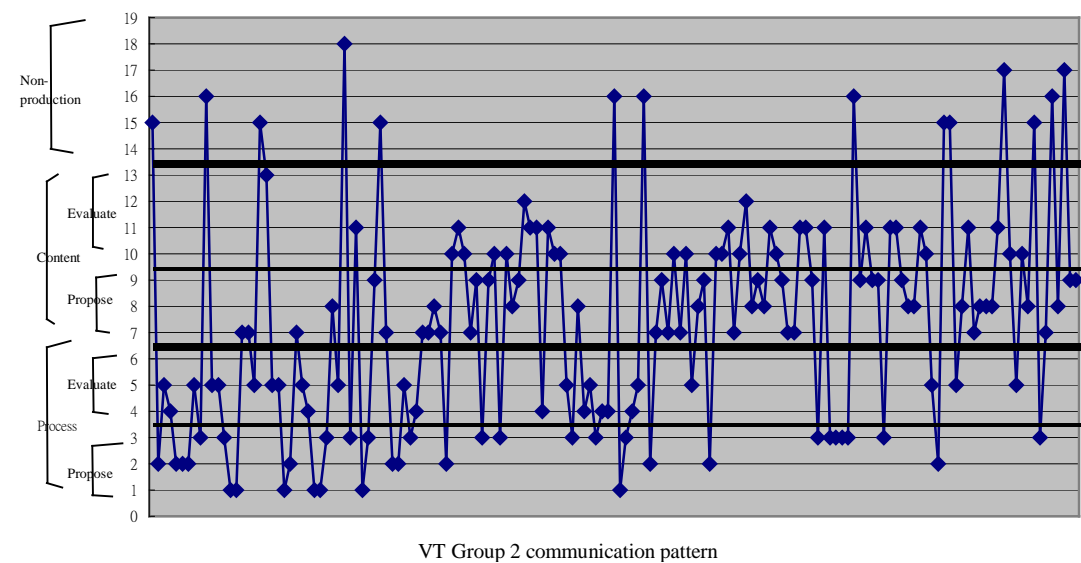
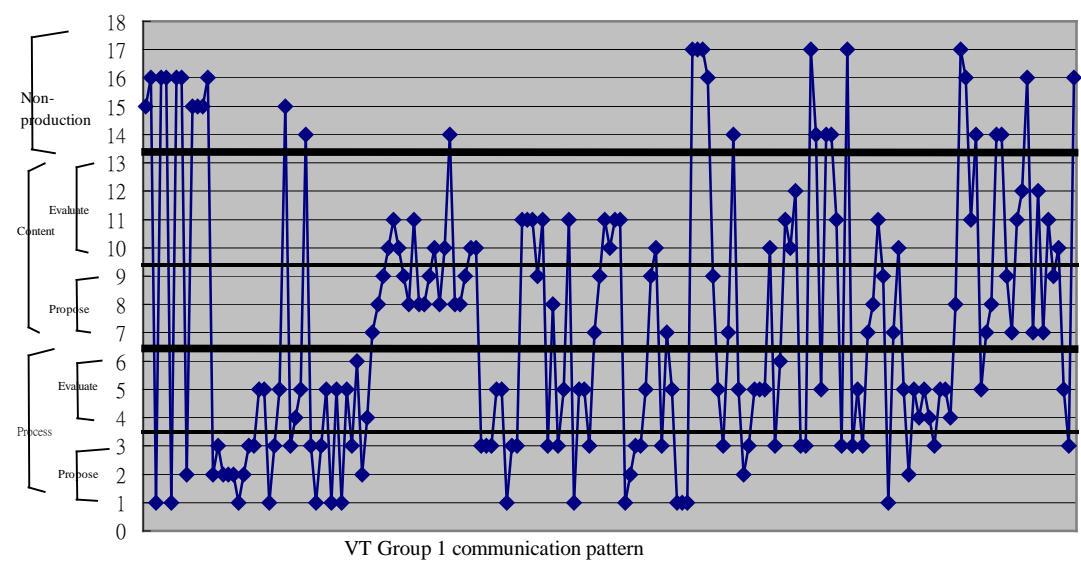


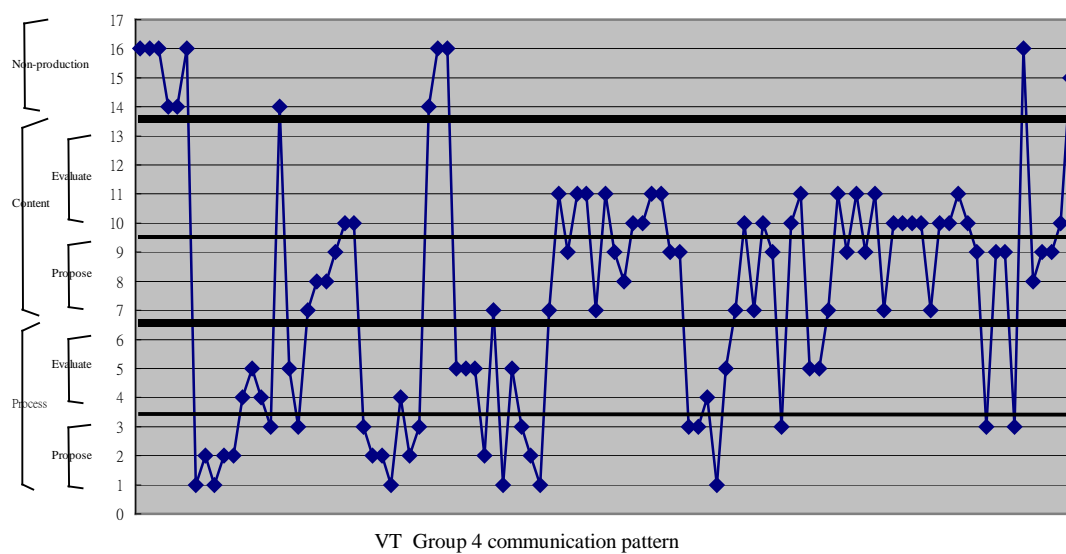
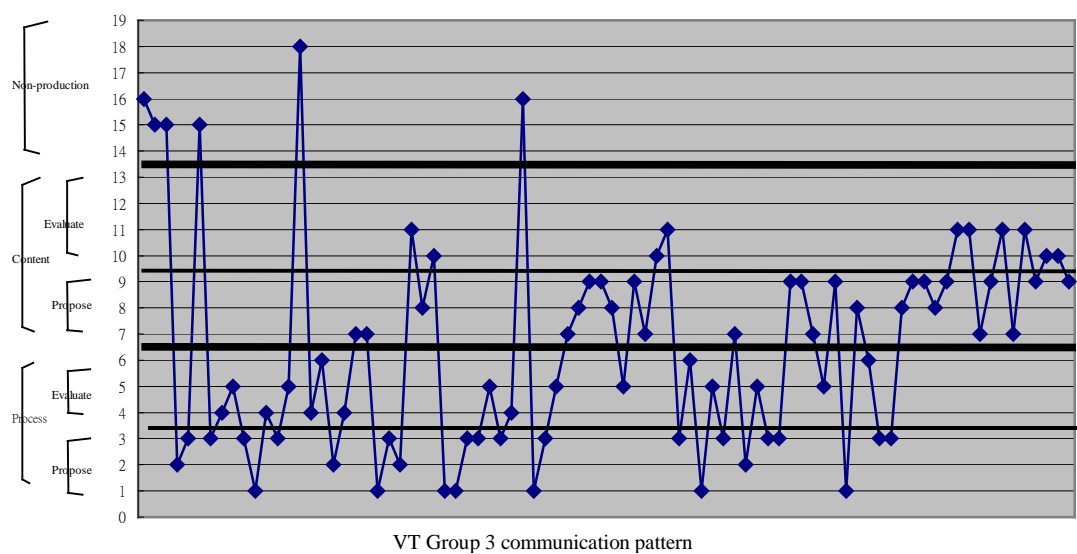
Appendix 5.3 The details of the frequency distribution and percentage of the postings of VT

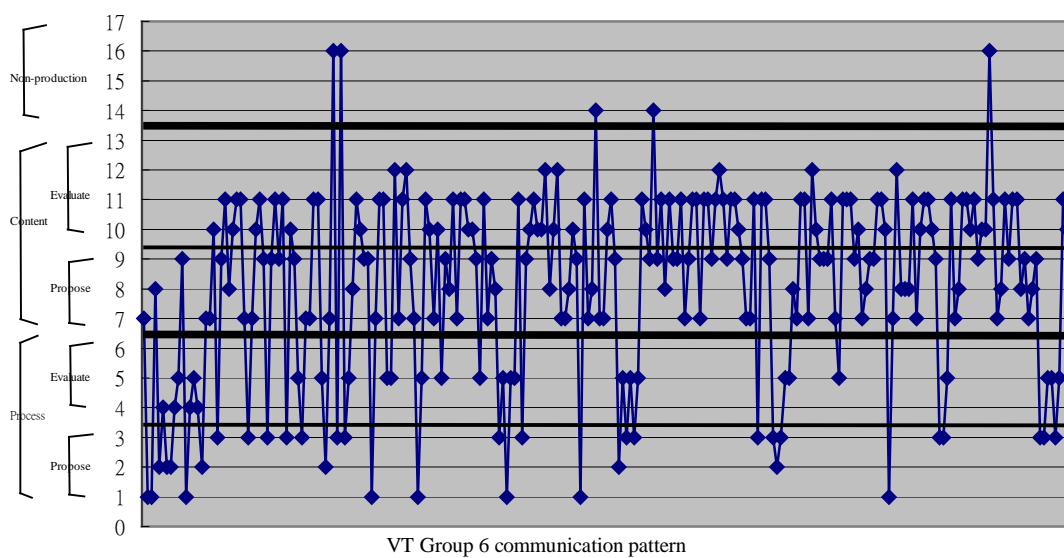
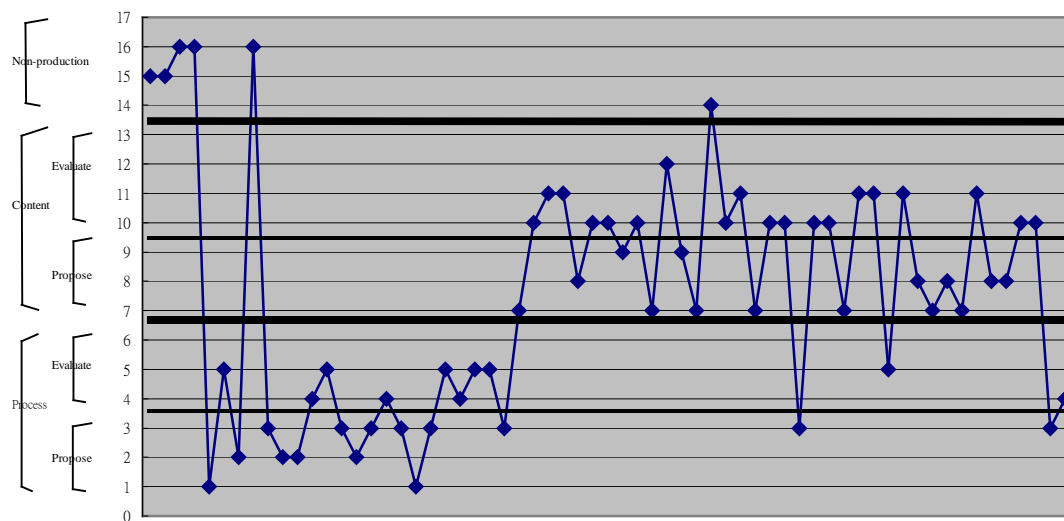
group	cat	posts	codes	codes/ posts	pp1	pp2	pp3	pp_sub	pe1	pe2	pe3	pe_sub	p_total	cp1	cp2	cp3	cp_sub	ce1	ce2	ce3	ce4	ce_sub	c_total
1	exc	172	181	1.05	14(8%)	10(6%)	29(16%)	53(29%)	5(3%)	28(15%)	2(1%)	35(19%)	88(49%)	10(6%)	11(6%)	11(6%)	32(18%)	12(7%)	16(9%)	3(2%)	0(0%)	31(17%)	63(35%)
2	exc	103	155	1.50	7(5%)	11(7%)	18(12%)	36(23%)	8(5%)	17(11%)	0(0%)	25(16%)	61(39%)	16(10%)	15(10%)	15(10%)	46(30%)	15(10%)	16(10%)	2(1%)	1(1%)	34(22%)	80(52%)
3	exc	77	84	1.09	7(8%)	4(5%)	15(18%)	26(31%)	5(6%)	8(10%)	3(4%)	16(19%)	42(50%)	8(10%)	6(7%)	12(14%)	26(31%)	4(5%)	6(7%)	0(0%)	0(0%)	10(12%)	36(43%)
4	exc	72	101	1.40	6(6%)	8(8%)	10(10%)	24(24%)	4(4%)	9(9%)	0(0%)	13(13%)	37(37%)	9(9%)	4(4%)	13(13%)	26(26%)	15(15%)	11(11%)	0(0%)	0(0%)	26(26%)	52(51%)
5	exc	58	63	1.09	2(3%)	4(6%)	8(13%)	14(22%)	4(6%)	6(10%)	0(0%)	10(16%)	24(38%)	7(11%)	5(8%)	2(3%)	14(22%)	11(17%)	7(11%)	1(2%)	0(0%)	19(30%)	33(52%)
Sub/Average		96.4	116.8	1.23	36(6%)	37(6%)	80(14%)	153(26%)	26(4%)	68(12%)	5(1%)	99(17%)	252(43%)	50(9%)	41(7%)	53(9%)	144(25%)	57(10%)	56(10%)	6(1%)	1(0%)	120(21%)	264(45%)
6	mod	213	241	1.13	8(3%)	7(3%)	19(8%)	34(14%)	4(2%)	23(10%)	0(0%)	27(11%)	61(25%)	32(13%)	18(7%)	35(15%)	85(35%)	26(11%)	57(24%)	7(3%)	0(0%)	90(37%)	175(73%)
7	mod	114	148	1.30	12(8%)	5(3%)	11(7%)	28(19%)	6(4%)	25(17%)	1(1%)	32(22%)	60(41%)	10(7%)	6(4%)	8(5%)	24(16%)	9(6%)	11(7%)	4(3%)	0(0%)	24(16%)	48(32%)
8	mod	114	141	1.24	5(4%)	7(5%)	29(21%)	41(29%)	6(4%)	24(17%)	0(0%)	30(21%)	71(50%)	9(6%)	5(4%)	9(6%)	23(16%)	8(6%)	15(11%)	1(1%)	0(0%)	24(17%)	47(33%)
9	mod	112	113	1.01	7(6%)	8(7%)	17(15%)	32(28%)	6(5%)	20(18%)	0(0%)	26(23%)	58(51%)	9(8%)	6(5%)	8(7%)	23(20%)	9(8%)	12(11%)	0(0%)	0(0%)	21(19%)	44(39%)
10	mod	125.6	149.6	1.22	36(5%)	29(4%)	92(12%)	157(21%)	30(4%)	111(15%)	1(0%)	142(19%)	299(40%)	65(9%)	39(5%)	68(9%)	172(23%)	59(8%)	105(14%)	13(2%)	0(0%)	177(24%)	349(47%)
Sub/Average		75	105	1.40	4(4%)	2(2%)	16(15%)	22(21%)	8(8%)	19(18%)	0(0%)	27(26%)	49(47%)	5(5%)	4(4%)	8(8%)	17(16%)	7(7%)	10(10%)	1(1%)	0(0%)	18(17%)	35(33%)
11	poor	71	89	1.25	7(8%)	7(8%)	9(10%)	23(26%)	6(7%)	11(12%)	0(0%)	17(19%)	40(45%)	4(4%)	5(6%)	9(10%)	18(20%)	7(8%)	18(20%)	2(2%)	0(0%)	27(30%)	45(51%)
12	poor	62	81	1.31	2(2%)	7(9%)	25(31%)	34(42%)	5(6%)	15(19%)	0(0%)	20(25%)	54(67%)	3(4%)	1(1%)	3(4%)	7(9%)	1(1%)	7(9%)	1(1%)	0(0%)	9(11%)	16(20%)
13	poor	46	59	1.28	4(7%)	4(7%)	13(22%)	21(36%)	5(8%)	14(24%)	0(0%)	19(32%)	40(68%)	3(5%)	1(2%)	1(2%)	5(8%)	4(7%)	5(8%)	0(0%)	0(0%)	9(15%)	14(24%)
14	poor	34	45	1.32	1(2%)	4(9%)	14(31%)	19(42%)	2(4%)	8(18%)	0(0%)	10(22%)	29(64%)	2(4%)	1(2%)	1(2%)	4(9%)	2(4%)	3(7%)	0(0%)	0(0%)	5(11%)	9(20%)
15	poor	25	34	1.36	0(0%)	1(3%)	6(18%)	7(21%)	5(15%)	3(9%)	0(0%)	8(24%)	15(44%)	3(9%)	1(3%)	7(21%)	11(32%)	1(3%)	5(15%)	0(0%)	0(0%)	6(18%)	17(50%)
Sub/Average		47.6	61.6	1.31	5(4%)	9(7%)	33(24%)	47(34%)	12(9%)	25(18%)	0(0%)	37(27%)	84(61%)	8(6%)	3(2%)	9(7%)	20(14%)	7(5%)	13(9%)	0(0%)	0(0%)	20(14%)	40(29%)

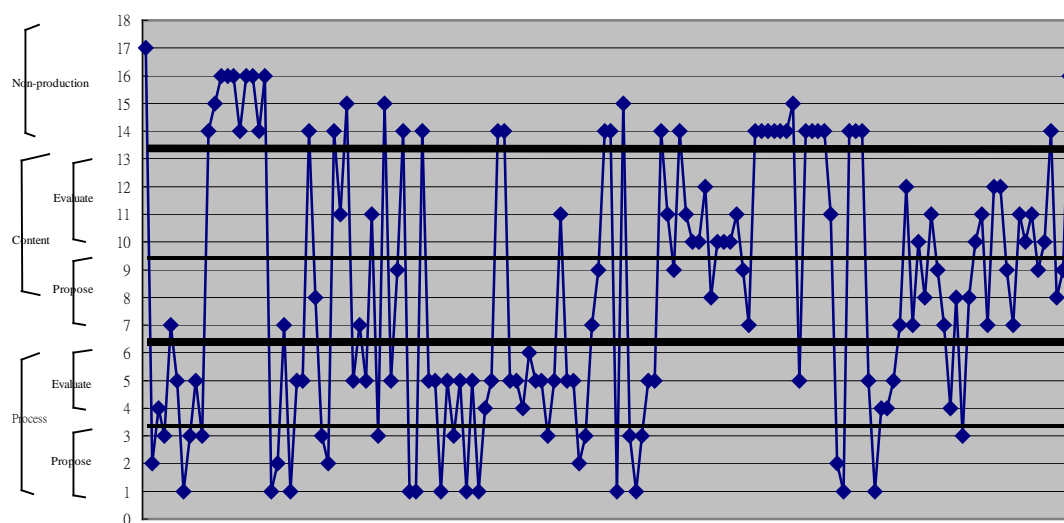
group	cat	posts	codes	codes/ posts	npt	npp	npi	npr	npd	npu	nps	np_sub	total
1	exc	172	181	1.05	9(5%)	5(3%)	10(6%)	6(3%)	0(0%)	0(0%)	0(0%)	30(17%)	181(100%)
2	exc	103	155	1.50	0(0%)	6(4%)	5(3%)	2(1%)	1(1%)	0(0%)	0(0%)	14(9%)	155(100%)
3	exc	77	84	1.09	0(0%)	3(4%)	2(2%)	0(0%)	1(1%)	0(0%)	0(0%)	6(7%)	84(100%)
4	exc	72	101	1.40	4(4%)	1(1%)	7(7%)	0(0%)	0(0%)	0(0%)	0(0%)	12(12%)	101(100%)
5	exc	58	63	1.09	1(2%)	2(3%)	3(5%)	0(0%)	0(0%)	0(0%)	0(0%)	6(10%)	63(100%)
Sub/Average		96.4	116.8	1.23	14(2%)	17(3%)	27(5%)	8(1%)	2(0%)	0(0%)	0(0%)	68(12%)	584(100%)
6	mod	213	241	1.13	2(1%)	0(0%)	3(1%)	0(0%)	0(0%)	0(0%)	0(0%)	5(2%)	241(100%)
7	mod	114	148	1.30	27(18%)	5(3%)	7(5%)	1(1%)	0(0%)	0(0%)	0(0%)	40(27%)	148(100%)
8	mod	114	141	1.24	12(9%)	4(3%)	5(4%)	2(1%)	0(0%)	0(0%)	0(0%)	23(16%)	141(100%)
9	mod	112	113	1.01	6(5%)	2(2%)	2(2%)	1(1%)	0(0%)	0(0%)	0(0%)	11(10%)	113(100%)
10	mod	125.6	149.6	1.22	49(7%)	16(2%)	26(3%)	9(1%)	0(0%)	0(0%)	0(0%)	100(13%)	748(100%)
Sub/Average		75	105	1.40	2(2%)	5(5%)	9(9%)	5(5%)	0(0%)	0(0%)	0(0%)	21(20%)	105(100%)
11	poor	71	89	1.25	0(0%)	1(1%)	1(1%)	2(2%)	0(0%)	0(0%)	0(0%)	4(4%)	89(100%)
12	poor	62	81	1.31	4(5%)	4(5%)	1(1%)	2(2%)	0(0%)	0(0%)	0(0%)	11(14%)	81(100%)
13	poor	46	59	1.28	1(2%)	1(2%)	3(5%)	0(0%)	0(0%)	0(0%)	0(0%)	5(8%)	59(100%)
14	poor	34	45	1.32	1(2%)	4(9%)	1(2%)	1(2%)	0(0%)	0(0%)	0(0%)	7(16%)	45(100%)
15	poor	25	34	1.36	0(0%)	1(3%)	1(3%)	0(0%)	0(0%)	0(0%)	0(0%)	2(6%)	34(100%)
Sub/Average		47.6	61.6	1.31	2(1%)	6(4%)	5(4%)	1(1%)	0(0%)	0(0%)	0(0%)	14(10%)	138(100%)

Appendix 5.4 The communication pattern of VT

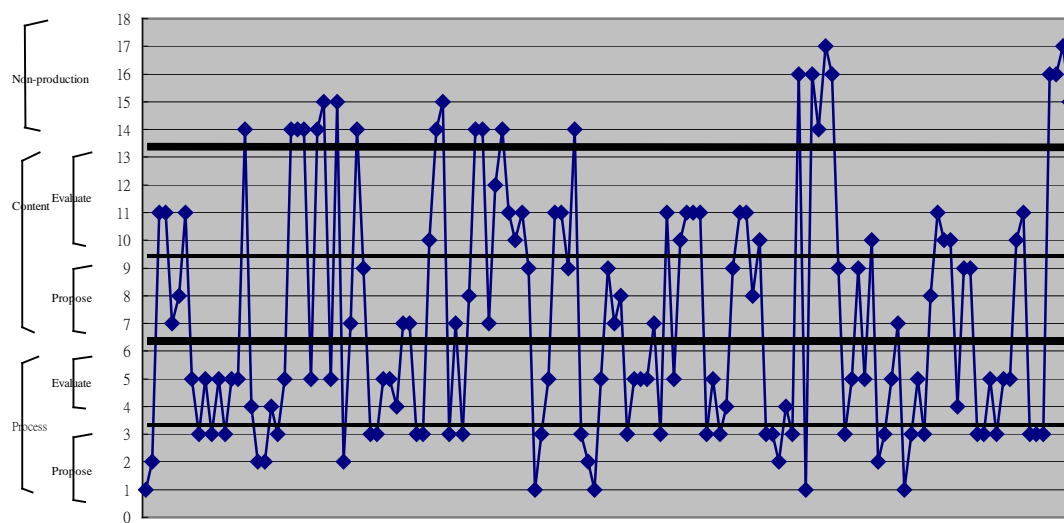




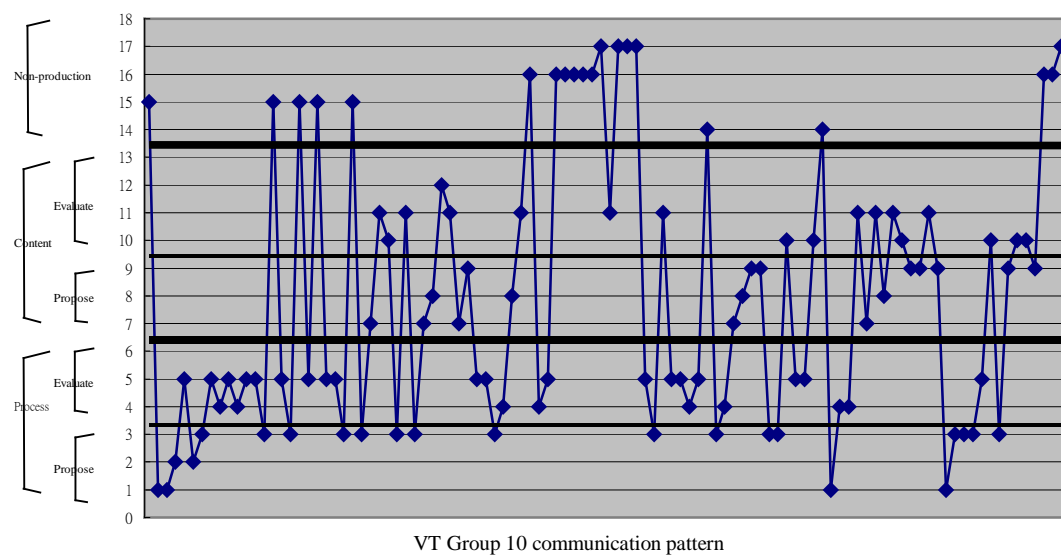
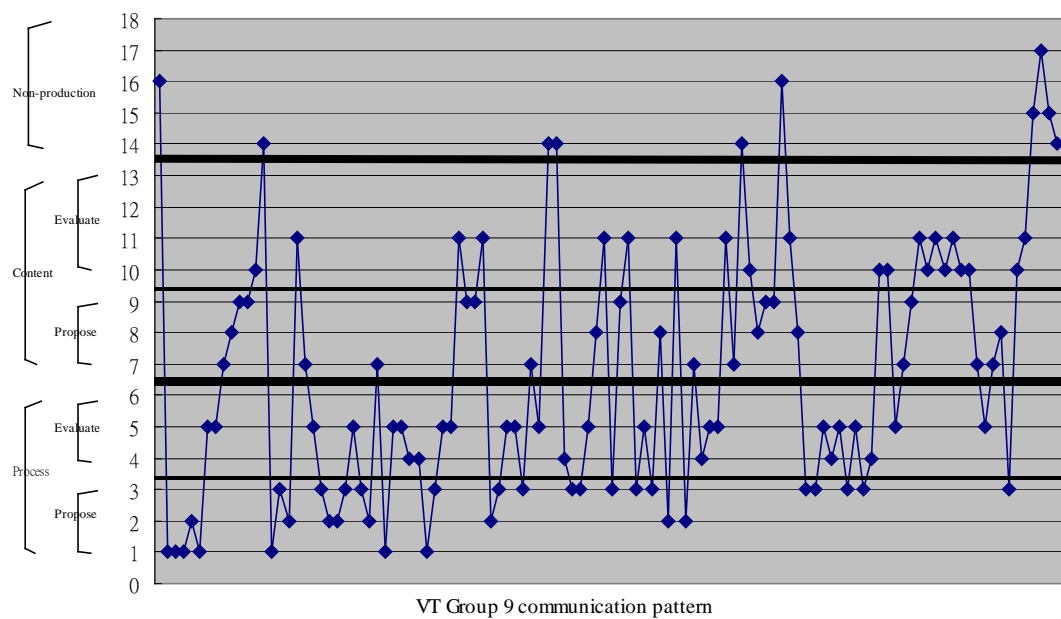


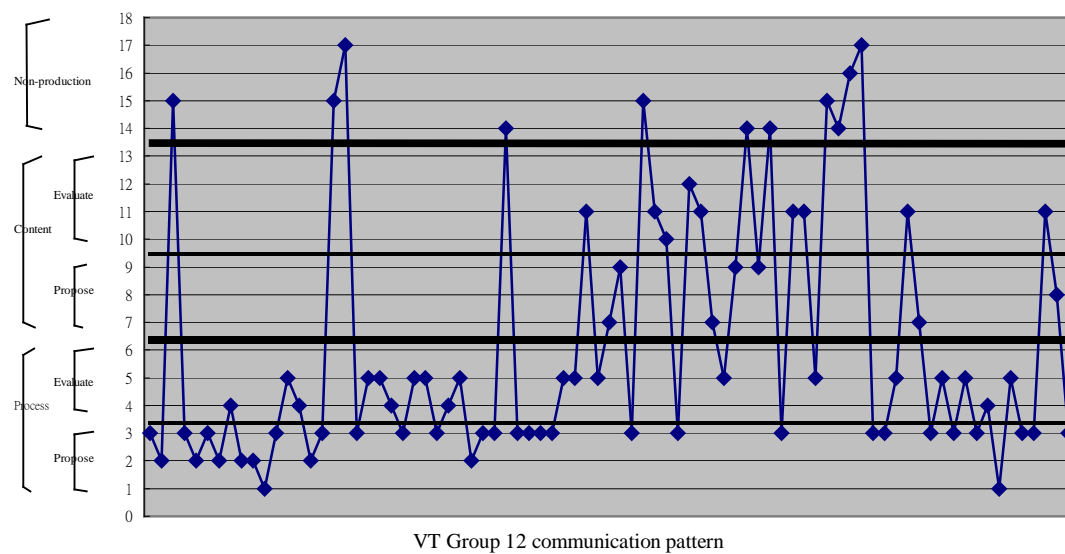
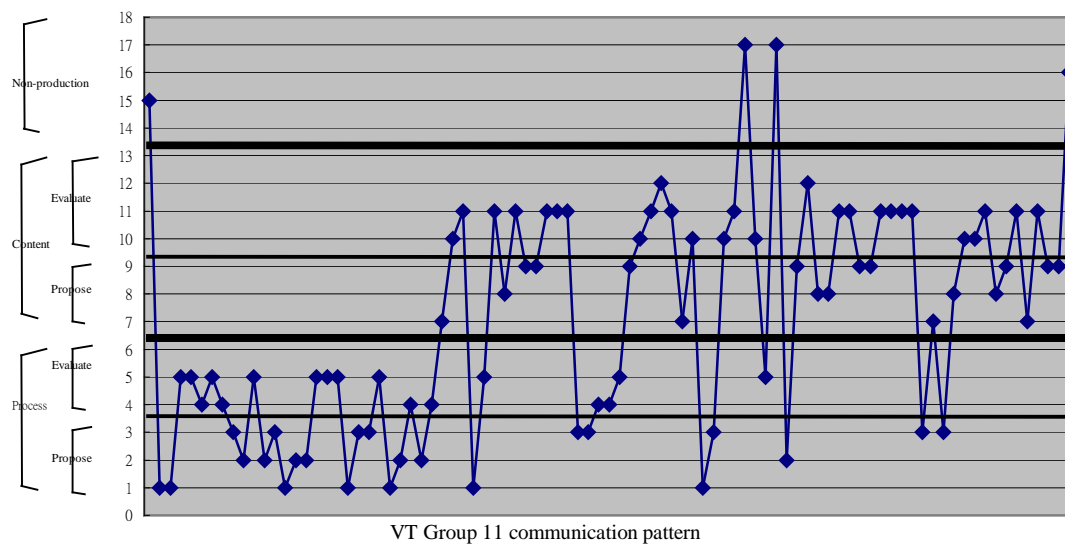


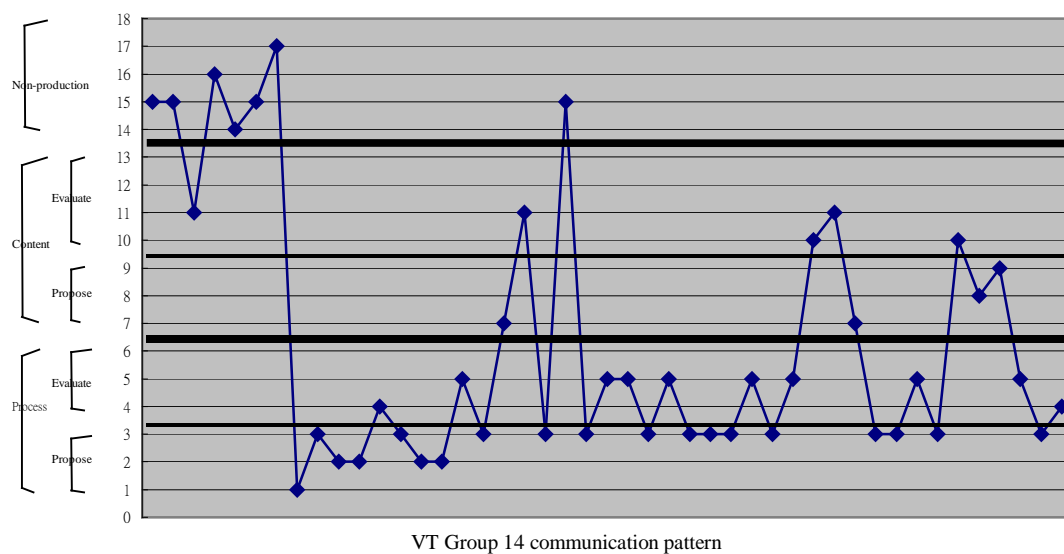
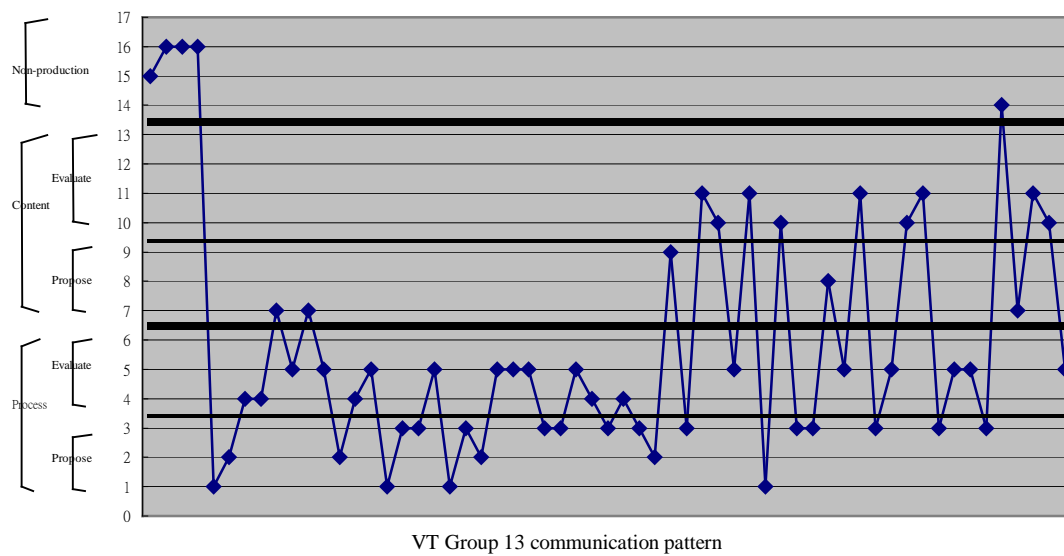
VT Group 7 communication pattern

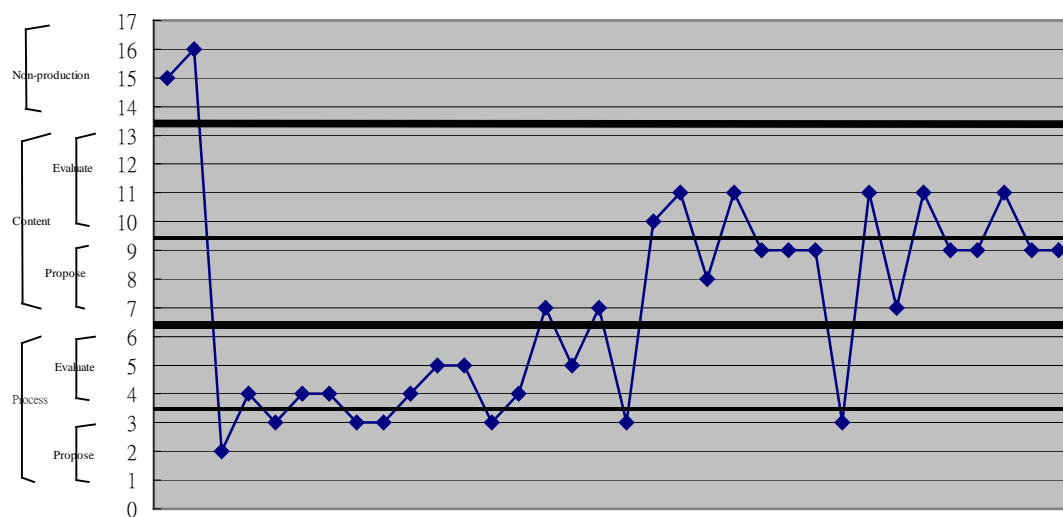


VT Group 8 communication pattern









VT Group 15 communication pattern

Appendix 6.1

TEAM CONTRACT

Complete the details below and hand a copy to your tutor

Team Number or Name: _____

- ☐ Our team has completed a team operating guidelines sheet and has agreement on expected team behaviour
- ☐ Our team has agreed that our desired mark is

It is agreed that the members of this team will:

1. Keep to the team operating guidelines.
2. Keep team members informed of any unforeseen difficulties that could affect our ability to keep to our guidelines (e.g., illness, accident etc).
3. Keep the tutor informed of our group's progress.
4. Share the overall project mark equally OR
Have 10% individual / 10% team mark. (Please tick one box)
5. Inform the Tutor/Unit Coordinator of any conflict between team members by
Week 9.

Note: Removal of any team member is considered a last resort and could only happen after a process of negotiation between the team members and the unit coordinator. Negotiation would include an opportunity to resolve problems. Action to request a team member's removal must be taken by Week 9. The excluded group member would be required to complete on individual project to an equivalent standard to that of a team.

Name	Signature	Date
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____

Appendix 7.1 Comparing this study's findings with Bordia's findings

Bordia's Findings	This Study's Findings	Support
CMC groups take longer to complete the allotted task	In this study, the time for FTF and VT is the same. Thus, this study has no relative finding corresponding to this finding	No
In a given time period CMC groups produce fewer remarks than FTF groups	VT members' perception of performance is lower than FTF	Yes
CMC groups perform better than FTF groups on idea generation tasks	In this study, task type is a fixed variable. Thus, this study has no relative finding corresponding to this finding	No
There is greater equality of participation in CMC groups	In this study, participation is not a measurable factor. Thus, this study has no relative finding corresponding to this finding	No
When time is limited, CMC groups perform better than FTF groups on tasks involving less, and worse on tasks requiring more, social-emotional interaction. Given enough time, CMC groups perform as well as FTF groups	In this study, the time and task type for FTF and VT is the same. And the task type is a fixed variable. So, this study has no relative finding corresponding to this finding	No
There is reduced normative social pressure in CMC groups.	In this study, social pressure has not been examined. Thus, this study has no relative finding corresponding to this finding	No
Perception of partner and task is poorer in CMC groups.	In this study, perceptions of partner and tasks have not been examined. Thus, this study has no relative finding corresponding to this finding	No
In CMC, evaluation of the communication partner is poorer under conditions of limited time. Evaluation of the medium is influenced by the type of the task	In this study, medium and task type are fixed variable. Thus, this study has no relative finding corresponding to this finding	No
There is higher incidence of uninhibited behaviour in CMC groups	In this study, incidence of uninhibited behaviour has not been examined. Thus, this study has no relative finding corresponding to this finding	No

CMC induces a state of deindividuation, which in turn leads to uninhibited behaviour	In this study, a state of deindividuation has not been examined. Thus, this study has no relative finding corresponding to this finding	No
CMC groups, as compared to FTF groups, exhibit less choice shift or attitude change	In this study, choice shift and attitude change have not been examined. Thus, this study has no relative finding corresponding to this finding	No

Appendix 7.2 Comparing this study's findings with the findings of section 2.2.2

The Findings of Section 2.2.2	This Study's Findings	Support
The performance of CMC is worse than FTF	VT members' perception of performance is lower than FTF	Yes
The satisfaction of CMC is lower than FTF	VT members' perception of satisfaction is lower than FTF	Yes
CMC groups take longer time to complete the tasks	In this study, the time for FTF and VT is the same. Thus, this study has no relative finding corresponding to this finding	No
It is more difficult for CMC to coordinate the task	From the analysis of interview and the discourse, it is difficult for VT to coordinate the tasks	Yes
Communication effectiveness is still ambiguous	From the analysis of interview and the discourse, communication effectiveness for VT is worse than FTF	confirm VT<FTF
CMC presents higher participation	In this study, participation has not been examined. Thus, this study has no relative finding corresponding to this finding	No
Social relationships is not easy to be built for CMC	From the analysis of interview and the discourse, social relationship is not easy to be built for VT than FTF	Yes
CMC shows higher conflict	In this study, conflict has not been found in both FTF and VT.	No
The decision quality of CMC is worse than FTF	In this study, decision quality has not been examined. Thus, this study has no relative finding corresponding to this finding	No
CMC is excellent in the idea generation tasks	In this study, task type is a fixed variable. Thus, this study has no relative finding corresponding to this finding	No